INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A STUDY OF BARRIERS AND FACILITATORS TO PARTICIPATION IN DISTANCE HIGHER EDUCATION BY WORKING ENGINEERS

A Dissertation

SUBMITTED TO THE GRADUATE FACULTY

in partial fullfillment of the requirements for the

degree of

Doctor of Philosophy

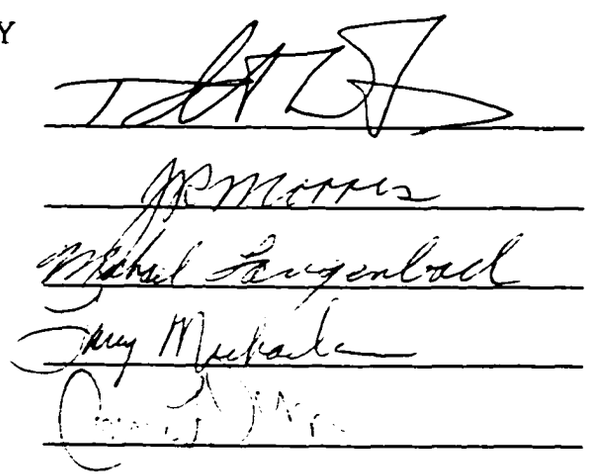
By

RONALD T. NOYES
Norman, Oklahoma
1998

A STUDY OF BARRIERS AND FACILITATORS TO PARTICIPATION IN DISTANCE HIGHER EDUCATION BY WORKING ENGINEERS

A Dissertation APPROVED FOR THE
DEPARTMENT OF EDUCATIONAL LEADERSHIP AND POLICY STUDIES

BY



ACKNOWLEDGMENTS

I sincerely appreciate the leadership provided by Dr. Robert D. Fox, my doctoral committee chair and graduate advisor, for his patience and understanding during my research wanderings. His guidance during the selection of the this research topic, Prospectus development, and suggestion to use discriminant function analysis (DFA) to provide structure to my quantitative data analysis was instrumental to the success this study. Dr. Fox's wisdom and expert guidance, encouragement and direction during the dissertation process was truly invaluable. His rare ability to cut straight to the nub of major problems in written manuscripts resulted in the excellence of this research product.

Dr. Dillon was most helpful in providing inspiration in the area of distance education through her instruction, advice and encouragement. Her interest, support and guidance in distance learning is deeply appreciated. Her critical review of the DE content in this dissertation is deeply appreciated.

I thank Dr. Morris for his indulgence in taking on a non-traditional, working engineer who was venturing into higher education fields of learning--when he didn't need to add another graduate student. His friendship, scholarly encouragement, and sincere interest were a great inspiration to me during this long journey. I sincerely appreciate his support.

Dr. Langenbach provided much needed direction during the Prospectus development phase of the study and encouraged me to proceed. His invaluable technical review of my Prospectus and Dissertation manuscripts, added significantly to the final product.

My group interactive learning process experience in Dr. Michaelsen's course was an inspiring part of my doctoral program. His practical approach to higher education and cooperation as outside faculty have added a fine dimension of excellence to the doctoral experience of this student.

I sincerely and deeply appreciate the support and collaboration of Dr. Jean Lorraine Thornbrugh, Ph.D. Her counsel and encouragement, unselfish and voluntary sharing of resources, data, and ideas were a continual inspiration to this graduate student.

Jean labored diligently and unfailingly in my behalf, bringing clear understanding to "DFA" as a statistical tool. She worked far beyond the call of duty as a fellow student, even after completing her Ph.D. and starting a new job. Without her unfailing technical assistance, encouragement, and moral support, this task would not have been completed.

Deep gratitude is expressed to Ms. Diane Sweeney, statistical instructor and Ph.D. candidate in the Department of Statistics at Oklahoma State University. Diane devoted untold hours, running data and helping me understand much of the interactive workings of DFA. She was totally unselfish with her time in providing valuable assistance to me when it was not in her charge at OSU. Her compensation was this challenging but successful consulting experience which she can list on her resume, a few reams of paper and **many thanks**. Without her statistical expertise, this project would have failed.

This dissertation is dedicated to my loyal, loving wife and lifelong companion, Zona G. Noyes, whose encouragement has sustained me through the past 10 years of this labor. I thank her for her loving support, for putting up with my hundreds of hours of isolation with my constant companions, my MAC IIsi and MAC Quadra computers. She provided much needed encouragement, assistance in preparing and mailing the several hundred survey mailings, typing of mailing addresses, Post Office runs, and the many other small details that helped me conduct the research and complete the manuscript. Without her loving and caring support, this project would have ended long ago. I thank her for her patience and assistance in typing during the writing of course papers, the Prospectus and Dissertation manuscripts, without which this dissertation would not have been completed.

I also dedicate this work to my children, Cynthia, Scott and David, son-in-law Matt Steinmetz and grandsons, Ryan and Samuel. They provided much needed inspiration and encouraged me to continue when my energy, drive and determination were flagging.

Finally, I thank the admistrators at NTU, especially Ms. Eileen Morree, Registrar and the hundreds of working engineers who gave of their valuable time to complete the questionnaires that made this research possible. I truly hope this work will be a benefit to them and future DE engineers throughout the U.S.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

ABSTRACT

Barriers and Facilitators to Participation in Distance Higher Education by Working Engineers

By

Ronald T. Noyes

Engineers who work for companies far from college campuses face continuing education barriers to participation in lifelong learning (LLL) like class conflicts with work, family and social responsibilities, as well as distance, travel cost and time barriers. Instructional television (ITV), poor advising, and lack of instructor contact, libraries and laboratories are major distance education (DE) barriers.

The purpose of this research was to determine why some engineers participate in continuing professional education (CPE) while other engineers in the same companies choose not to participate. No studies of barriers and facilitators to participation in CPE or DE by engineers were found during the search of literature. The questionnaire from a 1991 national pharmacy study of barriers and facilitators to participation in LLL was modified for engineers involved in CPE through distance education.

National Technological University (NTU), Ft. Collins, Colorado, which delivers M.S. degree engineering courses by satellite to U.S. corporations, was the DE cooperator. Three NTU participant groups were: Group I, "graduates"; Group II, engineers "admitted" to M.S. programs; and, Group III, engineers "taking" selected courses for CPE. Engineers who requested NTU information but who chose not to enroll were Group IV, "nonparticipants."

A panel of 20 experts recommended using two questionnaires to shorten the survey, simplify instructions and increase response rates. The survey had a 47 percent response.

Regression and discriminant function analysis (DFA) were used to process quantitative data. A theoretical discriminant function (DF) model, Z_{234T}, developed for "admitted" and "taking" groups versus "non-participants," was 82 to 88 percent accurate.

Split population samples were used to check internal and external validity. Reduction of open-ended question responses resulted in seven new barriers and 13 new facilitators to DE participation.

Conclusions: DF model Z_{234T} (primary study result) accurately classified participant engineers. Primary barriers to participation were: job and family constraints; work and family study interference; lack of desired courses; lack of suitable degree options; poor course advising; and, poor homework feedback. The best facilitators were: affordable learning; easy access to learning; NTU course schedule; taking class during work time; and, flexibility in making up exams and homework. The qualitative research produced 20 new barriers and facilitators to participation in DE, which will strengthen the engineering DE literature.

Recommendations: A study of *nonparticipation* by working engineers should be conducted. The seven new DE participation barriers and 13 new DE facilitators should be integrated into revised engineering DE questionnaires. The theoretical DF model Z_{234T} should be refined for use with a short questionnaire that includes only the DF model variables. The DF model and DF questionnaire should be used as a DE participation diagnostic tool kit to screen potentially successful engineering students for NTU and other engineering DE programs. Additional engineering DE research should be conducted to further validate the theoretical DF Model Z_{234T} model and the DF questionnaire.

BARRIERS AND FACILITATORS TO PARTICIPATION IN DISTANCE HIGHER EDUCATION BY WORKING ENGINEERS

CHAPTER I

INTRODUCTION

Barriers to Participation in Adult Education

Adult learners are frequently confronted with a variety of complications that restrict participation in formal continuing education programs due to a variety of obstructing factors. Many studies by adult education researchers have documented barriers and constraints to participation by adult learners beginning in the early 1970s (Boshier, 1973; Darkenwald, 1977; Hammer & Shale, 1981; Knox, 1987). Most barrier to participation studies have been about adults working in fields that do not require continuing professional education (CPE) for employment or advancement (Valentine & Darkenwald, 1990).

Today, many adults in the U.S., who want to take formal continuing education courses, are hindered by restrictions or conflicts they cannot control. Restrictive barriers to continuing education force these adults to be non-participants. Non-participants are restricted from continued learning by distance and lack of educational programs that fit their needs, work schedules or social interests (Anderson & Darkenwald, 1979; Hezel & Dirr, 1991a; Martindale & Drake, 1989; McDaniel & Gray, 1987).

Adults, who desire to learn, may be unskilled workers trying to improve technical job skills. Others may be skilled workers or professionals seeking higher education to advance in their job specialization or move into management.

Some professionals want to take advanced technology credit courses that relate to their CPE goals, career objectives or work program requirements. Others want to pursue graduate degree programs for advancement (Swanson, 1991).

Participation in distance education (DE) is evolving as a potential solution for credit and non-credit continuing education for many adult learners. Distance education involves taking courses in remote settings where the learner is not in a classroom with an instructor. DE learning takes place in instructional television (ITV) classrooms at work sites, university extension centers or home. ITV methods pose constraints to adult learners who want to discuss training material directly with an instructor.

An example of DE participation is when students receive instruction through satellite down-link or ground-link site ITV monitors. Feedback by students to instructors is accomplished through manually controlled or voice activated microphones, direct telephone bridge, after hours telephone, E-mail or facsimile. Instructors may use computer mediated communication (CMC) to discuss class materials live ("chat") or at other times to "discuss" class materials with students. Alternative DE instruction may be through video tape plus correspondence manual for instruction with express-mailed assignments and homework.

A facilitator for one student may be a barrier to another distance education student. CPE participation through distance education may involve perceived or real barriers in the form of non-traditional course delivery and feedback communication. Non-traditional instruction methods may be facilitators that are acceptable or preferred by some students. Other students may be hindered by receiving instruction from remote DE instructors.

Distance education participation offers great promise as a means of obtaining graduate training for working professionals. Only a limited amount of reported research, even with the potential offered through distance education, involves barriers to adult distance learning (Barker & Platten, 1988; Grimes; Hammer & Shale, 1981; McDaniel & Gray, 1987). Even fewer studies reported barriers to distance education CPE programs experienced by graduate engineers (Baldwin, 1987; Wergin, Boland & Haas, 1986). A limited amount of reported research has referred to facilitators or motivators to participation along with barriers to participation (Hammer & Shale, 1991; Van Valkenburg, 1988; Yamaguchi, 1992).

Engineering Distance Education

In the early 1970s, engineering educators in the National Research Council (NRC) and National Science Foundation (NSF) discussed U. S. engineers' need for continuing professional education. Engineering educators recognized that distance education had to be developed as a primary facilitator of CPE for engineers because many engineers were not close to engineering colleges.

In 1976 the NSF conducted a study that addressed the urgent technical education needs of engineers working in national defense projects. The NSF study concluded that distance education technology was needed as a facilitator to strengthen engineering CPE. NSF and the Alfred P. Sloan Foundation formed a non-profit distance education consortium: the Association for Media-based Continuing Education for Engineers (AMCEE). AMCEE's main purpose was to "increase the national effectiveness of continuing education for engineers" (Baldwin, 1987, p. 681).

AMCEE, formed as a consortium of fourteen leading engineering colleges, began producing and video taping engineering short courses and seminars. AMCEE video tapes were broadcast by satellite to some college down-link sites and shipped to other member colleges to train engineers on advanced engineering technology topics.

Although the 1976 NSF study initiated distance education through AMCEE delivery of technical training for engineers, it was a study focused on national defense, not on barriers and facilitators to participation by engineers. It did not focus on problems faced by individual working engineers with their family, social, professional and work problems. It was not designed to seek solutions to engineering adults' needs or concerns.

Important spin-offs of the AMCEE program evolved during the last decade. Engineering colleges, engineering education associations and consortiums developed state and regional distance education networks using ITV as the primary delivery medium. These were distance education programs developed by states or multi-state regions to meet CPE needs of engineers in their industries. Several of these programs are multi-

disciplinary efforts involving state legislatures, state higher education governing boards and engineering colleges at major state universities.

Early engineering distance education systems used microwave tower networks to transmit ITV courses. These were line-of-sight video/audio television signal transmission systems with relay towers spaced 25 to 30 miles apart.

The development of economical video recorders was the major breakthrough that accelerated ITV in distance education. Satellite transmission cost reductions made delivery of analog video and audio signals affordable, thereby enhancing satellites for DE use.

The third major ITV advancement was the introduction of compressed digital video (CDV) with audio sideband delivery. CDV signals are transmitted through digital satellite transponder and/or fiber optic ground line systems. These major technological advancements in the late 1970s and early 1980s further enhanced AMCEE's progress.

NSF's original plan was for AMCEE to produce and distribute video short courses to practicing engineers at or near their work place. This would minimize travel and time away from home or work while maximizing engineering learning. It became obvious that while AMCEE met critical short-term technology needs of engineers, it did not meet all of their technical academic needs or long-term professional career development goals.

NTU - Engineering Distance Education Model

AMCEE's Board of Directors decided to develop a permanent engineering ITV satellite network to replace their cumbersome ad hoc uplink station and satellite transponder rental program in 1982. They also voted to start a new graduate engineering "university of the air" designed around their satellite delivery program. This new academic program, the National Technological University (NTU), was incorporated as a joint program with AMCEE to share satellite transistor rental time and cost.

The champion and president of NTU, Lionel Baldwin, was Dean of Engineering at Colorado State University. The AMCEE Board of Directors elected to build NTU headquarters at Fort Collins, Colorado because of Baldwin's strong leadership. NTU,

founded by the fourteen university consortium that founded AMCEE, started video course delivery in 1984 and quickly became a national distance education model for engineers and a leading innovator of satellite distance education delivery (Baldwin, 1987).

NTU converted all transmissions from analog to CDV from 1992 to 1993. The use of CDV allowed them to immediately reduce from two satellite transponders, to operate two channels, to one transponder thereby cutting satellite rental costs in half. Digital signals allowed NTU to operate seven to eight production channels on one transponder with communication sideband channels. NTU's 47 university consortium delivered most of its 875 courses live to engineers at Fortune 500 companies and government laboratories.

NTU is an example of a well organized DE engineering degree program. NTU granted 711 Master of Science degrees in eleven engineering programs from 1986 through 1994. Although 4,894 engineers and technical managers were enrolled in 1993-94 with 1,450 in M.S. degree programs, NTU's distance education degree program services only a small segment of U.S. engineering graduates (NTU Highlights, 1994).

NTU provides non-credit teleconference seminars and workshops through its Advanced Technology and Management Programs (ATMP), in addition to the academic master of science credit program. ATMP provided seminar and workshop services to 110,000 registrants in 1993 on cutting-edge engineering and technical management topics such as computer software, engineering optics, wireless communication, TQM, non-linear dynamics and materials technology (NTU Executive Summary, 1996).

NTU is one CPE solution now available to a small select segment of U.S. engineering graduates. Students enrolled at NTU must be engineers or technical managers employed by large corporations and U.S. government laboratories at one of NTU's 650 down link sites. Suitable engineering courses are not always available from NTU.

Although NTU provides a model CPE solution for engineers in large corporations, most engineers work for medium or small companies that do not have access to NTU. Consequently, most engineers in the U.S. may still have difficulty accessing suitable

formal CPE from distance education sources to get the training they need. Plans are being made to offer new pilot programs designed to deliver NTU courses to engineers at small and medium sized manufacturers to fill the gap (NTU Annual Report, 1994).

The NSF engineering study that created AMCEE and NTU is one of two research studies found in the literature that involves distance education of graduate engineers. Some studies of undergraduate engineering programs discussed barriers, but no formal educational research studies were found that identified listings of barriers and facilitators to CPE by traditional or distance learning for graduate engineers. Many engineers are employed in locations that are distant from traditional campus-based engineering research universities. In these situations, DE is the primary solution to engineers educational needs.

There appears to be a major need for this research data by engineers and other professional groups, even though there has not been a study that addresses barriers and facilitators to distance learning by graduate engineers. Leading engineering educators recognized and dealt with this problem of inaccessibility to ongoing professional training courses in their own organizations in the 1970s.

The 1976 NSF program resulted in a national engineering study that recommended developing a distance learning consortium to deliver distance education workshops, seminars and short courses to member universities first by pre-taped video, followed by satellite to some with down link sites (Baldwin, 1987; Wergin et al., 1986).

Barriers and Facilitators in Engineering Distance Education

Engineers are expected to experience many of the same social, professional or work related barriers and constraints to participation in advanced learning that are faced by other adult workers. However, engineers may also experience barriers that are unique compared to other adults due to the specialized nature of their scientific education and work.

Most engineers have a need to learn and a great desire to participate in continuing technical education throughout their working lives. They are highly motivated to learn because of their strong desire to remain technically proficient for advancement in their

profession. Like other professionals, such as doctors, nurses, educators, or pharmacists, engineers often face serious barriers to participation in continuing education.

Continuing professional education (CPE) will be an ongoing need for engineers for decades. Engineers must update their knowledge base frequently due to rapid changes in science and technology. Today, many engineers face major problems in keeping their technical skills and knowledge updated. This dilemma is expected to become even more difficult with the rapid acceleration in information development and transfer through advancements in computer network and satellite delivery systems.

Distance engineering education barriers were addressed by Cranch, who stated:

> Except for the presence of government research contracts, there is not a national federal responsibility or coordinating role for engineering education. Lacking national coherence, our dual public/private system is distinguished by decentralization and diversity in an active, competitive environment. This environment provides a strong motivational force for improvement - - a force which has tremendous potential for continuing engineering education. Today, with the enormous acceleration in the pace of technological change, one must be committed to a personal program of continuing education in order to maintain professional competence. (1987, p. 658)

CPE participation for some engineers involves earning an advanced engineering degree related to their work. For other engineers, participation is limited to taking research based engineering courses to sharpen technical skills. Besides engineering and technical credit courses, CPE for engineers may include non-credit management or technical short courses, seminars, workshops, satellite video conferences and technical society meetings.

Many engineers are involved in specialized scientific work which requires leading-edge knowledge to maintain or enhance productivity, creativity and work skills. Lack of desired technical courses or poor timing of courses from university engineering colleges often restricts participation. Some engineers work at remote sites that limit class attendance. For both groups, participation in a variety of forms of distance education may be required.

A major CPE barrier faced by many engineers is that they can not leave work to attend resident graduate schools due to family responsibilities. Some engineers take evening and weekend classes when they find suitable courses. The option to participate may not be available in spite of engineers' desire to keep up-to-date and willingness to study while

working full time. Because engineers often work at locations that are one or more hours from engineering universities, their only CPE option will be distance education.

Engineering educators do not know exactly what distance education participation barriers engineers face, therefore they cannot understand why engineers do not participate in CPE. More importantly, they do not know the facilitators required to overcome the CPE participation barriers experienced by engineers; nor do they know what stimulates or motivates engineers who do overcome major barriers to participation in distance CPE.

Engineering educators need to learn what motivates working engineers to learn, to assist and motivate future engineers in CPE. Knowledge of major facilitators to CPE participation that can counter major learning barriers are needed. These facilitators to participation may involve people, facilities, organizations and support programs related to distance higher education. Facilitators may be "forces for change" that motivate engineering learners to overcome social, professional and distance barriers to participation in formal and informal educational processes.

Facilitators--a Needed Link to Engineering Distance Education

Research on barriers to participation in higher education for any adult group has limited value without facilitators that can overcome participation barriers. Barriers and facilitators to engineering distance education participation must be identified and studied together. Identifying primary facilitators with associated barriers will provide valuable information to help engineering distance educators improve CPE for engineers.

A study by Hanson and DeMuth (1991) addressed barriers and facilitators (solutions) to participation for a group of pharmacists. Their national pharmacy survey identified major barriers and facilitators to problems of participation the pharmacists experienced. However, this study was based on resident instruction in colleges, not distance education.

The Problem

No studies of barriers and facilitators to participation in campus based or distance higher education by graduate engineers were found. Though some of the barriers faced by

one group of professionals is similar to that faced by another, researchers do not know for sure what major CPE barriers and facilitators are faced by engineers. If they do not know the barriers to participation, they certainly do not know, nor can we predict the facilitators needed to improve participation in CPE through distance education. Research of working engineers' learning problems will help in developing facilitators needed by other engineers to overcome learning barriers.

Many technical professionals live and work at considerable distances from research university campuses or major technical learning centers that can service their continuing education needs (Knox, 1987). Several studies focused on barriers to participation by adult learners (Boshier, 1971 a; Cranch, 1987; Darkenwald, 1977; Hammer & Shale, 1981; Hezel & Dirr, 1991 a). Several studies informally suggested alternative means of facilitating participation (Cranch, 1987; Van Valkenburg, 1988; Wergin et al., 1986).

The NFS study recommended distance education for engineers but did not address the study of personal barriers and facilitators of engineers. That national study by NFS was based on development of a program designed to keep engineers in the defense industry current on defense technology (Baldwin, 1987; Wergin et al., 1986).

In view of the lack of studies of facilitators needed to overcome barriers to participation in resident instruction in general education, it is not surprising to find that only one study specifically researched both barriers and facilitators by a professional group--pharmacists. In the national study of practicing pharmacists, Hanson and DeMuth (1991) listed 16 barriers and 12 facilitators to participation in CPE.

In their study, one barrier and no facilitators mentioned distance education related to learning. The barrier question related to driving distance to attend regular university classes. Yet, because pharmacists operate drugstores and pharmacies in most towns and small cities, they are much more widely spread throughout the U.S. than engineers who typically work in industry and government in medium to large metropolitan areas. For example, approximately 35 percent of all agricultural engineers in the U.S. work within a

150-200 mile radius of Chicago because of the heavy machinery and automotive manufacturing that are located in that region.

Although the pharmacy study does not address distance education, it does provide a national survey and model for investigation of barriers and facilitators. The pharmacy survey instrument (Appendix E) was adapted as a survey instrument for this engineering distance education study. Besides changing the sample population focus from pharmacists to engineers, the scope of this study was expanded to include barriers and facilitators to distance education as a means of CPE for engineers.

Research Questions

Engineering educators must understand the central research problem and engineering education dilemmas. Several theoretical works have described barriers to participation in higher education by adults and some professional groups. One leading example was the Chain of Response Model developed by Cross (1981) who used opportunities (facilitators) and barriers in the development of her multi-directional thought process model for understanding participation by adults in learning activities.

No definitive studies of theoretical frameworks relating to barriers and facilitators of participation in distance education by engineers were discovered, even though theoretical models have been developed during the past two decades for barriers and facilitators of participation in general adult education.

Research questions which address the issues of barriers and facilitators of participation in graduate engineering distance education are:

Q 1. What significant barriers to participation are associated with engineers that deter them from participating in continuing distance higher education engineering academic programs?

Q 2. What significant facilitators of participation are associated with engineers that inspire them to overcome barriers to participation in continuing distance higher education engineering academic programs?

Q 3. What other significant factors are associated with barriers and facilitators to participation by engineers that affect their continuing participation in distance higher education engineering academic programs?

Significance of the Study

The purpose of this study it to determine why some engineers participate in continuing professional education (CPE) by distance learning while other engineers in "similar" circumstances do not participate. A deeper purpose is to learn what motivates engineers to participate or not participate--to determine what facilitators are needed to overcome the major barriers to participation in distance higher education by engineers who work in major U.S. industries and government agencies or laboratories.

The research plan, survey instrument, and statistical analysis outlined in Chapter 3 were designed to answer the research questions. These research elements are reflected in the following objectives:

Objective 1. Determine what barriers, or combination of barriers, to participation are most significant in deterring engineers from participating in distance higher education.

Objective 2. Determine what facilitators, or combination of facilitators, are most significant for engineers to overcome barriers to participation in distance higher education.

Objective 3. Determine other significant factors that may determine why some working engineers decide to participate in distance higher education when other engineers in similar situations and conditions do not participate.

The significance of this study is that engineering educators do not know what negative factors or forces block some engineers with similar circumstances from participating, or what positive factors or forces encourage other engineers to participate in distance higher education. Learning what restricts engineers from participating or motivates them to participate in distance education would be of value to leading engineering educators, especially those already involved in distance education programs. It could provide them new educational planning insight to help analyze restrictive barriers and improve facilitators

to enhance current distance education programs. This research may assist engineering educators determine if they are on the right track on DE programs.

Results of the study could also benefit engineering educators at campus based programs who are considering expansion into distance education programs. It could also aid their efforts to expand educational programs by providing CPE outreach to engineers in remote locations not being adequately served at this time.

Definition of Terms

The following definitions of key words or terms have been used throughout the text:

Barriers: Internal or external physical, mental, emotional, social or institutional obstacles or deterrents that make participation difficult or that keep adult learners from participating in formal educational learning or training programs. Cross (1981) classifies obstacles as: *situational*, *dispositional* or *institutional* barriers. *Situational* barriers were those arising from one's situation in life. *Dispositional* barriers were those related to attitudes and self-perceptions about oneself as a learner. *Institutional* barriers consist of those practices or procedures that exclude or discourage working adults from participating in educational activities like inconvenient schedules, locations, or inappropriate courses.

Candid classroom: Early distance education video tapes and satellite transmission were made with a video or television camera in the back of regular campus classrooms without special lighting or technical equipment to enhance video quality. Since these classrooms were not specially equipped for television, they were called "candid classrooms."

Continuing Education (CE): The Adults' Attitude towards Continuing Education (AACE) Scale defines continuing education as "credit and non-credit classes, workshops, seminars, discussion groups, conferences, training programs, and any other organized learning activity for adults who had completed or interrupted their formal schooling" (Darkenwald & Hayes, 1986, p. 5).

Continuing Professional Education (CPE): The acquisition of formally learned knowledge and skill that educated adult professionals need to maintain or enhance their

formal college education used in performing their work, advancement in their profession or o change employment. "Professionals learn through books, discussions with colleagues, formal and informal educational programs and the rigors of everyday practice" (Cevero, 1988, p. 1).

Distance Education (DE): Formal education that takes place in locations physically removed from resident instruction classrooms and instructors of educational institution campus facilities. Instructional communication, including student feedback, might be by: remote delivery using satellite transmission, microwave tower or fiber optic ground line ITV, video tape, computer mediated communication (E-mail, on-line computer conferencing or "chatting"), satellite video conference, telephone and facsimile.

Facilitators: Motivating factors, physical facilities or change forces that counter or resolve barriers and enable participation in formal adult education programs.

Instructional television (ITV): Educational program materials that are transmitted by video and audio signals, delivered by previously recorded video tape, direct satellite downlink, micro-wave transmission by ground towers, or fiber optic ground cables. From a timing standpoint, course materials can be provided or delivered by video tape, delayed broadcast or during live class instruction.

Life long learning (LLL): "Lifelong learning" can be interpreted that learning decisions and plans, and evaluation of learning outcomes are primary components within the overall learning process, with emphasis on learning by the learner. It might be more accurate to visualize lifelong learning as a "conceptual framework for conceiving, planning, implementing and coordinating activities to facilitate learning (throughout ones lifetime)" (Peterson, 1979, p. 5).

> Lifelong Learning is described as an all encompassing nomenclature that includes a variety of learning experiences which occur throughout an individual's life span as the learner seeks to acquire knowledge, skills, attitudes, and/or competencies relative to personal and professional growth. (Hanson & DeMuth, 1991, pp. 20-21)

The concept of LLL is not restricted to a specific type of learning experience (i.e., college degree), nor to the origin of the learning experience (learner initiated versus

instructor initiated), learning format (home study versus classroom), or focus of the desired learning outcome (personal or professional growth).

Non-participation: To inquire about but not follow-up, enroll and take part on a continuing basis in adult training programs, academic curriculums or courses as admitted students.

Professional: Licensed graduate whose scientific or technical work involves human health, welfare and public safety programs in major technical service fields accredited, administered and monitored by federal and state licensing oversight boards. Examples: professional engineers, land surveyors, pharmacists, physicians, nurses.

Participation: To enroll and take part on a continuing basis in training programs or higher education academic programs as a formally admitted student.

Problem: Some researchers define a *problem* as a specific situation of unknown conditions needing a solution or a research question needing an answer. Others say solving a research problem involves defining the relationship between two or more research variables. Problems do not exist in nature -- they exist only in the minds of people, making belief uncertain. Merriam and Simpson say a problem may be defined as something that "perplexes and challenges the mind" (1995, pp. 16-17) and a research problem is a catalyst for transferring one's curiosities into a workable tool for planning and guiding research .

CHAPTER II

REVIEW OF LITERATURE

Introduction to the Literature

This literature review traces the development of barriers and facilitators to participation in both academic and informal programs by adult learners and technical professionals. These selected studies report barriers and facilitators to participation in both resident and distance higher education during the past quarter century.

There have been many studies involving barriers to participation in adult education in the literature over the past 25 years. Merriam and Simpson stated that "Interest in why adults participate in education appears to be a perennial source of descriptive survey research" (1995, p. 143).

Most studies of barriers to participation have not included research on facilitators to participation. Early studies were not focused on the term "facilitators of participation", but some earlier studies reported activities considered as facilitators of participation, such as Lewin's Force Field Analysis and Cross' Chain-of-Response Model (Cross, 1981, pp. 112-113, 124-125; Lewin, 1947). The study of facilitators with barriers to participation appears to have been initiated during the past ten years.

The number of studies that researched barriers and facilitators of participation in adult higher education is small, although some educational research studies have dealt with barriers and opportunities (Cross, 1981), and barriers and improvements (Wergin et al., 1986) to participation in continuing education of adults. Knox (1987) discussed barriers and the lack of facilitators or stimulus with hard-to-reach (distance) adults. Grimes et al. (1988) did not specifically use the term "facilitators", but they did point out factors that could enhance student performance.

The only study discovered that was specifically directed to barriers and facilitators of participation by professionals was a national study of pharmacists by Hanson and DeMuth (1991). Although that study did not include distance education, their survey instrument was suitable to adaptation for barriers and facilitators to participation in engineering distance education.

The focus of this research was to determine the major barriers and facilitators of participation in engineering distance education. Literature related to barriers and facilitators of participation in higher education of graduate engineers is limited. A few studies of engineers in distance education were found that related to barriers but not facilitators. Reports of two engineering studies recommended distance education as a solution to CPE problems experienced by working engineers, but neither discussed barriers and facilitators (Baldwin, 1987; Wergin et al., 1986).

The lack of barriers and facilitators to participation research in DE by graduate engineers may be due to a lack of engineers in graduate education research. Distance education may often be the solution (facilitator) to barriers to participation in resident higher education. Cropley and Kahl (1983) theorized that the distinction between traditional and distance education was blurred:

> Face-to-face education and distance education, viewed as differing sets of organizational provisions for the fostering of learning, emphasize different kinds of learning processes, and depend upon somewhat different psychological properties in learners. Nonetheless, all practical learning settings, whether they are labeled 'school', 'adult education', 'distance education', or something else, involve a mixture of face-to-face learning and distance learning. The psychological difference between the two kinds of settings is thus not purely qualitative in nature, but is also quantitative: for instance, certain learner characteristics which are useful in face-to-face learning --- are indispensable for distance learning, while certain processes which are at the heart of distance learning --- are often given little emphasis in face-to-face settings, although they are in principle possible and even desirable there. The question thus arises of whether it would not be desirable to give more emphasis in face-to-face settings to psychologically desirable aspects of distance learning. (p. 27)

They maintained that in reality, many traits of each type of educational system were shared even at that time. Therefore, distance education seems to be evolving from a non-traditional to a traditional form of educational process. Facilitators of participation need to

be identified along with barriers in order to improve the effectiveness of distance learning for CPE of engineers.

The following sections review literature that highlight barriers and facilitators to participation in adult education, adults in distance education, and restrictions faced by working engineers in receiving advanced engineering education. Factors are discussed that facilitate solutions to barrier problems in these studies.

Barriers and Facilitators in Adult Education

Theoretical models of barriers to participation in adult education that were developed in the early 1970s expanded on leading typologies of adult education participation (Boshier, 1971 a). Boshier developed the Education Participation Scale (EPS) as a conceptual model of educational participation and used to predict adult educational institution dropout as well (1971 b, 1972). His 40 item EPS questionnaire, a major addition to participation modeling theory, contained six factors: social stimulation, social contacts, professional advancement, community service, cognitive interest and external expectations.

In a follow-up study, Boshier expanded development of the EPS by relating non-participation to external factors (educational environment) as well as internal factors (individual). The EPS was parallel and related to Boshier's Personality and Educational Environment Scales (PEES). The PEES instrument measured a student's perceptions or ratings of himself, his ideal self, his instructor, and his peers. It also asked for reasons for non-participation in adult education evening programs (1973).

Boshier's theory of motivational orientation suggested that participation in adult education was related to "life-chance" (lower socioeconomic groups), which he compared to "life-space" (upper socioeconomic groups). He related *life-chance* with lower income groups that he felt were suffering from "deficiency motivation" and *life-space* with "growth" or professional development of upper income groups (1977). His EPS and PEES models were modified for use in planning educational programs for older adults (Boshier and Riddell, 1978).

In the mid-1970s Darkenwald (1977) studied why adults participated in formal education. He concluded that Houle's three-factor typology was not adequate for evaluating adult education participation. He felt Boshier's six EPS factors involving adult education participation (professional development; social welfare; external expectations; social relationships; escape stimulation; and cognitive interest) represented a prediction model of participation versus non-participation. His adult education research validated Boshier's EPS findings.

An early theoretical study that was the forerunner of barriers and facilitators to participation in higher education was Kurt Lewin's (1947) seminal social research on group dynamics which resulted in his 'force field analysis' model. Cross described Harry Miller's adaptation of Lewin's concept of opposing positive (facilitator) and negative (barrier) motivational forces used by adults in making decisions about participating in continuing higher education (Cross, 1981, pp. 112-115).

In a study of concepts on cooperative adult education programs between business and industry sectors working with educational institutions, Darkenwald (1983) explored attitudes and personal perceptions of business managers concerning their educational priorities, costs and benefits. His study of business and industry projects the serious need for distance education for working engineers and other professionals such as doctors and nurses. NTU's M.S. degree engineering program satellite down-linked to major U.S. corporations and government agencies and research laboratories.

The Deterrents to Participation Scale Questionnaire (DPS-Q), a research tool to identify adults' attitudes toward deterrents to participation in adult education, was developed by Scanlon and Darkenwald (1984). The following year, Darkenwald and Valentine (1985) advanced their adult education participation theory as a factor model of barriers to participation in adult education. Their paper described how they adapted Scanlon and Darkenwald's Deterrents to Participation Scale for the general population as the Deterrents to Participation Scale-General (DPS-G). Data from 215 respondents, who completed the

DPS-G form, resulted in the listing of six major deterrents to participation: *lack of confidence*; *lack of course relevance*; *time constraints*; *low personal priority*; *cost*; and *personal problems* .

In a study to compare participation barriers by off-duty Air Force enlisted adults, Martindale and Drake (1989) identified eight barriers to participation in off-duty education using the Deterrents to Participation Scale (DPS-G). Eight barriers to participation found in this study were: *time constraints*; *lack of confidence*; *family problems*; *lack of interest*; *lack of encouragement*; *lack of course relevance*; *cost*; and *inconvenience*.

They developed variable loadings, item means and scale ranks for each of the eight factors. The eight factors they reported were clearly differentiated with no extraneous variable within them and were consistent with the structure established in the literature. The objective of their study was to validate DPS-G with a different population (Martindale & Drake 1989).

Fifer (1989) developed a 39 item instrument called the Continuing Professional Education Inventory (CPEI) to research barriers to continuing professional education (CPE). This survey instrument was pilot tested with selected teachers. The instrument was then used to assess feedback, following refinements, from 348 teachers in 42 Tennessee school systems. Six major barriers identified by factor analysis were: child care; inconvenience; lack of fulfillment; lack of school system support; second job; and personal time. Several relationships were listed between demographic factors and identified barriers.

The Adult Attitude toward Continuing Education Scale (AACES) was an instrument developed and tested statistically to evaluate criterion and construct validity related to adult education participation. The AACES was tested and factor analyzed from a sample population of 275 adults to identify their attitudes to participation, based on three major psychological dimensions: *learning enjoyment*, *adult education importance*, and *intrinsic value for continuing education* (Hayes & Darkenwald, 1990). Potential adult learners were studied to advance the field of barriers to participation knowledge.

The researchers re-evaluated six deterring factors identified in their 1985 research report and developed a descriptive typology of five non-participant categories of potential learners. These factors were people deterred by: *personal problems*; *lack of confidence*; *educational costs*; *lack of interest in formal education*; and *lack of interest in available courses* (Valentine & Darkenwald, 1990).

Table 1. Significant Developments in Barriers and Facilitators to Participation Research in Adult Education

Researchers	Date	Research Study or Report Findings/Developments
Lewin, K.	1947	Force Field Analysis Model of Participation.
Boshier, R.	1971	Personality and Educational Environment Scales (PEES).
Boshier, R.	1972	Education Participation Scale (EPS).
Boshier, R.	1977	Life-chance/Life-Space Theories of Education Participation.
Darkenwald, G.	1977	Conducted participation research; validated Boshier's EPS.
Cross, K. P.	1981	Chain-of-Response (COR) Model for Understanding Participation in Adult Learning Activities.
Darkenwald, G.	1983	Reported business manager's perceptions of education needs.
Scanlon, C. S. & G. Darkenwald	1984	Deterrents to Participation Scale questionnaire (DPS-Q).
Darkenwald, G. & T. Valentine.	1985	Validate Deterrents to Participation Scale Questionnaire (DPS-Q)
Knox, A. B.	1987	Developed four strategies (A-D) to reducing participation barriers in adult career education by hard-to-reach adults
Fifer, B. B.	1989	Continuing Professional Education Inventory (CPEI)
Martindale, C. M. & J. B. Drake.	1989	Validated DPS-G questionnaire with Airforce personnel study
Hayes, E. R. & G. Darkenwald.	1990	Adult Attitude to Continuing Education Scale (AACES)
Valentine. T. & G. Darkenwald.	1990	Refined DPS-Q; developed five non-participant categories of potential learners

Participation in adult career education by fully employed adults often involves reducing or eliminating barriers that confront these non-traditional students, especially those living in remote locations. Knox discussed barriers and the lack of stimulus or facilitators experienced by hard-to-reach adults. He addressed the problem of participation constraints

with a flexible strategy for increasing participation (facilitators) using four broad based approaches to barrier reduction through encouraging persistence and achievement. The four strategies Knox suggested in his study were:

A. Summarize major participation barriers and facilitators highlights for clientele;

B. Assess reasons and deterrents for your clientele;

C. Help clientele understand what they can do about barriers and facilitators; and

D. Show other organizations how to encourage continuing education participation.

Item A encouraged participants to summarize barriers and facilitators, identify problems and develop solutions. The researcher listed ten examples of specific strategies for guidelines B, C and D that might help encourage hard-to-reach adults or distance education candidates to persist in their quest for higher education (Knox, 1987).

A summary of major works of leading adult education researchers on barriers and facilitators to participation in continuing higher education is listed in Table 1. These major developments set the stage for the extension of the study of barriers and facilitators of professional and engineers studying by distance learning methods.

Barriers and Facilitators in Adult Distance Education

One of the earliest reports of an attempt to overcome barriers by facilitating participation in adult education was a paper presented at the 1981 Annual Meeting of Association for the Study of Higher Education in which Hammer and Shale (1981) reported their survey of 2,491 students "attending" Athabasca University, Alberta, Canada. They researched students' personal, demographic and geographic characteristics such as sex, age, number of people in the household, educational preparation, occupation, reason for pursuing college education, geographic location, learning situation preferences, and reasons for studying at Athabasca University.

The researchers found that Athabasca University's open admission policy and distance delivery method was important to remote full-time students and working adults as well as students located close to the university. Distance education, flexible timing format and

credit for previous education were instrumental in overcoming barriers to participation by these non-traditional students (Hammer & Shale, 1981).

The Annenberg/CPB Project study of the "Economics USA," a macro-/micro-economics telecourse delivered by Western Illinois University (WIU) in 1986-87, was another early study of barriers to participation in adult distance education by Grimes et al. (1988). This ITV course was structured around 28 half-hour video lessons in the form of TV news reports. In each lesson a news correspondent presented facts and historic film segments about a major economic issue. The correspondent was followed by an academic economist who analyzed each major economic issue.

About 1600 students from 100 colleges participated during the 1986-87 Fall/Spring academic year. Grimes et al. (1988) segregated their study of distance students from WIU's external degree program into two non-resident student groups: one traditional lecture class served as the "control" group while the remaining students served as the experimental group.

These three groups were described as:

Long Distance: Telecourses viewed at home; telephone contact with instructor; long distances to university support services/resources and homework, exams by mail.

Off-campus: Local non-residents; weekly telecourses; every four weeks, talk with instructors by telephone during interactive video; university services; campus exams.

Control: Traditional lecture classes held three times weekly; daily instructor contact, graduate student tutors; all university resources and exams in class.

Study group comparisons included identical objectives, grading processes, exams, homework assignments with the instructor. Off-campus group had greater instructor and supportive services access than long distance groups but less than the control group.

Research questions used in this study were:

> Does completion of an elementary economics course result in a measurable increase in economic knowledge and reasoning?

Will increased student-teacher contact and instructional support result in increased learning for students in the "Control" group vs. "off-campus" and "long-distance" students, and "off-campus" vs. "long-distance" students?

Will increased student-teacher contact and instructional support result in more positive attitudes toward economics as a discipline?

Researchers administered the Revised Test of Understanding in College Economics (TUCE), a 30 multiple-choice question test, to all participants with a pre-test and post-test to evaluate the learning process. Three major categories of knowledge were identified:

Recognition and Understanding: ability to recall, identify, and define economic concept;

Explicit Application : applying economic concepts to solve a specific problem; and

Implicit Application: applying economic reasoning to solve problems with unstated assumptions and extraneous information.

Researcher findings included:

* Telecourse students studied more than the control group.

* Distance learners scored lower on explicit application than the control group, but were equal or higher on implicit application.

* Telecourse students communicated more by telephone with the instructor and also scored higher on macro-economics than the "control" group.

* Student/teacher contact had a surprisingly small association on the degree of student learning and attitude formation. (Grimes et al., 1988)

Factors that facilitated student participation in this distance education course were noted, although this study did not use the term "facilitators of participation". For example, the telecourse format made it possible for students in the long distance group and possibly most of the off-campus students to participate. Access to campus resources/services and instructor communication were still major barriers to distance students but less of a problem to off-campus students. Results indicated that performance non-resident student was comparable to the control group, even with these constraints.

In another study, 25 students learning via telecourses serving urban, suburban and rural students at each of four colleges in Tennessee, Virginia, Illinois and South Dakota

were surveyed by Hezel and Dirr (1991 a) to identify and evaluate barriers to participation in distance education. Personal interviews were used to probe family concerns, work responsibilities, time, distance, transportation, child care and other barriers to traditional college courses that led these students to enroll in ITV courses. The researchers also evaluated the likelihood of students enrolling in courses that required using computers at home, work or campus extension centers.

In a second study by Hezel and Dirr (1991 b), physical distance often appears to be the main reason students participate in distance education, but time management was the major constraint that confronted subjects in this study. Study and travel time competition with work and family demands were primary problems. Most students (median) commuted 15 miles or less, mean travel time was over 80 minutes and median travel time was about 30 minutes, even though mean distance from colleges was 68 miles. Table 2 lists major reported obstacles to resident courses.

Table 2. Barriers to On-Campus Courses

Obstacles	*Very Important* %	*Somewhat Important* %	*Not Important* %
Time constraints	84	11	5
Work responsibilities	64	22	14
Family responsibilities	60	22	21
Distance from campus	54	21	25
Transportation	38	25	37
Child care	11	16	73

In addition to traditional barriers to participation, researchers included computer use, computer literacy and course availability as potential barriers. E-mail results in computer conferencing questions indicated 59 percent of off-campus ITV students were *very likely* to enroll in a course that required a computer at home, while 24 percent were *somewhat likely* to enroll in a course that required home use of computers to take the course. These results are compared to 46 percent and 28 percent who would use computers at work for

educational course communication. Instructor contact was also a major issue (Hezel & Dirr, 1991b).

Barriers and Facilitators in Engineering Distance Education

No studies, which focused on barriers and facilitators to participation, were found in the research reports of graduate engineering resident instruction or distance education, even though research on barriers and constraints to adult education has been on-going during the past 25 years. The lack of barrier and facilitator to participation studies in CPE or DE by engineers suggests that few reports of technical distance education have been made.

Cranch put the need for advanced continuing technical education for engineers in perspective when he stated:

> When engineers complete their pre-employment education and accept employment, they are in many ways just beginning to learn their profession, because only through some form of continuing education can they maintain their competence. Throughout a career the engineer learns through three major routes: on-the-job experience, personal professional development (journals, seminars, technical meetings) and through the structured educational programs which are our focus here. (1987, p. 659)

The major change that empowered ITV and telecourse instruction for engineers was described by Cranch:

> The technological breakthrough which made this feasible was a one-inch videotape recorder/player introduced by Ampex in 1966 for about $3,000. Before these portable units were introduced, broadcasters paid over $100,000 for recorders. (1987, 659)

By the early 1970s, engineering technology was changing so rapidly that "candid" classrooms that used live ITV instead of videotapes were required to keep course material updated. More than 40 regional ITV systems operating by 1987 was evidence of the acceptance of ITV technology by faculty and students. From 1967 to 1987, 24 universities awarded over 3,500 M.S. engineering degrees to part-time ITV students who completed all degree requirements through distance education (Baldwin, 1987).

The 1968 Goals of Engineering Education Report initiated an eight year national experimental project to provide engineering M.S. degree programming to part-time engineering students while working full-time at their job sites. This study described the urgent need for continued experimentation in "extending high-quality advanced degree

education to engineering students employed at locations remote from established campuses" (ASEE, 1968, p. 54). The goal was to develop on-campus type distance education delivery programs to extend this high quality advanced education to engineers employed by industries and government laboratories at locations, near to as well as remote from major engineering research universities. This recommendation, widely supported by engineering educators, was accomplished primarily through development of regional public and private university ITV systems (Wergin et al., 1986).

ITV delivered to job sites of busy engineers provided the convenience and flexibility needed by the engineers to earn advanced degrees and CPE while working full time. Video recorded class lectures watched on home television monitors with videtape players, allowed engineers to eliminate travel to class, make up missed classes, and mold course schedules to fit engineer's work schedules.

A wide range of professional engineering educational needs, ranging from graduate programs for young engineers to new technology high-tech seminars for working engineers to solve immediate problems, added complexity for early ITV developers. High technology seminars were much more expensive to develop than "candid classroom" presentations used in academic ITV.

In 1976 a non-profit consortium, the Association for Media-based Continuing Education for Engineers (AMCEE) was founded by the National Science Foundation and the Alfred P. Sloan Foundation to "increase the national effectiveness of continuing education for engineers" by producing and delivering short video telecourses and workshops for practicing engineers.

By 1982 the AMCEE Board of Directors had decided to investigate the development of a permanent engineering satellite ITV educational network to replace the cumbersome ad hoc uplink station and satellite transponder rental program. Implementation of this plan resulted in development of an academic degree program as a companion to AMCEE's video based short course program.

The new program, which started satellite course delivery in 1984, was the National Technological University (NTU). NTU was designed as to deliver master of science degree courses to engineers at major U.S. companies (NTU Annual Report, 1994).

In 1983-84 a new graduate engineering distance education system was initiated in Virginia. This masters degree engineering program involved courses taught at Virginia Polytechnic Institute & State University (VPI&SU), University of VA (UVA) and Virginia Commonwealth University (VCU). Courses were televised live from television classrooms at UVA and VPI&SU through Virginia's public television microwave network to VCU. M.S. degrees were issued from VPI&SU and UVA (Wergin et al., 1986).

Off-campus and distance TV students were older, full-time engineers. On-campus graduate students were typically in their mid-twenties. The evaluation committee developed the following four questions on student performance:

* Do the TV students perform academically on par with their on-campus counterparts?
* What might account for any significant differences?
* How do TV students react to their method of instruction?
* What are the side effects, if any, of off-campus ITV classrooms?

Researchers found that, although some lower performances were noted, most off-campus ITV students earned at least a B grade and 70 percent of these same students felt they had received an equivalent education to on-campus students. Students of several graduate engineering courses were surveyed to see what course characteristics they rated negatively, what problems they felt were restrictive and what they perceived as plausible solutions (facilitators) to these problems. Negative course characteristics identified by ITV students were textbook quality, workload, integration of materials and career applicability.

Common problems listed were:

* Lectures/homework too theoretical--lacked practical application;
* Instructor assumed students more knowledgeable than they were;
* Microphones inhibit class discussion/interaction;

* TV equipment was distracting and intrusive;
* Course material difficult to read on monitor;
* Course pace slow and boring;
* On-campus students perceived ITV students inadequately prepared;
* ITV technology depersonalized courses, depriving "live" class benefit; and,
* ITV verbal feedback to instructor seldom used. (Wergin et al., 1986, p. 110)

Changes/improvements (facilitators) suggested by the students were:

* Explore ways of reducing interference of TV apparatus for on-campus students;
* Major effort to have comfortable TV classroom atmosphere, on/off-campus;
* Don't rely solely on TV monitors to present material;
* Maintain eye contact with on-campus students, not just with the TV camera lens;
* Promote interaction between campus and remote students;
* Use qualified practicing engineers for off-campus tutorial assistance/advising;
* Build teaching dialogue between on/off-campus students and instructor; and,
* Provide timely/accessible advising to TV students. (Wergin et al., 1986, p. 110).

Little research has been directed to the development of facilitating solutions to overcome major educational barriers. Minimal effort has been devoted to developing and/or activating change agents to improve adult continuing education.

As ITV delivery increased researchers found that instruction and course quality improved dramatically, reflecting superior technical quality to earlier courses. Based on earlier problems a variety of auxiliary print and audio learning support materials were developed. This "course package" greatly enhanced the learning and knowledge retention process. Enhanced learning support was a motivator which enhanced potential adult participation. DE learning processes were being improved as support groups began to develop solutions to some of the earlier barriers and constraints (Grimes et al., 1988).

Van Valkenburg (1988), a visionary engineering education research leader, predicted future technology engineers would need to use distance education to maximize learning. "The educational system of the next century will be, or at least should be, an evolutionary step ahead of where we are today. But several current problems, if not satisfactorily resolved, may prevent engineering education from attaining that more advanced,

responsive, and effective condition (1988, p. 106)." He predicted future DE system designs as follows:

> The central education feature for simulation, design, and computation will be the workstation, with enhanced capacity, artificial intelligence, and high graphics capability. Creatively networked workstations will allow new levels of research and design collaboration with engineers accessing vast data bases and libraries.
>
> Teachers will use tutored video instruction. Learners clustered in small groups viewing tape or disk lectures can stop the lecture at any point to discuss it among themselves and/or with the tutor. On-screen query systems (artificial intelligence) will help answer questions, reducing the need for teachers to be present. Tutors will be accessible on-line during group instruction periods.
>
> New teaching materials to accompany tutored videos will be needed to handle new sciences such as bioprocessing and new materials like ceramics and polymers. These educational materials will be developed by consortia, formed to fund and produce video and scientific materials for use by a range of institutions.
>
> Engineering colleges will evolve into a matrix of discipline-oriented academic departments that will interact with interdisciplinary research centers. (Van Valkenburg, 1988, pp. 107-108)

The types of knowledge used in the work of people in each profession means different learning needs among professional groups. Engineers have different educational needs than pharmacists, physicians, or other technical professionals. Technology and methods used in solving engineering problems changes rapidly while basic engineering education related to fundamental science courses is based on scientific fact. Researchers predict that over half of an engineer's knowledge may become obsolete every three to five years. The need to update technical CPE to remain current is a challenge faced by engineers that requires broad based distance education facilitators. (Van Valkenburg, 1988)

Barriers to engineering continuing education were summed up by Cranch in a recent study as follows:

> Except for the presence of government research contracts, there is no national federal responsibility or coordinating role for engineering education. Lacking national coherence, our dual public-private system is distinguished by decentralization and diversity in an active, competitive environment. This environment provides a strong motivational force for improvement, a force which has tremendous potential for continuing engineering education.--Today, however, with the enormous acceleration in the pace of technological change, one must be committed to a personal program of continuing education in order to maintain professional competence. (1987, pp. 657-658)

Cranch stated that when graduate engineers are initially employed, they are just beginning to learn their profession. Continuing education is required for them to learn their job and maintain technical competence. Three major routes used by engineers for CPE are: on-the-job experience, personal professional development (journals, seminars, technical meetings) and structured educational programs -- the focus of this study.

Barriers to participation based on the 1985 NRC panel report on continuing engineering education were:

* Lack of time;
* No payoff, no need;
* Inconvenient location;
* Inadequate company financial support;
* Company or supervisor doesn't encourage;
* Other personal commitments more important;
* Travel distance (50 mile one-way, maximum);
* Needed courses not offered or conveniently available;
* Age--less participation by older mature engineers;
* Management career track--especially older engineers; and,
* Lack of management support--financial, time, encouragement. (Cranch, 1987)

Cooper (1991) discussed an academic engineering program using high quality distance education that was established in 1989 for engineers in corporations or government agencies by Oklahoma State University's College of Engineering, Architecture and Technology (CEAT). CEAT and OSU administrators worked jointly with the Oklahoma Regents for Higher Education and developed master of science degree programs in mechanical, electrical and chemical engineering delivered through fiber optic line telecourse DE programs, using a program negotiated with major employers of engineers in Oklahoma.

This program was popular with Oklahoma industry leaders. Seven engineers at Haliburton Corporation, located 135 miles southwest of the Oklahoma State University campus, received M.S. engineering degrees from OSU in 1993 without campus residency or any direct periodic commute to the OSU campus. Counseling and advising were completed through distance communication. Courses were transmitted live with direct

audio and compressed video signals through the Oklahoma State Regent's fiber optic network from OSU's state-of-the-art Educational Television System (ETS), which also transmitted NTU engineering courses by satellite uplink.

These digital compressed video telecourses originated from OSU's ETS Studio B. Studio B was a two-way video/audio television classroom where courses were transmitted live from classes at OSU to concurrent classes at one or more remote corporate or university DE classroom sites in Oklahoma.

OSU's fiber optic system used a CODEX compression and decompression system to provide digital video signal compression for cost-effective delivery and feedback transmission. Commercial clients installed the CODEX equipment at their educational sites. Each training site had a class coordinator and monitor who handled the logistics of express mailing class assignments to instructors. Classrooms were equipped with voice activated microphones with instructor override control of on-site video and audio bridges so the instructor could see and talk with students at any site (Cooper, 1991).

Yamaguchi (1992) studied problems of low participation in DE programs by Pacific Bell's Network Technology Department employees with 402 engineers and 119 technical management employees located at San Ramon, Sacramento, Pasadena and La Mesa.

The researcher used a modified version of the Deterrent to Participation Questionnaire (DPS-Q), a survey instrument developed by Scanlon and Darkenwald (1984). No pre-test or post-test was used in this study but five people reviewed the survey instrument and interacted with the researcher to fine-tune the cover letter and the instrument language. Eighty-seven surveys were sent to two sample population groups. Returns were received from 53 and 65 percent of the 87 participants sampled.

The research findings indicated that the reasons for non-participation went beyond personal motivation. Major employee concerns (barriers) listed were time constraints for study and attending classes. Low value placed on technical education by many participants was a serious underlying concern discovered by the researcher. Pacific Bell's provision to

pay all tuition costs and corporate sponsorship of on-site technical education programs through Stanford University, NTU and Chico State University seemed to resolve two major barriers for prospective students (Yamaguchi, 1992).

Table 3. Significant Developments in Barriers and Facilitators to Participation in Adult Distance Education

Researchers	Date	Research Study or Report Findings/Developments
Hammer, P. & Shale, D.	1981	Early study of distance education facilitators at Athabasca U., Athabasca, Alberta, that led to increased participation by distant learners in Saskatchewan.
Wergin, J. F., Boland, D. & Haas, T.	1986	Development of regional ITV systems for engineering course delivery to remote campuses.
Baldwin, L.	1987	Technological breakthrough making ITV affordable; video camera cost reduced from $100,000 to $3,000.
Cranch, E. T.	1987	Engineering education needs in U.S.; list of participation barriers from 1985 National Research Council report.
Grimes, P., Nielsen, J. & Niss, J.	1988	Annenberg/CPB Project study of 1600 students at 100 colleges participating in an ITV study of economics delivered from Western Illinois University.
Van Valkenberg, M.	1988	Projection of future engineering distance education delivery systems, including changes (facilitators) needed.
Cooper, B. L.	1991	Report of Oklahoma State U. fiber optic, compressed digital video delivery of M.S. engineering degree programs to corporations, universities and military bases.
Hezel, R. T. & Dirr, P. J.	1991	ITV course participation views by urban, suburban/rural students in Tennessee, Illinois, Virginia, South Dakota.
Hanson, A. L. & DeMuth, J. E.	1991	Study of barriers and facilitators to participation in life long learning by pharmacists in a nation wide study of 0.5 percent of all registered U. S. pharmacists.
National Technological University, Annual Report	1992	Reports NSF program to develop Association of Media-based Continuing Education for Engineers (AMCEE), that led to development of National Technological University (NTU), a satellite delivery distance education consortium of major U.S. engineering colleges.
Yamaguchi, W. S.	1992	Researcher used DPS-Q instrument to determine barriers and facilitators to participation in distance education courses experienced by Pacific Bell employees.

The respondents recommended cultural changes to increase the level of senior management support and encouragement of continuing professional education as a

requirement and expectation by management for advancement. Several workplace environment improvements were recommended to influence attitude changes by engineers and technical managers. The researcher recommended that Pacific Bell management decide if continuing technical education support was an employee benefit or a corporate investment in human capital (Yamaguchi, 1992).

Table 3 summarizes findings of leading adult distance education researchers relating to barriers and facilitators to participation in distance higher education. This table illustrates the major developments in distance education that have occurred during the past 15 years.

Engineering Distance Education Model for Barriers and Facilitators

Why do some working engineers participate in distance education when other engineers in similar working and home environments do not to participate? What facilitates participation in distance education for some working engineers while engineers in similar circumstances do not enroll? What can be done to eliminate or correct major participation barriers in adult CPE? These questions need research answers if engineering distance education in the U.S. is to advance.

Table 1 lists major advances in the developmental studies of participation barriers for adult education. These studies were about doctors, nurses, technical managers, engineers, pharmacists, biologists, computer scientists, psychologists and other working professionals who need continuing education and training in advanced technology to maintain or increase their professional qualifications. There appears to be a shortage of research information on facilitators of participation in CPE and distance education.

A national pharmacy study of barriers and facilitators included a life-long learning (LLL) random survey involving 0.5 percent of all registered pharmacists in the U.S. This was a major study of professionals that reported facilitators to participation barriers. Constraints and motivators experienced by pharmacists were expected to be similar to experiences of working engineers.

Fifty-one percent (394 participants) of the 772 pharmacy participants surveyed in this study responded to survey questions covering 16 potential barriers and 12 facilitators of LLL. "Job constraints" was listed as the greatest barrier (mean = 4.3), while "personal desire to learn/intellectual curiosity" was chosen as the greatest facilitator (mean = 5.8). The most common pharmacy learning activity listed, based on a 9 point (0-8) Likert scale was "communicating with one's peers" (mean = 6.2).

Nine practicing and three university pharmacy faculty served as an expert panel to identify barrier and facilitator factors they believed affected participation in LLL. The draft instrument was pilot tested on a pretest group selected from a diversified group of 126 Wisconsin pharmacists from hospitals, independent retail, chain retail and long-term care organizations. A seven point Likert scale was used to examine the 16 potential barriers and 12 facilitators to LLL participation.

Perceived barriers listed by Hanson and DeMuth (1991) were:

* Job constraints (lack of relief help, time off, etc.);
* Scheduling (location/distance/time) of group learning activities;
* Family constraints (e.g. spouse, children, personal);
* Lack of relevance of learning opportunities known to be available;
* Lack of information about available learning opportunities;
* Cost of participation in learning;
* Low personal priority of learning in relation to other activities;
* Professional burnout;
* Lack of quality of learning activities;
* Lack of learning opportunities to match your learning style;
* Lack of career advancement opportunities--learning activities;
* Lack of recognition for participating in learning activities;
* Negative experience with prior learning with pharmacy CE;
* Lack of confidence (e.g., fear of something new, doubts regarding ability to learn, perceived difficulty of learning encounter, etc.);
* Negative experience with prior learning at the college level; and,
* Negative experience with prior learning at the K-12 level. (p. 21-22)

The researchers developed a typology of learning facilitators. Twelve facilitators to participation (driving forces) listed to stimulate learning were:

* Personal desire to learn (intellectual curiosity);
* Professional licensure maintenance requirements;
* Learning enjoyment/relaxation as on-the-job change of pace;
* Opportunity to meet/interest in/exchange of ideas with others;
* Ease of access to learning opportunities;
* Affordable learning opportunities;
* Fear of obsolescence;
* CE provider advice/counseling related to learning opportunities;
* External source of encouragement (employer, professional organization);
* Increased recognition from and ability to serve the community;
* Professional/career advancement with possible financial reward; and,
* Family encouragement (internal source) (Hanson & DeMuth, 1991, p. 22).

The researchers also analyzed perceived barriers across demographic characteristics of pharmacists in the study sample evaluating primary characteristic relationships. Four demographic variables, related to a typology of perceived barriers listed by Hanson and DeMuth (1991), were:

* Employment -- related to job constraints, professional burnout, lack of learning opportunities to match learning style;
* Age - - related to family constraints and scheduling;
* Setting - - vs. cost of participation: and,
* Position - - strongly related to negative prior CE learning experience.

Additional evaluations and analyses were made, such as leisure and professional/leisure learning activities related to other demographic variables. This pharmacy study provided a research model of barriers and facilitators to continuing higher education participation by trained and licensed professionals (Hanson and DeMuth, 1991). The pharmacy study did not address distance education. Professionals, who seek advanced technical learning through distance education, such as engineers, may experience barriers which require specific facilitators.

The pharmacy research model survey instrument could be adapted for barriers and facilitators research use with other technical professionals such as engineers, physicians, nurses and scientists in a variety of professions or other technical fields. In this study, the pharmacy instrument in this study was modified for use in identifying barriers and facilitators to participation by engineers involved in using distance education for CPE.

The development and validation of a research instrument to study barriers and facilitators of participation in continuing distance education by engineers could expand the knowledge base, thereby filling a major gap in engineering educational research. This research program would provide an instrument for further study of distance education in other engineering settings and in other professions.

Summary of Barriers and Facilitators Research Literature

The theoretical orientation of this study focused on the need for distance education as a means of CPE for engineers who live and work at companies located at a distance away from research universities. Little is known of the interactive relationship between barriers and facilitators that determine how engineers participate in CPE, especially for engineers working in remote locations where distance education is their only option.

A quality distance education option for engineers in major U.S. corporations and government laboratories is provided by National Technological University (NTU), Fort Collins, Colorado. NTU was chosen as the laboratory for this DE study because of its national reputation and interest in advancing engineering education research.

In order to develop a suitable survey instrument for this distance engineering education study, the validated survey instrument on barriers and facilitators of participation of this large professional group of pharmacists by the national pharmacy study was selected for modification for use by engineers involved in CPE. Each engineer to be surveyed was expected to have experienced specific barriers relating to his or her employment situation, such as restrictions or constraints to enrollment and participation specific to NTU's complex academic class program delivery system.

CHAPTER III -- RESEARCH METHODS

INTRODUCTION

The review of the literature revealed a lack of studies concerned with participation in continuing professional education (CPE) by working engineers. Several studies were found about deterrents to participation conducted by Boshier (1972, 1977) and Darkenwald (1977). A model of participation in adult learning activities (Cross, 1981) and instruments to measure participation in adult education were developed and validated, Table 1. Few studies of participation in engineering education were found. This study was undertaken to evaluate perceived barriers and facilitators to participation as they relate to engineers involved in CPE with primary emphasis on distance education.

Landmark research related to barriers and facilitators to participation in adult distance education are listed in Table 3. However, only two references actually listed barriers to participation while only one was written about barriers and facilitators to adult education. No mention was made of barriers and facilitators by engineers. Yamaguchi (1992) studied barriers to distance education by Pacific Bell engineers and technical managers. He discussed reasons for lack of participation (barriers) by Pacific Bell employees in CPE technical distance education programs, but did not discuss facilitators.

The only study listed in the review of literature that measured both barriers and facilitators to participation by adult professionals in CPE was conducted by Hanson and DeMuth (1991). They conducted a national survey of pharmacists to evaluate barriers and facilitators to participation in CPE, leisure activities and lifelong learning (LLL). However, their study did not include distance education.

One study involved some aspects of distance education by adults learning through correspondence studies at Athabasca University, Athabasca, Alberta, Canada. No studies

were found of barriers and facilitators to participation in CPE by engineers at resident engineering colleges or through distance education.

Purpose of the Study

The purpose of this study was to evaluate barriers and facilitators to participation in continuing professional education (CPE) by working graduate engineers. Many engineers work for corporations throughout the U.S. that are not located close to engineering colleges at research universities. It appears that full-time engineers need distance education.

Therefore, a study was needed of barriers and facilitators to distance education (DE) by engineers who need to continue their graduate education and perhaps earn a master of science degree in engineering. Educational research involving engineers, who had completed or who were currently enrolled in a graduate engineering program delivered by distance media, was needed to better understand the barriers to participation and facilitators of participation faced by engineers involved in distance higher education.

The question, "Why do some engineers investigate graduate distance education programs but do not participate?" had not been investigated. This question points to *non-participants*, the central theme of this study of constraints to engineering participation. Engineering educators need to know what makes the difference between engineers who participate and those who do not participate in engineering distance higher education. They need to understand the profile, characteristics and thought patterns of *non-participants*.

A representative study of engineers in an engineering distance education program or who had been exposed to the program was conducted to discover what barriers were perceived to exist and what facilitators engineers thought would resolve those barriers to participation. The population selected for this study was engineering master of science degree graduates from National Technological University (NTU), Ft. Collins, CO, engineers who were currently enrolled at NTU, and engineers who inquired about academic programs but did not enroll or participate in any way. NTU was established in the mid-1980s as a major engineering education provider of engineering M.S. degree

programs by satellite delivery of taped or live courses delivered to company and government agency downlink classrooms. (Matson, 1992)

Approximately 4,900 students were enrolled in 12 technical M.S. degree programs with about 1,450 students in matriculation programs working on degrees in 1996. About 3,450 students, 70 percent of the NTU academic program enrollment, were taking selected courses, evidently to meet personal or company required CPE career objectives. NTU's M.S. degree curriculums included courses for electrical, mechanical, chemical, civil, computer, manufacturing systems, software engineers, and hazardous waste, engineering technology and engineering management. (NTU Executive Summary, 1996)

Authorization to conduct the research survey involving NTU graduates and current students was obtained from NTU's Vice President for Academics (NTU Letter of Authorization, Appendix A). The NTU Registrar was appointed by the Academic Vice President as NTU coordinator for this research study.

THE DESIGN

The Dependent Variable

The dependent variable in this study, *participation*, was measured and classified in two ways. In one way, three subgroups of participants at NTU, 1) M.S. "graduates," 2) engineers "admitted" to an M.S. degree program, and 3) engineers "taking" selected courses for CPE) were compared with engineering co-workers, who have inquired about NTU engineering courses and degree programs but who did not participate in any manner. The three "participant" groups were each compared by individual groups with the fourth group, the "non-participants" of the study.

Secondly, the dependent variable, *participation*, was evaluated and classified by examining NTU "participants" as a collapsed or combined group of current NTU students versus "non-participants." Because the non-participant population was developed from recent inquiries, it was felt that active students would be more comparable than graduates, who may have been out of the program for four to six years.

Independent Variables

The independent variables in this study were the *Likert scale type questions about barriers to participation* and *facilitators of participation* in LLL and DE, and the *interval scale demographic construct* responses. There were three sections of independent variables in the study. One was a set of twenty-six discrete Likert scale variables related to barriers and facilitators to participation in LLL. These variables covered education in general. A second set of twenty independent variables were developed to extend the study to include distance education. A third set of variables was ordinal scale demographic variables.

The primary difference between LLL and DE variables is the delivery method of learning--LLL involves direct teacher or TA and student classroom instruction with immediate, direct feedback versus DE programs that take place in isolation by ITV satellite delivery of instruction with express mail, e-mail, telephone and fax feedback responses on counseling and advising, student questions and test or homework assignments.

DE variables focused on those barriers and facilitators related to engineering courses taught by faculty from a consortium of 47 engineering colleges throughout the U.S. by satellite delivery to ITV classrooms at over 500 U.S. corporations.

This research was conducted to learn more about why engineers participated or did not participate in LLL and distance higher education through the study of these independent variables with the interaction of demographic variables. The underlying theory of this study was that the difference between those engineers, who enrolled and advanced in NTU's easily accessible academic program, and their engineering peers, who chose not to participate in the same NTU program, were influenced by DE barriers and facilitators to participation, and by major demographic barriers.

Barriers and facilitators to participation in LLL for engineers were expected to be similar to many of the same variables faced by pharmacists, physicians, nurses and other technical professionals. Anticipated common perceived LLL barriers were time, finances, access, workload, lack of relevance of available courses, professional burnout, low

impression of available academic programs, perceived course quality and loss of confidence in academic ability due to absence from higher education and graduate study.

DE barriers expected to be significant were resistance to ITV learning, which included: NTU course conflicts with work schedules, NTU academic standards and reputation too low, unsatisfactory NTU counseling, advising quality, and course feedback. Demographic variables, expected to be significant, were: age, sex, marital status, number of dependents, distance and time from work, transportation limitations, as well as distance and time from engineering colleges.

Distance from their worksite may also be a barrier to many engineers who do not live close to corporate DE classrooms if courses were scheduled during non-work hours which required students to return to NTU classrooms in the evenings. It was also expected that DE variables would have a greater effect in characterizing engineers than LLL variables because of their isolation from engineering colleges.

SURVEY RESEARCH METHOD

Data Collection

Mail survey was selected as the method to collect the research data for several reasons. Timing was not critical. Financial and personnel resources were limited, and although the population of engineers in this study was modest in size, it was widely-spread geographically. Mail survey results would provide responses from all areas of the U.S.

Engineers are used to studying technical materials with the types of thought processes required in responding to multiple option examination questions. They were expected to respond well to a written survey received at home where they could complete it at their leisure. The pharmacy research was conducted by mail survey. The type of questions in the modified pharmacy questionnaire lend themselves well to mail survey questionnaire design. Optional open-ended questions, added to the Likert scale questions in the survey to allow participants to express their individual ideas and feelings, would be more likely to be returned when the questionnaire was completed at the respondent's convenience.

A well-designed mail survey instrument, identified with NTU, accompanied by study objectives and appropriate reasons for the survey, were expected to be favorably received by NTU engineering students and graduates. Non-participants of NTU might view the survey as an opportunity to state their reasons for non-participation. They might relate their specific problems and lack of facilitators to participation to NTU leaders with the hope of initiating beneficial changes that would improve their future educational opportunities in the NTU system. These reasons all supported a mail survey.

Survey Sample

The participant sample population for this study were the graduates and current students of National Technological University (NTU). These were engineers who worked at over 500 major U.S. corporations and U.S. government agencies that had NTU satellite downlink classrooms to receive CPE for their engineers and technical employees. Three groups of NTU engineering graduates or students were the *participants* of the study.

Group I, NTU **"graduates,"** were selected from a pool of about 1650 NTU alumni who had completed their degree since 1990. Group II, **"admitted,"** were engineers who were enrolled in one of 12 degree programs provided by NTU. Group III, **"taking,"** were engineers who were taking selected NTU courses for CPE purposes but who were not admitted to a degree program.

Group IV, ***non-participants***, were engineers working at NTU corporate or government agency downlink sites who sent inquiries to NTU about academic programs, but who did not follow-up, enroll or participate in any way. NTU's Registrar had accumulated a file of 122 inquiry cards from February, 1996, to September, 1996, and had cross-referenced them with registration files to make sure they had not enrolled and were not a current participant.

Instrumentation

The national study of 850 pharmacists conducted by Hanson and DeMuth (1991) was the only research discovered that documented and validated a survey instrument to study

barriers and facilitators to participation of CPE by a group of professionals. The pharmacy questionnaire (Appendix E), which followed Boshier's barriers to participation findings, was selected for this study to adapt as a mail survey questionnaire for engineers involved in CPE. The pharmacy questionnaire model was also modified to study barriers and facilitators to DE experienced by engineers since many engineers live and work in areas that are remotely located from engineering colleges.

Questionnaire Review Panel

A panel of engineering educators involved in delivery, course development, site coordination and administration of major engineering distance education programs was requested from NTU (Appendix D) to elicit assistance in reviewing revised terminology of the pharmacy questionnaire for engineers and to help develop the DE and demographic sections of the survey instrument. This group of twenty engineering education leaders served as an expert questionnaire review advisory panel during the development of the new engineering survey instrument.

Each panelist received a cover letter explaining why they were selected, the mission and responsibilities of the questionnaire review panel, a copy of research objectives and supplemental information from the Prospectus, and the national pharmacy survey questionnaire (Appendix E) from the University of Wisconsin School of Pharmacy, and a draft copy of the engineering survey questionnaire (Appendix F) adapted from the national pharmacy questionnaire.

Included in their information packet was a copy of Hanson and DeMuth's journal article on their national pharmacy survey, a list of potential barrier and facilitator questions for engineers learning by distance education and a summary of Dillman's (1978) mail survey guidelines. Panelists were asked to review all questions, discard questions of marginal value, add new questions and prioritize or rank questions based on perceived importance.

Useful responses from the first mailing were received from about half of the review panel. Several panelists felt that adding the distance education section to the questionnaire

would make it too long. They suggested shortening the questionnaire by deleting the "Leisure Activities" section. Suggestions were incorporated into a second draft questionnaire for panel review. During the second review, panelists recommended changing the seven point and nine point Likert scales used by the pharmacists to four or five points to reduce confusion and time required to complete the survey. They said that four and five point scales would provide statistical accuracy and improve returns.

Panelists also recommended separating the questionnaire to simplify instructions and reduce length, with separate questionnaires for participants and non-participants. They felt that two shorter questionnaires could be identical in Likert scale questions with slight variations in open-ended questions and instructions. Less complex instructions would minimize ambiguity and confusion by participants and improve statistical results. Internal validity would be improved through better understanding and more accurate responses. Short surveys that were quicker and easier to complete would increase the rate of returns.

Several panelists suggested using sequential questionnaire numbering systems (recommended by Dillman, 1978) to avoid mailing duplicate surveys to respondents who had returned the survey. They also suggested that a sample population of 150 to 200 per NTU group would provide a suitable statistical pool with a 30 percent return rate. Two hundred random names and addresses were requested for each of the three NTU groups. Major recommendations made by the review panel are listed in the following section.

Review Panel Recommendations

A summary of key recommendations from the questionnaire review panel used in developing the final survey instruments were:

1. Develop two separate questionnaires for NTU *participants* and *non-participants* with similar instructions to minimize confusion and enhance returns.
2. Reduce seven-point and nine-point Likert rating scales to four-point and five-point scales to simplify understanding and enhance completion rates.
3. Use a sample population of 150 to 200 engineers per NTU group.

4. Use a numerical code system on questionnaires for monitoring returns to minimize duplication on follow-up mailings.

5. Rewrite questions in a "positive" tone where needed to reduce ambiguity and improve understanding for more accurate responses to improve internal validity.

6. Eliminate demographic questions that provide little useful data.

7. Delete "Leisure Time Activities" section to shorten the survey length.

8. Streamline the questionnaires to make them seem less time consuming.

9. Conduct a pilot study using five names from each of the four groups to test and validate the two survey instruments before the full survey mailing.

10. Include open-ended questions to obtain in-depth perceptions by participants and non-participants of other perceived barriers and facilitators to participation at NTU, and goals/benefits of CPE by distance learning, to further validate DE.

11. For Group IV, "non-participant" engineers, panelists felt that a minimum of 60 engineers should be surveyed with a 40 percent or higher response; they felt that at least 24 completed returns would provide a statistically sound data base.

Revised Survey Instruments

Format and text used in the engineering questionnaires were adapted from the pharmacy survey instrument validated by Hanson and DeMuth in their national study of barriers and facilitators to participation in LLL education from a random survey of 0.5 percent of working pharmacists in the U.S. (1991). Distance education questions and instructions were added to determine if there were significant differences between barriers and facilitators to participation in general engineering education compared with engineering DE. These questions were necessary because many U.S. engineers with large U.S. corporations and government agencies were located far from engineering colleges.

The review panel's suggestions listed above were incorporated into the final draft engineering questionnaires. Panelists recommended developing two separate engineering questionnaires that closely followed the national pharmacy survey's Likert scale LLL and demographic section question wording to provide continuity and external validity between the pharmacy and engineering surveys.

SA ___ (Survey A) questionnaire number blocks were established for the three NTU *participant* group surveys (Appendix G). The SB ___ (Survey B) number block was used

for the *non-participant* group survey (Appendix H). All Likert scale questions were identical on both survey questionnaires.

The questionnaire review panel recommended the addition of open-ended survey questions after LLL and DE sections in order to discover additional potential barriers and facilitators to participation in engineering LLL and DE in this engineering distance education survey. Six additional open-ended questions were included after the DE facilitator section to provide engineers the opportunity to express themselves in more depth about their short-term and long-term goals, suggest additional NTU facilitators as well as discuss perceived career and life changes that had occurred as a result of taking NTU or other engineering college courses. These qualitative questions were to provide each respondent the opportunity to relate unique personal experiences which the Likert scale questions did not allow them to share.

Qualitative responses might reveal unique attitudes about NTU and DE, subtle NTU system flaws and irritating NTU enrollment discrepancies or advisory deficiencies in addition to expected statistically valid quantitative data. Unique patterns of barrier and facilitator factors might be revealed that could provide new direction and enhance future engineering distance education programs when brought to light collectively.

The *Purpose* , some Likert scale and demographic section instructions in the SB questionnaire were worded slightly different but had similar meaning to SA questionnaires. Open-ended questions were common on both questionnaires through question 61.

The Learning Activities section of the pharmacy questionnaire was revised for engineers by using engineering terminology where needed. Three of the 16 pharmacy barrier questions, which did not seem relevant for engineers, "negative experience with prior learning at the K-12 level", "Negative experience with prior learning within pharmacy CE" and "low personal priority of learning in relation to other activities," were deleted. Eleven of 12 pharmacy facilitator questions were used with slight rewording for engineers. One new barrier and one new facilitator question was added for a total of 14 barrier and 12

facilitator questions in the LLL section. "Barriers to Distance Education at NTU," questions 38-52 and "Facilitators to Distance Education at NTU," questions 54-58, were added as DE questions suggested by questionnaire review panelists.

SB survey instructions and questions were changed only where SA questionnaire guidelines were not appropriate for non-NTU engineers. Instructions for questions 60-65 of the SB group questionnaire and questions 62-65 were worded similar to SA group questionnaire instructions to maintain internal validity between the two surveys.

Questions 62-65 on the SB questionnaire were written to provide similar answers to question responses on the SA questionnaire. Demographic questions 1-14 were common between questionnaires. SB demographic questions 15-19 reflected differences between NTU and non-NTU programs.

Survey instruments on barriers to participation used in other research studies were reviewed for instrument and question designs and style details for these questionnaires. (Price, 1990; Yamaguchi, 1992) The two draft survey questionnaires, SA and SB, were forwarded to selected members of the review panel for a third time to refine comments, edits and suggested format changes. The panelists felt both questionnaires were ready for pilot testing except for minor modifications that involved rewording some DE questions in the final draft questionnaires.

A randomized computer selection of approximately 200 names and addresses of graduate or student engineers from each of the three participant groups were supplied by NTU's Registrar following NTU's August, 1996 graduation. This sample population represented about 20 percent of NTU "graduates", 15 percent of engineers "admitted" to degree programs and 8-10 percent of engineers "taking" courses for CPE.

The NTU Registrar accumulated 122 NTU admissions information response cards from engineers who had not applied for admission from February through August, 1996. All of these names and addresses were used to make up the initial *non-participants* population in Group IV.

Pilot Study

Review panelists recommended that 20 participants from the sample population (five per group) receive the draft questionnaires as a pilot survey to detect if corrections to the instruments were needed and if instructions were clearly understood. The draft instruments were pilot-tested for clarity and understanding by five engineers from each of the four population groups using the initial mailing and one follow-up mailing. The pilot study was used to verify the instrument's external validity and reliability as viewed by respondents.

The pilot survey also helped to evaluate respondent attitude about survey length, evaluate effectiveness of the initial and follow-up cover letters, mail delivery timing and correct any mistakes that might be revealed. The first pilot mailing had four returns for a 20 percent response in two weeks. Five returns were received from the second mailing for a 45 percent total response. Dillman suggested that a 20-30 percent response from the first mailing and 40-50 percent from two mailings were acceptable returns (1978).

Three completed surveys were received from one group, and two were received from each of the other three survey groups. Several respondents completed open-ended questions. Responses indicated that instructions and questions were clearly understood.

The Survey

The NTU Registrar's mailing list included 198 "graduates" in Group I, 207 "admitted" in Group II, 198 "taking" in Group III, and 122 non-participants in Group IV for a total of 725 addresses. Corrections of duplication between lists resulted in slightly over 200 addresses in Group I and slight reductions in Group II and Group III.

Survey questionnaires and envelopes were printed, numbered and merged with cover letters (Appendix I) in late December, 1996. The 705 letter main survey was mailed January 3 and 4, 1997. Through January 27, 222 surveys (including the pilot survey) from the four groups were received, for an initial response from 680 correct addresses of 32 percent. On January 27 the second mailing of surveys was made. A total of 322 usable surveys were received by March 9, 1997, the survey cut-off date.

A total of 131 returns were received from a population of 212 in Group I for a return response of 62 percent. Group II, "admitted," had 76 returns from a sample population of 177 representing a 43 percent return. Group III engineers "taking" courses returned 71 completed questionnaires from a population of 194 for a 37 percent return. "Non-participants" from Group IV returned 44 surveys from 97 active addresses for a 45 percent response rate. The total response was 322 completed and usable returns from surveys received by 680 current addresses for a 47 percent.

Acquisition and Statistical Analysis of Data

Fundamental descriptive statistical analysis of data included mean, standard deviation, percentages and Pearson's correlations. This data was used for comparison with the pharmacy study results and for comparative analysis of the four sub-groups of engineers.

Linear multivariate discriminant function analysis (DFA) was used to analyze the 55 Likert scale questions and significant ordinal scales demographic variables to develop two-group discriminant function equations or quantitative predictive models. These models were expected to be a useful tool to predict the dependent variable, *participation*, in terms of significant independent of barrier and facilitator variables.

It was felt that these discriminant function (DF) model prediction equations could be useful in characterizing future engineers according to their participant status into participant or non-participant groups. DF models could also be instrumental in defining a "non-participant" engineer, which was expected to be useful in screening participants in future DE and LLL graduate engineering programs.

It was anticipated that the DF model might provide a further test of significance of the 26 LLL and 21 DE survey questions to check internal validation of the survey instruments. An open-ended question was included at the end of each of the four LLL and DE Likert scaled question section to further increase the utility and overall value of the research. Six open-ended questions were added after the DE section to provide information on short -term and long-term career goals, suggested changes (facilitators) that might improve DE at

NTU and other DE programs, and to solicit perceptions of career and life changes that had resulted from the respondents CPE graduate program experiences.

One expected result from the analysis of quantitative data was to identify the primary barriers and facilitators for graduate engineers involved in distance education at NTU and similar academic institutions. These responses were expected to answer the first and second research questions. The analysis and synthesis of the qualitative survey data from written responses to the open-ended questions were expected to provide answers to the third research question by identifying underlying themes and which include additional barriers and facilitators to DE which would further support and validate quantitative response data.

Limitations of the Study

The results of this study are limited to full-time engineers working at major U.S. corporations or government agencies who continue their engineering education through DE programs provided by leading U.S. engineering colleges through satellite downlink telecourses provided by National Technological University, Ft. Collins, Colorado. Adaptation of the results of this study to other engineering distance education programs must be done with the knowledge that results may be skewed.

CHAPTER IV

DATA ANALYSIS

Introduction

The data for this study was collected in two ways. Quantitative data was collected based on two survey instruments that were developed in comparison with a questionnaire used in a national survey of barriers and facilitators to participation in lifelong learning by pharmacists. The first part of the survey instrument for engineers was developed by modifying the pharmacy questionnaire language for use by engineers. A second major section that involves barriers and facilitators to participation in distance education by engineers was added to the questionnaire.

Qualitative data was collected by including ten open-ended questions in the survey instrument. Four of these questions were placed at the end of the four barriers and facilitators quantitative question sections. Six open-ended questions, placed at the end of the Likert scale sections, requested information on short-term and long-term goals, achievements resulting from goals, recommendations for improvements in their DE graduate engineering programs and professional and personal life changes resulting from their graduate studies.

The chapter was organized in five primary stages in order to present this data appropriately. First, descriptive statistics from demographic data responses were used to develop a general profile of the engineering population.

Summary statistics was used for all engineers about their attitudes toward learning (questions 1-9), followed by barrier and facilitator questions about LLL and DE. Data about engineers was compared with similar data about pharmacists to see how these professional groups were alike as well as how they differed in their perceptions and attitudes toward learning activities and LLL.

Demographic data was analyzed in the second major section, comparing the four groups of engineers to see if there were major differences in characteristics between groups. Their perceptions and attitudes about learning activities and their responses to the Likert Scale data questions were reviewed to examine their perceptions of barriers and facilitators to participation in LLL and DE.

The third section of this chapter reviewed data used in the development of a statistical model for use in classifying participation in LLL and DE, based on these basic statistical profiles. This model, processed by discriminant function analysis (DFA), a backward step-wise multivariate linear regression analysis program, focused on developing a discriminant function (DF) model (DF equation) that could be used to accurately classify a relatively high percentage of the sample into the correct group of engineers who were participants compared to those who were non-participants based on the overall population of this study.

This DF prediction model was designed as an educational tool that was focused on providing solutions to help engineers overcome barriers to participation in LLL and DE. The DF model was the most important product of this research study. It provided a diagnostic tool for selecting NTU "participants" as well as the basis for developing a profile of the "non-participant" engineer.

In the fourth major section, qualitative responses to the ten open-ended survey questions were evaluated and synthesized to see if there were possible themes of repetitive barriers and facilitators to participation which evolved that reinforced the quantitative responses of the engineers. These themes were carefully examined to see how they corresponded to significant LLL and DE barriers and facilitators to participation variables. It was felt that these new barrier and facilitator themes resulting from this qualitative analysis of data could be useful in extending the data base in LLL and DE for graduate engineering programs in the U.S.

The fifth section of the chapter is the Summary of Research Findings. It sets the stage for the conclusions and recommendations in Chapter 5.

Description of the Engineering Population

This section reviewed the data of the engineering sample population as a complete group of approximately 320 engineers to provide an underpinning foundation for the study. Men represented 79 percent of the 302 responses reporting age while 21 percent were women. The average age of men in the study was 37 years with a 39 year range from 23 to 62 years. Women averaged 36 years with a range of 21 to 51 years or a 30 year span.

The largest age group in the study, 54 percent, were 31 to 40 years old, followed by 22 percent who were between 41 and 50 years old and 18 percent between 21 and 30. Only six percent were 51 years or older. This was intuitively expected as engineers typically graduate with a B.S. degree at about 22 years of age, then work for 10 to 15 years before deciding to update their undergraduate degree, which would place the majority in the 31 to 40 year age bracket.

Marital and family conditions often present conflicts to graduate study, especially when working full-time and trying to maintain other family and social responsibilities. The majority of the group, 80 percent, were married. About 15 percent of the study group were single while four percent were separated or divorced. Some of those who were separated or divorced said that long, intense graduate study was the cause of their family disruption.

Several married engineers indicated that their graduate study program had created a major strain on their marital relationship. Others indicated that they had separated, but were rejoined by their spouse following the completion of their M.S. degree, or when they completed or discontinued their CPE studies. Marital conditions created barriers to participation for some married engineers involved in graduate studies.

Slightly over one-third (37 percent) of the respondents held a B.S. degree only. When combined with the group that had already received B.S. and M.S. engineering degrees (41

percent), 78 percent held engineering bachelors or masters degrees, while another 15 percent had earned an M.S. engineering degree without a bachelors degree in engineering.

Six engineers, who had earned Ph.D. degrees, were still taking CPE courses to stay abreast of rapid technology changes in their field. The desire to work on a Ph.D. degree was expressed by 38 individuals (12 percent of the population) in response to survey question 61 relating to their long-term educational goals. Another 12 percent of the respondents indicated they wanted NTU to initiate an MBA program for engineers while an additional 14 percent said they wanted more management courses to help them move from engineering to a management career path. Thus, 122 of 322 respondents (38 percent) requested that NTU expand their academic offerings to include engineering doctoral studies, business or engineering management programs.

These requests for advanced educational DE opportunities were from engineers who may have been seeking new opportunities in their fields. Part of those requesting Ph.D. programs commented on their interest in a career change, moving from industrial and commercial engineering production occupations to university teaching and research as a professional career and life change. These engineers apparently viewed the lack of the DE academic programs they sought as a barrier to their continuing participation in CPE.

Significant demographic results were summarized in Table 4 where the engineering study population was characterized as follows:

* By **gender**, 79 percent were men and 21 percent were women.

* The mean **age** for men was 37 years with a S.D. of 7.7 and a range from 23 to 62 years; the mean age for women was 36 years with a S.D. of 7.2 and a range of 21 to 51 years. By age category, 18 percent of the sample were 30 years of age or younger, 54 percent were between 31 and 40 years of age, 22 percent were 41 to 50 years, while 6 percent were over 50 years old; thus, 72 percent of the sample were 40 years of age or younger.

* By **education**, 37 percent held a B.S. engineering degree, 41 percent held both B.S. and M.S. engineering degrees, 15 percent had non-engineering undergraduate and

engineering M.S. degrees, while 2 percent were engineering Ph.D.'s. Therefore, 58 percent had advanced degrees at the time of the survey, while some engineers with advanced degrees were working to earn another M.S. degree.

Table 4. Demographic Characteristics of the Engineering Population

Demographic Variable

I. Sex (D1) & Age (D2)

			Age					
	N	Percent	Mean	Min.	Max.	S.D.	Std. Error	T-test
Men	251	79.4	37.2	23	62	7.7	0.49	1.55
Women	65	20.6	35.6	21	51	7.2	0.92	

Frequency Missing = 6

II. Age by Groups (D2)

	N	Percent
21-30	56	18.5
31-40	162	53.6
41-50	66	21.9
51+	18	6.0
Totals	302	100.0

Frequency Missing = 20

III. Marital Status (D3)

	N	Percent
Single	47	15.0
Married	253	80.5
Separated	10	3.2
Divorced	3	1.0
Widowed	1	0.3
Totals	314	100.0

Frequency Missing = 8

IV. Engineering Degrees (D5)

	N	Percent
BS	116	36.8
MS (non-engineering B.S.)	47	14.9
BS + MS	128	40.7
Ph.D.	6	1.9
Other	18	5.7
Totals	315	100.0

Frequency Missing = 7

Table 4. (Continued)

V. Registered Professional Engineers (D6)

	N	Percent
PE Yes	29	9.1
EIT Yes/PE No	48	15.1
EIT No	240	75.8
Totals	317	100.0

Frequency Missing = 5

VI. Types of Engineering Positions (D9)

(Consolidated)	N	Percent
Manufacturing	100	31.5
Computer/Electronic	80	25.2
Research	16	5.0
Safety/Test	21	6.6
Other Engineer	68	21.4
Technical, Non-Engineer	33	10.3
Totals	318	100.0

Frequency Missing = 4

VII. Type of Work Setting (D10)

(Consolidated)	N	Percent
Computer/Electronic	97	30.7
Communication/Semiconductor	72	22.8
Research Labs	27	8.5
Government Agency	26	8.2
Aerospace Industry	25	7.9
General Mfgr./Other	69	21.9
Totals	316	100.0

Frequency Missing = 6

VIII. Driving Time to Nearest Engineering College (D15)

(Minutes)	N	Percent
0-15	84	27.7
16-30	95	31.4
31-60	78	25.7
61-90	28	9.2
91-120	9	3.0
121+	9	3.0
Totals	303	100.0

Mean driving time = 45.2 minutes ; Median driving time = 30 minutes
Frequency Missing = 19

* From a **marital standpoint**, 84 percent of the study group were married (3 percent were separated); 16 percent were single, divorced or widowed.

* Only 9 percent had earned their **professional engineer (PE) license** while 15 percent passed the "engineer in training" (EIT) exam, the initial phase of professional engineering registration.
* For **engineering title or position**, the data was consolidated to reduce the data set from 15 individual job title categories to five types of engineering and technical manager work categories to make the data more useful and manageable. Using these five categories, 32 percent worked in manufacturing, 25 percent were computer or electronic engineers, 5 percent were research engineers, 7 percent worked in safety or testing, 21 percent were in other types of engineering work and 10 percent were not in engineering positions.
* For **work settings**, the data was reduced from 25 individual employment settings to six types of employment organizations to enhance the meaningfulness of the data. Within those six organizational settings, 31 percent of the engineers worked for a computer or electronics company, 23 percent were employed by a communications company or semi-conductor manufacturer, 8 percent worked in universities or private or government research laboratories, 8 percent were employed by government agencies, and 8 percent were in aviation or aerospace related industries. The balance, 22 percent, worked in general manufacturing or a related type of general engineering employment. Three women engineers listed "other" on "work setting" and commented that they were unemployed and staying home to raise their children.
* When asked the **driving time to the nearest engineering college**, 28 percent were within a 15 minute commute, 31 percent listed 16-30 minutes of travel time, nine percent required up to 90 minutes, while six percent listed 1.5 to 4 hours of travel time.
* The **mean driving time** was 45 minutes; **median driving time** was 30 minutes.
* The **mean driving distance** to the nearest engineering college was 27 miles; the **median driving distance** was 15 miles.

Engineering Participation in Lifelong Learning

The first three LLL survey questions deal with how respondents perceived themselves as lifelong learners. A four-point Likert scale ranged from "strongly disagree" (score = 1) to "strongly agree" (score = 4). Most respondents generally declared themselves to be *lifelong learners*. The mean response to question one, "I consider myself a lifelong learner" of 3.66 with a median response, "strongly agree," was appropriate for these technical professionals. This median score and statement was supported by their verbal

responses on questions 60-62 where a majority of respondents verified that they set and achieved learning goals. The third question, "I am successful in achieving some of my career learning goals" received a mean of 3.33, while the second question, "I have identified goals in my pursuit of lifelong learning" ranked third with a mean = 3.17.

Questions four through nine relate to learning activities for engineers that were written similar to the questions on the pharmacy survey. A four-point Likert scale ranged from "Not at all" (score = 1) to "at least once per week (score = 4). The learning activity with the strongest response was "Communicate with peers/colleague in discussions, problem-solving, etc. (mean = 3.66) with a median response of "at least once per week." The second strongest response was "Use Internet/WWW or reference library for information" (mean = 3.22) with a median response of "at least once per week" followed by "Read an engineering journal, book or other technical materials" (mean = 3.23) with a median response of "at least once per month."

Respondents indicated moderate participation in organized CE programs. Median responses for the questions "Participate in continuing education programs (in-house training,---study courses, satellite teleconferences, etc.)" (mean = 2.49) and "Attend professional engineering meetings,---education related" (mean = 1.69) were "at least once/year." Most engineers did not rank question eight, "Contribute to a professional program, publication or training program" very high (mean = 1.54).

Comparing Engineers with Pharmacists

Demographic profiles of the engineers were developed that were similar to those describing the pharmacists to provide a comparison of engineers with pharmacists. Descriptive statistics for engineers was compared with similar data from the pharmacy model in Table 5 to help validate this study.

Results from engineers' responses to demographic questions were compared to the pharmacy survey data to evaluate similarities between the two professional groups in terms of gender, age and professional education characteristics of the study populations. From

the viewpoint of gender, about 15 percent more women were professional pharmacists than engineers, with 21 percent women engineers and 36 percent women pharmacists.

The mean age for engineers was 37 while the average pharmacist was 42 years of age, so the general pharmacy study population was older. The majority (54 percent) of working engineers were 30-39 years old compared to 36 percent of pharmacists surveyed. Engineers and pharmacists under thirty years (18 compared to 16 percent) and between 40 and 50 years (22 compared to 23 percent) were similar. The major age difference were the over 50 pharmacists who make up 26 percent of the population, compared to only 7 percent of engineers at 50 + years.

Table 5. Demographic Characteristics of Engineers versus Pharmacists

Demographic variable	Engineers		Pharmacists	
	N	Percent	N	Percent
Sex				
Female	65	20.6	140	35.5
Male	251	79.4	254	64.5
Total	316	100.0	394	100.0
Age (Years)[a]				
Less than 30	54	17.9	63	16.4
30-39	162	53.6	137	35.7
40-49	66	21.9	88	22.9
50 +	20	6.6	96	25.0
Total	302	100.0	384	100.0
Degree				
BS	116	36.8	343	87.5
MS	47	14.9	19	4.8
BS+MS	128	40.7	--	--
Ph.D.	6	1.9	9	2.3
PharmD	--	--	17	4.4
Other	18	5.7	4	1.0
Total	315	100.0	392	100.0

[a]Engineers: Mean = 36.9, S.D. = 7.6; Pharmacists: Mean = 41.7, S.D = 15.6.

The higher percentage of pharmacists above 50 years of age was understandable. Many pharmacists indicated that they owned their pharmacy and continued to be active in the business until retirement in their sixties. Their education, training and skills were focused on their profession. From their responses to the question of career burnout,

Engineers indicated a tendency to change career direction in their late-thirties to late-forties by moving into business management or administrative roles as a mid-life change to avoid, or as a result of professional burnout.

The concept of career change was further supported by engineer's responses to open-ended survey questions 60-62 concerning career goals, achievements and advancements. Many participant engineers responded that they were taking advanced engineering education courses at NTU or through other DE sources (for non-participants) in order to move into corporate management positions or to start their own businesses. Some were requesting that NTU start an MBA program or offer a Ph.D. program so they could shift to management or leave industry to teach at engineering colleges.

From the view of professional education, most pharmacists (88 percent) ended their formal academic training at the B.S. level, with only 5 percent receiving an M.S. degree while 2 percent were Ph.D.'s, and 4 percent received PharmD's. Once commercial pharmacists learned the druggist business, they often had the opportunity to become a business partner or to buy out a retiring pharmacy owner. Except for states where professional licensure required annual CE units be earned, many licensed pharmacists appeared to take only minimal graduate course work, as indicated in Table 5 where 88 percent of pharmacists had a B.S. as their terminal degree.

In comparison, only 37 percent of engineers had stopped at the B.S. level while many B.S. engineers were working toward an M.S. degree with NTU or another engineering university. An additional 41 percent had already earned B.S. and M.S. degrees, while 15 percent of the engineers surveyed had earned a non-engineering B.S. and an engineering M.S. Two percent of engineers taking NTU courses were Ph.D.'s.

In regard to their personal attitude and perceptions of themselves as life long learners (LLL), pharmacists and engineers exhibited similar traits. Both ranked themselves high on the variable, ***"I consider myself to be a lifelong learner"*** and ***"I have identified goals in my pursuit of lifelong learning"*** (Questions 1 and 2 on the engineers

survey). Beyond that point, engineers and pharmacy professionals tended to diverge in relation to their attitudes toward learning activities. Table 6 compares several similar learning activities that both engineers and pharmacists were asked to evaluate. Tables 6, 7 and 8 list the original mean data responses from the pharmacy survey plus adjusted means (AM) and adjusted standard deviation (ASD) columns to provide an equivalent data comparison to those received from engineers.

Table 6. Comparison of Learning Activities by Engineers and Pharmacists

Variable	Engineers[1,6] Mean[3]	Pharmacists[2,6] AM[4,5]	Pharmacists[2,6] Mean[3]
Talk with peers to solve problems	3.66 (0.60)	3.11 (1.02)	6.22 (2.03)
Use Library/Internet for information	3.32 (0.83)	1.26 (1.12)	2.52 (2.25)
Read journals, books, technical materials	3.23 (0.74)	2.80 (0.82)	5.59 (1.63)
Participate in continuing education	2.49 (0.88)	1.58 (0.65)	3.16 (1.30)
Attend professional programs	1.69 (0.69)	0.97 (0.96)	1.94 (1.93)
Contribute to professional programs	1.54 (0.76)	0.58 (0.78)	1.16 (1.58)

1. Engineers Scale: 1) Not at All; 2) Once per year; 3) Once per month; 4) Once per week. 2. Pharmacist Scale: 0) Not at All; 1) Once per Year; 2) Once per 6 Months; 3) Once per 3 Months; 4) Once per Month; 5) Every two weeks; 6) Every week; 7) Every 2-3 days; 8) Every day. 3. Standard Deviation = (SD); 4. AM = Adjusted Mean = Mean x 4/8 = Mean x 0.5; 5. ASD = Adjusted SD = SD x 0.5 = (ASD).; 6. N_E = 320; N_P = 389-391.

It should be noted that between the engineering and pharmacy survey comparisons of learning activities data in Table 6 and comparative barriers and facilitators to participation data in Tables 7 and 8, there was a time lapse of seven and a half years between the July, 1989, pharmacy survey and the January, 1997, engineering survey. That much time lapse may have had some effect in the comparative responses.

A second consideration was that the Likert scales used in all sections of the Pharmacy survey instrument were considered (by the engineering questionnaire review panel) to be much too long and unwieldy to use in an engineering survey. The review panel strongly recommended that the nine point scale (0-8) used by pharmacists in their "learning activities" section be reduced to four or five points. Therefore, the eight point maximum

mean values in Table 5 for the pharmacists were adjusted by using a 0.5 (4/8) multiplier to provide comparable values to four point maximum values used for engineers.

Questions in Table 6 were ranked from highest to lowest mean for engineers. This illustrates that there were basic difference in priorities placed on these six variables by engineers compared to pharmacists. While both agreed that discussing issues with peers was the best method of learning, engineers placed use of library and Internet sources of technical information as their second-ranked learning activity while pharmacists tended to refer to journals, books and technical materials for their second source of professional support data. The fact that pharmacists rated the library fourth (AM = 1.26), was not surprising as the Internet was not yet routinely used by pharmacists in 1989 and many local libraries may have not maintained the reference publications needed by pharmacists to answer their technical research questions.

Overall, the mean ratings from 3.66 to 3.23 for the first three questions, ranked by engineers for learning activities, reflected the continuing rapid change in technology that they had to keep up with in order to maintain job proficiency. Since the four groups of engineers included only one group, "admitted," whose members were continuously enrolled in graduate courses, the mean value of 2.49 still reflected a much stronger response than the pharmacists with an adjusted mean of 1.57. Had the Internet been available on every pharmacist's work desk in 1989, or if both groups were surveyed in 1997, it was anticipated that the pharmacists' mean value for the library/Internet question would have been much higher. Rapid changes in communication technology create a disparity in data with a time lapse of three-fourths of a decade.

For direct comparison between the engineering survey's four point scale and the pharmacists' 7 point scale, a 4/7 = 0.57 multiplier was used on the pharmacy data to provide equivalent comparisons with the engineering data in Tables 7 and 8. The legend below each table includes the Likert scales used in each survey and includes the adjustment factors to make the data comparable.

Of the 16 questions on barriers to participation in the pharmacy survey, the three questions at the bottom of Table 7 did not seem appropriate for engineers. After review by the questionnaire review panel, one new question, plus the 13 original questions used by the pharmacists, were included for the fourteen barrier questions (questions 10-23) in the engineering survey questionnaires. These questions were listed from highest to lowest mean values for the engineering responses.

Table 7. Barriers to LLL Participation by Engineers versus Pharmacists

Variable	Engineers[1,6] Mean[3]	Pharmacists[2,6] AM[4,5]	Pharmacists[2,6] Mean[3]
Study time conflicts (travel, job)	2.72 (0.82)	-- --	-- --
Job constraints (no time off, etc.)	2.67 (0.89)	2.43 (0.88)	4.27 (1.54)
Family constraints (spouse, child)	2.44 (0.95)	2.01 (0.97)	3.52 (1.70)
No advancement from education	2.09 (0.98)	1.49 (0.96)	2.62 (1.68)
Scheduling of learning activities	2.07 (0.84)	2.26 (0.79)	3.96 (1.38)
Lack of recognition from learning	2.02 (1.05)	1.42 (0.91)	2.49 (1.58)
Lack of relevance of learning opportunity	1.88 (0.78)	1.89 (0.74)	3.32 (1.29)
Lack of quality of learning activities	1.86 (0.83)	1.67 (0.74)	2.93 (1.30)
Cost of participation in learning	1.81 (0.95)	1.78 (0.86)	3.12 (1.50)
Lack of infor. about learning opportunity	1.72 (0.78)	1.83 (0.82)	3.21 (1.43)
Professional burnout in job/career	1.61 (0.76)	1.71 (0.87)	3.00 (1.52)
Lack of learn'g opportunity to match style	1.58 (0.75)	1.65 (0.83)	2.89 (1.45)
Lack of confidence (fear, doubts)	1.50 (0.69)	1.26 (0.71)	2.21 (1.25)
Negative college learning exper.	1.32 (0.61)	1.02 (0.70)	1.79 (1.22)
Negative K-12 learning experience	-- --	0.83 (0.55)	1.45 (0.97)
Negative pharmacy CE learning experience	-- --	1.35 (0.78)	2.37 (1.37)
Low learning priority vs other activity	-- --	1.73 (0.77)	3.04 (1.35)

1. Engineers Likert Scale: 1) Almost Never; 2) Occasionally; 3) Frequently; 4) Almost Always. 2. Pharmacist Likert Scale: 1) Never; 2) Almost Never; 3) Once in Awhile; 4) Sometimes; 5) Frequently; 6) Almost Always; 7) Always. 3. Standard Deviation = (SD); 4. AM = Adjusted Mean = Mean x 4/7 = Mean x 0.57; 5. ASD = Adjusted SD = SD x 0.57 = (ASD); 6. N_E = 321-322; N_P = 383-393.

Although the pharmacy adjusted mean and standard deviation ratings were generally lower than engineering ratings for each question, and the rankings were not in the same

order, a similar trend was evident in the data. For example, ***job constraints*** was ranked as the second highest barrier for engineers and highest for pharmacists, but the next two items, ***family constraints*** and ***no advancement from education*** with scores of 2.44 and 2.09, were significantly higher for engineers than for pharmacists with adjusted mean scores of 2.01 and 1.49.

Independent variables that had similar adjusted means for pharmacists as the means for engineers were: ***Lack of relevance of learning opportunities, Lack of learning opportunities to match learning style Cost of participation in learning, Lack of information about learning opportunities, and Professional job burnout.***

Table 8. Facilitators to LLL participation by Engineers versus Pharmacists

Variable	Engineers[1,6] Mean[3]	Pharmacists[2,6] Mean[3]	Pharmacists[2,6] AM[4,5]
Personal desire to learn	3.62 (0.56)	3.28 (0.66)	5.75 (1.15)
Easy access to learning opportunities	2.80 (0.90)	2.51 (0.86)	4.40 (1.50)
Affordable learning opportunities	2.74 (0.92)	2.50 (0.81)	4.39 (1.42)
Fear of obsolescence	2.49 (0.94)	2.19 (0.98)	3.84 (1.72)
Enjoyment/relax/change of pace	2.48 (0.87)	2.78 (0.75)	4.88 (1.31)
Profession/career advancement	2.41 (0.96)	1.89 (1.05)	3.32 (1.85)
Interaction/idea exchange w/others	2.36 (0.89)	2.71 (0.79)	4.76 (1.39)
Family encouragement	2.11 (0.97)	1.87 (1.01)	3.28 (1.77)
Maintain professional license	2.00 (0.94)	2.94 (0.97)	5.16 (1.70)
Society recognition/ comm. service	1.94 (0.94)	1.95 (0.93)	3.42 (1.63)
Better CE provider advice/counsel	1.94 (0.96)	2.12 (1.01)	3.72 (1.77)
External encouragement/support	1.91 (1.08)	2.04 (0.92)	3.58 (1.62)

1. Engineers Likert Scale: 1) Almost Never; 2) Occasionally; 3) Frequently; 4) Almost Always.
2. Pharmacist Likert Scale: 1) Never; 2) Almost Never; 3) Once in Awhile; 4) Sometimes; 5) Frequently; 6) Almost Always; 7) Always. 3. Standard Deviation = (SD); 4. AM = Adjusted Mean = Mean x 4/7 = Mean x 0.57; 5. ASD = Adjusted SD = SD x 0.57 = (ASD); 6. N_E = 308-319; N_P = 387-393.

Engineers, felt stronger and more stressed about ***Family constraints, No advancement from education, Scheduling of learning activities, Lack of recognition from learning*** and ***Lack of quality of learning activities*** than pharmacists, based on their barrier responses. These factors may have registered higher

with engineers because of the need to earn a graduate degree for advancement and the fact that, even though this section of the survey dealt with LLL, it was being completed by engineers who were primarily taking college courses through DE. Some engineers (Group II, "admitted") may have been taking two courses per semester in order to complete the 10 to 11 course program in minimum time. Although rated higher by engineers than pharmacists, two factors, ***Lack of confidence (fear, doubts)*** and ***Negative college learning experience***, received relatively low mean scores by both groups.

The review of the engineers' attitudes towards facilitators of participation in LLL shows more contrast with pharmacists' views than the barrier comparisons. The top three facilitators picked by engineers in Table 8 were ***Personal desire to learn, Easy access to learning opportunities*** **and** ***Affordable learning opportunities***. These categories were ranked higher by engineers than pharmacists.

The three top rankings for pharmacists were ***Personal desire to learn, Maintain professional license,*** and ***Enjoyment, relaxation and change of pace***. Pharmacists ranked their second and third selections higher than the comparable mean rankings of those variables by engineers.

Maintaining their professional license was the second highest motivator for pharmacists. Pharmacists must be licensed and maintain yearly CE credits in many states to retain their licensure by state law because of their direct work in public health. Many of the engineers in this survey worked in industries which did not require professional engineering registration. Some engineers may have been driven to take CPE courses because of fear of the rapid change in engineering technology which would render their skills obsolete if their technical expertise was not maintained.

The three lowest ranked motivators for both engineers and pharmacists were ***Society recognition and community service, Family encouragement,*** and ***Better CE advice and counsel***. Many engineers also appeared to be motivated by personal desire to keep their skills current and facilitators that support that factor. Pharmacists also seemed

to be fairly self-motivated but seemed to enjoy education and talking with peers about changes in drug technology as a diversion from daily routine.

Comparing Engineers by Groups

There were four subgroups of engineers of the 322 engineers who returned surveys: Group one, N = 131, NTU "graduates" since 1990; Group two, N = 76, engineers "admitted" to an NTU M.S. degree program; Group three, N = 71, engineers enrolled at NTU who were "taking" a course periodically for academic credits; Group four, N = 44, "non-participants," engineers who worked for companies with NTU satellite downlink sites who had mailed in a request card for information about NTU M.S. degree programs, but who had not followed on the NTU curriculum and registration materials by completing and mailing the registration forms so they could take an NTU course.

Demographic data that compare the four engineering groups was listed in Table 9 by mean and standard deviation. Group members, who showed significant differences in demographic variables between at least one group and the other groups, were compared by factors including gender, age, engineering degrees, years in engineering, years in current position, distance, travel time and transportation factors relating to work and engineering colleges, enrollment date in engineering colleges and number of graduate credit hours.

Graduates were three to five years older than the other three groups, and as expected, "graduates" had been working in their field longer, with an average of 14 years. This was about six more years than "admitted" engineers and four more years than "taking" and non-participant engineers. This coincides with the age differences between groups.

All four group means were very close, ranging from the least time of five years for "admitted," "graduate" and "taking" groups and six years for non-participants, when asked about the length of time in their current jobs. This indicates that engineers tended to be quite mobile, moving vertically or laterally to advance in their profession.

"Graduates" had completed an average of 2.7 college degrees compared to 1.9 degrees

for "admitted," 2.1 degrees for "taking" and 2.2 degrees for non-participants. This was substantiated by the fact that "graduates" had accumulated 33 hours of engineering college credits at NTU (30 credit hours is the typical requirement for an M.S. degree at most engineering colleges) versus 18 hours for "admitted" and ten hours for "taking" groups.

Non-participants had earned 26 hours of graduate credit (standard deviation of 28 hours) and 2.2 degrees per person at other engineering colleges. It appears that the majority of non-participants might be characterized as having inquired about NTU more from the standpoint of taking specific technical courses for CPE than for earning a degree.

Table 9. Differences in Mean and Standard Deviation by Engineering Group for Ordinal Demographic Variables

		Group I		Group II		Group III		Group IV	
Var.	Descriptor	Mean	SD	Mean	SD	Mean	SD	Mean	SD
D1	Gender	1.2	0.4	1.2	0.4	1.1	0.4	1.3	0.5
D2	Age	39.6	7.1	34.9	6.7	34.4	8.1	36.7	7.6
D5	Engineering degrees earned	2.7	0.6	1.9	1.6	2.1	1.5	2.2	1.7
D7	Years work in engineering	14.4	6.8	8.3	5.8	10.0	7.8	10.6	8.7
D8	Years in present engineering job	5.3	5.7	4.9	4.5	5.3	4.7	5.7	4.9
D11*	Travel distance to work	15.9	14.5	15.3	11.4	15.0	13.2	15.4	12.6
D12*	Travel time to work	25.6	15.9	25.1	15.3	24.2	16.2	28.0	16.8
D14*	Travel dist. to nearest engr. college	24.9	25.8	36.7	42.3	21.8	22.5	25.6	35.1
D15*	Travel time to nearest engr. college	41.2	49.9	49.9	46.0	31.5	24.7	31.8	23.3
D19	Date enrolled in graduate course	89.3	2.7	93.6	2.1	91.0	17.7	87.8	9.2
D20	Number of graduate credits	33.2	6.9	17.7	12.1	10.2	18.3	26.5	28.5

Group population ranges: N_1 = 124-131; N_2 = 71-75; N_3 = 49-71; N_4 = 21-39.
*Transportation method: car = 1; car pool = 2; bus = 3; train = 4; taxi = 5; bicycle = 6; walk = 7.

Nonparticipants seem to be similar to the "taking" group from the standpoint of interest in taking selected technical CPE courses at engineering colleges, based on their accumulation of academic graduate credits while earning an M.S. degree. They exhibit an aggressive nature at continuing their engineering education similar to "admitted" engineers, as shown by the number of engineering graduate course credit hours earned. It seems that a combined group of "admitted" and "taking" groups would make a suitable composite

group to compare with non-participants in developing a DF model, since non-participants were close to the age of "admitted" and "taking" groups.

Time was listed by working engineers as a primary constraint when they considered taking engineering graduate courses or earning an advanced engineering degree. Consequently, travel time to and from work, and to and from an engineering college, was a major barrier in addition to family and work responsibilities.

Mean travel time to work was not significantly different for the four groups, but "non-participants" and "taking" groups had a mean travel time to the nearest engineering college of 32 minutes compared to 41 minutes for graduates and 50 minutes for "admitted" engineers . Lower travel time to a local college could be a restricting factor for non-participants which may have influenced their decision not to enroll at NTU.

Mode of transportation, types of roads and highways and congested city street driving can cause times to vary widely for the same relative distance to work or college locations. For example, one respondent listed the distance and time to work as 105 miles in 100 minutes and to their nearest engineering college as 95 miles in 90 minutes. Another engineer lived six miles from work but had a 20 minute drive; their nearest college was 60 miles with a driving time of 90 minutes.

While distance to and from work or college was important, because time varies widely, D12, travel time to work and D15, travel time to the nearest engineering college, were expected to be more important than the actual distance traveled as variables that characterize engineers in a DF model.

Engineering Barriers to Lifelong Learning

A four-point Likert rating scale ranging from "almost never" (score = 1) to "almost always" (score = 4) was used to examine 14 questions dealing with barriers to lifelong learning (LLL). Questions in Tables 10 and 11 were listed in numerical sequence with the three highest and three lowest barriers ranked by superscript according to their order of importance by group with number one being the highest mean value per group.

There was not much variation between the three participant groups and the non-participants, as noted by the top five ranked LLL barrier means. The three greatest LLL barriers (Questions 10-23) for the three participant groups were "Work/family don't leave study time" (means = 2.70, 2.72, 2.75) followed by "Job constraints (no help, time off)" (means = 2.66, 2.59, 2.70) second, and "Family constraint (spouse, children)" (means = 2.49, 2.38, 2.39), third. Non-participants felt that "Job constraints (no help, time off)" (mean = 2.81) was their greatest constraint, followed by "Work/family don't leave study time" (mean = 2.76), and "Family constraint (spouse, children)" (mean = 2.50).

Table 10. Barriers to Participation in Lifelong Learning by Engineers

Question Barrier	Group I Mean	SD	Group II Mean	SD	Group III Mean	SD	Group IV Mean	SD
10. Lack of confidence since college	1.46[13]	0.74	1.54[13]	0.64	1.42[13]	0.60	1.71[12]	0.77
11. Lack of relevance of avail. courses	1.92	0.82	1.83[10]	0.72	1.75	0.75	2.09	0.76
12. Job constraints (no help, time off)	2.66[2]	0.89	2.59[2]	0.87	2.70[2]	0.95	2.81[1]	0.86
13. Work/family don't leave study time	2.70[1]	0.82	2.72[1]	0.72	2.75[1]	0.92	2.76[2]	0.82
14. Cost of participation in learning	1.76[10]	0.95	1.83	0.94	1.75	0.90	2.07	1.02
15. Family constraint (spouse, children)	2.49[3]	0.93	2.38[3]	0.91	2.39[3]	1.00	2.50[3]	1.04
16. Problems getting desired courses	2.02	0.83	2.06[4]	0.84	1.96[4]	0.77	2.48[4]	0.92
17. Lack of quality in desired courses	1.88	0.84	1.86	0.78	1.70	0.80	2.12	0.92
18. Neg. prior learning experience	1.27[14]	0.58	1.36[14]	0.56	1.31[14]	0.62	1.43[14]	0.77
19. Professional burnout in job/career	1.62[11]	0.80	1.56[12]	0.68	1.62[10]	0.80	1.64[13]	0.76
20. Learning doesn't result in advanc'nt	2.19[4]	1.02	1.92[5]	0.88	1.94[5]	0.94	2.36[5]	1.03
21. Courses don't match learning style	1.56[12]	0.68	1.59[11]	0.80	1.52[12]	0.69	1.76[11]	0.93
22. Lack of company recognition	2.16[5]	1.01	1.88	0.95	1.92	1.00	2.02	1.16
23. Lack of info. on learning op'tunies	1.72	0.73	1.83	0.84	1.56[11]	0.67	1.86[10]	0.98

Scale: 1) Almost Never; 2) Occasionally; 3) Frequently; 4) Almost Always. Standard Deviation = SD;
Rank of top, bottom five variables listed by Superscript on Mean: **Rankings 1-5 = bold.**

Other leading LLL barriers for all engineering groups in decreasing mean values rank were: "Problems getting desired courses," "Learning doesn't result in advancement," "Lack of company recognition" and "Lack of relevance of available courses."

"Cost of participation in learning," listed frequently as a complaint in verbal responses, ranked from eighth to tenth in importance by all groups. This lower ranking may be because corporations, who support NTU courses, pay for tuition as a reimbursement after satisfactory completion of a course with an "A" or "B" grade. Most NTU students must pay tuition fees initially, which could cost $500 to $850 per credit hour, or $1,500 to $2,550 for a three hour course, plus fees, in addition to text books, mailing, Internet connection and other costs. One NTU participant moved to a non-NTU participating company said, "It cost me $7,000 for my last 8 credit hours out of my pocket."

Among the three lowest ranked barriers that were perceived as least critical by all four subgroups, "Negative prior learning experience" was ranked last (14th). "Lack of confidence since college" was ranked next to last (13th) by the three participant groups while non-participants ranked it 12th. Groups 1 and 3 selected "Courses don't match learning style" as 12th, while Groups 2 and 4 ranked "Professional burnout in job/career" as 12th and 13th respectively, Table 10.

Engineering Barriers to Distance Education

In barriers to participation in DE, Table 11, the top five and lowest five ranked barriers to participation among the four groups were listed by prefix numbers on the means with scattered results. The top three DE barriers for Group I were: "Local college degree rank higher" (mean = 3.02); "Better advising at local college" (mean = 2.75); and "NTU instructor counseling unsatisfactory" (mean = 2.51). Group II DE barriers were: "NTU course feedback unsatisfactory" (mean =3.00); "Local college degree rank higher" (mean = 2.93); and "NTU instructor counseling unsatisfactory" (mean = 2.75); Barriers for Group III were: "Local college degree rank higher" (mean = 3.15); "Better advising at local college" (mean = 3.04); and "NTU course feedback unsatisfactory" (mean =2.87).

Only one of the top five barriers selected by *participants* was selected as a top DE barrier by Group IV, *non-participants*. The *nonparticipant's* first priority, "Local college

degree rank higher" (mean = 3.17), was also the top priority of all participant groups; but their next three rankings, "NTU schedule is unsatisfactory" (mean = 3.12), "NTU course work conflict with work" (mean = 3.07) and "NTU degree options not suitable" (mean = 2.93) were on opposite extremes from *participant* groups. Although *non-participants* agreed with participants on their top DE barrier, the fact that their next three DE barrier priorities were totally different than those of the participant groups shows that *non-participants* attitudes and perceptions about DE barriers contrasts sharply with *participants*.

Table 11. Barriers to Participation in Distance Education by Engineers

Question Barrier	Group I Mean	SD	Group II Mean	SD	Group III Mean	SD	Group IV Mean	SD
38. Better advising at local college	2.75[2]	1.10	2.74[4]	1.12	3.04[2]	0.85	2.88[5]	0.89
39. Local college degree rank higher	3.02[1]	1.26	2.93[2]	1.20	3.15[1]	1.15	3.17[1]	1.10
40. NTU schedule is unsatisfactory	1.91[14]	1.22	2.00[13]	1.18	2.38	1.27	3.12[2]	0.86
41. NTU course work conflict w/work	2.18	1.28	2.39	1.31	2.65[5]	1.29	3.07[3]	1.00
42. NTU doesn't fit my learning style	1.67[15]	0.92	1.97[14]	1.01	2.31[13]	1.12	2.57[14]	1.15
43. NTU degree out of date when rec'd.	2.18	1.15	2.25	0.91	2.28[14]	0.93	2.64[13]	0.82
44. NTU standards/reputation too low	2.18[11]	1.09	2.25	1.01	2.60	1.06	2.76	0.93
45. NTU course qual. unsatisfactory	2.33	1.21	2.64[5]	1.23	2.54	1.00	2.55[15]	0.80
46. Downlink classr'm unsatisfactory	2.29	1.13	2.47	1.16	2.46	1.00	2.64[12]	0.79
47. NTU site coordinator supp't unsat.	2.07[13]	1.16	2.08[12]	1.22	2.27[15]	1.11	2.83	0.88
48. Peers don't recom'd NTU program	2.44[4]	1.14	2.24[11]	1.02	2.39	1.01	2.79	0.84
49. NTU degree options not suitable	2.08[12]	1.18	1.92[15]	1.10	2.32[12]	1.22	2.93[4]	1.04
50. NTU instructor counseling unsatisf.	2.51[3]	1.20	2.75[3]	1.22	2.82[4]	1.02	2.78	0.76
51. NTU course materials unsatisfact'y	2.34	1.10	2.55	1.14	2.38[11]	1.02	2.74[11]	0.59
52. NTU course feedback unsatisfact'y	2.40[5]	1.21	3.00[1]	1.11	2.87[3]	1.21	2.74	0.62

Scale: 1) Strongly Disagree; 2) Mildly Disagree; 3) Neutral/Not Applicable; 4) Mildly Agree; 5) Strongly Agree. Standard Deviation = SD; Rank = Superscript on Mean: **Rankings 1-5 = bold.**

Non-participant engineers often worked at the same corporations as NTU participants. They were familiar with NTU downlink classrooms and may have observed colleagues taking NTU classes periodically. *Non-participants* seemed to have developed a definite feel for the type of instruction and the satellite downlink method of delivery used in NTU courses. They ranked the question, "NTU doesn't fit my learning style" (mean = 2.57, 14th

From their responses in Table 11, it appeared that many of them felt that NTU's course schedule was not compatible with their work schedule or the type of work they were involved in, which was in sharp contrast to Group I and Group II, who ranked "NTU schedule is unsatisfactory" as their 14th and 13th ranked barriers (mean = 1.91 and 2.00 respectively). Another point of contrast was that *non-participants'* standard deviations were generally smaller and more tightly grouped than SD's of the three *participant* groups. This could indicate that they were more cohesive in their attitudes and responses.

Distance education or DE was a possible solution for many *non-participant* engineers with distance or work conflicts that fulfilled their CPE requirements to maintain proficiency in technical skills. Some engineering DE providers (including NTU) delivered courses at convenient times in centralized local classrooms, with flexible delivery and feedback (project, homework and examination return) policies designed for busy engineers.

NTU has offered hundreds of distance education engineering courses from a consortium of 45 major engineering colleges using one-way satellite telecourse delivery to corporate classroom sites with feedback through telephone, fax, e-mail and U.S. Postal or express mail, as a DE provider since 1985. NTU provided twelve engineering and technical M.S. curriculums by satellite down-link to over four hundred Fortune 500 companies and large government organizations by 1996.

Some engineers appeared to learn well under NTU's remote logistical conditions while others seemed to be reluctant to take CE courses through ITV from NTU telecourses. Facilitators such as company supported daytime or work time classes, reimbursed tuition and improved instructor response to questions, tests and homework returns might provide offsetting incentives to DE concerns by participating engineers.

The primary DE barriers that were in contrast between *non-participants* and *participants* appeared to be poor course schedules, work conflicts, perceptions that NTU's reputation was low and the fact that their peers didn't seem to recommend NTU. Other *non-participants'* mean scores that were significantly different than most *participants* scores

were "Inadequate course materials," and "Delayed or disruptive feedback on homework and tests." These and other aspects of distance education may have presented major barriers to learning that were difficult for *non-participants* to overcome.

In addition to these constraints, *non-participant* engineers may not have had encouragement by company leaders or home support needed to maintain a positive motivation to study. DE barriers seem to cause grave concerns about earning an NTU M.S. degree as a LLL goal for *non-participants*. The major barriers appeared to be "Lack of relevance of course materials," "Personal financial uncertainties," "Paying high tuition costs up-front with the need for successful completion mandatory for reimbursement", "Income tax expenses on reimbursement", "driving time" and "distance to a less expensive engineering college" during evening hours.

Nonparticipants lived a mean of 32 minutes one way (64 minutes round-trip) from a local engineering college compared to about 42 minutes for graduates and 50 minutes (100 minutes round-trip) for "admitted" engineers. This time factor may have been a contributing factor to nonparticipants attendance at local engineering colleges instead of participating at NTU. A savings of 36 minutes mean travel time (100-64 minutes) per class day over a study program of several years could be a beneficial facilitator when combined with other interactive social and work related barriers and facilitators. The time savings combined with direct contact with the instructor, direct feedback on tests and homework, and access to libraries and laboratories could provide a cumulative reason that might influence *non-participants* to favor attending local colleges instead of participating in NTU.

Engineering Facilitators to Lifelong Learning

A four-point Likert scale was used to rate the twelve facilitators to LLL listed in Table 12. The top and bottom four variables were ranked by prefix number on the means according to their order of importance by group with number one being the highest and number 12 the lowest mean value per group. When two or more variables had identical means, the higher rankings were selected, based on the smaller SD value. The greatest

LLL (Questions 25-36) facilitators for the three participant groups were "Personal desire to learn, curiosity" (means = 3.63, 3.58, 3.62).

Groups I and III ranked "Ease of access to learning opportunities" (means = 2.84 and 2.87) as second in importance, while Group II preferred "Affordable learning opportunities" (mean = 2.67). Third priorities for Groups I and III were "Affordable learning opportunities" (means = 2.65 and 2.78) while Group III selected "Ease of access to learning opportunities" (mean = 2.67).

Table 12. Facilitators to Participation in Lifelong Learning by Engineers

Question Barrier	Group I Mean	SD	Group II Mean	SD	Group III Mean	SD	Group IV Mean	SD
25. Personal desire to learn, curiosity	**3.63[1]**	0.57	**3.58[1]**	0.62	**3.62[1]**	0.52	**3.67[1]**	0.48
26. Enjoyment, relaxing, change/pace	2.56	0.87	2.14	0.84	**2.46[4]**	0.79	**2.83[3]**	0.85
27. Interact and exchange ideas w/peers	2.43	0.95	2.12	0.82	2.32	0.81	2.64	0.79
28. Maintain prof. license and job skills	**1.93[9]**	0.91	**2.02[9]**	1.07	**1.93[12]**	0.87	**2.28[9]**	0.92
29. Money supp't/reward by employer	**1.76[12]**	1.01	**1.93[12]**	1.07	**2.01[10]**	1.16	**2.12[11]**	1.15
30. Encouragement through family	2.08	0.94	2.10	0.92	2.10	0.94	2.31	1.16
31. Society recognition and service	**1.78[11]**	0.93	**2.01[10]**	0.91	**1.98[11]**	1.02	**2.21[10]**	0.81
32. Professional/career advancement	2.27	0.94	**2.57[4]**	0.93	2.46	0.97	2.45	1.02
33. Ease of access to learning opport.	**2.84[2]**	0.86	**2.67[3]**	1.00	**2.87[2]**	0.84	**2.83[4]**	0.93
34. Fear of obsolescence	**2.57[4]**	0.91	2.41	0.97	2.41	0.85	2.60	1.08
35. Affordable learning opportunities	**2.65[3]**	0.90	**2.71[2]**	1.00	**2.78[3]**	0.90	**2.98[2]**	0.87
36. Company site coord. advice/counsel	**1.90[10]**	0.95	**2.01[11]**	1.02	**2.01[9]**	0.88	**1.76[12]**	1.04

Likert Scale: 1) Almost Never; 2) Occasionally; 3) Frequently; 4) Almost Always.
Standard Deviation = SD; Rank = Superscript on Mean: **Rankings 1-4 = bold.**

Non-participants agreed with *participants* on their top facilitator, "Personal desire to learn, curiosity" (means = 3.67). This variable emphasizes that as a whole, engineers tend to be highly motivated self-starters. *Non-participants* selected "Affordable learning opportunities" (mean = 2.98) followed by "Enjoyment, relaxing, change of pace" (mean = 2.83) for their second and third ranked facilitators. They ranked "easy access to learning" fourth (mean = 2.83).

Other leading facilitators were: "Fear of obsolescence" and "Interact and exchange ideas w/peers." Most of the top four group rankings were close. There was less contrast between *participants* and *non-participants* on LLL facilitators, compared with DE barriers.

Engineers' Responses to Distance Education Facilitator Questions

Most engineers apparently desire to continue technical learning, as indicated by their perception that they consider themselves to be lifelong learners in both degree and non-degree program CPE situations. Unfortunately, engineers were often employed at company work sites which were not located close to an engineering university. They worked at the same time that many engineering courses were taught and delivered live by satellite to down-link sites. Some engineers may have lived near an engineering college but work conflicts with daytime class schedules or their required on-the-job travel precluded taking residence courses or even satellite downlink courses like NTU provides.

Table 13. Facilitators to Participation in Distance Education by Engineers

Question	Barrier	Group I Mean	SD	Group II Mean	SD	Group III Mean	SD	Group IV Mean	SD
54.	NTU courses w/flexibility/makeup	**4.46[1]**	1.01	**4.05[2]**	1.08	**4.24[1]**	1.06	**3.36[1]**	0.82
55.	NTU courses taken on work time	3.18[4]	1.37	2.82[4]	1.32	3.32[3]	1.17	2.95[4]	0.88
56.	NTU sched. better than local college	**4.25[2]**	1.22	**4.08[1]**	1.20	**3.96[2]**	1.05	**3.31[2]**	0.81
57.	NTU instruct'n better than local coll.	3.51[3]	0.95	3.24[3]	0.98	3.17[4]	0.88	3.19[3]	0.59
58.	NTU cost less than local college	2.30[5]	1.06	2.04[5]	1.25	2.34[5]	1.04	2.76[5]	0.79

Likert Scale: 1) Strongly Disagree; 2) Mildly Disagree; 3) Neutral/Not Applicable; 4) Mildly Agree; 5) Strongly Agree. Standard Deviation = SD; Rank = Superscript on Mean; **Rank 1-2 = bold.**

Changes in DE course delivery timing and flexibility in course completion were facilitating factors that were of interest to engineers in all groups. Follow-up and feed-back changes to improve the flexibility of taking NTU courses by full-time engineers were also facilitating factors that were likely to be more significant than lowering costs (although important) or improved instruction.

Engineers' responses to distance education facilitator questions ranged from "Strongly Disagree" (score = 1) to "Strongly Agree" (score = 5). The highest ranked DE question, Table 13, "NTU courses with flexibility and makeup" (means of 4.46 to 4.05 for *participants* and 3.36 for *non-participants*) indicated that this would be a significant enhancement to most NTU participants if it were available as an option. The second ranked facilitator for all groups except *admitted* (*admitted* ranked this facilitator highest) was "NTU schedule better than local college" (means of 4.02 to 3.96 for *participants* and 3.31 for *non-participants*). This facilitator would be a strong enticement to participation.

The third ranked facilitator, "NTU instruction better than local college" (means ranged from 3.17 to 3.51 for *participants*, and 3.19 for *non-participants*), received mostly a "neutral " median response with a SD range from 0.88 to 0.98 for *participants* and 0.59 for *non-participants*. Generally, respondents "Mildly disagreed" with the fourth ranked DE facilitator question, "NTU costs and fees are lower than local engineering colleges" (mean of 2.76 for *non-participants* and 2.34 to 2.04 for *admitted*). This question could have been rewritten as follows, "I favor NTU fees that are lower than local engineering college fees," in order to distinguish between cost versus participant attitude. This would remove some ambiguity from the existing phrasing of the question.

Review of the data shows that there was a substantial differential in mean values, Although *non-participants* were in general agreement with participants on these five facilitator questions. The *non-participants'* mean of 3.36 on question 54, "NTU courses w/flexibility/makeup" was well below the nearest *participant* mean of 4.05 (Group II). Question 56, "NTU schedule better than local college" shows a similar gap between the *non-participants* ' mean value of 3.31 when compared to Group III with the nearest mean of 3.96. Contrasts between *non-participants* and *participants* were observed on the other three facilitator questions to a lesser extent, .

This spread between the mean values indicates that even in general agreement on the sequence of priority, attitude differences exist that distinctly separate the *non-participants*

from *participants*. These mean differences on DE facilitator variables came into sharp focus as a central factor in the linear multivariate discriminant function analysis process used in developing the discriminant function model in the next section.

Discriminant Function Analysis

Discriminant function analysis (DFA) will analyze differences between two or more groups and provide a sound means to assign or classify any sample data case into the group it resembles (Klecka, 1980). DFA works well when two or more groups exist which differ on several independent variables that can be measured on an interval or ratio scale (four or five point Likert scale).

DFA is a canonical multivariate analysis of variance (MANOVA) process that develops a discriminant function (DF) model equation. It is used in educational research when dependent variables are categorical or nominal level while independent variables have interval or ratio level (Likert scale) responses. Therefore, it fit the needs of this study to develop a DF prediction model for engineers involved in DE. **This DF model equation will be the primary product of this research.**

Linear backward step-wise discriminant analysis was the DFA process used to analyze the survey data and develop a DF model that would better identify and discriminate *participant* from *non-participant* engineers in distance higher education. The DFA regression program selects and retains variables with the strongest significant positive or negative correlations, eliminating the weakest remaining variable during each iterative step until the strongest group with a minimum number of variables is selected.

A raw weighting coefficient is first assigned to each selected variable, then it processes the raw weighting scores into standardized DF weighting scores for each independent variable. "Pooled Within-Class Standardized Canonical Coefficients," standardized weighting coefficients that were combined with their highly correlated (associated) independent variables to develop the DF model, were the appropriate weighting coefficient data for the independent variables selected in the DF model.

In DF equations, means of each selected significant variable are multiplied by their weighted coefficient. Coefficient weighting is based on the comparable strength of that variable compared to all other variables in the model. The product of the negative and positive weighting coefficients determine a score for each person's case.

When this linear combination of correlated variables and their standardized weighting coefficients are assembled in equation form, it comprises the discriminant function or DF model for the two data groups (Klecka, 1980). Independent variable weighting coefficients for the selected group are used by the DF to compute a classifying score for each data set. This classifying score is compared to the *critical cutting score* to classify each person into one of the two related groups.

When the standardized weighting coefficients are used the discriminant function equation or DF model takes this form:

$$Z = W_1X_1 + W_2X_2 + W_3X_3 + \ldots + W_nX_n$$

Where:

Z = Discriminant score using standardized weighting coefficients.

Wi = Standardized discriminant weight coefficient for independent variable i.

X_i = Independent variable i. (Hair, Anderson, Tatham & Black, 1995, p. 180)

Primary factors in DFA

Important functions that were evaluated during the DF process are:

Critical cutting scores--a function that determines individual object selection into an appropriate group based on the separation of the centroid of group means;

Hit ratio or hit rate (HR)--successful classification divided by total population of two groups equals classification accuracy.

Internal validation of DF--comparing hit rates of *resubstitution analysis* versus *cross-validation samples*; close HR values indicate good internal validity.

External validation of DF--comparison of hit rates of *resubstitution analysis* versus *holdout sample classification summary analysis* (Uses 50 percent holdout sample); close HR values indicate good external validity.

A total study population of 20:1 times the number of independent variables is preferred, but researchers consider that a 10:1 ratio is satisfactory (Klecka, 1980). The population to independent variable ratio used for this study was 680/67 = 10.1:1.

Cutting Scores

Discriminant mean scores for the selected data for each group in the DF model were averaged to develop the cut-off score, and a group means or "centroid" was developed. The standardized centroid for each group was used to calculate the "critical cutting score", the dividing point that determines which group each subject fits best. Wider distances between group mean centroids improves DF model classification or prediction accuracy.

The "critical cutting score" or "cut-off score" was the average of the correlation means of the two groups, if both groups were the same size. A formula that uses weighting factors called "class means" or centroids was used to compute the "cutting score" for the two groups, to compensate for irregular group size. Each group means centroid value was multiplied by the number of subjects in that group. The sum of these products was divided by the total subjects in both groups to compute the cutting score (Hair et al., 1995).

Selection Criteria

Klecka states that, "Step-wise procedures produce an optimal set of discriminating variables. This set may not be the best (maximal) combination. To secure a maximal solution, one would have to test all possible combinations (all possible pairs, all possible triplets, and so on) (1980, p.53)." Wilks lambda is used as a statistic for selecting out weak variables. Wilk's lambda considers the differences between groups while evaluating cohesiveness or homogeneity within groups. Cohesiveness is the measure of strength exhibited or degree to which cases cluster near their group centroids.

Classification Accuracy or Hit Rate and Validity

"Hit rate" or "hit ratio" (HR) results serve a dual purpose. They not only describe the level of classification accuracy of the DF equation or model, but collectively, the three sets of hit rates from the three analysis methods for each two-group data set provide a statistical method of evaluating *internal* and *external validity*, or the reliability of the DF model's

performance. Huberty (1984) said that the *optimum hit rate* is a good indicator of suitable probability of accurate classification when knowledge of all parameters was involved.

One way to accomplish ***external validity*** and ***internal validity analysis*** with DFA is to analyze a "hold-out" sample as outlined by Klecka in the section, *Primary Factors for DFA*. The four data sets were each split with 50 percent of the data used as an *analysis* sample to *classify* the data set in the DF and to check *internal validity*, to validate the DF models in this study. The other 50 percent, the "hold-out" sample, was used to *externally validate* DF model performance.

Resubstitution of the analysis sample for **analysis** and *cross-validation* are compared for accuracy as a check of **internal validity.** *Summary classification* of the hold-out sample is compared with *resubstitution analysis* to check **external validity.** Both internal validity and external validity were checked statistically using these three analysis processes as described by Klecka (1980).

Discriminant Function Models

Linear multivariate backward step-wise DFA was used to develop a DF predictive model to compare each of the three participant groups (NTU engineering "graduates", engineers "admitted" to an NTU degree program, and engineers "taking" selected courses for CPE) with engineers in Group IV, "non-participants" at NTU.

Three preliminary DF models were developed that could classify an engineer known to be from a specific group, into his or her correct *participant* or *non-participant* study group, based on their survey question response scores, with a relatively high accuracy. Three DF models, Z_{14}, *Graduates* vs *Non-participants*; Z_{24}, *Admitted* vs *Non-participants*; and Z_{34}, *Taking* vs *Non-participants*, were developed using the DFA procedure for two-group DF classification to help refine and interpret the data.

One goal of this research was to design a single comprehensive discriminant function (DF) model prediction equation that could be used to predict participation of future NTU

engineers. Their selection would be based on their responses in completing specific questions that are the equation variables.

Composite DF Model Development

The three two-group DF models resulted in acceptable classification accuracies (HR's) of their group members. However, none of the individual models seemed to represent the "current NTU student" at the time of the survey. It appeared that a refined, more representative DF composite group model might be a better predictor of the NTU DE program by more accurately classifying each engineer from these combined groups into their respective participant or non-participant groups than the individual DF group models, since each of the three participant groups represented different factions at NTU.

The DF Model equation for Groups 1 and 4 classification (Table 14) is:

$$Z_{14} = + 0.89\ Q56 + 0.43\ D2 + 0.41\ Q19 - 0.36\ Q44 + 0.32\ Q21 + 0.32\ D15 - 0.29\ Q10 - 0.25\ Q20 - 0.19\ Q39 - 0.16\ Q7 + 0.14\ Q6 + 0.09\ Q15 - 0.01\ Q42$$

Table 14. DF Model Z14 Significant Variables and Weighting Coefficients

Variable	Coeff.	Variable Description
Q56	+ 0.89	NTU schedule better for me than local engineering colleges
D2	+ 0.43	Age
Q19	+ 0.41	Professional burnout in job or career
Q44	- 0.36	NTU's academic standards and reputation are too low
Q21	+0.32	Lack of learning opportunities that match my learning style
D15	+ 0.32	Average travel time to nearest engineering college
Q10	- 0.29	Lack of confidence, time lapse since participation in formal studies
Q20	- 0.25	Learning activities don't result in career advancement
Q39	- 0.19	Local engineering college degree ranked higher than NTU

Table 14 (continued)

Q7	- 0.16	Attend professional engineering meetings @ local, state, national levels
Q6	+ 0.14	Communicate with peers/colleagues in discussions, problems solving.
Q15	+ 0.09	Family constraints (e.g., spouse, children, personal)

The DF Model equation for Groups 2 and 4 classification (Table 15) is:

$$Z_{24} = + 0.90\ Q56 + 0.83\ Q5 - 0.62\ Q49 + 0.56\ D15 + 0.38\ Q52 + 0.37\ Q13 - 0.36\ Q40 - 0.34\ Q8 + 0.24\ Q7 - 0.16\ Q35 - 0.10\ Q39 - 0.07\ Q50$$

Table 15. DF Model Z24 Significant Variables and Weighting Coefficients

Variable	Coeff.	Variable Description
Q56	+ 0.90	NTU schedule better for me than local engineering colleges
Q5	+ 0.83	Use Internet/WWW or reference library for information
Q49	- 0.62	NTU does not have the degree options I'm interested in
D15	+ 0.56	Average travel time to nearest engineering college
Q52	+ 0.38	NTU course feedback (homework return/evaluation) not satisfactory
Q13	+ 0.37	Work, social activities, family don't leave enough time for studying
Q40	- 0.36	Availability/time of NTU credit courses at worksite not satisfactory
Q8	- 0.34	Contribute to professional program, publication or training program
Q7	+ 0.24	Attend professional engineering meetings @ local, state, national levels
Q35	- 0.16	Affordable learning opportunities
Q39	- 0.10	Local engineering college degree ranked higher than NTU
Q50	- 0.07	NTU instructor counseling quality/accessibility not satisfactory

The DF Model equation for Groups 3 and 4 classification (Table 16) is:

$$Z_{34} = + 1.21\ Q56 + 0.94\ Q50 + 0.90\ Q52 + 0.79\ Q54 - 0.69\ Q19 + 0.57\ Q55 - 0.52\ Q51 - 0.51\ Q39 - 0.43\ D12 - 0.42\ Q26 + 0.42\ Q35 + 0.38\ Q18 + 0.31\ D15 + 0.27\ Q40 + 0.26\ Q1 + 0.26\ Q21 + 0.25\ Q9 - 0.23\ Q45 - 0.21\ Q25 - 0.16\ Q28 - 0.15\ Q11$$

Table 16. DF Model Z34 Significant Variables and Weighting Coefficients

Variable	Coeff.	Variable Description
Q56	+ 1.21	NTU schedule better for me than local engineering colleges
Q50	+ 0.94	NTU instructor counseling quality/accessibility not satisfactory
Q52	+ 0.90	NTU course feedback (homework return/evaluation) not satisfactory
Q54	+ 0.79	NTU courses allow flexibility in makeup classes and homework
Q19	- 0.69	Professional burnout in job or career

Table 16 (continued)		
Q55	+ 0.57	NTU courses taken partially on company time without makeup work
Q51	- 0.52	Quality of some NTU course materials was not satisfactory
Q39	- 0.51	Local engineering college degree ranked higher than NTU
D12	- 0.43	Average travel time to work
Q26	- 0.42	Enjoyment/relaxation through learning -- change pace from routine
Q35	+ 0.42	Affordable learning opportunities
Q18	+ 0.38	Negative prior learning experience in engineering continuing education
D15	+ 0.31	Average travel time to nearest engineering college
Q40	+ 0.27	Availability/time of NTU credit courses at worksite not satisfactory
Q1	+ 0.26	I consider myself to be a lifelong learner.
Q21	+ 0.26	Lack of learning opportunities that match my learning style.
Q9	+ 0.25	Participate in CPE programs (in-house seminars, satellite telecourse)
Q45	- 0.23	Quality of some NTU instruction not satisfactory
Q25	- 0.21	Personal desire to learn, intellectual curiosity
Q28	- 0.16	Required to maintain professional license or needed job skills
Q11	- 0.15	Lack of relevance of learning opportunities known to be available

The DF Model equation for Groups 2, 3 and 4 classification (Table 17) is:

$$Z_{234} = -0.62\,Q56 - 0.45\,Q54 - 0.43\,D15 + 0.42\,Q49 + 0.31\,D12 - 0.29\,Q23 + 0.28\,Q16 + 0.13\,Q26 + 0.06\,Q47 + 0.04\,Q40 + 0.03\,Q27$$

Table 17. DF Model Z234 Significant Variables and Weighting Coefficients		
Variable	Coeff.	Variable Description
Q56	- 0.62	NTU schedule better for me than local engineering colleges
Q54	- 0.45	NTU courses allow flexibility in makeup classes and homework
D15	- 0.43	Average travel time to nearest engineering college
Q49	+ 0.42	NTU does not have the degree options I'm interested in
D12	+ 0.31	Engineering degree earned (BS Engr., MS Engr., BS + MS Engr., Ph.D.)
Q23	- 0.29	Lack of information about available learning opportunities
Q16	+ 0.28	Problems in scheduling desired courses
Q26	+ 0.13	Enjoyment/relaxation through learning -- change of pace from routine
Q47	+ 0.06	NTU site coordinator did not provide support needed
Q40	+ 0.04	Availability/time of NTU credit courses at worksite not satisfactory
Q27	+ 0.03	Opportunity to meet/interact/exchange ideas with others

The development of a composite or hybrid NTU participation model seemed to be a valuable product of this study. The initial DF model considered was to collapse all three participant sub-groups into one overall participant group.

DF model Z_{1234} was developed, but after studying individual group demographics, it was apparent that due to rapid advances in satellite DE delivery by ITV, the classification accuracy of an all-encompassing composite group would be mediocre by including NTU graduates of several years, when compared to the three individual DF models.

Group one participants, "graduates," who earned degrees several years earlier, were somewhat older and would not be characteristic of current student attitudes on NTU academic programs and technology, consequently they were expected to bias and compromise the data. So, DF model Z_{1234} was discarded.

It appeared that engineers "admitted" to a matriculation program, (Group II) who represented the full time degree student aspect of NTU, combined with Group III engineers, who were "taking" random courses to stay on the cutting edge of technology, would be much closer to representing the "average" current engineer involved in DE at NTU. This group of participants would represent engineers who were either continuously enrolled or were taking an average of at least one course per year.

Non-participants were about the same age as "admitted" and "taking" group engineers,. They were aggressive academically, much like the "admitted" group, and had accumulated almost enough graduate credit hours on average to qualify for an M.S. degree. As shown in Table 9, many *non-participants* had already earned M.S. engineering degrees (D5 mean = 2.2, SD = 1.7). They also exhibited an interest in taking selected technical courses at NTU, similar to engineers in the "taking" group, who were currently or recently enrolled at NTU at the time of the study.

Therefore, it seemed logical that developing a "composite" DF model, Z_{234}, composed of NTU "admitted" and "taking" engineers to compare with *non-participant* engineers

would make an excellent DF role model for this study. The Z_{234} model data was then run as a two-group study like groups Z_{14}, Z_{24}, and Z_{34}.

Each of the four DF equations was broken down with its components listed in tabular form by variable, power coefficient and variable description in Tables 14-17, for improved clarification and understanding by future readers. The four DF model equations are each listed directly above their respective table. Each table lists the power coefficients in descending order of weighting power, regardless of sign. The sign on the coefficient determines if the variable has a positive or negative effect on the classification. The coefficient value indicates what part of the variable's full value is attributed to the selection of that person or object into the correct group.

The "hit rate" for all four discriminant function equations, Z_{14}, Z_{24}, Z_{34} and Z_{234}, were developed when processing the sample data for the *analysis* groups and the *validation* groups as summarized in Table 19. This table summarizes the two-group DF hit rate results in a classification matrix that provides a clear comparison between the 50 percent Analysis Resubstitution and Cross-Validation Summary procedures (used for *internal validation*), and the 50 percent Holdout Sample, Classification Summary, which is used for *external validation*. Percentages of correct placement of more than 50 percent indicate that the DF equations are performing at better than random chance selections, or the flip of a coin.

Theoretical DF Model

All the computer generated two-group DF models and the DF Z_{234} composite model had good classification selection accuracy. The DF Z_{234} model, which combined "admitted" and "taking" engineers, was developed as a prediction model for possible use with DE providers like NTU.

This composite DF model performed equal to or better than the three individual group models, but the 14 computer selected variables did not seem suitable for future model use. It did not seem to contain a suitable group of DE selection or classification variables that would provide the "maximal" (best) prediction of NTU engineers' participation.

Based on Klecka's (1980) suggestion that the DFA selection of the DF model may not always contain the "maximal" set of variables, it seemed that an improved "theoretical" DF composite model might be developed using selected variables from the Z_{234} model and high weighted variables from the other two-group DF models as a starting point.

An ideal "theoretical" DF model should consist of a set of predicting variables which would more accurately characterize and separate both *participants* and *non-participants* into their correct groups than the individual DF models. The theoretical DF model was expected to produce a classification holdout validation selection accuracy with closer resubstitution analysis and cross-validation analysis sample accuracies than the computer generated models. A close grouping of the 50% holdout *summary sample* HR to the *resubstitution analysis sample* HR would indicate strong *external validity* of the DF model.

Several trials were made by "plugging in" modified variable lists developed from the three DFA selected two-group models (Z_{24}, Z_{34} and Z_{234}). The DFA program was used to analyze the effect of deleting weak variables and substituting strong variables from the computer selected models. This DFA substitution trial re-analysis process resulted in the development of research methodology for analysis of a "theoretical" composite model.

Weak coefficients were deleted and shorter models were run again. In some cases weak variables were deleted and strong variables from another DF model were added to see if classification accuracy could be improved. Deletion of weaker coefficient variables in some DF test versions resulted in lower HR scores than the DF model with weak variables.

This trial and re-evaluate process accomplished two things. In some cases, it resulted in developing some two-group DF models with shorter, stronger sets of variables while improving the hit ratio. In general the *hold-out classification summary* score improved, sometimes at the expense of a lower *resubstitution analysis* score.

Klecka pointed out that raising the hold-out sample classification score closer to the resubstitution analysis score was more important than a high resubstitution analysis score. He also said that the re-substitution analysis score tends to predict higher scores than the

cross-validation analysis and *50% holdout summary analysis* methods. He also stated that moving the *hold-out sample validation* and the *resubstitution analysis* score classification scores closer together improves *external validity* while moving the *cross-validation analysis* score closer to the *resubstitution analysis* score improves *internal validity* (1980).

The classification results of the DF composite model, Z_{234}, showed improved hit ratio accuracy compared to the three basic DF models Z_{14}, Z_{24} and Z_{34}. The "theoretical" version of the combined model, Z_{234T}, was started by analyzing a variety of computer selected DF model variables from the initial Z_{24}, Z_{34} and Z_{234} DF models. Then selected Likert scale and demographic variables that showed significant correlation differences between participants and non-participants were also picked from Tables 9-13 for use in trials to develop the theoretical DF model. Finally, all Likert scale and 12 interval scale demographic variables were reviewed for potential DE impact.

Over two dozen trial computer runs were made with alternative sets of DF composite model variables and the selection accuracy of each model in each of the three analysis modes were evaluated and tabulated. The primary objective was to develop an improved composite DF model with a minimum number of variables which all contained powerful weighting coefficients. A second objective was to improve internal and external validity of the theoretical model by tightening the space between the three sets of analysis and validation classification hit rates.

The variables and power coefficients generated from these series of Z_{234T} model trial runs resulted in refining the variables based on variable coefficient strengths, contrasting differences between *non-participants* and *participants*, and HR accuracy values. The final Z_{234T} list of variables was gradually improved through a process of review of data from several draft test models. The description of each variable was reviewed for logical application and the range of power coefficients for each variable was tabulated. Weaker variables were deleted and stronger variables with descriptions that correlated well to DE were retained and/or inserted. Separation of means became wider and validity increased.

Some demographic variables (such as date first enrolled in graduate course and professional engineering registration) with moderate to strong coefficients were removed from the DFA data base because they were not useful as a future predictor of participation. The demographic variable, *total credit hours earned*, was removed because of a low response rate by *non-participants*, which reduced the number of data sets from the 50 percent analysis and 50 percent holdout samples that the computer would allow from 17 to 18 sets down to 10 to 11 sets, although it consistently had moderate to strong coefficients. Leaving this variable in the model weakened the DF analysis across all groups.

The DF theoretical composite prediction model that provided the best classification results, Z_{234T}, contained 11 independent variables, Table 18. The DF Model theoretical equation for Groups II, III and IV classification follows:

$$Z_{234T} = + 0.71\ Q56 + 0.48\ D15 + 0.47\ Q54 - 0.47\ Q49 + 0.46\ Q55 + 0.40\ Q52 - 0.31\ Q58 - 0.25\ D5 - 0.22\ Q26 + 0.22\ Q5 - 0.18\ D12$$

The theoretical DF model Z_{234T} classification accuracy values are listed in Table 19. The DF model statistical data for DF models Z_{14}, Z_{24}, Z_{34}, Z_{234} and Z_{234T} are listed in a logical format with performance and evaluation coefficients such as Wilks lambda and Eigenvalues summarized for each group model in Tables 1-5, Appendix J. These tables display data using a format similar to data listed in Hair et al.'s Table 4.7 "Summary of Two-Group Step-wise Discriminant Analysis Results" (1995, p. 216) which may be useful in future research studies.

The model Z_{34} had a higher *Resubstitution Analysis* prediction accuracy at 96 percent than the Z_{234} or Z_{234T} models; its hit rates on the other two analysis categories were marginal based on priori and maximum chance comparisons as shown in Table 19. Z_{234T} had the strongest weighting coefficients and most consistent scores with 88 percent for *Resubstitution Analysis*, 84 percent for *Cross-validation Analysis*, and 82 percent for *Holdout Classification Summary*.

Table 18. DF Model Z234T Significant Variables and Weighting Coefficients

Variable	Coeff.	Variable Description
Q56	+ 0.71	NTU schedule better for me than local engineering colleges
D15	+ 0.48	Average travel time to nearest engineering college
Q54	+ 0.47	NTU courses allow flexibility in makeup classes and homework
Q49	- 0.47	NTU does not have the degree options I'm interested in
Q55	+ 0.46	NTU courses taken partially on company time without makeup work
Q52	+ 0.40	NTU course feedback (homework return/evaluation) not satisfactory
Q58	- 0.31	NTU's tuition and fees lower than local engineering colleges
D5	- 0.25	Engineering degrees (BS Engr., MS Engr., BS + MS Engr., Ph.D., DoE)
Q26	- 0.22	Enjoyment/relaxation through learning -- change pace from routine
Q5	+ 0.22	Use Internet/WWW or reference library for information
D12	- 0.18	Travel time to work

This model design met the objective for internal and external validity. The variables (Q58, Q56, Q55, Q54, Q52, Q49, Q26, Q5, D15, D12 and D5) provide excellent selection criteria for DE program participants in meeting the other objective for theoretical DF model development. Scores for all the models are compared in Table 19.

Results show that the five DF models correctly classified subjects into groups at hit rate percentages for *Resubstitution Analysis*, *Cross-Validation Analysis*, and *Holdout Classification Summary* of 90, 75, 74 for *graduates vs non-participants* and 91, 87, 74 for *admitted vs non-participants*. Hit rates were 96, 75, 69 for *taking vs non-participants*, 91, 80, 82 for *taking + admitted vs non-participants* and 88, 84, 82 for the theoretical composite model for *taking & admitted vs non-participants*. All hit rates equal or exceed their calculated priori and maximum chance values. These classification accuracy values are considered as statistically acceptable.

The theoretical composite group DF model, Z234T had the strongest *external validity* as shown by the minimum difference between the *resubstitution* vs the *holdout* hit rate of 88 - 82 = 6 points for *external validity*, although all five DF models were acceptable. Other hit

rate score differences for *external validity* were 9 points for Z_{234}, 16 points for Z_{14}, 17 points for Z_{24} and 27 points for Z_{34}. Model Z_{24} and Model Z_{234T} tied for best *internal validity* with a difference for *resubstitution* minus *cross-validation* of 4 points. Other score differences were 11 points for Z_{234}, 15 points for Z_{14} and 21 points for Z_{34}.

Table 19. DF Classification Matrices & Selection Hit Rates

Comparison DF Analysis	Discriminant Function	Incorrect P	Incorrect NP	Correct P	Correct NP	Correct Tot	Total N	HR% Tot/N	C_{pr}	C_{mx}
50% Analysis Sample, Resubstitution Summary Analysis										
Grad vs Npart	Z_{14}	5	3	57	11	68	76	90	67	79
Adm vs Npart	Z_{24}	3	2	33	15	48	53	91	55	66
Take vs Npart	Z_{34}	1	1	34	16	50	52	96	56	67
Adm/Take vs Npart	Z_{234}	2	6	67	11	78	86	91	68	80
Adm/Take vs Npart	Z_{234T}	4	6	66	11	77	87	88	69	80
50% Analysis Sample, Cross-Validation Summary Analysis (Internal Validation)										
Grad vs Npart	Z_{14}	9	10	50	7	57	76	75	67	79
Adm vs Npart	Z_{24}	3	4	31	15	48	53	87	55	66
Take vs Npart	Z_{34}	5	8	27	12	39	52	75	56	67
Adm/Take vs Npart	Z_{234}	10	7	62	7	69	86	80	68	80
Adm/Take vs Npart	Z_{234T}	7	7	63	10	73	87	84	69	80
50 % Holdout Sample, Holdout Classification Summary (External Validation)										
Grad vs Npart	Z_{14}	10	9	50	4	54	73	74	67	79
Adm vs Npart	Z_{24}	5	9	27	12	39	53	74	55	66
Take vs Npart	Z_{34}	3	12	21	12	33	48	69	56	67
Adm/Take vs Npart	Z_{234}	8	8	63	8	71	87	82	68	80
Adm/Take vs Npart	Z_{234T}	9	6	61	8	69	84	82	69	80

C_{pr} = Priori chance; C_{mx} = Maximum chance (if all placed in participant group);
P = Participants; NP = Non-participants; Tot = Total; N = Population; HR% = % Hit Rate.

Table 20. Cutting Scores for Classifying Engineers into Two Groups

Comparison DF Analysis	Discriminant Function	N_A	N_B	Z_A	Z_B	Z_{CU}
Grad vs Npart	Z_{14}	60	16	0.40	-1.50	0.0000
Adm vs Npart	Z_{24}	35	18	0.93	-1.80	0.0028
Take vs Npart	Z_{34}	35	17	-1.09	2.25	0.0019
Adm/Take vs Npart	Z_{234}	70	17	-0.42	1.74	0.0021
Adm/Take vs Npart (Theor)	Z_{234T}	70	17	0.41	-1.67	0.0036

N_A = Participant population; N_B = Non-participant population; Z_A = Centroid of class means, participants; Z_B = Centroid of class means, non-participants; Z_{CU} = DF critical cutting score.

Table 20 summarizes the critical cutting scores, Z_{cu}, for the five two-group models. The Group I cutting score of 0.00 indicates an evenly balanced distribution of the means. The other four cut-off scores are also evenly balanced.

Table 21. Significant DF Model Participation Variables for Engineers

Variable	Question	DF Models				
		Z_{14}	Z_{24}	Z_{34}	Z_{234}	Z_{234T}
Q1	I consider myself to be a lifelong learner	–	–	0.26	–	–
Q5	Use Internet/WWW or reference library for information	–	**0.83**	–	–	0.22
Q6	Communicate with peers/colleague to discuss problems	0.14	–	–	–	–
Q7	Attend non CE professional engineering meetings	-0.16	0.24	–	–	–
Q8	Contribute to a professional program, publication, training	–	-0.34	–	–	–
Q9	Participate in CE programs (in-house training, satellite teleconf's)	–	–	0.25	–	–
Q10	Lack of confidence since participation in formal courses	-0.29	–	–	–	–
Q11	Lack of relevance of available learning opportunities	–	–	-0.15	–	–
Q13	Work, social activities, family don't leave time to study	–	0.37	–	–	–
Q15	Family constraints (e.g. spouse, children, personal)	0.09	–	–	–	–
Q16	Problems in scheduling desired courses	–	–	–	0.28	–
Q18	Negative prior learning experience in engineering CE	–	–	0.37	–	–
Q19	Professional burnout in jog or career	**0.41**	–	**-0.69**	–	–
Q20	Learning activities don't result in career advancement	-0.25	–	–	–	–
Q21	Lack of learning opportunities that match learning style	0.32	–	0.26	–	–
Q23	Lack of information about available learning opportunities	–	–	–	-0.29	–
Q25	Personal desire to learn, intellectual curiosity	–	–	-0.20	–	–
Q26	Enjoyment/relaxation through learning, change pace	–	–	**-0.42**	0.13	-0.22
Q27	Opportunity to interact/exchange ideas with others	–	–	–	0.03	–
Q28	Required to maintain professional license/job skills	–	–	-0.16	–	–
Q35	Affordable learning opportunities	–	-0.16	**0.42**	–	–
Q39	Advis'g/counseling at local engr'ng college better than NTU	-0.19	-0.10	**-0.51**	–	–
Q40	Availability/time NTU course at worksite, not satisfied	–	-0.36	0.27	–	–
Q42	NTU satellite course doesn't match learning style	-0.01	–	–	–	–
Q44	NTU's academic standards and reputation are too low	-0.36	–	–	–	–
Q45	Quality of some NTU instruction not satisfactory	–	–	-0.23	–	–
Q47	NTU site coordinator did not provide support needed	–	–	–	0.06	–
Q49	NTU doesn't have degree options I'm interested in	–	**-0.62**	–	**0.42**	**-0.47**
Q50	NTU instructor counseling quality/timing, not satisfied	–	0.07	**0.94**	–	–
Q51	Quality of some NTU course materials not satisfactory	–	–	**-0.52**	–	–
Q52	NTU course feedback (homework evaluation), not satisfactory	–	0.38	**0.90**	–	**0.40**
Q54	NTU courses flexible class/homework making up	–	–	**0.79**	**-0.45**	**0.47**
Q55	NTU courses partly on company time, no makeup	–	–	**0.57**	–	**0.46**
Q56	NTU schedule better than local engineering college	**0.88**	**0.90**	**1.21**	0.25	**0.71**
Q58	NTU tuition/fees lower than local engineering college	–	–	–	–	-0.31
D2	Age	**0.43**	–	–	–	–
D5	Engineering degrees, BS, MS, BS+MS, Ph.D., Other	–	–	–	–	-0.25
D12	Average time, to/from work	–	–	**-0.43**	0.31	-0.18
D15	Avg. time to/from nearest engineering college, minutes	0.32	**0.56**	0.31	**-0.43**	**0.48**

Note: Strong coefficients (above **0.40**) are listed in **bold type.**

All variables selected as significant by the DFA programs are listed in Table 21. Thirty five of 55 Likert scale and four of 11 ordinal level demographic variables were selected as significant by at least one DFA process. Only two variables, Q56 and D15, were selected

by all five two-group DFA procedures. Six variables, Q54, Q52, Q49, Q39, Q26 and D12 were listed by three groups.

These DF models did not have as much variable overlap as might be expected, especially for DF Models Z_{24}, Z_{34}, Z_{234} and Z_{234T}. These four group models selected only nine variables that were common between Models Z_{234} or Z_{234T}, and Model Z_{24} or Z_{34}, which were collapsed to form Models Z_{234} or Z_{234T}. These variables were Q5, Q26, Q49, Q52, Q54, Q55, Q56, D12 and D15.

By far the strongest standardized mean weighting scores for variables that engineers reported as significant between group 4 and groups 1, 2, 3, and group 23 were facilitators in distance education, variables Q54, Q55 and Q56, when considering the coefficient strength (disregarding the sign) of those variables listed as significant for the five groups. The strongest weightings (0.40 or higher) were for the 15 variables identified as: Q5, Q19, Q26, Q35, Q39, Q49, Q50, Q51, Q52, Q54, Q55, Q56, D2, D12, D15. Variable Q56, *NTU course schedule better for me than local engineering college*, received the heaviest weighting on four of the five groups.

Theoretical DF Model Z_{234T}, the principle product of this research, is expected to be potentially useful as an effective DF selection model. It is anticipated that DF Z_{234T} could be used by engineering educators at NTU for future use in classifying engineers who may be excellent candidates for academic programs at NTU. This model may also be used by other DE engineering course providers to select candidates for their programs.

Interpreting DF Model Z_{234T}: Participant vs Non-participant Engineers

What are the primary differences of non-participant engineers (NPE) compared to participant engineers (PTE)? One should remember that to evaluate the differences, NPE work at the same corporations as PTE. They may be in the same type of job, but there is a difference. A profile of the NPE is highlighted by theoretical DF model Z_{234T} variables and weighting coefficients and three key demographics variables. Table 18 should be referenced during this discussion of the interpretation of the DF model.

Demographically, NPE were about 1.5 to 2.5 years older than "admitted" or "taking" engineers and about three years younger than "graduate" engineers. Educationally, NPE were aggressive, having earned an average of 26 credit hours earned which were about seven hours less than "graduates" but eight hours more than "admitted" and 16 more than "taking" engineers. The questions then might be posed, "Where did the NPE take their CPE courses?" "Why did they choose not to take courses at NTU?"

Exact college locations cannot be determined, but the reasons why they chose not to participate at NTU may be found by examining their profile in the theoretical DF model. The Z_{234T} DF model can be interpreted for either participants or nonparticipants, as one is the reflection of the other in the DF model. When the PTE is dominant, the NPE is subordinate, and vice versa.

Interpretation begins by checking the sign of the Group Means or Centroid of the two group populations. In this case the Group 23 (PTE) centroid is -1.67 and the Group 4 (NPE) centroid is + 0.41. The sign of a coefficient "points" toward the opposite sign of the centroid, so since PTE has a negative (-) centroid, all + weightings indicate that PTE have stronger means on variables Q56, Q55, Q54, Q52, D15 and Q5 than NPE. NPE exhibit stronger responses on Q49, Q58, D5, Q26 and D12.

The standardized weighting coefficient value is its relationship to a maximum strength of 1.0. Therefore, variable Q56 at +0.71 is rated at 71 percent of its potential strength and the + sign indicates that PTE has the stronger variable mean since the PTE centroid is -1.67. Q49 represents almost half of its potential in this equation at - 0.47 and reflects that NPE has the stronger mean value in this variable.

In relation to the eleven variables, the six variables with (+) signs show that PTE have the higher group mean value and are dominant on those variables. The fact that it was selected indicates that there is a strong correlational difference between NPE and PTE on each of these independent variables. Five variables have (-) signs, consequently, for these

variables NPE are dominant. However, these are the weaker variables so the DF model selects for PTE, the participants.

The first variable in the theoretical DF model, *participants* (PTE), are the dominant group with the strongest weighting coefficient (+ 0.71). *Non-participants* do not think that NTU's schedule was better than their local college (Q56), so their group mean value on that variable was lower or weaker. Each variable's weighting was based on strong correlational differences between the two groups, which is why this DF model has high classification or strong discrimination value as well as strong internal and external validation.

Weighting coefficients can be viewed as functioning similar to standardized regression coefficients, where the higher the numerical value, the greater the correlation, and the sign points to which group is represented the strongest. NPE's strongest difference (-0.47) was that they felt NTU did not have the degree options they were interested in , Q49. Their opinions or attitudes (and group means) were not as strong on the questions of Average travel time to nearest college, D15 (+0.48), NTU courses allowing flexibility in making up classes and homework, Q54 (+0.47), NTU courses taken on company time, Q55 (+0.46), and NTU course feedback (homework return/evaluation) not satisfactory, Q52 (+0.40), where a stronger value indicates a greater travel time.

NPE experience shorter travel times to local colleges as shown by the lower numerical mean on D15. This could be a reason that they chose to stay with the benefits of local colleges at the expense of traveling to classes instead of participating in NTU courses where the classroom was close to the work station.

NPE was dominant on variable Q58, NTU's tuition and fees were lower than local engineering college, with a correlation weighting of (-0.31). NPE's higher mean value on Q58 shows that since PTE knew that NTU's fees were higher, they "disagreed", with a lower mean score than NPE, so NPE won by default. Variable Q58 should be re-written.

NPE average 2.2 engineering degrees compared to 1.9 and 2.1 for "Taking" and "Admitted" engineers, or a mean of about 2.0 for PTE, so they were dominant on variable,

D5. NPE's dominance on Enjoyment/relaxation through learning, Q26 may indicate that they take classes for the technical knowledge and are less inclined to be stressed by trying to make a specific higher grade. PTE had a higher mean on Q5, Use of the Internet/WWW or reference library for information, so dominance shifted back to PTE, but since the variable only has a coefficient weight of + 0.22, the difference is not large.

A Profile of the Non-Participant Engineer

The analysis of the DF Model in the previous section illustrates several personality differences between the NPE and his/her NTU peers. *Non-participant engineers*, although working in similar engineering job conditions as their *participant* colleagues, have differing attitudes, barrier and facilitator concepts and demographic characteristics, such as:

* NPE were about two years older than "admitted" and "taking" PTE;
* On average, NPE had more college education, indicated by more credit hours and more degrees earned than "admitted" and "taking" PTE; however, about half of the NPE did not list any additional CPE credits beyond the B.S. degree;
* It appears NPE received much of their CPE from local engineering colleges, since the average NPE had an M.S. degree (mean of 2.2 with SD = 1.7). With an M.S. degree completed, their primary focus appeared to be on specific engineering courses to maintain technical competence.
* NPE responded that taking college courses didn't pay off in better job or better pay, which seems to differ from the general attitude of PTE. Maybe this means that NPE are not "strivers" like PTE.
* Although NTU had a better class schedule, the schedule was of little benefit as the NTU degree options or course selections apparently did not appeal to many NPE.
* The NPE did not like one-way ITV type NTU classes as they indicated that NTU's delivery did not fit their learning style, Q42. These data would indicate that they may prefer live classroom instruction, interaction with fellow students, group study with discussion of class assignments and homework projects with peers, "hands-on" laboratory experiments and use of research libraries.
* NPE score on Q.5, Use Internet/WWW or reference library for information, was lower than PTE, so they were less active in use of computer mediated communication.
* NPE may have been interested in the facilitator, NTU's tuition and fees are lower than local engineering colleges, but considering their mean response, it seemed apparent

that local college in-state tuition rates were lower than NTU fees. Even when travel expenses for travel to local colleges were added to local registration and tuition, NPE were apparently not convinced to participate at NTU.

* They were somewhat more conservative on travel than Taking (mean = 1.4).
* NPE seemed to be more casual and less status conscious, based on their responses to open-ended questions. They resembled *Taking* more than *Admitted* or *Graduates*.
* Overall, the typical NPE seemed to be more independent and conservative than most PTE, with an interest in staying current in CPE through local colleges, but with less concern about moving up the ladder in the corporate engineering environment.

Qualitative Responses to the Survey

Ten open-ended questions were added to the survey instruments in an attempt to probe deeper into the underlying concerns of barriers and facilitators to participation in CPE at NTU by engineers through engineering distance education processes and methods. Four open-ended questions, Q24, Q37, Q53 and Q59 were added at the end of the four LLL and DE sections of the questionnaires. Six more questions, Q60-65 were added ahead of the demographic section.

These qualitative data questions were designed to learn more from NTU participants and non-participants about their views and concerns of barriers and facilitators to participation in continuing professional education (CPE) at NTU, add depth to the understanding and analysis of quantitative data. Their feedback could also reinforce internal validity of the instruments and support quantitative barrier and facilitator responses.

It was anticipated that qualitative data would add new information to the literature data base by identifying new barriers and facilitators to participation in distance education specifically related to engineers. These qualitative questions were included to provide a deeper understanding of the psychological insight by engineers to barriers and facilitators to participation in lifelong learning in general and more specifically to LLL through DE means such as the academic programs provided by NTU, in addition to expanding the interpretation of quantitative data. It was also felt that these survey results might broaden the views and increase the depth of understanding of leading engineering educators and

other DE providers about how engineers view barriers and facilitators to participation in graduate studies through distance learning.

Qualitative Question Philosophy

Questions 24, 37, 53 and 59, added after major barrier and facilitator survey sections, and 60 and 61 added at the end of each survey, are identical in both surveys. Questions 62 through 65 are not identical, but Survey B questions for non-participants were written to provide similar meaning to corresponding questions in Survey A. Nonparticipants had not taken NTU courses, but they may have taken similar courses at local engineering colleges or other engineering DE programs that provided similar experiences to NTU. Therefore, it was felt that similar meaning could be provided by responses to both survey instruments. Nonparticipants worked at the same companies as engineers who were taking NTU courses, therefore, it was anticipated that most nonparticipants were somewhat familiar with NTU's academic program and satellite delivery process so their responses would provide useful data.

Survey questions 60-62 were written to seek information about short-term and long term goals, achievements, and the overall results and effects of distance higher education programs offered by NTU and other colleges. These responses were invited to provide DE planners with insight to immediate and future DE aspirations and concerns were being considered by participating and non-participating engineers.

Question 63 was written to elicit additional insight to specific facilitating or motivating improvements or changes which should be considered by NTU administrators to strengthen and enhance NTU's DE program delivery as well as programs of other DE program providers. Since this question evokes a "facilitator" type response, it was analyzed with facilitator questions 37 and 59.

The ten open-ended questions (in each questionnaire) are listed below for reference:

Question 24. Other barriers that you feel are important? (List all that apply)

Question 37. Other facilitators you feel are significant? (List all that apply)

Question 53. List other barriers (Please be specific)

Question 59. List additional factors that you feel would act as facilitators to enrollment at NTU (Be specific).

Question 60. Please describe your current short-term (< 12 months) goals with respect to lifelong learning (e.g., no goals, meet licensure requirements; seek specific learning opportunities; etc.) _____

Question 61. Please describe your current long-term (> 12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.) _____

Question 62. (Survey A) What major learning goals have you achieved as a result of your participation in academic courses at NTU or completion of your degree from NTU? (Explain) _____

Question 62. (Survey B) What major CPE/learning goals have you achieved as a result of your participation in academic courses at local colleges or distance education programs? Describe your educational programs. _____

Question 63. (Survey A) What new services or changes in existing services from NTU do you feel would better enable you to meet your lifelong learning CPE goals and needs?

_____

Question 63. (Survey B) What new services or changes in existing services at NTU do you feel might cause you to enroll at NTU to meet your lifelong learning/CPE goals and needs? _____

Question 64. (Survey A) What professional career/employment changes have resulted from your participation in academic courses or completion of your degree from NTU? (Be specific) _____

Question 64. (Survey B) What professional career/employment changes have resulted from your participation in academic courses or completion of a degree from a distance education program, other than NTU? _____

Question 65. (Survey A) What major life changes have resulted from your participation in NTU academic courses or completion of your degree from NTU? (Explain in detail)

_____

Question 65. (Survey B) What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution, other than NTU? _____

These questions were written to elicit creative ideas and innovations concerning how NTU administrators, NTU down-link site coordinators, cooperating universities, and other DE providers could improve their program quality and delivery methods. It was felt that respondents' suggestions might provide valuable insight for improving DE programs like NTU beyond what the statistical Likert scale question results might provide.

Questions 64 and 65 were designed to solicit information from both NTU participants and non-participants concerning professional or personal life experiences that had occurred as a result of their advanced engineering education experiences from NTU or other engineering colleges. These were evidently changes they felt had resulted in major changes or re-direction of their professional engineering or technical careers, or had caused significant life changes.

This was an attempt to learn of immediate and long term results of distance education as it affected each respondent personally so that NTU administrators could understand more clearly the sociological and psychological cost of earning an M.S. degree while working full time and caring for a family.

Individual responses and comments, either transcribed exactly as written or abstracted to reflect the meaning as stated by the respondent, are recorded in data files, Appendices L and M. Abstracted qualitative responses to LLL and DE barrier and facilitator questions 24, 37, 53, 59 and 63 were used in Appendix L. Raw data are recorded in the sequence in which they were recorded from surveys for qualitative questions Q60-62, 64-65.

Most of the responses were mature, well thought out comments given to help improve LLL continuing professional education through DE for future engineers. Participants' remarks focused more on improving NTU programs than comments by non-participants.

All written comments were reviewed and synthesized, then a list of barrier and facilitator themes was developed. In general, "Graduates" verbal responses were directed toward recommendations that might help improve NTU and aid future NTU students. Their comments reflected less stress than those of the other two participant groups who were actively involved in NTU academic programs at the time of the survey.

The "Admitted" group responses reflect current needs of engineers who are heavily involved in completing a long and tiring academic degree program by distance education. Some participants had almost completed their degrees while many had several more courses to complete. Their comments reflect the need for immediate relief of constraints.

Frustration from difficult problems and experiences was evident in many of their verbal comments at the end of LLL and DE barrier and facilitator question sections.

Comments by the "Taking" group were generally those of people with short-term commitments, so stress was less evident in their responses. Some of their comments were similar to comments of their "admitted" and "graduate" colleagues, but in general, their suggestions do not seem to convey the same level of depth and experience.

Suggested Facilitators to Lifelong Learning Program

Responses to Questions 37, 59 and 63 relate to facilitators to participation that were perceived by participants in all three groups and the non-participants (Appendix L). The survey responses from each group seem to provide information or ideas beyond those included in the 12 LLL facilitators listed in questions 25 through 36, and five DE facilitators listed in questions 54 through 58 in the survey. New facilitating themes and key ideas emerging from these survey responses are listed below.

The *non-participants* expressed a different view point than the three NTU groups as might be expected. Their experience base was that of engineers who had some knowledge of NTU, but who were "on the outside looking in." They related to their LLL and DE experiences through other, more fragmented educational options. However, some non-participants provided useful suggestions, especially to Question #63 (Survey B):

> "What new services or changes in existing services at NTU might cause you to enroll at NTU to meet your lifelong learning CPE goals and needs?

Their responses, similar to comments by participants (Appendix L) to this question, reflected innovative ways of providing more flexible, interactive, self-directed methods of learning by DE through NTU in the future.

Synthesis and Analysis of Qualitative Responses

The types of changes engineers have experienced as a result of their distance learning CPE experiences are of particular interest in this chapter. Some engineers listed changes that were situational, professional and work-related while others experienced deeper life direction changes. Some engineers related positive experiences that influenced and

changed their direction in life, like meeting their life partner in an NTU course at their corporate training site.

Other engineers related changes involving pain, suffering and deep personal sacrifices. Some experienced separation and divorce as a result of their years of course work and the study isolation required in earning an M.S. degree or taking courses for CPE from NTU.

Many "participant" respondents expressed deep emotions and anxiety related to their NTU learning experiences. Non-participants expressed similar concerns resulting from their LLL and DE studies at other engineering colleges.

After studying and analyzing these responses to open-ended barrier questions 24 and 53, and open-ended facilitator questions 37, 59, and 63 through an intellectual "factor analysis" process, a set of common topics or themes emerged. These common ideas or themes reflected similar responses by non-participants and participants, and were used to synthesize and categorize raw data responses for barrier and facilitator questions in Appendix L in a more useful manner.

Important common themes among responses were developed which extended the list of barriers and facilitators to LLL through distance higher education. Possible new solutions (facilitators) to barriers that may affect distance higher education for engineers that were suggested by respondents were characterized under these common themes. Summary responses to questions 24, 37, 53, 59 and 63 are listed in Tables 22 and 23 below. General themes from responses to questions 60-62 and 64-65 (Appendix M) are summarized in less detail in the following section.

Similar responses were characterized and grouped with like responses under a common theme. Themes that repeated barriers or facilitators listed in the survey instruments were included when they were a dominant concept that emerged from studying the responses.

Dominant themes were listed to make important points when they surfaced. For example, comments about reducing NTU tuition costs were listed to emphasize the need to reduce tuition fees to overcome a major barrier of making NTU courses affordable to more

engineers. Most NTU company engineers were required to pay tuition fees initially, then were reimbursed after satisfactory completion of the course. If their performance resulted in an unsatisfactory course completion, they had to absorb the entire cost, regardless of mitigating circumstances that resulted in a poor performance.

New and unique barrier and facilitator themes providing new data for NTU and other DE providers were listed in Tables 22 and 23. All themes developed for both barriers and facilitators are listed in Appendix L. Evaluation of the meaning of selected thematic responses were included as part of qualitative discussion in the Findings at the end of this chapters and in the Conclusions, Chapter 5.

Differences relating to NTU course background experience became evident by the type and number of suggestions received by each group. "Graduates" demonstrated a different experience level and perspective than many of those "admitted" because of the time lapse when courses were taken and degrees were completed.

Those engineers "taking" random courses for CPE had taken fewer courses on average, and had limited experience and a different academic focus than "admitted" engineers who were taking required courses in a degree program curriculum. "Non-participants" had a different perspective than the other groups because they lacked direct NTU course and administrative contact experiences.

Raw data responses from questions 60-62 and 64-65 were recorded either as originally transcribed from each survey questionnaire or were summarized to reduce lengthy replies and were "catalogued" by question number and group in Appendix M in a user-friendly listing. This was developed for use in comparative analysis with results of the statistical data, and also provided for more efficient future use by interested engineering DE program developers and educational leaders.

Barrier Themes to LLL and DE Programs at NTU

Barrier survey responses to open-ended questions 24 on LLL barriers and 53 on DE barriers to participation were synthesized and grouped into a list of seven new barrier

themes in Table 22. These seven barrier themes emerged from reviewing and reducing all survey responses in the two main barrier sections for questions 24 and 53 for each survey group into a list of common themes, then listing each response under the appropriate theme as a means of rechecking the theme. Although a total of 27 themes were recorded, 20 of these were repeated barrier variables previously listed in the survey questionnaires. Of the seven new barrier variables in Table 22, six are clearly DE variables. Item 1 could be either LLL or DE, but it is listed as LLL since no direct reference to distance was made.

Table 22. New Barriers to Participation Variables

1. Had to pay for course from own pocket. (LLL)
2. Ph.D. program not offered by NTU. (DE)
3. MBA program not offered by NTU. (DE)
4. NTU entry level courses are too basic. (DE)
5. No Library and laboratory facilities available. (DE)
6. Entrance requirements for non-traditional students too restrictive--NTU needs to allow credit for engineering work experience. (DE)
7. Lack of motivation when studying alone--NTU needs a peer support group. (DE)

All written open-ended barrier question responses from those survey questions were correlated under the 27 corresponding themes (listed in Appendix L) by survey group as a means of compiling, compressing and processing the raw data listed in Appendix L. Themes for all questions were randomly developed and were not listed by priority.

This list of new LLL and DE barrier themes was developed to extend the original list of LLL barrier questions and the added list of DE barrier questions. All relevant responses to questions from all four groups were listed under one of these 27 topic statements. The data for questions 24 and 53 was listed by survey group, SA-I, SA-II, SA-III and SB-IV in the group data set compiled in Appendix L.

Facilitator Themes to LLL and DE Programs at NTU

Open-ended facilitator questions 37, 59 and 63 were added to appropriate survey sections to learn more from survey respondents regarding their views and concerns about facilitators to participation in continuing professional education (CPE) at NTU, LLL and

DE. Facilitator responses to these three open-ended questions on LLL and DE facilitators to participation were synthesized and grouped into a list of 33 barrier themes. From this group, 13 new barrier variables were listed in Table 23.

These 13 new facilitator variables evolved from evaluating and synthesizing all survey responses in the two main LLL and DE facilitator section open-ended questions 37 and 59, and question 63 at the end of the survey, for each survey group into the list of common themes, then cross-listing each response under the appropriate theme. Although 33 themes were recorded, several pairs of themes were consolidated from two to one common variable. Other themes were repeated facilitators listed previously in survey questionnaires.

All written open-ended facilitator responses from those survey questions were listed under one of these 33 corresponding themes by survey group as a means of compiling, consolidating and processing the raw data, listed in Appendix L. Themes for all questions were randomly selected and were not listed by priority.

Table 23. New Facilitators of Participation Variables

1. Self-scheduled, self-paced -- home or work station viewing of video tapes with e-mail or fax for homework and tests.
2. Convenient down-link classroom or direct delivery to engineering work stations.
3. NTU organized peer support network at NTU companies with Internet web site to encourage fellow engineers to take NTU courses or degrees.
4. Joint NTU/University degree w/40 percent of courses taken from one NTU University.
5. Offer engineering business courses and MBA program for engineering managers.
6. Offer Ph.D. program through NTU downlink/Internet sites.
7. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.
8. NTU down-link classroom at small non-NTU company worksites.
9. More grading emphasis on homework and projects, less on exams.
10. NTU operate like a "real" university with real university ID's that are accepted.
11. Distribute/access NTU class notes and courses on Internet/WWW sites. Marketing NTU programs with expanded satellite coverage w/Internet interface.
12. Option of testing out of prerequisite courses based on experience with initial probationary enrollment.
13. Lower cost auditing and a 6-15 hour CPE short curriculum package with 2-5 courses.

This listing of LLL and DE facilitator themes was developed to extend the original list of LLL facilitator questions and the added listing of DE facilitator questions. All relevant responses to questions from all four groups were listed under one of the theme statements. The data was listed by survey group, SA-I, SA-II, SA-III and SB-IV, with each of the questions 37, 59 and 63 listed as a subtopic in the group data set listed in Appendix L.

Facilitator responses to open-ended question 37 on LLL facilitators and questions 59 and 63 on DE facilitators to participation were synthesized and grouped into the listing of 13 new facilitator variables in Table 23. These new facilitator themes were listed as they evolved from studying and analyzing all the survey responses. This listing of new facilitators provides significant new data to the LLL and DE literature for engineers. These variables focus especially on distance learning engineering educators and researchers.

Lifelong Learning Goals

Two dominant topics did emerge from the review of responses to Questions 60-62 from all four groups, even though no attempt was made to characterize and develop themes which related to LLL and DE short-term and long-term goals and accomplishments. These topics were: 1) the concept of NTU providing broader programs to include engineering business courses with an MBA program for engineers; and 2) the development of a program to offer Ph.D. degrees in several engineering disciplines via NTU downlink sites and/or the Internet. These two prominent factors further reinforce the interest exhibited in new DE facilitator variables #5 and #6, Table 23.

Career and Life Changes Resulting from LLL DE Program at NTU

Survey respondents reported that completion of NTU and other engineering college courses resulted in changes in professional careers by NTU participants and non-participants. Major *career changes* noted by respondents were:

* More responsibility in their current position;
* Changes to more important technical assignments;
* Career ladder changes;
* Moves to better opportunities in their field or a new field;

* Increased confidence in their professional ability;
* Greater respect from superiors, colleagues and family; and
* Increased income.

Some participants responded that their advanced degree or CPE course work resulted in major *life changes*. Primary *life changes* noted were:

* Finding a life mate while taking NTU courses;
* Separation or divorce due to the inability of one or both to cope with study induced stresses;
* Moves to other geographic regions of the U.S. with their company;
* Changing jobs, working for a new company; and,
* Starting their own company.

Educational administrators at NTU and other DE engineering education providers should take serious note of these life change findings. When an employee suffers serious family problems due to study-related stress, the company suffers as the employee cannot function with the work efficiency of an engineering colleague who has a well-balanced and happy home life.

Those who suffered serious strife within a family unit due to the stress of getting an engineering masters degree might have been helped immeasurably by being able to accomplish part of his studies at his work station through e-mail or through Internet related computer mediated communication, better advising and counseling, flexible course timing, setting his or her own pace so that course work could be deferred during times of domestic stress or crisis, or when children might need more attention and help.

When a respondent writes, "I lost my wife due to getting my M.S. degree. I'm totally serious about what I'm saying!", a major loss is felt in this person's life.

Summary of Research Findings

In this study 322 complete survey returns were received from a total of 680 correct addresses for a 47 percent return rate. Of the 322 responses, 278 (86 percent) were *participants* in three categories and 44 (14 percent) were *non-participants*. There were

about two participants in each of the three participant group compared to each non-participant in the study. There were seven primary findings in this study.

Finding number one:

Finding one suggests that LLL barriers and facilitators perceived by engineers are somewhat different than those perceived by pharmacists. Hanson and DeMuth (1991) developed a survey instrument to identify barriers and facilitators to participation in CPE experienced by pharmacists in a national survey. Their pharmacy survey instrument was adapted for use by engineers and expanded to include DE for this study.

Yamaguchi (1992) conducted a factor analysis study that focused on barriers experienced by technical managers and staff engineers from Pacific Bell Corporation who were taking courses from two DE providers in California, but did not solicit or evaluate facilitators to participation. The present study adds to the educational data base for engineers by comparing barriers and facilitators to participation in LLL by engineers at major U.S. corporations and government agencies with the experiences of pharmacists.

Finding number two:

Finding two showed significant differences in mean values from Likert scale barrier and facilitator questions and demographic interval or ordinal data questions for the four groups of engineers. This finding of NTU engineering participation by full-time engineers taking engineering courses by satellite expands on work reported by Wergin (1986) who studied problems (barriers) encountered and changes/improvements (facilitators) suggested by older off-campus working engineering students enrolled in an ITV masters degree engineering program delivered by the Virginia statewide fiber optic network.

That program was taught by telecourse by a consortium of three Virginia universities in 1983-84. Older off-campus engineers were compared with younger on-campus engineering students. **Finding number two** responds to research questions one and two by identifying significant correlations between non-participants and some of the participant engineer groups.

Finding number three:

Finding three resulted in the development of a theoretical discriminant function equation, DF Model **Z234T**. This engineering DE participation prediction equation should be useful in the future to accurately select engineers for successful enrollment and performance at NTU.

The development of DF Model **Z234T** was the most important development of the study. This statistical model is built on the premise that it incorporates the most significant, powerful barrier and facilitator to participation variables in DE, LLL and key demographics which discriminate between engineers who are likely to participate compared to engineers who are not likely to participate in DE programs at NTU.

This finding builds on reports by Van Valkenberg (1988) who predicted future DE delivery systems, Baldwin (1987) who described technological breakthroughs in satellite delivery that made it possible to develop NTU, and Cranch (1987) who cited the lack of coordinated engineering education support programs and listed barriers to participation in CPE. It supports research questions one and two by identifying the significant and decisive barrier and facilitator variables that discriminate rigorously between participants and nonparticipants.

Finding number four:

Finding four resulted from the synthesis of responses from the four engineering groups to open-ended qualitative survey questions where seven new barriers to participation to DE were developed from the data analysis. This finding supports and expands the engineering literature of Wergin (1986) discussed earlier and Cranch (1987) who cited primary barriers to participation in ITV courses by working engineers. It also responds to research question three by identifying additional factors that were perceived as barriers to participation in distance CPE by engineers. These new variables should provide an opportunity to identify weaknesses in the NTU program the will benefit engineers in the future.

Finding number five:

Finding five resulted from the synthesis of responses from the four engineering groups to open-ended qualitative survey questions where 13 new facilitators to participation to DE were developed from the data analysis. These facilitator variables fill a void of data not found in the literature except for theories posed by Van Valkenberg (1988) when he predicted the types of future DE programs that engineers throughout the U.S. would need in order to facilitate future participation by engineers in CPE to maintain or enhance technical skills while working full-time. It also relates to Cooper's (1991) description of DE delivery systems in Oklahoma, which expands on Van Valkenberg's philosophy. This qualitative data finding also supports research question three.

Finding number six:

Finding six resulted from the review of responses by the four groups to open-ended questions 60, 61 and 62 relating to setting current and long-term future goals or asks respondents to discuss completed goals. Review of these qualitative data resulted in identifying two new programs that survey respondents felt were needed at NTU: an MBA program for engineers who were working in administrative roles and wanted to earn an MBA from NTU; a Ph.D. program in an engineering field of interest.

This finding not only relates to Van Valkenberg's (1988) philosophy of future distance CPE needs, but if realized, the addition of engineers with Ph.D.'s earned through DE programs could help build the future support base of DE qualified faculty who have valuable industry experience. This type of instructor would be a major asset to future DE programs because he/she could better relate to and advise working engineers. This finding also supports research question three.

Finding number seven:

Finding seven developed from responses of survey respondents about career or life changes that resulted due to their NTU graduate degree program or from taking selected courses at NTU (participants) or at a local engineering college (non-participants) in

response to qualitative questions 64 and 65. These findings support the research reported by Cranch (1987) and Wergin (1986) by illustrating and highlighting the emotional and psychological results of overcoming barriers to participation, both in rewards gained as well as penalties incurred.

This data points out to future engineering educators who must be cognizant of and responsive to the sociological cost of distance learning in relation to other social obligations and personal responsibilities of engineers who feel they must participate in engineering CPE. This finding identifies factors that relate to research question three.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

This study is about *participation* in continuing professional education through a distance education delivery method provided by the National Technological University, Ft. Collins, Colorado. It involved engineers who investigated an educational need, then proceeded to enroll and begin an academic study program while other engineers working at the same corporations or government agencies inquired but declined to enroll or register after receiving the same academic program information.

Furthermore, this study is about barriers and facilitators to participation in LLL and DE. The difference in *participation* and *non-participation* was that *participants* registered, enrolled and participated; while *nonparticipants* inquired, but did not follow-up. For a variety of reasons, non-participants elected to follow a different CPE path than NTU. As indicated by their lack of response to question D 17, almost half of the *nonparticipants* appeared to have not participated in any CPE program.

The profile of the nonparticipant engineer characterizes the *nonparticipants* compared to "admitted" and "taking" NTU engineers. It also provides additional insight about the personality and demographic characteristics of *nonparticipants* which relates to reasons why these engineers chose not to participate in DE at NTU.

The survey response data indicates that many NTU engineers in this study faced barriers to participation. As "participants," they overcame their barriers directly through self desire and determination, or they found facilitators or support systems that allowed them to overcome substantial barriers. The range of standard deviations would indicate that

some of the barriers listed did not pose a problem to some of the NTU students. What may have been a DE or LLL barrier for some engineers may not be a major concern to others.

This study began with the identification of **The Problem**. The basis of the Problem was that apparently no study of barriers and facilitators to campus based engineering education or DE for graduate engineers has been conducted. Engineering educators do not know the extent and types of CPE, higher education barriers that are specifically unique to engineers working in remote locations from engineering college campuses.

The needed facilitators to participation in continuing DE for engineers that increase and improve the level of participation in academic CPE in remote locations cannot be accurately predicted if the unique barriers to participation for engineers are not known. This research study of barriers and facilitators to participation in continuing DE for working engineers was initiated to identify significant barriers and facilitators to participation and develop a statistical model that would aid in predicting participation.

Research Questions

Answering these three research questions will help resolve **The Problem** and thus enhance future engineering continuing professional education through distance education as well as resident engineering college lifelong learning methods.

The three research questions were:

Q 1. What significant barriers to participation are associated with engineers that deter them from participating in continuing distance higher education engineering academic programs?

Q 2. What significant facilitators of participation are associated with engineers that inspire them to overcome barriers to participation in continuing distance higher education engineering academic programs?

Q 3. What other significant factors are associated with barriers and facilitators to participation by engineers that affect their continuing participation in distance higher education engineering academic programs?

The findings of this research study answer these three questions. Significant barriers that engineers faced in participating in LLL and DE continuing professional education (CPE), and facilitators that these same engineers perceived as helping them overcome

barriers, were identified in two ways from the existing listings of independent variables. First, answers were developed by standard regression analysis in the form of significant means which were compared as correlation data between groups. This means data in Tables 10, 11, 12 and 13 identified significant LLL and DE barrier and facilitator variables.

Next, DFA analysis compared significant means between engineers in two groups who had differing attitudes and demographic characteristics. This data analysis was used to develop a theoretical DF model equation which is expected to be useful in accurately predicting group membership of engineering participants in DE programs who completed these same survey questions.

An additional research method that responds to research question three was the synthesis of qualitative data from open-ended questions that was related to the same types of ideas and concepts as some of the quantitative questions. This synthesis of data resulted in the development of seven new LLL and DE barriers to participation variables and 13 new LLL and DE facilitator to participation variables through qualitative "factor analysis."

Research Question One

What significant barriers to participation are associated with engineers that deter them from participating in continuing distance higher education engineering academic programs?

Findings

The barriers to participation that answer *research question one* are identified as answers in the following discussion. Research finding number three relates to the development of the theoretical DF Model Z_{234T} which provides accurate selection discrimination between NTU participant and non-participant engineers using Pooled Within-class Standardized Canonical Coefficients, or standardized weighting scores that are multiplied by each person's variable means to classify them into their correct group. This DF model, with 11 independent variables, identified two significant DE barriers to participation: Q52, "NTU course feedback (homework return/evaluation) not satisfactory"; Q49, "NTU does not

have the degree options I'm interested in." Significant demographic barriers were D15, "time from nearest engineering college and D12, "travel time to work", where family needs for transportation conflict with the engineers need to get to work or go to classes. Additional major barrier variables were also identified and ranked according to priority in Table 10 for LLL variables and Table 11 for DE variables. Significant LLL barriers were: Q 13, "work/family don't leave enough study time"; Q12, "job constraints"; Q15, "family constraint (spouse, children)"; Q16, "problems getting desired courses"; and, Q20, "learning doesn't result in advancement." Significant DE barriers were: Q 39, "local college degree ranks higher"; Q38, "better advising at local college"; Q50, "NTU instructor counseling unsatisfactory"; Q48, "peers don't recommend NTU program"; and Q45 "NTU course quality unsatisfactory."

Besides the barriers where *nonparticipants* agreed with *participants*, additional DE Barriers ranked as their top five barriers by *nonparticipants* were: Q40, "NTU schedule unsatisfactory"; Q41, "NTU course work conflict with company work"; Q44, "NTU standards, reputation too low." Since these *nonparticipants* engineers did not enroll at NTU, the DE and LLL barriers that they ranked highest must be seriously considered.

Conclusions

Seventeen significant barriers to participation are identified in the findings in response to Research Question One. These barriers, especially those that are rated high in priority for non-participants, pose a serious problem to engineers who want to get a M.S. engineering degree by DE at NTU, or even those who want to take specific engineering courses to improve or maintain technical proficiency.

Theoretical DF Model, Z_{234T} is the major product of this research study. With classifying hit rate accuracies of 81 percent for Hold-out Sample Summary Analysis, compared to 91 percent on Resubstitution Analysis and 85 percent for Cross-Validation Analysis, using the 50 percent split sample of the population, both the internal and external validity are very stable. This DF model appears to have potential as a distance education

student selection diagnostic tool for correctly classifying engineers similar to those who participated in this study for NTU and similar DE organizations.

Recommendations for Future Research

Continued research should be conducted to further develop theoretical DF Model Z_{234T}. Testing and research with other sample populations of engineers currently enrolled at NTU is recommended. This approach of DF model development should be the subject of other educational research for professional groups that study through distance learning means. The research questionnaires should also be further refined and tested with engineers in other DE engineering programs. The researcher believes that this DF model has serious implications as an educational diagnostic tool for use in CPE through DE for engineers at NTU and other distance engineering programs.

Research Question Two

What significant facilitators of participation are associated with engineers that inspire them to overcome barriers to participation in continuing distance higher education engineering academic programs?

Findings

Facilitators to participation that answer *research question two* are identified in the following discussion. Research finding number three relates to the development of the theoretical DF Model $\mathbf{Z_{234T}}$ which provides selection discrimination between NTU participant and nonparticipant engineers that classifies them into their correct group with a relatively high degree of accuracy.

This DF model, composed of 11 independent variables, identified four significant DE facilitators to participation: Q56, "NTU schedule better for me than local engineering colleges" (the strongest facilitator in the model); Q55, "NTU courses taken partially on company time without makeup work"; Q54, "NTU courses allow flexibility in makeup classes and homework"; Q58, "NTU's tuition and fees lower than local engineering colleges."

One significant LLL facilitator in this model is Q26, "Enjoyment/relaxation through learning -- change pace from routine." A significant Learning Activities facilitator was Q5, "Use Internet/WWW or reference library for information". D5, "Engineering degrees (BS Engr., MS Engr., BS + MS Engr., Ph.D., DoE)", was a significant demographic facilitator.

Table 12 lists LLL facilitators compared by groups that were ranked for priority by group. Highest priority facilitators were: Q36, "Personal desire to learn"; Q33, "Ease of access to learning opportunities"; Q35, "Affordable learning opportunities"; Q34, "Fear of obsolescence"; and, Q32, "Professional/career advancement".

Conclusions

The thirteen new facilitators to participation identified in the findings provide a significant response to Research Question Two. These new facilitators, especially those that are rated high by non-participants, should be given special attention by NTU and other DE providers and researchers. If available, these facilitators might provide a means of overcoming some of the barriers to participation in CPE through DE by current *non-participants*, those engineers who must rely on organizations like NTU for their post graduate work. These motivators could inspire engineers who need to work toward an M.S. engineering degree or taking selected technical courses to maintain or improve professional skills but haven't started their post graduate work yet.

Theoretical DF Model Z_{234T}, a major development of this study, relies heavily on DE facilitators as its power base. It should be given serious consideration for use in higher education and distance learning programs to help select engineering candidates who will be successful, both at NTU and other engineering DE schools.

Recommendations for Future Research

Continued development should be devoted to improving the two research questionnaires as instruments used to develop and improve future DF models. Factor analysis of the DE portion of the survey should be conducted to incorporate the 13 new facilitators with the five existing DE facilitator variables into the questionnaire through a

statistically sound process. Question 58 should be rewritten for clearer understanding, therefore minimizing potential bias. Improved survey questionnaires that are further validated statistically will improve educational research both for CPE at engineering colleges and DE programs like NTU.

Research Question Three

What other significant factors are associated with barriers and facilitators to participation by engineers that affect their continuing participation in distance higher education engineering academic programs?

Findings

Research question three is answered by research finding number four and research finding number five, which involve the analysis and synthesis of open-ended qualitative question responses concerning barriers and facilitators to participation both in LLL and DE. Research findings number four discussed the evolution by intellectual factor analysis of seven new barriers to participation, identified from written responses to Q24 and Q53 in the two survey questionnaires. Research findings number four identified 7 new barriers variables in response to questions 24 and 53; research findings number five identified 13 new facilitator variables from responses to questions Q37, Q59 and Q63.

The seven new barrier variables are:

1. Had to pay for course from own pocket.
2. Ph.D. program not offered by NTU.
3. MBA program not offered by NTU.
4. NTU entry level courses are too basic.
5. No Library and laboratory facilities available.
6. Entrance requirements for non-traditional students too restrictive--NTU needs to allow credit for engineering work experience.
7. Lack of motivation when studying alone--NTU needs a peer support group.

The 13 new facilitator variables are:

1. Self-scheduled, self-paced -- home or work station viewing of video tapes with e-mail or fax for homework and tests.
2. Convenient down-link classroom or direct delivery to engineering work stations.

3. NTU organized peer support network at NTU companies with Internet web site to encourage fellow engineers to take NTU courses or degrees.
4. Joint NTU/University degree w/40 percent of courses taken from one NTU University.
5. Offer engineering business courses and MBA program for engineering managers.
6. Offer Ph.D. program through NTU downlink/Internet sites.
7. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.
8. NTU down-link classroom at small non-NTU company worksites.
9. More grading emphasis on homework and projects, less on exams.
10. NTU operate like a "real" university with real university ID's that are accepted.
11. Distribute/access NTU class notes and courses on Internet/WWW sites. Marketing NTU programs with expanded satellite coverage w/Internet interface.
12. Option of testing out of prerequisite courses based on experience and initial probationary enrollment.
13. Lower cost auditing and a 6-15 hour CPE short curriculum package with 2-5 courses.

Conclusions

The seven new DE barriers (Table 22) and 13 new DE facilitators (Table 23) and listed above, which also respond to the previous two research questions, are the second most important development and findings of this study. Many of these barriers and facilitators provide important new insight into distance education participation for engineers.

Recommendations for Future Research

These new findings, although currently focused on NTU, should be refined to reflect on CPE of engineers in other DE settings. NTU should dedicate administrative staff time to study this list and incorporate these variables into a diagnostic prediction tool for use in their admissions as a DE attitude evaluator, which can be used to successfully classify and screen potential engineering graduate students.

The two survey questionnaires used in this research should be improved by evaluating and integrating the twenty new DE variables with the twenty existing DE variables. Factor analysis should be used to reduce this combined group of 22 barriers and 18 facilitators to a reduced number of validated variables for each section of the survey instrument.

These improved survey questionnaires can have substantial value in future CPE studies of engineers learning through DE, in conjunction with an associated, refined Theoretical Z234T DF Model for classifying engineers with a high degree of accuracy according to their potential ability to succeed as an NTU or DE engineer in the future.

An important research program that should be conducted would be to conduct an in-depth study of nonparticipants. The objective would be to find out more explicitly why they do not participate at NTU and what form of CPE, if any, they pursue.

NTU instructors from the 45-50 major engineering colleges in the U.S. that are the DE course providers to NTU should be surveyed to determine what they perceive are the barriers (both minor and major) to participation by engineers, based on results of this study. They should also be asked what they recommend as facilitators that could be economically developed by NTU or by the engineering college that delivers a course or courses to NTU, that would overcome the perceived significant barriers identified in this study. Instructors should be surveyed prior to their review of the results of this study, to get their unbiased perceptions.

NTU administrators should be surveyed to determine what they perceive are the barriers (both minor and major) to participation by engineers and what facilitators could be economically developed that would overcome the perceived barriers identified in this study as well as those identified in the survey of administrators.

NTU site coordinators should be surveyed to determine what they perceive are the barriers (both minor and major) to participation by engineers, and what might be facilitators that could be economically developed which would overcome the perceived barriers identified in this study as well as those identified in the survey of site coordinators.

Summary Comments and Implications for Engineering DE

This has been a challenging, but rewarding study of problems that engineers face while studying to earn a master of science degree in one of 12 disciplines offered by NTU. The

response to Q5 in the survey as a significant variable in the DF Z234T model should be given special consideration.

Engineering distance education in the future will follow the lead and trend of high technology information delivery systems, or "information super-highways." The major forces in future DE for engineers will be Internet access to libraries and laboratory data, satellite delivery of digital data and images, ITV, e-mail in addition to and/or supplemented by express mail delivery of video tapes that may be interactive, computer flash-fax, with high speed file transfer, just as Van Valkenburg (1988) predicted.

The qualitative survey responses to open-ended questions by the 322 respondents (listed in Appendices L and M) support the concepts of Van Valkenberg (who predicted that a wide range of high tech educational systems would deliver engineering education to future engineers), the DE satellite systems described by Baldwin (1987) and the fiber optic delivery technology for graduate programs outlined by Cooper (1991). The thirteen new facilitators listed in Table 23 project the DE systems Van Valkenberg (1988) proposed.

Future distance education must use satellite delivery of telecourses directly to engineering work stations to provide needed flexibility in distance learning by working engineers. Video tape programs for flexible home study is needed, as well as Internet and Web delivery and feedback systems for engineering DE programs to provide the flexibility and interactive feedback to provide direct, fast response.

More flexible delivery and feed-back programs are needed to relieve the sociological stresses of earning an advanced engineering degree or taking selected technical courses for CPE. To be of maximum usefulness, these systems should allow courses to be presented without a "term -- semester or quarter" time basis; i.e., "out of sync" with the traditional campus based engineering course degree programs, similar to historical written correspondence courses, as the DE method of the future.

Engineering educators have the tools at their disposal to produce highly innovative, flexible learning conditions and experiences that will enhance the speed of learning by

stimulating the inquisitive nature of engineers. Responses to open-ended survey questions highlight these future engineering DE delivery options: "*at my desk*", "*on my PC*", "*direct and taped so I can hear the instructor as many times as I want on a key point*", "*flexible to fit my travel schedule*", and "*no need for semesters*".

The theoretical DF model, Z_{234T}, provides a means for development of better advice and counseling tools for NTU and other DE providers for prior selection and screening of engineers for DE programs. Characterizing the candidate for registration in the type DE classes being presented minimizes student failures by selecting potentially successful participants and enhances the success of working DE engineering graduate students.

In retrospect, if this researcher had been able to collaborate more effectively with DE experts early in the study, more in-depth, better focused Likert scale questions may have produced quantitative results similar to the qualitative responses. This may have resulted in more in-depth results than were possible by statistical means in this research study. This thought occurred after summarizing hundreds of written comments from respondents. The researcher feels that the written responses by survey participants have added substantially to the depth of the study and will be useful to engineering educators in the future.

Engineers suffer from similar barriers to those of pharmacists and other professionals, but they also face additional, unique challenges. Lack of laboratory facilities make "hands-on" engineering research studies impossible through satellite delivery classes in classrooms at remote corporate downlink sites.

Lack of a university library is more of a handicap for engineers than other professionals in accessing current technology to solve engineering problems covered in satellite downlink classes. This was a highly frustrating problem to many NTU students, especially those who have no access to an engineering college library within driving distance.

This is a problem that NTU (and other engineering DE CPE providers) needs to address with 45-50 cooperating universities that are somewhat accessible to many engineers (located within 100 miles). NTU needs to provide an NTU student ID card that

is honored by all major U.S. research universities.

A master's research thesis problem is difficult to administer via satellite delivery, depriving students of the possibility of major and valuable experience of direct instructor interaction normally received in campus based engineering degree programs. Serious efforts must be made by DE providers to overcome this problem by careful selection of instructors who are DE skilled, "camera friendly", and who can improve ITV programs.

Highly technical engineering design problems are difficult to assign and develop when engineers cannot interact directly with instructors. The problem is exacerbated by tedious feedback methods and poor teacher-to-learner communication resulting in unsatisfactory, frustrating learning experiences by mature working engineers.

The researcher believes that many of the barriers to learning experienced by these engineers can be economically solved, including making DE engineering M.S. degrees economically available to the hundreds of thousands of engineers who work at medium and small corporations across the U.S., based on suggestions of the 322 working engineers.

It seems conceivable that engineering Ph.D. programs could be developed where the majority of the course work could be conducted by DE with innovative means of conducting the dissertation research. If suitable researchable problems can be resolved for dissertations that are of direct value to the corporation that employs a Ph.D. candidate, then support by the engineer's own company might provide fellowship or research grant scholarships that would allow candidates to take a sabbatical to complete the dissertation research with full-time (or at least part-time) residency at the granting research university. The resulting research should result in assets worth the expenditure by the company.

The suggested concept of earning 40 percent of the degree program course credits from one NTU university, then receiving the degree from that university (or jointly from NTU and that university) should be given serious consideration for M.S. and Ph.D. degrees. If this DF model can be used accurately to select or place survey participants into the correct group of engineers, it would be developed as a useful future predictive tool for engineering

educators at NTU by using the validated DF model survey questions as a screening system. The DF model might also be modified and validated for use by other "similar" or closely related engineering college DE programs as a diagnostic instrument for correctly classifying a high percentage of future engineering candidates into their specific DE academic programs. Similar DF models might be adapted for use in screening future engineering college candidates at many resident engineering colleges, with further research refinement.

It would be helpful to develop a larger group of non-participants by maintaining the initial request cards to a program (NTU or other DE engineering program) over a longer collection period in future studies. A separate research study of non-participation could be conducted with more focus on why non-participants did not enroll to determine what went wrong, and what changed their mind or dampened their interest in CPE through NTU.

Peer groups of NTU graduates should be organized to act as a proactive support group of mentors to potential or new NTU students who have problems they want to discuss with "experienced peers." This peer "advisory council" of professional working NTU graduates is a facilitator that several respondents have requested and should be given serious consideration by NTU administrators.

Other major DE program providers should consider establishing similar groups for their DE programs. It is a way of including NTU alumni in a service that is beneficial to all parties involved, and can provide a great service to the new NTU candidate. It's a program that would have very little cost. It's as close as the Internet and E-mail.

A final recommendation is that Ph.D. students in education need an early awareness of DFA and factor analysis statistical programs and how they interact (where they fit) in various types of educational research. This should be part of the "cap" course in the research section of the plan of study. Learning these methods early would have helped this research immensely, saving one to two years of research time with the rate of progress and organization of this study. Neither method was included, discussed or mentioned in the three quantitative tools courses required of Ph.D. students at OU.

REFERENCES

Anderson, R. E. & G. G. Darkenwald. (1979). Participation and persistence in American adult education: Implications for public policy and future research from a multivariate analysis of a national data base. Direction Papers in Lifelong Learning. EXXON Education Foundation, New York.

Baldwin, L. V. (1987). Tune in for professional development, In Continuing Education, Engineering Education, American Society for Engineering Education, 77, 7/8, 679-683.

Barker, B. O. & M. R. Platten. (1988). Student perceptions on the effectiveness of college credit courses taught via satellite, American Journal of Distance Education, 2, 2 44-50.

Boshier, R. (1971 a). Motivational orientations of adult education participants: A factor analytic exploration of Houle's typology. Adult Education, 21, 2, 3-26.

Boshier, R. (1971 b). An instrument and conceptual model for the prediction and diagnosis of dropout from educational institutions. Monographs in adult education, Victoria University of Wellington, NZ, 28 p.

Boshier, R. (1972). The development and use of a dropout prediction scale: A theoretical model. Adult Education, 22, 2, 87-99.

Boshier, R. (1973). Educational participation and dropout: A theoretical model. Adult Education, 23, 4, 255-82.

Boshier, R. (1977). Motivational orientations re-visited: Life-space motives and the education participation scale. Adult Education, 27, 2, 89-115.

Boshier, R. & G. Riddell. (1978). Education participation scale factor structure for older adults, Adult Education, 28, 3, 165-75.

Cevero, R. M. (1988). Effective Continuing Education for Professionals. San Francisco: Jose Bass Publishers.

Cooper, B. L. (1991). Seminar: Distance education by compressed video in Oklahoma, College of Engineering, Architecture, and Technology, Oklahoma State University, October.

Cranch, E. T. (1987). Continuing engineering education in the United States: An overview and assessment, In Continuing Education, Engineering Education, American Society for Engineering Education, 77, 7/8, 657-668, April/May.

Cropley, A. J. & T. N. Kahl. (1983). Distance education and distance learning: Some psychological considerations, Distance Education, 4, 1, 27-39.

Cross, K. P. (1981). Adults as Learners. San Francisco: Jose Bass Publishers.

Darkenwald, G. G. (1977). Why adults participate in education: Some implications for program development of research on motivational orientations. Speech presented to the faculty of the University Extension Division, Rutgers University, January 26, 19 p.

Darkenwald, G. G. (1983). Perspectives of business and industry on cooperative programming with educational institutions. Adult Education Quarterly, 33, 4, 230-243.

Darkenwald, G. G. (1984). Participation in education by young adults. New Directions for Continuing Education, 21, 15-28, March.

Darkenwald, G. G. & E. R. Hayes. (1986). Adults' attitudes towards continuing education. Paper presented at the National Conference of the American Association for Adult and Continuing Education, Hollywood, Florida, 16 p., October.

Darkenwald, G. G. & Valentine, T. (1985). Factor structure of deterrents to public participation in adult education, Adult Education Quarterly, 35 (4), 177-193, Summer.

Dillman, D. A. (1978). Mail and Telephone Surveys: The Total Design Method, New York: Wiley Publishing.

Executive Summary. (1996). National Technological University, Ft. Collins, CO, Revised, March.

Fifer, B. B. (1989). Identifying barriers to participation by educators on continuing professional education. Paper presented at the 18th Annual Meeting of the Mid-South Educational Research Association, Little Rock, AR, November 7-10, 36 p.

Final Report: Goals of Engineering Education. (1968) ASEE. 54.

Grimes, P. W., J. E. Nielsen & J. F. Niss. (1988). The performance of nonresident students in the economics USA telecourse, American Journal of Distance Education, 2, 2, 36-43.

Hair, J. F., Jr., R. E. Anderson, R. L. Tatham, & W. C. Black. (1995). Multivariate Data Analysis with Readings, Fourth Edition. Englewood Cliffs, New Jersey: A. Simon & Schuster Company.

Hammer, P. & D. Shale. (1981). Removing barriers to the participation of adult learners in higher education, ASHE Annual Meeting 1981 Paper, Annual Meeting of the Association for the Study of Higher Education, Washington D.C., 21 p.

Hanson, A. L. & DeMuth, J. E. (1991). Facilitators and barriers to pharmacists' participation in lifelong learning, American Journal of Pharmaceutical Education, 55, 20-29, Spring.

Hayes, E. R. & G. G Darkenwald. (1990). Attitudes toward adult education: An empirically-based conceptualization. Adult Education Quarterly, 40, 3, 158-68, Spring.

Hezel, R. T. & Dirr, P. J. (1991a). Barriers that lead students to take television-based college courses, Tech Trends, 36, 1, 33-35.

Hezel, R. T. & Dirr, P. J. (1991b). Understanding television-based distance education: identifying barriers to university attendance, Research in Distance Education, 3, 1, 2-5.

Huberty, C. J. (1984). Issues in the use and interpretation of discriminant analysis, Psychological Bulletin, 95, 1, 156-171.

Klecka, W. R. (1980). Discriminant Analysis. Newbury Park, California: Sage Publications. 7-54.

Knox, A. B. (1987). Reducing barriers to participation in continuing education, Lifelong Learning: An Omnibus of Practice and Research, 10, 5, 7-9, Feb.-Mar.

Lewin, K. (1947). Frontiers in Group Dynamics: Concept, Method and Reality in Social Science. Human Relations, June, 1, 5-41.

McDaniel, R. H. & W. H. Gray. (1987). Barriers faced by rural adult learners: A synopsis of a survey of seven rural states, Community Education Research Digest, 1, 2, 58-66, Spring.

Martindale, C. M. & Drake, J. B. (1989). Factor structure of deterrents to participation in off-duty adult education programs, Adult Education Quarterly, 39, 2, 63-75.

Merriam, S. B. & E. L. Simpson. (1995). A Guide to Research for Educators and Trainers of Adults. Malabar, Florida: Krieger Publishing Company.

National Technological University: ANNUAL REPORT 1993-94. (1994). National Technological University, Ft. Collins, CO, 14 p.

NTU Highlights. (1994). National Technological University, Ft. Collins, CO, October.

Peterson, R. E. (1979). Lifelong Learning in America, San Francisco: Jose-Bass Publishers.

Scanlon, C. S. & G. G. Darkenwald. (1984). Identifying deterrents to participation in continuing education, Adult Education Quarterly, 34, 3, 155-166, Spring.

Swanson, J. L. & Tokar, D. M. (1991). College students' perceptions of barriers to career development, Journal of Vocational Behavior, 38, 92-106.

Valentine, T. & Darkenwald, G. G. (1990). Deterrents to participation in adult education: profiles of potential learners, Adult Education Quarterly, 41, 1, 29-42, Fall.

Van Valkenburg, M. E. (1988). Preparing the engineers of the 21st century, Engineering Education, American Society for Engineering Education, 79, 2, 103-108.

Wergin, J. F., D. Boland & T. W. Haas. (1986). Televising graduate engineering courses: Results of an instructional experiment, In Findings, Engineering Education, American Society for Engineering Education, 77, 2, 109-114, November.

Yamaguchi, W. S. (1992). A Study of the low participation in continuing technical education by Pacific Bell employees. National Technological University Management of Technology Field Research Project, California State University, Hayward, CA.

APPENDICES

Appendix A

National Technological University Authorization Letter

National Technological University
700 Centre Avenue
Fort Collins, CO 80526-1842
303-484-0668 (FAX)
303-495-6400

A HIGHER Order of Education™

December 30, 1992

Transmitted via FAX 405-744-6059

Ronald T. Noyes, P.E., Professor
Oklahoma State University
224 AG Hall
Stillwater, OK 74078-0469

Dear Ron:

I am responding to your letter of December 13, to Eileen Moree. I am pleased to inform you that NTU is very interested in your proposed dissertation research study as detailed in your enclosure. We will provide you with the support needed to accomplish your stated goals. The support includes providing names and addresses of various categories of survey participants, the use of NTU letterhead stationary, help in the Q-sort process with an expert review panel to help select questions, pilot surveys and any other reasonable actions. We cannot demand student participation, but we can urge such action.

I am enclosing a draft report of a field research project which has just been completed by Wayne Yamaguchi of Pacific Bell. This report addresses the questions you have raised and should be of interest to your proposed effort. If you have any questions, please contact me.

Ms. Moree will be your NTU contact for the dissertation effort. I wish you success in your work, and I look forward to your results which should be useful to NTU.

Sincerely,

Roy

Roy H. Mattson
Academic Vice President

RHM:tk
Enclosure
c: Eileen Moree

Appendix B

Institutional Research Clearance Memo

OFFICE OF RESEARCH ADMINISTRATION

The University of Oklahoma
Norman Campus

MEMORANDUM

TO: Jennifer Gourley, Curriculum Advisor
Graduate College

FROM: Karen M. Petry, Director
Office of Research Administration

DATE: May 18, 1998

SUBJECT: IRB-Review of Use of Human Subjects in Research
Project (FY98-222)

This is to confirm that the Institutional Review Board, Norman Campus, has reviewed Mr. Ronald T. Noyes's study, "A Survey of Barriers and Facilitators to Participation In Higher Distance Education By Engineers In Industry." This study meets the criteria for consideration under the exempt from Board review category.

Please contact me if you require any additional information regarding this approval.

cc: Dr. E. Laurette Taylor, Chair, IRB
Mr. Ronald T. Noyes, Principal Investigator, Biosystems & Agricultural Engineering

Appendix C

University of Wisconsin Survey Use Authorization Letter

University of Wisconsin–Madison School of Pharmacy

EXTENSION SERVICES IN PHARMACY

425 N. Charter Street
Madison, Wisconsin 53706
Telephone (608) 262-3130
FAX (608) 262-2431

March 14, 1995

Ronald T. Noyes, P.E., Professor
Extension Agricultural Engineer
Oklahoma State University
Department of Agricultural Engineering
214 Agricultural Hall
Stillwater, OK 74078-0469

Dear Professor Noyes:

I am responding to your letter of February 28 in which you requested information relative to the Facilitator/Barrier Study of 1990 as well as permission to utilize our survey in your work.

I have enclosed some information that was readily accessible. This includes: a copy of a preliminary instrument which was pretested and from which the facilitator/barrier survey instrument was derived; a copy of the original instrument; a copy of materials from a poster presentation on the topic of facilitators/barriers (this may simply duplicate other information, but I will let you determine that); and a copy of the manuscript itself which represents the full report of the portion of the study pertaining to facilitators/barriers.

You are welcome to use what you wish, as along as the appropriate acknowledgement is provided. You should also be aware that our survey instrument was based on one originally developed by Cheryl Livneh (Portland State University).

Good luck.

Sincerely,

Alan L. Hanson, PhD
Professor

enc.

Appendix D

Questionnaire Review Panel Address List

APPENDIX D

Questionnaire Review Panel for Barriers/Facilitators to Participation Study at NTU

Ms. Eileen Moree, Director
Admissions & Records, NTU
700 Centre Avenue
Ft. Collins, CO 80526

Mr. Nick Canada, Commander, Code 0643A
Naval Surface Warfare Center, Crane Div.
300 Highway 361
Crane, IN 47522-5001

Mr. Jim Carr, Technical Education Coord.
Hewlett-Packard Company
P. O. Box 39, M/S 0352
Boise, ID 83714

Ms. Kathi Collins, Assistant Director
ITV Network, Olin 108
University of Southern California
Los Angeles, CA 90090-1455

Dr. Bill Cooper, Head
Engineering Extension
College of Engineering
511 Engineering North
Oklahoma State University
Stillwater, OK 74078

Ms. Claire Daughtry, Mgr.
Instructional Television Program
Engineering Dean's Office
University of California, Davis
Davis, CA 95616

Ms. Judy Day
Hewlett-Packard Company
1400 Fountain Grove Parkway, Bldg. 2USI
Santa Rosa, CA 95403-1799

Dr. Charles Elliott, Director
Center for Professional Development
Arizona State University
Engineering Center, G148
Tempe, AZ 85287-7506

Dr. Jim Fikry, Mgr., Graduate Extension Ed.
College of Engineering
North Carolina State University
Raleigh, NC 27695-7902

Dr. John Hren
Material Sciences & Engineering
University Box 7907
North Carolina State University
Raleigh, NC 27695-7907

Dr. Howard Kimmel, Assistant Vice-President for Academic Affairs
New Jersey Institute of Technology
University Heights, NJ 07102

Dr. Linda Krute, Professor
University of Illinois, Urbana/Champaign
422 Engineering Hall
Urbana, IL 61801

Ms. Susan M. Kryczka, Director
Network Northeastern
Northeastern University
360 Huntington Avenue
Boston, MA 02115

Dr. Fred Mowie, Professor
Department of Electrical Engineering
MSE Building, Purdue University
West Lafayette, IN 47907

Dr. Don Novotny, Professor
College of Engineering
University of Wisconsin-Madison
1415 Johnson Drive, Room 2422
Madison, WI 53706

Dr. Philip H. Swain, Director
Continuing Engineering Education
Purdue University
1575 Civil Engineering Building
West Lafayette, IN 47907-1575

Ms. Anne Taylor, Edu. & Training Specialist
U.S. Air Force, Rome Laboratory/SUR
26 Electronic Parkway
Griffiss AFB, NY 13441-4514

Ms. Laurel Townsend
AT&T, Bell Laboratories
200 Laurel Avenue, Room 3C-130
Middletown, NJ 07748-4801

Mr. Bill Woodward
IBM, Systems Storage Product Division
9000 S. Rita Road, 05M/040
Tucson, AZ 85744

Dr. Douglas Yeager, Vice President, Marketing, NTU
700 Centre Avenue
Ft. Collins, CO 80526

Appendix E

University of Wisconsin Pharmacy Questionnaire

University of Wisconsin Madison

SCHOOL OF PHARMACY 425 N. CHARTER STREET MADISON, WISCONSIN 53706 PHONE 262-3130 (AREA CODE 608)

EXTENSION SERVICES IN PHARMACY

July 14, 1989

Dear Colleague:

Extension Services in Pharmacy at the School of Pharmacy of the University of Wisconsin is conducting a nationwide survey of pharmacists to examine a variety of factors associated with professional and leisure learning activities (e.g., lifelong learning). As a provider of continuing pharmacy education, we believe the data collected through this survey will enable us, as well as other educational providers, to more effectively help you determine and achieve your lifelong learning goals.

Your name has been randomly selected from a list of all licensed pharmacists in the United States. It is our hope that you would be willing to complete the enclosed survey form and thus provide information which will have an impact on the future of lifelong learning (including pharmacy continuing education).

Please complete this survey and return in the enclosed envelope by July 28. The information you provide will be held in strict confidence. The code number on the survey form is to facilitate a follow-up request should one be necessary.

Thank you for your cooperation.

Sincerely,

Alan L. Hanson, Ph.D., R.Ph.
Professor

James E. De Muth, Ph.D., R.Ph.
Professor

LIFELONG LEARNING

Lifelong learning can be described as a philosophy recognizing that learning occurs throughout one's lifespan by participation in a variety of planned or deliberate learning endeavors such as degree programs, professional continuing education, pursuit of a hobby or reading for pleasure – just to name a few. Included in this philosophy is a recognition not only of the importance of the individual in making learning decisions but also the unique skills, motivations, goals, learning preferences that each person brings to the learning environment. Within this context, a lifelong learner can be described as one who is conscious of him/herself as a learner throughout life, sees new learning as the logical way to handle problems, is highly motivated to carry out learning throughout life, and welcomes change/challenge throughout life as providing opportunities for new learning.

Listed below are three statements dealing with lifelong learning. Please indicate by circling the appropriate number, how accurately each statement describes you.

1	Strongly Disagree		5	Mildly Agree	
2	Disagree	4 Undecided	6	Agree	
3	Mildly Disagree		7	Strongly Agree	

1.	I consider myself to be a lifelong learner.	1	2	3	4	5	6	7
2.	I am able to identify goals in my pursuit of lifelong learning.	1	2	3	4	5	6	7
3.	I am successful in achieving my lifelong learning goals.	1	2	3	4	5	6	7

LEARNING ACTIVITIES

The purpose of this portion of the questionnaire is to determine the types of learning activities in which you regularly participate. Please indicate your average amount of participation in each of these following areas over the past twelve months by using the following scale:

0 - not at all	3 - at least once every three months	6 - at least once a week
1 - at least once a year	4 - at least once a month	7 - at least once every 2-3 days
2 - at least once every six months	5 - at least once every other week	8 - at least once a day

Professional Pharmacy Learning Activities

1.	Read a journal, book or other reference source.	0	1	2	3	4	5	6	7	8
2.	Use of a library for information.	0	1	2	3	4	5	6	7	8
3.	Communicate with peers (answering questions, discussions with colleagues, problem solving, etc.).	0	1	2	3	4	5	6	7	8
4.	Attend professional organization meetings, such as committees or business meetings, but not continuing education related (local, state, national).	0	1	2	3	4	5	6	7	8
5.	Contribute to a presentation or publication; give an in-service program.	0	1	2	3	4	5	6	7	8
6.	Attend continuing education programs (in-services, seminars, home study courses, teleconferences, etc.).	0	1	2	3	4	5	6	7	8

Leisure Time Learning Activities (including hobby, religious, civic or recreational experiences)

1.	Read a book or magazine for enjoyment.	0	1	2	3	4	5	6	7	8
2.	Read a book or magazine for personal improvement (self-help,hobby,leisure pursuits).	0	1	2	3	4	5	6	7	8
3.	Use of a library for information.	0	1	2	3	4	5	6	7	8
4.	Attend civic or church organization meetings, including committees or business.	0	1	2	3	4	5	6	7	8
5.	Contribute to or give a presentation to group(s) on non-pharmacy related topic(s).	0	1	2	3	4	5	6	7	8
6.	Peer/colleague discussions on non-pharmacy topics.	0	1	2	3	4	5	6	7	8
7.	Learn through electronic media (educational TV,videos,radio,computers,etc.)	0	1	2	3	4	5	6	7	8
8.	Attend continuing education programs (non-credit or credit non-pharmacy related courses through university or vocational-technical institute).	0	1	2	3	4	5	6	7	8

BARRIERS TO LEARNING

Listed below are general factors which may serve as potential barriers to the learning process. For each factor, please indicate by circling a number from the corresponding scale, the extent to which that factor might have served as a barrier to your participation in lifelong learning.

1 Never
2 Almost Never
3 Once in Awhile
4 Sometimes
5 Frequently
6 Almost Always
7 Always

1.	Lack of confidence (e.g., fear of something new, doubts regarding ability to learn, perceived difficulty of learning encounter, etc.).	1 2 3 4 5 6 7
2.	Lack of relevance of learning opportunities known to be available.	1 2 3 4 5 6 7
3.	Job constraints (lack of relief help, time off, etc.).	1 2 3 4 5 6 7
4.	Low personal priority of learning in relation to other activities.	1 2 3 4 5 6 7
5.	Cost of participation in learning.	1 2 3 4 5 6 7
6.	Family constraints (e.g., spouse, children, personal).	1 2 3 4 5 6 7
7.	Negative experience with prior learning at the K - 12 level.	1 2 3 4 5 6 7
8.	Scheduling (location/distance/time) of group learning activities.	1 2 3 4 5 6 7
9.	Negative experience with prior learning at the college level.	1 2 3 4 5 6 7
10.	Lack of quality of learning activities.	1 2 3 4 5 6 7
11.	Negative experience with prior learning within pharmacy CE.	1 2 3 4 5 6 7
12.	Professional burnout.	1 2 3 4 5 6 7
13.	Lack of career advancement opportunities as a result of participating in learning activities.	1 2 3 4 5 6 7
14.	Lack of learning opportunities to match your learning style.	1 2 3 4 5 6 7
15.	Lack of recognition for participating in learning activities.	1 2 3 4 5 6 7
16.	Lack of information about available learning opportunities.	1 2 3 4 5 6 7

FACILITATORS TO LEARNING

Listed below are general factors which, may serve as potential facilitators to the learning process. For each factor, please indicate by circling a number from the corresponding scale, the extent to which that factor might have served as a facilitator to your participation in lifelong learning.

1 Never
2 Almost Never
3 Once in Awhile
4 Sometimes
5 Frequently
6 Almost Always
7 Always

1.	Personal desire to learn (e.g., intellectual curiosity).	1 2 3 4 5 6 7
2.	Enjoyment/relaxation provided by learning as change of pace from the "routine".	1 2 3 4 5 6 7
3.	Opportunity to meet/interact/exchange ideas with others.	1 2 3 4 5 6 7
4.	Requirement for maintenance of professional licensure.	1 2 3 4 5 6 7
5.	Encouragement through an external source (e.g., employer,professional organization).	1 2 3 4 5 6 7
6.	Encouragement through family.	1 2 3 4 5 6 7
7.	Opportunity to increase recognition from and ability to serve the community.	1 2 3 4 5 6 7
8.	Professional/career advancement with potential for financial reward.	1 2 3 4 5 6 7
9.	Ease of access to learning opportunities.	1 2 3 4 5 6 7
10.	Fear of obsolescence.	1 2 3 4 5 6 7
11.	Affordable learning opportunities.	1 2 3 4 5 6 7
12.	Assistance of a CE provider to offer advice/counseling relative to learning opportunities/issues/problems.	1 2 3 4 5 6 7

DEMOGRAPHIC INFORMATION

For each of the items listed below, please check the most appropriate response or provide the information requested.

1. Sex: ___ F ___ M 2. Age: ___

3. Which of the following pharmacy degrees have you earned (check all that apply):
___ B.S. ___ M.S. ___ Pharm.D. ___ Ph.D. ___ Other (please specify:_____)

4. Total years in pharmacy practice: _____ 5. Years in current job position/status: _____

6. Total hours worked per week in pharmacy-related practice: _____

7. In which state do you currently practice pharmacy?_____

8. In what other states are you licensed to practice pharmacy?
_____

9. Which one of the following best describes your employment setting:
___ Hospital ___ Retail, Independent ___ Retail, Chain (more than 4 stores)
___ Long Term Care ___ Clinic ___ Other (please specify: _____)

10. Which one of the following best describes your employment position:
___ Owner, Co-owner (Retail) ___ Institutional Management (Hospital Dir./Asst. Dir)
___ Employee (Retail) ___ Staff (Hospital, LTC)
___ Other (Please specify:_____)

11. Marital Status: ___ Single ___ Married ___ Divorced ___ Separated ___ Widowed

12. If married, indicate highest level of education attained by spouse:
___ H.S. ___ B.S. ___ M.S. ___ Pharm.D. ___ Ph.D. ___ Other (please specify: _____)

13. If married, which of the following best describes spouse's employment:
___ Not employed outside the home ___ Employed, Part-time ___ Employed, Full-time

14. Number of dependent children (including step and/or foster children): ____

15. Please describe your short-term (less than 6 months) goals with respect to lifelong learning (e.g., no goals; meet licensure requirements; seek specific learning opportunities; etc.):

16. Please describe your long-term (more than 6 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; etc.)

17. What type(s) of services would you like to receive from a continuing education provider to better enable you to meet your lifelong learning needs:

Appendix F

Draft Engineering Survey Questionnaire

APPENDIX F -- Draft Engineering Survey Instrument

Survey of Barriers and Facilitators to Participation in Higher Education by Engineers In Industry

(Your identity will be kept confidential)

Purpose: This survey is designed to help determine what causes some engineers to participate while other engineers in "similar" circumstances do not participate in continuing professional education (CPE) through distance education. A further purpose is to determine the primary barriers and major facilitators to participation in distance higher education by working engineers in major U.S. industries and government agencies or laboratories.

LIFELONG LEARNING - - Lifelong learning (LLL) is described as a personal philosophy that recognizes that learning must continue throughout a professional's working lifetime. Learning involves participation in a variety of planned or deliberate learning endeavors such as degree programs, continuing professional education telecourses, seminars or workshops, pursuit of a hobby or reading for pleasure. This philosophy recognizes the importance of the individual in making learning decisions that involve the unique skills, motivations, goals, and learning preferences each person brings to their learning environment. In this context, a lifelong learner can be described as a person who is conscious of him/herself as a learner throughout life, sees new learning as the logical way to handle problems, is highly motivated to carry out learning, and welcomes the change and challenge of new learning opportunities.

Listed below are three statements dealing with lifelong learning. **Based on the LLL description above, please indicate by circling the appropriate number from the seven-point scale, how accurately each statement describes you.**

1	Strongly Disagree	5	Mildly Agree
2	Disagree	6	Agree
3	Mildly Disagree	7	Strongly Agree
4	Undecided		

1. I consider myself to be a lifelong learner.	1	2	3	4	5	6	7
2. I am able to identify goals in my pursuit of lifelong learning.	1	2	3	4	5	6	7
3. I am successful in achieving my lifelong learning goals.	1	2	3	4	5	6	7

LEARNING ACTIVITIES

This portion of the questionnaire is to determine the types of learning activities in which you regularly participate. **Please indicate your average amount of participation in each of these following areas during the past twelve months by circling the appropriate number using the following scale:**

0 - not at all	3 - at least once every three months	6 - at least once a week
1 - at least once a year	4 - at least once a month	7 - at least once every 2-3 days
2 - at least once every six months	5 - at least once every other week	8 - at least once a day

Learning Activities of Practicing Engineers

1. Read a journal, book or other reference source.	0	1	2	3	4	5	6	7	8
2. Use of a library for information.	0	1	2	3	4	5	6	7	8
3. Communicate with peers (colleague discussions; problem solving, etc.)	0	1	2	3	4	5	6	7	8
4. Attend professional organization meetings, such as committee or business meetings, but not continuing education related (local, state, national)	0	1	2	3	4	5	6	7	8
5. Contribute to a presentation or publication; give an in-service program.	0	1	2	3	4	5	6	7	8
6. Participate in continuing education programs (in-services, seminars, home study courses, teleconferences, etc.).	0	1	2	3	4	5	6	7	8

Please indicate your average amount of participation in each of these following areas during the past twelve months by circling the appropriate number using the following scale:

0 - not at all	**3 - at least once every three months**	**6 - at least once a week**
1 - at least once a year	**4 - at least once a month**	**7 - at least once every 2-3 days**
2 - at least once every six months	**5 - at least once every other week**	**8 - at least once a day**

Leisure Time Learning Activities (including hobby, religious, civic or recreational experiences)

1. Read a book or magazine for enjoyment	0	1	2	3	4	5	6	7	8
2. Read a book/magazine for personal improvement (self-help, hobby, leisure)	0	1	2	3	4	5	6	7	8
3. Use of a library for information	0	1	2	3	4	5	6	7	8
4. Attend civic/church organization meetings, including committees/business	0	1	2	3	4	5	6	7	8
5. Contribute to/give a presentation to groups on non-engineering topics	0	1	2	3	4	5	6	7	8
6. Peer or colleague discussions on non-engineering topics.	0	1	2	3	4	5	6	7	8
7. Learn through electronic media (educational TV, videos, radio, computers)	0	1	2	3	4	5	6	7	8
8. Participate in continuing education programs (non-credit/credit non-engineering related courses -- university, vocational-technical, other schools.)	0	1	2	3	4	5	6	7	8

BARRIERS TO LEARNING

Listed below are general factors which may serve as potential barriers to the learning process. **For each factor, please indicate by circling a number from the corresponding seven-point scale, the extent to which that factor might have served as a barrier to your participation in lifelong learning.**

1 Never		**5 Frequently**	
2 Almost Never	**4 Sometimes**	**6 Almost Always**	
3 Once in a While		**7 Always**	

1. Lack of confidence (e.g., fear of something new, doubts regarding ability to learn, perceived difficulty of learning encounter, etc.).	1	2	3	4	5	6	7
2. Lack of relevance of learning opportunities know to be available.	1	2	3	4	5	6	7
3. Job constraints (lack of relief help, time off, etc.).	1	2	3	4	5	6	7
4. Low personal priority of learning in relation to other activities.	1	2	3	4	5	6	7
5. Cost of participation in learning.	1	2	3	4	5	6	7
6. Family constraints (e.g., spouse, children, personal).	1	2	3	4	5	6	7
7. Negative experience with prior learning in relation to other activities.	1	2	3	4	5	6	7
8. Scheduling (location/distance/time) of group learning activities.	1	2	3	4	5	6	7
9. Negative experience with prior learning at the college level.	1	2	3	4	5	6	7
10. Lack of quality of learning activities.	1	2	3	4	5	6	7
11. Negative experience with prior learning within engineering CPE.	1	2	3	4	5	6	7
12. Professional burnout.	1	2	3	4	5	6	7
13. Lack of career advancement opportunities as a result of participating in learning activities.	1	2	3	4	5	6	7
14. Lack of learning opportunities to match your learning style.	1	2	3	4	5	6	7
15. Lack of recognition for participating in learning activities.	1	2	3	4	5	6	7
16. Lack of information about available learning opportunities.	1	2	3	4	5	6	7

FACILITATORS TO LEARNING

Listed below are general factors which may serve as potential facilitators to the learning process. For each factor, please indicate by circling a number from the corresponding scale, the extent to which that factor might have served as a facilitator to your participation in lifelong learning.

1	Never			5	Frequently			
2	Almost Never	4	Sometimes	6	Almost Always			
3	Once in a While			7	Always			

1. Personal desire to learn (e.g., intellectual curiosity).	1	2	3	4	5	6	7
2. Enjoyment/relaxation provided by learning as change of pace from the "routine."	1	2	3	4	5	6	7
3. Opportunity to meet/interact/exchange ideas with others.	1	2	3	4	5	6	7
4. Requirement for maintenance of professional licensure.	1	2	3	4	5	6	7
5. Encouragement through an external source (e.g., employer, professional organization).	1	2	3	4	5	6	7
6. Encouragement through family.	1	2	3	4	5	6	7
7. Opportunity to increase recognition from and ability to serve community.	1	2	3	4	5	6	7
8. Professional/career advancement with potential for financial reward.	1	2	3	4	5	6	7
9. Ease of access to learning opportunities.	1	2	3	4	5	6	7
10. Fear of obsolescence.	1	2	3	4	5	6	7
11. Affordable learning opportunities.	1	2	3	4	5	6	7
12. Assistance of a CE provider to offer advice/counseling relative to learning opportunities/issues/problems.	1	2	3	4	5	6	7

DEMOGRAPHIC INFORMATION

For each of the items listed below, please check the most appropriate response or provide information requested.

1. Sex: _____ male; ____ female
2. Age: _____
3. Which of the following engineering degrees have you earned (check all that apply.)?
   ___ BS ___ MS ___ Ph.D. ___ Doctor of Engineering; ___ Other earned degrees? (Explain)
   _____
4. Registered Professional Engineer? ____ Yes ____ No ____; EIT or IT? ____ Yes ____ N
5. Total years in engineering practice: _____
6. Years in current job position/status: _____
7. Total hours worked per week in engineering-related practice: _____
8. In which state do you currently practice engineering work? _____
9. Which one of the following best describes your engineering employment position?

   _____ Design engineer _____ Research engineer _____ Manufacturing engineer
   _____ Construction engineer _____ Computer engineer _____ Systems engineer
   _____ Maintenance engineer _____ Sanitation engineer _____ Environmental engineer
   _____ Safety Engineer _____ Industrial engineer _____ Electronic engineer
   _____ Other type of engineer (Explain) _____
   _____ Don't work in engineering (Explain) _____

DEMOGRAPHIC INFORMATION (Cont'd.)

10. Which one of the following best describes your employment setting?

____ Computer Mfg.	____ Appliance Mfg.	____ Government Research Lab
____ Aircraft Mfg.	____ Aerospace Mfg.	____ Private Research Lab
____ Trucking Mfg.	____ Semiconductor Mfg.	____ University Faculty/Adm.
____ Petrochemical Mfg.	____ Insurance Corporation	____ Aircraft Component Mfg.
____ Textile Mfg.	____ U.S. Dept of Defense	____ Non-Profit Association
____ Electronics Mfg.	____ U.S. Bureau of Mines	____ National Space Agency
____ Steel Mfg.	____ Communications Corp.	____ Defense/Aerospace Mfg.
____ Machinery Mfg.	____ Telecommunications	____ Shipping/Transportation
____ Aluminum Mfg.	____ U.S. Dept. of Energy	____ Other (Specify) _____

11. Marital Status: ___ Single ___ Married ___ Divorced ___ Separated ____ Widowed

12. If married, indicate the highest level of education attained by spouse:
___ H.S. ___ B.S. ___ B.A. ___ M.S. ___ Ph.D. ___ Ed.D. ___ Other (Explain) _____

13. If married, which of the following best describes spouse's employment: ____ Not employed outside the home; _____ Employed, Part Time; _____ Employed, Full Time.

14. No. of dependent children [including step and/or foster children]: _____

15. One-way distance to work _____ miles;

16. Average travel time to/from work ____ minutes.

17. Transportation method: ___ personal car; ___ car pool; ____ bus; ___ train.

18. Work hours: starting time _____ ; quitting time _____; meal time at work _____.

The following information relates to NTU academic programs. If you have ever been admitte to NTU, please fill out all applicable items. If you have never taken an NTU course, ski questions 19- 24.

19. NTU Status: Enrolled ___ yes ___ no; Considered Enrolling ___ yes ___ no;
NTU graduate ___ yes ___ no.

20. Date first enrolled at NTU _____ ;

21. Degree program title _____

22. Total NTU credit hours earned _____ hrs.

23. Cumulative GPA at NTU _____/4.00

24. Date of NTU degree _____ (Actual or expected date).

The following questions are related to your lifelong learning goals and the services you feel are needed to increase your degree of success at meeting those goals.

25. Please describe your short-term (less than 6 months) goals with respect to lifelong learning (e.g., no goals, meet licensure requirements; seek specific learning opportunities; etc.) _____

_____

_____

26. Please describe your long-term (more than 6 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification is a specialty; obtain advanced or additional degree, i.e. MBA; etc.) _____

_____

27. What type(s) of services would you like to receive from a continuing education provider to better enable you to meet your lifelong learning needs? _____

_____

Appendix G

Participant Survey Questionnaire, SA ___

SA _____

A Survey of Barriers and Facilitators To Participation In Higher Distance Education By Engineers In Industry

In Cooperation with

National Technological University -- NTU®

(Your identity will be kept strictly confidential)

Purpose -- *This survey was developed to determine the major barriers and facilitators to participation faced by engineers working on continuing professional education (CPE) through National Technological University's satellite delivery distance education degree program medium.*

This survey also seeks to discover factors that keep some engineers from participating in NTU distance learning while other engineers in "similar" circumstances participate. The types of changes engineers have experienced as a result of their CPE distance learning experiences are also of interest.

Please take 30-40 minutes to complete the survey, fold and mail it using the prepaid envelope. If you want to comment on questions or further qualify your answers, please use questionnaire margins or blank spaces. Your comments will be reviewed and included in the survey analysis.

Thanks for your help! *Future distance education students will benefit!*

Acknowledgment:

This survey instrument is patterned from the questionnaire developed for the National Survey of Pharmacists in July, 1989 by the Extension Services of Pharmacy, School of Pharmacy, University of Wisconsin, Madison. Their cooperation is greatly appreciated.

LIFELONG LEARNING: Engineers must participate in continuing professional education (CPE) throughout their working life to remain current. CPE includes a variety of planned technical learning actions such as advanced engineering degrees, seminars, workshops, conferences, consulting with experts, engineering telecourses and reading. Lifelong learners are motivated persons who welcome challenging learning opportunities and see continued learning as a logical way to solve problems. As lifelong learners, engineers make decisions involving their skills, motivations, goals, and learning preferences that affect their learning environment.

Listed below are three statements about lifelong learning. **Based on the lifelong learning description above, please indicate by circling the appropriate number from the four-point scale, how accurately each statement describes you.**

1 - Strongly Disagree 2 - Mildly Disagree 3 - Mildly Agree 4 - Strongly Agree

1. I consider myself to be a lifelong learner. 1 2 3 4
2. I have identified goals in my pursuit of lifelong learning. 1 2 3 4
3. I am successful in achieving some of my career learning goals. 1 2 3 4

LEARNING ACTIVITIES OF ENGINEERS

This section is to determine the types of learning activities in which you regularly participate. **Please indicate your average amount of participation in each of the following areas during the past twelve months by circling the appropriate number from the four-point scale:**

1 - Not at all **3 - At least once per month**
2 - At least once per year **4 - At least once per week**

4. Read an engineering journal, book or other technical materials. 1 2 3 4
5. Use Internet/WWW or reference library for information. 1 2 3 4
6. Communicate with peers/colleague in discussions; problem solving, etc. 1 2 3 4
7. Attend professional engineering meetings, such as local, state, national committee or business meetings, not continuing education related. 1 2 3 4
8. Contribute to a professional program, publication or training program. 1 2 3 4
9. Participate in continuing education programs (in-house training, seminars, credit or non-credit study courses, satellite teleconferences, etc.). 1 2 3 4

BARRIERS TO LIFELONG LEARNING BY ENGINEERS

Listed below are general factors which may be potential barriers to continued learning. **For each factor, indicate by circling a number from the following four-point scale, the extent to which that factor may have served as a barrier to your participation in lifelong learning.**

1 - Almost Never 2 - Occasionally 3 - Frequently 4 - Almost Always

10. Lack of confidence, time lapse since participation in formal studies 1 2 3 4
11. Lack of relevance of learning opportunities known to be available 1 2 3 4
12. Job constraints (lack of help, inadequate time off, work load pressures) 1 2 3 4
13. Work, social activities, family don't leave enough time for studying 1 2 3 4
14. Cost of participation in learning 1 2 3 4
15. Family constraints (e.g., spouse, children, personal) 1 2 3 4
16. Problems in scheduling desired courses (location/distance/time) 1 2 3 4
17. Lack of quality of available or desired courses 1 2 3 4
18. Negative prior learning experience in engineering continuing education 1 2 3 4
19. Professional burnout in job or career 1 2 3 4
20. Learning activities don't result in career advancement 1 2 3 4
21. Lack of learning opportunities that match my learning style 1 2 3 4
22. Lack of company recognition from participating in learning activities 1 2 3 4
23. Lack of information about available learning opportunities 1 2 3 4
24. Other barriers that you feel are important? (List all that apply)

_____

_____

_____

_____

FACILITATORS TO LIFELONG LEARNING BY ENGINEERS

Listed below are general factors which may serve as potential facilitators to the learning process. **For each factor, please indicate by circling a number from the following scale, the extent to which that factor may have served as a facilitator to your participation in lifelong learning.**

1 - Almost Never 2 - Occasionally 3 - Frequently 4 - Almost Always

25. Personal desire to learn, intellectual curiosity	1 2 3 4
26. Enjoyment/relaxation through learning -- change of pace from "routine"	1 2 3 4
27. Opportunity to meet/interact/exchange ideas with others	1 2 3 4
28. Requirement to maintain professional license or needed job skills	1 2 3 4
29. Encouragement through monetary support or reward by employer	1 2 3 4
30. Encouragement through family	1 2 3 4
31. Opportunity to increase recognition from and ability to serve society	1 2 3 4
32. Professional/career advancement with potential for financial reward	1 2 3 4
33. Ease of access to learning opportunities	1 2 3 4
34. Fear of obsolescence	1 2 3 4
35. Affordable learning opportunities	1 2 3 4
36. Corporate site coordinator assistance through advice/counseling relating to NTU learning opportunities/issues/problems	1 2 3 4

37. Other facilitators you feel are significant? (List all that apply) _____

_____

_____

ENGINEERING DISTANCE EDUCATION -- In distance education (DE), students receive formal instruction in locations physically removed from instructors who teach in classrooms on college campuses. In engineering DE, teaching and student feedback may be through satellite, microwave or fiber optic ground line telecourse or video tape ITV transmission, computer mediated communication (e-mail or computer conferencing), satellite video conference, direct telephone and facsimile.

BARRIERS TO DISTANCE EDUCATION AT NTU

The following section relates to engineering distance education at NTU. These questions includes factors which may have been barriers to your participation in distance CPE at NTU.

For each question, please circle a number from the following five point scale that indicates the extent to which each factor may have served as a barrier to your participation in NTU academic distance education programs. Underline or list your most important barrier.

1 - strongly disagree 2 - mildly disagree 3 - neutral /not applicable
4 - mildly agree 5 - strongly agree

38. Advising/counseling at local engineering college is better than NTU	1 2 3 4 5
39. Local engineering college degree ranked higher than NTU	1 2 3 4 5
40. Availability/time of NTU credit courses at worksite not satisfactory	1 2 3 4 5
41. NTU course-work conflicts with work schedule	1 2 3 4 5
42. NTU satellite course delivery doesn't match my learning style	1 2 3 4 5
43. Information from some courses not current when degree is received	1 2 3 4 5
44. NTU's academic standards and reputation are too low	1 2 3 4 5
45. Quality of some NTU instruction not satisfactory	1 2 3 4 5
46. Quality of NTU downlink site classroom facilities not satisfactory	1 2 3 4 5
47. NTU site coordinator did not provide support needed	1 2 3 4 5
48. Engineering peers don't recommend NTU academic programs	1 2 3 4 5
49. NTU does not have the degree options I'm interested in	1 2 3 4 5
50. NTU instructor counseling quality/accessibility not satisfactory	1 2 3 4 5
51. Quality of some NTU course materials was not satisfactory	1 2 3 4 5
52. NTU course feedback (homework return/evaluation) not satisfactory	1 2 3 4 5

53. List others barriers (**Please be specific**) _____

_____

FACILITATORS TO DISTANCE EDUCATION AT NTU

The following list includes factors which may have acted as facilitators to your participation in distance CPE at NTU.

For each question, please <u>circle a number</u> from the following five point scale that indicates the extent to which that factor may have served as a facilitator to your participation in NTU academic distance education programs. <u>Underline or list your most important facilitator.</u>

1 - strongly disagree 2 - mildly disagree 3 - neutral /not applicable
4 - mildly agree 5 - strongly agree

54. NTU courses allow flexibility in making up classes and homework 1 2 3 4 5
55. NTU courses taken partially on company time without makeup work 1 2 3 4 5
56. NTU course schedule better for me than local engineering college 1 2 3 4 5
57. Quality of instruction at NTU better than local engineering college 1 2 3 4 5
58. NTU's tuition and fees are lower than local engineering colleges 1 2 3 4 5

59. List additional factors that you feel would act as facilitators to enrollment at NTU (Be specific). _____

CPE LEARNING GOALS & RESULTING CHANGES

The following questions relate to how NTU programs helped you achieve your CPE learning goals, and what NTU services would further facilitate your success in meeting your goals. (Explain in detail)

60. Please describe your current short-term (< 12 months) goals with respect to lifelong learning (e.g., no goals, meet licensure requirements; seek specific learning opportunities; etc.) _____

_____

61. Please describe your current long-term (> 12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.) _____

_____

CPE LEARNING GOALS AND RESULTING CHANGES (Continued)

62. What major learning goals have you achieved as a result of your participation in academic courses at local colleges or distance education programs? **(Describe your educational programs)** _____

_____

63. What new services or changes in existing services at NTU might cause you to enroll at NTU to meet your lifelong learning CPE goals and needs? _____

_____

The following questions relate to professional and personal changes you feel have resulted from your participation in academic distance education programs.

64. What professional career/employment changes have resulted from your participation in academic courses or completion of a degree from a distance education program?

_____

_____

65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

_____

_____

DEMOGRAPHIC INFORMATION

For each of the items listed below, please check the most appropriate response or provide the information requested.

1. Sex: _____ male; ____ female 2. Age: _____ 3. No. dependents _____
4. Marital Status: __ Single; __ Married; __ Divorced; __ Separated; __ Widowed
5. Which of the following engineering degrees have you earned (check all that apply.)?
   ___ BS ___ MS ___ Ph.D. ___ Doctor of Engineering; ___ Other earned degrees?
   _____
6. Registered Professional Engineer? ___ Yes ___ No; EIT? ___ Yes ___ No

DEMOGRAPHIC INFORMATION (Continued)

7. Total years working in engineering: ____ 8. Total years in current job/position: ____

9. Which one of the following best describes your engineering job position?

____ Design engr.	____ Research engr.	____ Manufacturing engr.
____ Construction engr.	____ Computer engr.	____ Systems engr.
____ Maintenance engr.	____ Sanitation engr.	____ Environmental engr.
____ Safety engr.	____ Industrial engr.	____ Electronic engr.
____ Test engr.	____ Other type of engineer (Explain) _____	

_____

____ I don't work in engineering (Explain) _____

_____

10. Which **one** of the following **best describes** your employment setting?

____ Computer Mfg.	____ Appliance Mfg.	____ Gov't. Research Lab
____ Aircraft Mfg.	____ Aerospace Mfg.	____ Private Research Lab
____ Truck Mfg.	____ Semiconductor Mfg.	____ University Faculty/Adm.
____ Insurance Corp.	____ Petrochemical Mfg.	____ Aircraft Component Mfg.
____ Textile Mfg.	____ Dept of Defense	____ Non-Profit Association
____ Electronics Mfg.	____ Bureau of Mines	____ Shipping/Transportation
____ Metal Mfg.	____ Communications Co.	____ Defense/Aerospace Mfg.
____ Machinery Mfg.	____ Dept. of Energy	____ National Space Agency
____ Aluminum Mfg.	____ Other (Specify) _____	

11. One-way distance ____ (miles); average travel time ____ (minutes) to/from work.

12. Transport ation means: ___ car; ___ car pool; ___ bus; ___ train/subway; ___ taxi.

13. Work hours: starting time _____ ; quitting time _____; meal time at work _____

14. Distance from nearest engineering college _____ miles; _____ minutes

The following information relates to NTU academic programs. If you have ever been admitted to NTU, please fill out all applicable items.

15. Academic status at NTU - - I have: **enrolled** in courses ____ yes ____ no; been **admitted** to degree program ____ yes ____ no; **graduated** ____ yes ____ no.

16. Date first enrolled at NTU _____ ; 17. Total NTU credit hours earned _____

18. Degree program title _____

19. Date of NTU degree (Mo/Yr) _____ (Actual or expected date of graduation).

Thanks again for your valuable assistance

Appendix H

Non-Participant Survey Questionnaire, SB ___

SB ____

A Survey of Barriers and Facilitators To Participation In Higher Distance Education By Engineers In Industry

In Cooperation with

National Technological University -- NTU®

(Your identity will be kept strictly confidential)

Purpose -- *This survey was developed to determine the major barriers and facilitators to participation faced by engineers working on continuing professional education (CPE) through a distance education medium such as National Technological University's satellite delivery degree programs.*

This survey also seeks to discover factors that keep some engineers from participating in NTU distance learning while other engineers in "similar" circumstances participate. The types of changes engineers have experienced as a result of their CPE distance learning experiences are also of interest.

Please take 30-40 minutes to complete the survey, fold and mail it using the prepaid envelope. If you want to comment on questions or further qualify your answers, please use questionnaire margins or blank spaces. Your comments will be reviewed and included in the survey analysis.

Thanks for your help! *Future distance education students will benefit!*

Acknowledgment:

This survey instrument is patterned from the questionnaire developed for the National Survey of Pharmacists in July, 1989 by the Extension Services of Pharmacy, School of Pharmacy, University of Wisconsin, Madison. Their cooperation is greatly appreciated.

LIFELONG LEARNING: Engineers must participate in continuing professional education (CPE) throughout their working life to remain current. CPE includes a variety of planned technical learning actions such as advanced engineering degrees, seminars, workshops, conferences, consulting with experts, engineering telecourses and reading. Lifelong learners are motivated persons who welcome challenging learning opportunities and see continued learning as a logical way to solve problems. As lifelong learners, engineers make decisions involving their skills, motivations, goals, and learning preferences that affect their learning environment.

Listed below are three statements about lifelong learning. **Based on the lifelong learning description above, please indicate by circling the appropriate number from the four-point scale, how accurately each statement describes you.**

1 - Strongly Disagree 2 - Mildly Disagree 3 - Mildly Agree 4 - Strongly Agree

1. I consider myself to be a lifelong learner. 1 2 3 4
2. I have identified goals in my pursuit of lifelong learning. 1 2 3 4
3. I am successful in achieving some of my career learning goals. 1 2 3 4

LEARNING ACTIVITIES OF ENGINEERS

This section is to determine the types of learning activities in which you regularly participate. **Please indicate your average amount of participation in each of the following areas during the past twelve months by circling the appropriate number from the four-point scale:**

1 - Not at all
2 - At least once per year
3 - At least once per month
4 - At least once per week

4. Read an engineering journal, book or other technical materials. 1 2 3 4
5. Use Internet/WWW or reference library for information. 1 2 3 4
6. Communicate with peers/colleague in discussions; problem solving, etc. 1 2 3 4
7. Attend professional engineering meetings, such as local, state, national committee or business meetings, not continuing education related. 1 2 3 4
8. Contribute to a professional program, publication or training program. 1 2 3 4
9. Participate in continuing education programs (in-house training, seminars, credit or non-credit study courses, satellite teleconferences, etc.). 1 2 3 4

BARRIERS TO LIFELONG LEARNING BY ENGINEERS

Listed below are general factors which may be potential barriers to continued learning. **For each factor, indicate by circling a number from the following four-point scale, the extent to which that factor may have served as a barrier to your participation in lifelong learning.**

1 - Almost Never 2 - Occasionally 3 - Frequently 4 - Almost Always

10. Lack of confidence, time lapse since participation in formal studies 1 2 3 4
11. Lack of relevance of learning opportunities known to be available 1 2 3 4
12. Job constraints (lack of help, inadequate time off, work load pressures) 1 2 3 4
13. Work, social activities, family don't leave enough time for studying 1 2 3 4
14. Cost of participation in learning 1 2 3 4
15. Family constraints (e.g., spouse, children, personal) 1 2 3 4
16. Problems in scheduling desired courses (location/distance/time) 1 2 3 4
17. Lack of quality of available or desired courses 1 2 3 4
18. Negative prior learning experience in engineering continuing education 1 2 3 4
19. Professional burnout in job or career 1 2 3 4
20. Learning activities don't result in career advancement 1 2 3 4
21. Lack of learning opportunities that match my learning style 1 2 3 4
22. Lack of company recognition from participating in learning activities 1 2 3 4
23. Lack of information about available learning opportunities 1 2 3 4
24. Other barriers that you feel are important? (List all that apply)

_____

_____

_____

_____

FACILITATORS TO LIFELONG LEARNING BY ENGINEERS

Listed below are general factors which may serve as potential facilitators to the learning process. **For each factor, please indicate by circling a number from the following scale, the extent to which that factor may have served as a facilitator to your participation in lifelong learning.**

1 - Almost Never 2 - Occasionally 3 - Frequently 4 - Almost Always

25. Personal desire to learn, intellectual curiosity	1 2 3 4
26. Enjoyment/relaxation through learning -- change of pace from "routine"	1 2 3 4
27. Opportunity to meet/interact/exchange ideas with others	1 2 3 4
28. Requirement to maintain professional license or needed job skills	1 2 3 4
29. Encouragement through monetary support or reward by employer	1 2 3 4
30. Encouragement through family	1 2 3 4
31. Opportunity to increase recognition from and ability to serve society	1 2 3 4
32. Professional/career advancement with potential for financial reward	1 2 3 4
33. Ease of access to learning opportunities	1 2 3 4
34. Fear of obsolescence	1 2 3 4
35. Affordable learning opportunities	1 2 3 4
36. Corporate site coordinator assistance through advice/counseling relating to NTU learning opportunities/issues/problems	1 2 3 4

37. Other facilitators you feel are significant? (List all that apply) _____

_____

_____

ENGINEERING DISTANCE EDUCATION -- In distance education (DE), students receive formal instruction in locations physically removed from instructors who teach in classrooms on college campuses. In engineering DE, teaching and student feedback may be through satellite, microwave or fiber optic ground line telecourse or video tape ITV transmission, computer mediated communication (e-mail or computer conferencing), satellite video conference, direct telephone and facsimile.

BARRIERS TO DISTANCE EDUCATION AT NTU

The following section relates to engineering distance education at NTU. These questions includes factors which may have been barriers to your participation in distance CPE at NTU.

For each question, please circle a number from the following five point scale that indicates the extent to which each factor may have served as a barrier to your participation in NTU academic distance education programs. Underline or list your most important barrier.

1 - strongly disagree 2 - mildly disagree 3 - neutral /not applicable
4 - mildly agree 5 - strongly agree

38. Advising/counseling at local engineering college is better than NTU	1 2 3 4 5
39. Local engineering college degree ranked higher than NTU	1 2 3 4 5
40. Availability/time of NTU credit courses at worksite not satisfactory	1 2 3 4 5
41. NTU course-work conflicts with work schedule	1 2 3 4 5
42. NTU satellite course delivery doesn't match my learning style	1 2 3 4 5
43. Information from some courses not current when degree is received	1 2 3 4 5
44. NTU's academic standards and reputation are too low	1 2 3 4 5
45. Quality of some NTU instruction not satisfactory	1 2 3 4 5
46. Quality of NTU downlink site classroom facilities not satisfactory	1 2 3 4 5
47. NTU site coordinator did not provide support needed	1 2 3 4 5
48. Engineering peers don't recommend NTU academic programs	1 2 3 4 5
49. NTU does not have the degree options I'm interested in	1 2 3 4 5
50. NTU instructor counseling quality/accessibility not satisfactory	1 2 3 4 5
51. Quality of some NTU course materials was not satisfactory	1 2 3 4 5
52. NTU course feedback (homework return/evaluation) not satisfactory	1 2 3 4 5

53. List others barriers (**Please be specific**) _____

_____

FACILITATORS TO DISTANCE EDUCATION AT NTU

The following list includes factors which may have acted as facilitators to your participation in distance CPE at NTU. Consider facilitators that you feel may have encouraged you to enroll in NTU courses.

For each question, please circle a number from the following five point scale that indicates the extent to which that factor may have served as a facilitator to your participation in NTU academic distance education programs. Underline or list your most important facilitator.

1 - strongly disagree 2 - mildly disagree 3 - neutral /not applicable
4 - mildly agree 5 - strongly agree

54. NTU courses allow flexibility in making up classes and homework 1 2 3 4 5
55. NTU courses taken partially on company time without makeup work 1 2 3 4 5
56. NTU course schedule better for me than local engineering college 1 2 3 4 5
57. Quality of instruction at NTU better than local engineering college 1 2 3 4 5
58. NTU's tuition and fees are lower than local engineering colleges 1 2 3 4 5
59. List additional factors that you feel would act as facilitators to enrollment at NTU.

_____

CPE LEARNING GOALS AND RESULTING CHANGES

The following questions relate to your CPE learning goals, and what NTU programs and services might help facilitate your success in meeting your goals. (Explain in detail)

60. Please describe your current short-term (< 12 months) goals with respect to lifelong learning (e.g., no goals, meet licensure requirements; seek specific learning opportunities; etc.) _____

_____

61. Please describe your current long-term (> 12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.) _____

_____

CPE LEARNING GOALS AND RESULTING CHANGES (Continued)

62. What major learning goals have you achieved as a result of your participation in academic courses at local colleges or distance education programs? **(Describe your educational programs)** _____

_____

63. What new services or changes in existing services at NTU might cause you to enroll at NTU to meet your lifelong learning CPE goals and needs? _____

_____

The following questions relate to professional and personal changes you feel have resulted from your participation in academic distance education programs.

64. What professional career/employment changes have resulted from your participation in academic courses or completion of a degree from a distance education program?

_____

_____

65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

_____

_____

DEMOGRAPHIC INFORMATION

For each of the items listed below, please check the most appropriate response or provide the information requested.

1. Sex: _____ male; ____ female 2. Age: _____ 3. No. dependents _____
4. Marital Status: __ Single; __ Married; __ Divorced; __ Separated; __ Widowed
5. Which of the following engineering degrees have you earned (check all that apply.)?
   ___ BS ___ MS ___ Ph.D. ___ Doctor of Engineering; ___ Other earned degrees?
   _____
6. Registered Professional Engineer? ___ Yes ___ No; EIT? ___ Yes ___ No

DEMOGRAPHIC INFORMATION (Continued)

7. Total years working in engineering: ____ 8. Total years in current job/position: ____

9. Which one of the following best describes your engineering job position?

____ Design engr.	____ Research engr.	____ Manufacturing engr.
____ Construction engr.	____ Computer engr.	____ Systems engr.
____ Maintenance engr.	____ Sanitation engr.	____ Environmental engr.
____ Safety engr.	____ Industrial engr.	____ Electronic engr.
____ Test engr.	____ Other type of engineer (Explain) _____	

_____

____ I don't work in engineering (Explain) _____

_____

10. Which **one** of the following **best describes** your employment setting?

____ Computer Mfg.	____ Appliance Mfg.	____ Gov't. Research Lab
____ Aircraft Mfg.	____ Aerospace Mfg.	____ Private Research Lab
____ Truck Mfg.	____ Semiconductor Mfg.	____ University Faculty/Adm.
____ Insurance Corp.	____ Petrochemical Mfg.	____ Aircraft Component Mfg.
____ Textile Mfg.	____ Dept of Defense	____ Non-Profit Association
____ Electronics Mfg.	____ Bureau of Mines	____ Shipping/Transportation
____ Metal Mfg.	____ Communications Co.	____ Defense/Aerospace Mfg.
____ Machinery Mfg.	____ Dept. of Energy	____ National Space Agency
____ Aluminum Mfg.	____ Other (Specify) _____	

11. One-way distance ____ (miles); average travel time ____ (minutes) to/from work.

12. Transportation means: ___ car; ___ car pool; ___ bus; ___ train/subway; ___ taxi.

13. Work hours: starting time _____ ; quitting time _____; meal time at work _____

14. Distance from nearest engineering college _____ miles; _____ minutes

The following information relates to graduate programs. If you have enrolled in a graduate course or degree program, please fill out all applicable items.

15. Academic status - - I have: **enrolled** in courses ____ yes ____ no; been **admitted** to degree program ____ yes ____ no; **graduated** ____ yes ____ no.

16. Date first enrolled in graduate course _____ ; 17. Total credit hours earned _____

18. Degree program title _____

19. Date of degree (Mo/Yr) _____ (Actual or expected date of graduation).

Thanks again for your valuable assistance

Appendix I

Survey Cover Letters

Oklahoma State University

DIVISION OF AGRICULTURAL SCIENCES & NATURAL RESOURCES

Department of Biosystems and Agricultural Engineering
Stillwater, Oklahoma 74078-0497

January 2, 1997

_____
_____
_____

RE: Ph. D. Research Survey of Barriers and Facilitators to Participation at NTU

Dear Mr. _____;

I'm conducting a survey to determine the types of ***barriers to participation*** problems you've experienced while taking NTU distance education (DE) engineering courses. I also want to identify problem solutions -- ***facilitators to participation*** -- that you feel could help to improve NTU academic programs.

This survey is part of my Ph. D. dissertation research (my "final exam") -- returning the completed survey will be a major help to me in completing my degree in Higher Education (with minor in Distance Education) at the University of Oklahoma. Finishing the Ph. D. will help me in my work as an extension engineer on the OSU faculty.

Although some problems are common, you may have faced different barriers than those faced by other NTU engineers. I want to evaluate the constraints you faced and compare them to the spectrum of problems faced by other students. Problem solutions or facilitators you suggest could help resolve problems faced by other engineers. Combined input from you and your colleagues can help initiate changes and improvements in NTU's academic courses and support services program.

I use an identifying "**SA ___** " number on the survey cover to avoid sending reminder letters to those who have already returned their survey. If you would like to receive a summary from the study, **please circle the SA ____ number** at the top of the survey. We think the results will be very useful in improving engineering distance education.

Your response is very important to this study of engineering distance education at NTU. I would appreciate it if you would take 30-40 minutes **today** (or soon after) to complete the survey form and return it in the stamped self-addressed return envelope. I hope to receive your survey *in the next 7-10 days*. ***Your survey responses will be kept strictly confidential***. Thank you in advance for your help.

Sincerely yours

Ronald T. Noyes, P.E., Professor
Biosystems & Agricultural Engineering
Candidate for Ph. D., University of Oklahoma
NTU Research Study Coordinator

Enclosure

Oklahoma State University

DIVISION OF AGRICULTURAL SCIENCES & NATURAL RESOURCES

Department of Biosystems and Agricultural Engineering
Stillwater, Oklahoma 74078-0497

January 2, 1997

_____
_____
_____

RE: Ph. D. Research Survey of Barriers and Facilitators to Participation at NTU

Dear Mr. _____;

During the past year, NTU received an inquiry indicating your interest in NTU academic programs. Since you did not enroll, I am trying to determine the types of problems or *barriers to participation* you may have experienced that caused you not to enroll at NTU. I also want to identify problem solutions -- *facilitators to participation* -- that you feel could have influenced you to enroll in one of NTU's academic courses or degree programs.

This questionnaire is part of my Ph. D. dissertation (my "final exam"). Returning the completed survey will be a major help to me in completing my degree in Higher Education with Distance Education (DE) minor at the University of Oklahoma. Finishing the Ph. D. will also help me in my work as an extension engineer on the OSU faculty.

Although problems you experienced are unique, they may be similar to problems faced by other *engineers who inquired but did not enroll.* Restraints you experienced may be different than those faced by *engineers who enrolled at NTU.* We want to evaluate the full spectrum of problems and restraints faced by engineers. Problem solutions or facilitators you suggest could resolve problems faced by other engineers and may help initiate changes in NTU's academic program and support services.

I use an identifying "**SB ___** " number at the top of the survey cover to avoid sending reminder letters to those who have already returned their survey. If you would like to receive a summary of the study, please **circle the SB ___ number** at the top of the survey. We think the results will be very useful in improving engineering distance education.

Your response is very important to this study of engineering distance education at NTU. I would appreciate it if you would take 30-40 minutes **today** (or soon after) to complete the survey form and return it in the stamped self-addressed return envelope. I hope to receive your survey *in the next 7-10 days. **Your individual responses to this survey will be kept strictly confidential.*** Thank you in advance for your help.

Sincerely yours,

Ronald T. Noyes, P.E., Professor
Biosystems & Agricultural Engineering
Candidate for Ph. D., University of Oklahoma
NTU Research Study Coordinator

Enclosure

Oklahoma State University

DIVISION OF AGRICULTURAL SCIENCES & NATURAL RESOURCES

Department of Biosystems and Agricultural Engineering
Stillwater, Oklahoma 74078-0497

January 27, 1997

_____
_____
_____

RE: Ph. D. Research Survey of Barriers and Facilitators to Participation at NTU

Dear Mr. _____;

The NTU survey I sent you in early January may have caught you at a busy time, but I really do need your help. I'm an engineer and non-traditional distance education (DE) student trying to finish a Ph.D. in higher education with a DE minor. Since I started my Ph.D., I've driven 60,000 miles from Oklahoma State University (OSU) to the University of Oklahoma, and taken 75 credit hours while working full time -- some educators might say this is one form of "Distance Ed!"

I stopped midway through an engineering Ph. D. program while on Purdue University's faculty to develop an engineering department in a new manufacturing plant. For the next 17 years, I was Chief Engineer and Vice-President, Engineering for a grain dryer manufacturer. I joined OSU's agricultural engineering faculty in 1985. In 1988, I started a Ph. D. in higher education with a DE minor as a continuing professional education (CPE) program to support my extension agricultural engineering work at Oklahoma State University.

After an NTU study I conducted at OSU, Roy Matson, Academic Vice-President invited me to work on a DE dissertation research study at NTU. Engineering DE research is needed for two reasons. There is little engineering distance education data in higher education literature. The results of this study can help NTU and other providers improve engineering DE programs for you and other industry engineers who have limited access to engineering college courses.

Last summer, a Hewlett-Packard (H-P) engineer who helped me review my surveys asked to use my questionnaires with H-P engineers in California. H-P uses NTU and two other DE Centers, but participation is a problem. She said H-P needs current research information to determine why more of their engineers and technical managers don't pursue available DE academic programs for CPE. Like H-P, many corporations needed this type of research data.

As I said in my letter in early January, this survey is the focus of my Ph. D. dissertation research -- my "final exam". I need your completed survey form to strengthen my dissertation data base. *NTU and other U.S. engineering distance educators also need your survey data*. Your input can help initiate change and improvement in NTU's academic support services programs.

Your response is vitally important to this NTU study of engineering distance education. Please take 30-40 minutes **today,** complete the survey form and return it in the stamped return envelope. I hope to receive your completed survey in ***the next 7-10 days*** (or soon after). If you would like a copy of study summary results, **circle the SA ____ number** at the top of your survey cover sheet. ***Individual responses to this survey will be kept strictly confidential.***

Sincerely yours

Ronald T. Noyes, P.E., Professor
Biosystems & Agricultural Engineering
Candidate for Ph. D., University of Oklahoma
NTU Distance Education Study Coordinator

Oklahoma State University

DIVISION OF AGRICULTURAL SCIENCES & NATURAL RESOURCES

Department of Biosystems and Agricultural Engineering
Stillwater, Oklahoma 74078-0497

January 27, 1997

_____
_____
_____

RE: Ph. D. Research Survey of Barriers and Facilitators to Participation at NTU

Dear Mr. _____;

The NTU survey I sent you in early January may have caught you at a busy time, but I really do need your help. I'm an engineer and non-traditional distance education (DE) student trying to finish a Ph.D. in higher education with a DE minor. Since I started my Ph.D., I've driven 60,000 miles from Oklahoma State University (OSU) to the University of Oklahoma, and taken 75 credit hours while working full time -- some educators might say this is one form of "Distance Ed!"

I stopped midway through an engineering Ph. D. program while on Purdue University's faculty to develop an engineering department in a new manufacturing plant. For the next 17 years, I was Chief Engineer and Vice-President, Engineering for a grain dryer manufacturer. I joined OSU's agricultural engineering faculty in 1985. In 1988, I started a Ph. D. in higher education with a DE minor as a continuing professional education (CPE) program to support my extension agricultural engineering work at Oklahoma State University.

After an NTU study I conducted at OSU, Roy Matson, Academic Vice-President invited me to work on a DE dissertation research study at NTU. Engineering DE research is needed for two reasons. There is little engineering distance education data in higher education literature. The results of this study can help NTU and other providers improve engineering DE programs for you and other industry engineers who have limited access to engineering college courses. ***Your viewpoint is needed by NTU since you inquired about NTU's programs but didn't enroll***

Last summer, a Hewlett-Packard (H-P) engineer who helped me review my surveys asked to use my questionnaires with H-P engineers in California. H-P uses NTU and two other DE Centers, but participation is a problem. She said H-P needs current research information to determine why more of their engineers and technical managers don't pursue available DE academic programs for CPE. Like H-P, many corporations needed this type of research data.

As I said in my letter in early January, this survey is the focus of my Ph. D. dissertation research -- my "final exam". I need your completed survey form to strengthen my dissertation data base. *NTU and other U.S. engineering distance educators also need your survey data*. Your input can help initiate change and improvement in NTU's academic support services programs.

Your response is vitally important to this NTU study of engineering distance education. Please take 30-40 minutes **today,** complete the survey form and return it in the stamped return envelope. I hope to receive your completed survey in ***the next 7-10 days*** (or soon after). If you would like a copy of study summary results, **circle the SB ____ number** at the top of your survey cover sheet. ***Individual responses to this survey will be kept strictly confidential.***

Sincerely yours

Ronald T. Noyes, P.E., Professor
Biosystems & Agricultural Engineering
Candidate for Ph. D., University of Oklahoma
NTU Distance Education Study Coordinator

Appendix J

Discriminant Function Summary Tables

Table 1. Canonical Discriminant Functions, Group 1 & 4

DF Model Z_{14}

$$Z_{14} = 0.89\,Q56 + 0.43\,D2 + 0.41\,Q19 - 0.36\,Q44 + 0.32\,Q21 + 0.32\,D15 - 0.29\,Q10 - 0.25\,Q20 - 0.19\,Q39 - 0.16\,Q7 + 0.14\,Q6 + 0.09\,Q15 - 0.01\,Q42$$

DF	Eigenvalue	% Variance	Function Cumulative	Canonical Correlation	Wilk's lambda	Approx. F	Num D.F.	DEN D.F.	Prob >F
Z_{14}	0.6209	100.0	100.0	0.6189	0.6170	2.9611	13	62	0.0021

Group Means (Centroids)

Group	Group Centroid
1	0.4015
4	-1.5056

Group Classification Summary

	Analysis Sample (Resubstitution)			**Analysis Sample** (Cross-Validation)			**Validation Sample** (Classification of Hold-out)		
	Classified Into			Classified Into			Classified Into		
	1	4		1	4		1	4	
From 1	57	3	60	50	10	60	50	9	59
From 4	5	11	16	9	7	16	10	4	14
Total	62	14	76	59	17	76	60	13	73

Classification Accuracy (% group cases classified correctly); Hit Rate (HR)

Resubstitution

$$HR_{res} = \frac{57 + 11}{76} = \frac{68}{76} = 0.8947 = 89.5\%$$

Internal Cross-Validation

$$HR_{cv} = \frac{50 + 7}{76} = \frac{57}{76} = 0.7500 = 75.0\%$$

External Validation w/Holdout

$$HR_{ho} = \frac{50 + 4}{73} = \frac{54}{73} = 0.7397 = 74.0\%$$

Accuracy Compared to Chance Criterion

Compare to Priori chance criterion:

$C_{pro} = p^2 + (1-p)^2$

$= (0.7895)^2 + (0.2105)^2 =$

$= 0.6233 + 0.0443 = 0.6676 = 66.8\%$

Compare to Maximum chance criterion:

Group 1 membership has a proportion of 0.7895; all objects placed in this group would be classified correctly 79.0% of the time.

$HR_{res} = 89.5\%$

$HR_{cv} = 75.0\%$

$HR_{ho} = 74.0\%$

$C_{pro} = 66.8\%$

$Ch_{max} = 79.0\%$

Calculating Press's Q Evaluation for Significance

$$\text{Press's Q} = \text{to } X_{(1)}^2 = \frac{(N_t - 2N_c)^2}{N_t (DF-1)}$$

$$Q_{res} = \frac{(76 - 2(57+11))^2}{76(2-1)} = \frac{(76-136)^2}{76} = \frac{(-60)^2}{76} = \frac{(3600)}{76} = 47.37$$

Compared to critical value for alpha = 0.01 for 1 df.= 6.63, $Q_{res} = 47.37$ is significant.

$$Q_{cv} = \frac{(76 - 2(50+7))^2}{76(2-1)} = \frac{(76-114)^2}{76} = \frac{(-38)^2}{76} = \frac{(1444)}{76} = 19.0$$

Compared to critical value of alpha = 6.63, $Q_{cv} = 19.0$ is significant.

$$Q_{ho} = \frac{(73 - 2(50+4))^2}{73(2-1)} = \frac{(73-108)^2}{73} = \frac{(-35)^2}{73} = \frac{(1225)}{73} = 16.78$$

Compared to critical value of alpha = 6.63, $Q_{ho} = 16.78$ is significant.

Table 2. Canonical Discriminant Functions, Group 2 & 4

DF Model Z_{24}

$$Z_{24} = 0.90\,Q56 + 0.83\,Q5 - 0.62\,Q49 + 0.56\,D15 + 0.38\,Q52 + 0.37\,Q13 - 0.36\,Q40 - 0.34\,Q8 + 0.24\,Q7 - 0.16\,Q35 - 0.10\,Q39 - 0.07\,Q50$$

DF	Eigenvalue	% Variance		Canonical Correlation	Wilk's lambda	Approx. F	Num D.F.	DEN D.F.	Prob >F
		Function	Cumulative						
Z_{24}	1.7360	100.0	100.0	0.7966	0.3655	5.7866	12	40	0.0001

Group Means (Centroids)

Group	Group Centroid
2	0.9269
4	-1.8023

Group Classification Summary

	Analysis Sample (Resubstitution) Classified Into			**Analysis Sample** (Cross-Validation) Classified Into			**Validation Sample** (Classification of Hold-out) Classified Into		
	2	4		2	4		2	4	
From 2	33	2	35	31	4	35	27	9	36
From 4	3	15	18	3	15	18	5	12	17
Total	36	17	53	34	19	53	32	21	53

Classification Accuracy (% group cases classified correctly); Hit Rate (HR)

Resubstitution	Internal Cross-Validation	External Validation w/Holdout
$HR_{res} = \frac{33+15}{53} = \frac{48}{53} =$	$HR_{cv} = \frac{31+15}{53} = \frac{46}{53}$	$HR_{ho} = \frac{27+12}{53} = \frac{39}{53}$
$= 0.9057 = 90.6\%$	$= 0.8679 = 86.8\%$	$= 0.7358 = 73.6\%$

Accuracy Compared to Chance Criterion

Compare to Priori chance criterion:

$C_{pro} = p^2 + (1-p)^2$

$= (0.6604)^2 + (0.3396)^2 =$

$= 0.4361 + 0.1153 = 0.5514$

$= 55.1\%$

Compare to Maximum chance criterion:

Group 2 membership has a proportion of 0.6604; all objects placed in this group would be classified correctly 66.0% of the time.

$HR_{res} = 90.6\%$

$HR_{cv} = 86.8\%$

$HR_{ho} = 73.6\%$

$C_{pro} = 55.1\%$

$Ch_{max} = 66.0\%$

Calculating Press's Q Evaluation for Significance

Press's Q = to $X_{(1)}^2 = \dfrac{(N_t - 2N_C)^2}{N_t(DF-1)}$

$Q_{res} = \dfrac{(53 - 2(33+15))^2}{53(2-1)} = \dfrac{(53-96)^2}{53} = \dfrac{(-43)^2}{53} = \dfrac{(1849)}{53} = 34.89$

Compared to critical value for alpha = 0.01 for 1 df.= 6.63, $Q_{res} = 34.89$ is significant.

$Q_{cv} = \dfrac{(53 - 2(31+15))^2}{53(2-1)} = \dfrac{(53-92)^2}{53} = \dfrac{(-39)^2}{53} = \dfrac{(1521)}{53} = 28.70$

Compared to critical value of alpha = 6.63, $Q_{cv} = 28.70$ is significant.

$Q_{ho} = \dfrac{(53 - 2(27+12))^2}{53(2-1)} = \dfrac{(53-78)^2}{53} = \dfrac{(-25)^2}{53} = \dfrac{(625)}{53} = 11.79$

Compared to critical value of alpha = 6.63, $Q_{ho} = 11.79$ is significant.

Table 3. Canonical Discriminant Functions, Group 3 & 4

DF Model Z_{34}

Z_{34} = + 1.21 Q56 +0.94 Q50 + 0.90 Q52 + 0.79 Q54 - 0.69 Q19 + 0.57 Q55 - 0.52 Q51 - 0.51 Q39 - 0.43 D12 - 0.42 Q26 + 0.42 Q35 + 0.38 Q18 + 0.31 D15 + 0.27 Q40 + 0.26 Q1 + 0.26 Q21+ 0.25 Q9 - 0.23 Q45 - 0.21 Q25 - 0.16 Q28 - 0.15 Q11

DF	Eigenvalue	% Variance		Canonical Correlation	Wilk's lambda	Approx. F	Num D.F.	DEN D.F.	Prob >F
		Function	Cumulative						
Z_{34}	2.5578	100.0	100.0	0.8479	0.2811	3.6541	21	30	0.0006

Group Means (Centroids)

Group	Group Centroid
3	- 1.0930
4	2.2502

Group Classification Summary

	Analysis Sample (Resubstitution)			**Analysis Sample** (Cross-Validation)			**Validation Sample** (Classification of Hold-out)		
	Classified Into			Classified Into			Classified Into		
	3	4		3	4		3	4	
3	34	1	35	27	8	35	21	12	33
From 4	1	16	17	5	12	17	3	12	15
Total	35	17	52	32	20	52	24	24	48

Classification Accuracy (% group cases classified correctly); Hit Rate (HR)

Resubstitution	Internal Cross-Validation	External Validation w/Holdout
$HR_{res} = \frac{34 + 16}{52} = \frac{50}{52} =$	$HR_{cv} = \frac{27 + 12}{52} = \frac{39}{52}$	$HR_{ho} = \frac{21 + 12}{48} = \frac{33}{48}$
$= 0.9615 = 96.1\%$	$= 0.7500 = 75.0\%$	$= 0.6875 = 68.8\%$

Accuracy Compared to Chance Criterion

Compare to Priori chance criterion:

$C_{pro} = p^2 + (1-p)^2$

$= (0.6731)^2 + (0.3269)^2 =$

$= 0.4531 + 0.1069 = 0.560 = 56.0\%$

Compare to Maximum chance criterion:

Group 3 membership has a proportion of 0.6731; all objects placed in this group would be classified correctly 67.3% of the time.

$HR_{res} = 96.1\%$

$HR_{cv} = 75.0\%$

$HR_{ho} = 68.8\%$

$C_{pro} = 56.0\%$

$Ch_{max} = 67.3\%$

Calculating Press's Q Evaluation for Significance

Press's Q = to $X_{(1)}^2 = \dfrac{(N_t - 2N_c)^2}{N_t (DF-1)}$

$$Q_{res} = \frac{(52 - 2(34+16))^2}{52(2-1)} = \frac{(52-100)^2}{52} = \frac{(-48)^2}{52} = \frac{(2304)}{52} = 44.31$$

Compared to critical value for alpha = 0.01 for 1 df.= 6.63, $Q_{res} = 44.31$ is significant.

$$Q_{cv} = \frac{(52 - 2(27+12))^2}{52(2-1)} = \frac{(52-78)^2}{52} = \frac{(-26)^2}{52} = \frac{(676)}{52} = 13.0$$

Compared to critical value of alpha = 6.63, $Q_{cv} = 13.0$ is significant.

$$Q_{ho} = \frac{(48 - 2(21+12))^2}{48(2-1)} = \frac{(48-66)^2}{48} = \frac{(-18)^2}{48} = \frac{(324)}{48} = 6.75$$

Compared to critical value of alpha = 6.63, $Q_{ho} = 6.75$ is significant.

Table 4. Canonical Discriminant Functions, Group 234

DF Model Z_{234}

$$Z_{234} = -0.62\,Q56 - 0.45\,Q54 - 0.43\,D15 + 0.42\,Q49 + 0.31\,D12 - 0.29\,Q23 + 0.28\,Q16 + 0.13\,Q26 + 0.05\,Q47 + 0.04\,Q40 + 0.03\,Q27$$

DF	Eigenvalue	% Variance		Canonical Correlation	Wilk's lambda	Approx. F	Num D.F.	DEN D.F.	Prob >F
		Function	Cumulative						
Z_{234}	0.4837	100.0	100.0	0.5710	0.6740	3.2537	11	74	0.0011

Group Means (Centroids)

Group	Group Centroid
23	- 0.3412
4	1.3847

Group Classification Summary

	Analysis Sample (Resubstitution)			**Analysis Sample** (Cross-Validation)			**Validation Sample** (Classification of Hold-out)		
	Classified Into			Classified Into			Classified Into		
	23	4		23	4		23	4	
23	67	2	69	62	7	69	63	8	71
From 4	6	11	17	10	7	17	8	8	16
Total	73	13	86	72	14	86	71	16	87

Classification Accuracy (% group cases classified correctly); Hit Rate (HR)

Resubstitution: $HR_{res} = \frac{67 + 11}{86} = \frac{78}{86} = 0.9070 = 90.7\%$

Internal Cross-Validation: $HR_{cv} = \frac{62 + 7}{86} = \frac{69}{86} = 0.8023 = 80.2\%$

External Validation w/Holdout: $HR_{ho} = \frac{63 + 8}{87} = \frac{71}{87} = 0.8161 = 81.6\%$

Accuracy Compared to Chance Criterion

Compare to Priori chance criterion:

$C_{pro} = p^2 + (1-p)^2$

$= (0.8023)^2 + (0.1977)^2 =$

$= 0.6437 + 0.0391 = 0.6828$

$= 68.3\%$

Compare to Maximum chance criterion:

Group 23 membership has a proportion of 0.8023; all objects placed in this group would be classified correctly 80.2% of the time.

$HR_{res} = 90.7\%$

$HR_{cv} = 80.2\%$

$HR_{ho} = 81.6\%$

$C_{pro} = 68.3\%$

$Ch_{max} = 80.2\%$

Calculating Press's Q Evaluation for Significance

$$\text{Press's Q} = \text{to } X_{(1)}^2 = \frac{(N_t - 2N_c)^2}{N_t (DF-1)}$$

$$Q_{res} = \frac{(86 - 2(67+11))^2}{86(2-1)} = \frac{(86-156)^2}{86} = \frac{(-70)^2}{86} = \frac{(4900)}{86} = 57.0$$

Compared to critical value for alpha = 0.01 for 1 df.= 6.63, $Q_{res} = 57.0$ is significant.

$$Q_{cv} = \frac{(86 - 2(62+7))^2}{86(2-1)} = \frac{(86-138)^2}{86} = \frac{(-52)^2}{86} = \frac{(2704)}{86} = 31.44$$

Compared to critical value of alpha = 6.63, $Q_{cv} = 31.44$ is significant.

$$Q_{ho} = \frac{(87 - 2(63+8))^2}{87(2-1)} = \frac{(87-142)^2}{87} = \frac{(-55)^2}{87} = \frac{(3025)}{87} = 34.77$$

Compared to critical value of alpha = 6.63, $Q_{ho} = 34.77$ is significant.

Table 5. Canonical Discriminant Functions, Group 234T

DF Model Z_{234T}

$$Z_{234T} = +0.71\ Q56 + 0.48\ D15 + 0.47\ Q54 - 0.47\ Q49 + 0.46\ Q55 + 0.40\ Q52 - 0.31\ Q58 - 0.25\ D5 - 0.22\ Q26 + 0.22\ Q5 - 0.18\ D12$$

$$Z_{234T} = +0.65\ Q56 - 0.48\ Q49 + 0.47\ Q55 + 0.46\ Q54 + 0.43\ Q52 + 0.38\ D15 - 0.29\ Q58 - 0.29\ D5 - 0.28\ Q26 - 0.24\ D13 + 0.21\ Q5$$

DF	Eigenvalue	% Variance	Function Cumulative	Canonical Correlation	Wilk's lambda	Approx. F	Num D.F.	DEN D.F.	Prob >F
Z_{234T}	0.6969	100.0	100.0	0.6408	0.5893	4.75917	11	75	0.0001

Group Means (Centroids)

Group	Group Centroid
23	-1.6744
4	0.4066

Group Classification Summary

		Analysis Sample (Resubstitution) Classified Into			**Analysis Sample** (Cross-Validation) Classified Into			**Validation Sample** (Classification of Hold-out) Classified Into		
		23	4		23	4		23	4	
From	23	66	4	70	63	7	70	61	9	70
	4	6	11	17	7	10	17	6	8	14
Total		72	15	87	70	17	87	67	17	84

Classification Accuracy (% group cases classified correctly); Hit Rate (HR)

Resubstitution	Internal Cross-Validation	External Validation w/Holdout
$HR_{res} = \frac{66 + 11}{87} = \frac{77}{87}$	$HR_{cv} = \frac{63 + 10}{87} = \frac{73}{87}$	$HR_{ho} = \frac{61 + 8}{84} = \frac{69}{84}$
$= 0.8850 = 88.5\%$	$= 0.8391 = 83.9\%$	$= 0.8214 = 82.1\%$

Accuracy Compared to Chance Criterion

Compare to Priori chance criterion:

$C_{pro} = p^2 + (1-p)^2$

$= (0.8046)^2 + (0.1954)^2 =$

$= 0.6474 + 0.0382 = 0.6856$

$= 68.6\%$

Compare to Maximum chance criterion:

Group 23 membership has a proportion of 0.8046; all objects placed in this group would be classified correctly 80.4% of the time.

$HR_{res} = 88.5\%$

$HR_{cv} = 83.9\%$

$HR_{ho} = 82.1\%$

$C_{pro} = 68.6\%$

$Ch_{max} = 80.4\%$

Calculating Press's Q Evaluation for Significance

Press's Q = to $X_{(1)}^2 = \dfrac{(N_t - 2N_c)^2}{N_t (DF-1)}$

$Q_{res} = \dfrac{(87 - 2(66+11))^2}{87(2-1)} = \dfrac{(87-154)^2}{87} = \dfrac{(-67)^2}{87} = \dfrac{(4489)}{87} = 51.60$

Compared to critical value for alpha = 0.01 for 1 df.= 6.63, $Q_{res} = 51.60$ is significant.

$Q_{cv} = \dfrac{(87 - 2(63+10))^2}{87(2-1)} = \dfrac{(87-146)^2}{87} = \dfrac{(-59)^2}{87} = \dfrac{(3481)}{87} = 40.01$

Compared to critical value of alpha = 6.63, $Q_{cv} = 40.01$ is significant.

$Q_{ho} = \dfrac{(84 - 2(61+8))^2}{84(2-1)} = \dfrac{(84-138)^2}{84} = \dfrac{(-54)^2}{84} = \dfrac{(2916)}{84} = 34.71$

Compared to critical value of alpha = 6.63, $Q_{ho} = 34.71$ is significant.

Appendix K

Raw Data Responses to Quantitative Questions

Summary Statistics

Variable	N	Mean	Std Dev	Minimum	Maximum
NO	320	544.5187500	244.7564965	101.0000000	1019.00
G	320	2.0750000	1.0743519	1.0000000	4.0000000
Q1	316	3.6582278	0.6500027	1.0000000	4.0000000
Q2	316	3.1645570	0.7203241	1.0000000	4.0000000
Q3	315	3.3301587	0.6764075	1.0000000	4.0000000
Q4	318	3.2327044	0.7382729	1.0000000	4.0000000
Q5	318	3.3333333	0.8267352	1.0000000	4.0000000
Q6	318	3.6603774	0.5978952	1.0000000	4.0000000
Q7	318	1.6855346	0.6891531	1.0000000	4.0000000
Q8	318	1.5440252	0.7595525	1.0000000	4.0000000
Q9	318	2.4842767	0.8798863	1.0000000	4.0000000
Q10	320	1.5031250	0.6948013	1.0000000	4.0000000
Q11	320	1.8812500	0.7788093	1.0000000	4.0000000
Q12	320	2.6750000	0.8926731	1.0000000	4.0000000
Q13	320	2.7250000	0.8186693	1.0000000	4.0000000
Q14	320	1.8125000	0.9514055	1.0000000	4.0000000
Q15	320	2.4437500	0.9550846	1.0000000	4.0000000
Q16	319	2.0752351	0.8433878	1.0000000	4.0000000
Q17	320	1.8656250	0.8327578	1.0000000	4.0000000
Q18	320	1.3187500	0.6120204	1.0000000	4.0000000
Q19	319	1.6081505	0.7648299	1.0000000	4.0000000
Q20	320	2.0937500	0.9781107	1.0000000	4.0000000
Q21	320	1.5843750	0.7505941	1.0000000	4.0000000
Q22	320	2.0218750	1.0546908	1.0000000	4.0000000
Q23	320	1.7281250	0.7825424	1.0000000	4.0000000
Q25	319	3.6206897	0.5582527	1.0000000	4.0000000
Q26	319	2.4764890	0.8679725	1.0000000	4.0000000
Q27	319	2.3605016	0.8858466	1.0000000	5.0000000
Q28	319	2.0000000	0.9450300	1.0000000	4.0000000
Q29	319	1.9059561	1.0832903	1.0000000	4.0000000
Q30	319	2.1191223	0.9671871	1.0000000	4.0000000
Q31	318	1.9402516	0.9396032	1.0000000	4.0000000
Q32	318	2.4088050	0.9611628	1.0000000	4.0000000
Q33	318	2.8050314	0.9019991	1.0000000	4.0000000
Q34	318	2.5000000	0.9389907	1.0000000	4.0000000
Q35	317	2.7381703	0.9196658	1.0000000	4.0000000
Q36	308	1.9383117	0.9615201	1.0000000	4.0000000
Q38	320	2.8281250	1.0317026	1.0000000	5.0000000
Q39	320	3.0500000	1.2024009	1.0000000	5.0000000
Q40	320	2.1937500	1.2418859	1.0000000	5.0000000
Q41	320	2.4500000	1.2855600	1.0000000	5.0000000
Q42	320	2.0031250	1.0637912	1.0000000	5.0000000
Q43	320	2.2812500	1.0150706	1.0000000	5.0000000
Q44	320	2.3687500	1.0659852	1.0000000	5.0000000
Q45	320	2.4781250	1.1279394	1.0000000	5.0000000

Summary Statistics

Variable	N	Mean	Std Dev	Minimum	Maximum
Q46	320	2.4187500	1.0709728	1.0000000	5.0000000
Q47	320	2.2156250	1.1530549	1.0000000	5.0000000
Q48	320	2.4250000	1.0537290	1.0000000	5.0000000
Q49	320	2.2093750	1.1889932	1.0000000	5.0000000
Q50	320	2.6718750	1.1233443	1.0000000	5.0000000
Q51	320	2.4531250	1.0434102	1.0000000	5.0000000
Q52	318	2.6949686	1.1529854	1.0000000	5.0000000
Q54	320	4.1687500	1.0724353	1.0000000	5.0000000
Q55	320	3.0937500	1.2683605	1.0000000	5.0000000
Q56	320	4.0218750	1.1648548	1.0000000	5.0000000
Q57	320	3.3281250	0.9106594	1.0000000	5.0000000
Q58	320	2.3062500	1.0914135	1.0000000	5.0000000
D1	315	1.2063492	0.4053280	1.0000000	2.0000000
D2	302	36.9569536	7.6084497	21.0000000	62.0000000
D3	312	1.6250000	1.5746433	0	9.0000000
D4	313	1.9137380	0.4892135	1.0000000	5.0000000
D5	315	2.3015873	1.2947090	1.0000000	6.0000000
D6	315	3.5650794	0.9159171	0	4.0000000
D7	315	11.5174603	7.5123368	0	40.0000000
D8	315	5.2634921	5.1112247	0	28.0000000
D9	317	8.6151420	5.0287299	1.0000000	15.0000000
D10	316	13.5348101	8.4482772	1.0000000	26.0000000
D11	311	15.5080386	13.2158543	0	105.0000000
D12	311	25.4340836	15.8851116	0	100.0000000
D13	314	1.2356688	1.1971218	0	15.0000000
D14	303	27.0247525	31.4150576	0	200.0000000
D15	302	39.9403974	42.1473025	0	480.0000000
D16	307	1.2149837	2.3679581	1.0000000	40.0000000
D17	305	1.2655738	0.4497387	1.0000000	3.0000000
D18	305	1.5278689	0.5065788	1.0000000	3.0000000
D19	272	90.6691176	8.7579633	1.0000000	97.0000000
D20	246	23.4024390	16.7374880	0	95.0000000
D21	203	216.6699507	467.9216576	9.0000000	2002.00
PARTIC	320	0.8687500	0.3382024	0	1.0000000

Summary Statistics

---------- G=1 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
NO	131	492.1755725	226.7797807	301.0000000	1019.00
Q1	129	3.6666667	0.6166104	1.0000000	4.0000000
Q2	130	3.1538462	0.7518611	1.0000000	4.0000000
Q3	129	3.5116279	0.6264518	1.0000000	4.0000000
Q4	131	3.1908397	0.8238232	1.0000000	4.0000000
Q5	131	3.3893130	0.8092971	1.0000000	4.0000000
Q6	131	3.7404580	0.5051700	2.0000000	4.0000000
Q7	131	1.5954198	0.6418558	1.0000000	4.0000000
Q8	131	1.5419847	0.7153218	1.0000000	4.0000000
Q9	131	2.2519084	0.7268849	1.0000000	4.0000000
Q10	131	1.4580153	0.7365151	1.0000000	4.0000000
Q11	131	1.9160305	0.8231101	1.0000000	4.0000000
Q12	131	2.6641221	0.8910727	1.0000000	4.0000000
Q13	131	2.7022901	0.8198936	1.0000000	4.0000000
Q14	131	1.7557252	0.9534682	1.0000000	4.0000000
Q15	131	2.4885496	0.9312226	1.0000000	4.0000000
Q16	131	2.0152672	0.8319091	1.0000000	4.0000000
Q17	131	1.8778626	0.8414539	1.0000000	4.0000000
Q18	131	1.2671756	0.5794484	1.0000000	4.0000000
Q19	130	1.6153846	0.8010131	1.0000000	4.0000000
Q20	131	2.1908397	1.0161352	1.0000000	4.0000000
Q21	131	1.5572519	0.6811789	1.0000000	3.0000000
Q22	131	2.1603053	1.1011658	1.0000000	4.0000000
Q23	131	1.7175573	0.7261575	1.0000000	4.0000000
Q25	130	3.6307692	0.5724754	2.0000000	4.0000000
Q26	130	2.5615385	0.8716361	1.0000000	4.0000000
Q27	130	2.4307692	0.9477715	1.0000000	5.0000000
Q28	130	1.9307692	0.9080899	1.0000000	4.0000000
Q29	130	1.7615385	1.0100568	1.0000000	4.0000000
Q30	130	2.0769231	0.9451253	1.0000000	4.0000000
Q31	130	1.7846154	0.9316537	1.0000000	4.0000000
Q32	130	2.2692308	0.9465438	1.0000000	4.0000000
Q33	130	2.8384615	0.8608977	1.0000000	4.0000000
Q34	130	2.5692308	0.9144699	1.0000000	4.0000000
Q35	130	2.6538462	0.8953934	1.0000000	4.0000000
Q36	127	1.9055118	0.9464476	1.0000000	4.0000000
Q38	131	2.7480916	1.0978546	1.0000000	5.0000000
Q39	131	3.0229008	1.2616573	1.0000000	5.0000000
Q40	131	1.9083969	1.2181347	1.0000000	5.0000000
Q41	131	2.1755725	1.2799093	1.0000000	5.0000000
Q42	131	1.6717557	0.9151944	1.0000000	5.0000000
Q43	131	2.1832061	1.1489228	1.0000000	5.0000000

Summary Statistics

G=1

Variable	N	Mean	Std Dev	Minimum	Maximum
Q44	131	2.1832061	1.0940505	1.0000000	5.0000000
Q45	131	2.3282443	1.2117549	1.0000000	5.0000000
Q46	131	2.2900763	1.1265232	1.0000000	5.0000000
Q47	131	2.0687023	1.1581872	1.0000000	5.0000000
Q48	131	2.4351145	1.1374684	1.0000000	5.0000000
Q49	131	2.0839695	1.1769463	1.0000000	5.0000000
Q50	131	2.5114504	1.2049029	1.0000000	5.0000000
Q51	131	2.3435115	1.1008458	1.0000000	5.0000000
Q52	129	2.4031008	1.2088177	1.0000000	5.0000000
Q54	131	4.4580153	1.0096423	1.0000000	5.0000000
Q55	131	3.1755725	1.3670908	1.0000000	5.0000000
Q56	131	4.2519084	1.2174596	1.0000000	5.0000000
Q57	131	3.5114504	0.9475995	1.0000000	5.0000000
Q58	131	2.2977099	1.0647835	1.0000000	5.0000000
D1	130	1.1923077	0.3956381	1.0000000	2.0000000
D2	126	39.5873016	7.0781578	27.0000000	62.0000000
D3	129	1.9302326	1.6065590	0	8.0000000
D4	129	1.9457364	0.2880451	1.0000000	3.0000000
D5	131	2.6717557	0.5743591	1.0000000	4.0000000
D6	130	3.6230769	0.8377284	1.0000000	4.0000000
D7	131	14.4503817	6.8446652	0	34.0000000
D8	131	5.3282443	5.6737489	0	28.0000000
D9	131	8.7251908	4.7878909	1.0000000	15.0000000
D10	131	12.8244275	9.0063917	1.0000000	26.0000000
D11	129	15.8759690	14.4644001	0	105.0000000
D12	129	25.5581395	15.8720012	0	100.0000000
D13	130	1.1461538	0.8269824	0	7.0000000
D14	124	24.8669355	25.8403564	0.5000000	125.0000000
D15	125	41.2320000	49.9417622	5.0000000	480.0000000
D16	131	1.0152672	0.1230843	1.0000000	2.0000000
D17	131	1.0152672	0.1230843	1.0000000	2.0000000
D18	131	1.0076336	0.0873704	1.0000000	2.0000000
D19	125	89.3360000	2.6879180	83.0000000	93.0000000
D20	103	33.1067961	6.9379782	18.0000000	70.0000000
D21	130	93.3923077	2.4824849	86.0000000	97.0000000
PARTIC	131	1.0000000	0	1.0000000	1.0000000

Summary Statistics

---------- G=2 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
NO	76	613.0000000	75.5911811	503.0000000	907.0000000
Q1	76	3.6184211	0.6317617	1.0000000	4.0000000
Q2	76	3.2105263	0.6390783	1.0000000	4.0000000
Q3	76	3.3289474	0.6809436	1.0000000	4.0000000
Q4	76	3.2894737	0.6696425	2.0000000	4.0000000
Q5	76	3.2763158	0.9033078	1.0000000	4.0000000
Q6	76	3.6052632	0.6341177	1.0000000	4.0000000
Q7	76	1.7236842	0.7411466	1.0000000	4.0000000
Q8	76	1.4736842	0.6627958	1.0000000	4.0000000
Q9	76	2.8289474	0.9435841	1.0000000	4.0000000
Q10	76	1.5394737	0.6416809	1.0000000	4.0000000
Q11	76	1.8289474	0.7190393	1.0000000	3.0000000
Q12	76	2.5921053	0.8668353	1.0000000	4.0000000
Q13	76	2.7236842	0.7229326	1.0000000	4.0000000
Q14	76	1.8289474	0.9435841	1.0000000	4.0000000
Q15	76	2.3815789	0.9087296	1.0000000	4.0000000
Q16	76	2.0657895	0.8380219	1.0000000	4.0000000
Q17	76	1.8552632	0.7780993	1.0000000	4.0000000
Q18	76	1.3552632	0.5586638	1.0000000	3.0000000
Q19	76	1.5657895	0.6799123	1.0000000	3.0000000
Q20	76	1.9210526	0.8757954	1.0000000	4.0000000
Q21	76	1.5921053	0.8029551	1.0000000	4.0000000
Q22	76	1.8815789	0.9517297	1.0000000	4.0000000
Q23	76	1.8289474	0.8388589	1.0000000	4.0000000
Q25	76	3.5789474	0.6167259	1.0000000	4.0000000
Q26	76	2.1447368	0.8438633	1.0000000	4.0000000
Q27	76	2.1184211	0.8159592	1.0000000	4.0000000
Q28	76	2.0263158	1.0704975	1.0000000	4.0000000
Q29	76	1.9342105	1.0749949	1.0000000	4.0000000
Q30	76	2.1052632	0.9176629	1.0000000	4.0000000
Q31	75	2.0133333	0.9078239	1.0000000	4.0000000
Q32	75	2.5733333	0.9324964	1.0000000	4.0000000
Q33	75	2.6666667	1.0044944	1.0000000	4.0000000
Q34	75	2.4133333	0.9738935	1.0000000	4.0000000
Q35	75	2.7066667	0.9969322	1.0000000	4.0000000
Q36	75	2.0133333	1.0199806	1.0000000	4.0000000
Q38	76	2.7368421	1.1239030	1.0000000	5.0000000
Q39	76	2.9342105	1.2037223	1.0000000	5.0000000
Q40	76	2.0000000	1.1775681	1.0000000	5.0000000
Q41	76	2.3947368	1.3072000	1.0000000	5.0000000
Q42	76	1.9736842	1.0062960	1.0000000	5.0000000
Q43	76	2.2500000	0.9110434	1.0000000	4.0000000

Summary Statistics

G=2

Variable	N	Mean	Std Dev	Minimum	Maximum
Q44	76	2.2500000	1.0082989	1.0000000	5.0000000
Q45	76	2.6447368	1.2296769	1.0000000	5.0000000
Q46	76	2.4736842	1.1601573	1.0000000	5.0000000
Q47	76	2.0789474	1.2194333	1.0000000	5.0000000
Q48	76	2.2368421	1.0180821	1.0000000	5.0000000
Q49	76	1.9210526	1.1046949	1.0000000	5.0000000
Q50	76	2.7500000	1.2233833	1.0000000	5.0000000
Q51	76	2.5526316	1.1360133	1.0000000	5.0000000
Q52	76	3.0000000	1.1430952	1.0000000	5.0000000
Q54	76	4.0526316	1.0819086	1.0000000	5.0000000
Q55	76	2.8157895	1.3237374	1.0000000	5.0000000
Q56	76	4.0789474	1.1973655	1.0000000	5.0000000
Q57	76	3.2368421	0.9780037	1.0000000	5.0000000
Q58	76	2.0394737	1.2483674	1.0000000	5.0000000
D1	75	1.2400000	0.4299591	1.0000000	2.0000000
D2	72	34.8611111	6.6698936	24.0000000	55.0000000
D3	75	1.3466667	1.3704737	0	6.0000000
D4	75	1.8933333	0.4813644	1.0000000	3.0000000
D5	75	1.8800000	1.5935682	1.0000000	6.0000000
D6	75	3.6933333	0.7879727	1.0000000	4.0000000
D7	75	8.2666667	5.7945299	0	24.0000000
D8	75	4.8933333	4.5428094	0	23.0000000
D9	75	8.5200000	5.1710211	1.0000000	15.0000000
D10	75	14.1333333	8.4250805	1.0000000	26.0000000
D11	75	15.3333333	11.4104425	0	60.0000000
D12	75	25.1466667	15.2746861	0	60.0000000
D13	75	1.0400000	0.2567994	0	2.0000000
D14	71	36.6830986	42.2962544	1.0000000	200.0000000
D15	72	49.9027778	45.9874936	1.0000000	240.0000000
D16	75	1.0000000	0	1.0000000	1.0000000
D17	75	1.0666667	0.2511236	1.0000000	2.0000000
D18	75	1.8933333	0.3107677	1.0000000	2.0000000
D19	71	93.5915493	2.1552425	85.0000000	96.0000000
D20	73	17.6849315	12.1333754	0	52.0000000
D21	53	384.7924528	687.7086357	95.0000000	2002.00
PARTIC	76	1.0000000	0	1.0000000	1.0000000

Summary Statistics

---------- G=3 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
NO	71	798.9859155	55.5598758	703.0000000	894.0000000
Q1	71	3.6619718	0.6957763	1.0000000	4.0000000
Q2	70	3.1571429	0.6732081	1.0000000	4.0000000
Q3	70	3.1571429	0.6286796	1.0000000	4.0000000
Q4	71	3.2816901	0.6586371	2.0000000	4.0000000
Q5	71	3.3098592	0.8034132	1.0000000	4.0000000
Q6	71	3.6338028	0.5913528	2.0000000	4.0000000
Q7	71	1.6619718	0.5841639	1.0000000	3.0000000
Q8	71	1.5352113	0.8251577	1.0000000	4.0000000
Q9	71	2.6619718	0.8442014	1.0000000	4.0000000
Q10	71	1.4225352	0.6014737	1.0000000	4.0000000
Q11	71	1.7464789	0.7505866	1.0000000	3.0000000
Q12	71	2.7042254	0.9470913	1.0000000	4.0000000
Q13	71	2.7464789	0.9214633	1.0000000	4.0000000
Q14	71	1.7464789	0.9058273	1.0000000	4.0000000
Q15	71	2.3943662	1.0068178	1.0000000	4.0000000
Q16	70	1.9571429	0.7696360	1.0000000	4.0000000
Q17	71	1.7042254	0.7998994	1.0000000	4.0000000
Q18	71	1.3098592	0.6231613	1.0000000	3.0000000
Q19	71	1.6197183	0.7993962	1.0000000	4.0000000
Q20	71	1.9436620	0.9394120	1.0000000	4.0000000
Q21	71	1.5211268	0.6940390	1.0000000	4.0000000
Q22	71	1.9154930	0.9963717	1.0000000	4.0000000
Q23	71	1.5633803	0.6704454	1.0000000	3.0000000
Q25	71	3.6197183	0.5173061	2.0000000	4.0000000
Q26	71	2.4647887	0.7897737	1.0000000	4.0000000
Q27	71	2.3239437	0.8241818	1.0000000	4.0000000
Q28	71	1.9295775	0.8672443	1.0000000	4.0000000
Q29	71	2.0140845	1.1648784	1.0000000	4.0000000
Q30	71	2.0985915	0.9434728	1.0000000	4.0000000
Q31	71	1.9859155	1.0211053	1.0000000	4.0000000
Q32	71	2.4647887	0.9685185	1.0000000	4.0000000
Q33	71	2.8732394	0.8439631	1.0000000	4.0000000
Q34	71	2.4084507	0.8548595	1.0000000	4.0000000
Q35	70	2.7857143	0.8991599	1.0000000	4.0000000
Q36	69	2.0144928	0.8827223	1.0000000	4.0000000
Q38	71	3.0422535	0.8525025	1.0000000	5.0000000
Q39	71	3.1549296	1.1544682	1.0000000	5.0000000
Q40	71	2.3802817	1.2690401	1.0000000	5.0000000
Q41	71	2.6478873	1.2883943	1.0000000	5.0000000
Q42	71	2.3098592	1.1160075	1.0000000	5.0000000
Q43	71	2.2816901	0.9286411	1.0000000	5.0000000

Summary Statistics

---------- G=3 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
Q44	71	2.6056338	1.0620583	1.0000000	5.0000000
Q45	71	2.5352113	0.9975826	1.0000000	5.0000000
Q46	71	2.4647887	0.9975826	1.0000000	5.0000000
Q47	71	2.2676056	1.1078647	1.0000000	5.0000000
Q48	71	2.3943662	1.0068178	1.0000000	5.0000000
Q49	71	2.3239437	1.2162548	1.0000000	5.0000000
Q50	71	2.8169014	1.0185404	1.0000000	5.0000000
Q51	71	2.3802817	1.0193303	1.0000000	5.0000000
Q52	71	2.8732394	1.2062880	1.0000000	5.0000000
Q54	71	4.2394366	1.0618688	1.0000000	5.0000000
Q55	71	3.3239437	1.1683278	1.0000000	5.0000000
Q56	71	3.9577465	1.0479452	1.0000000	5.0000000
Q57	71	3.1690141	0.8780810	1.0000000	5.0000000
Q58	71	2.3380282	1.0412035	1.0000000	5.0000000
D1	71	1.1408451	0.3503376	1.0000000	2.0000000
D2	69	34.4492754	8.0814534	21.0000000	60.0000000
D3	70	1.3714286	1.6433567	0	9.0000000
D4	71	1.9014085	0.6359454	1.0000000	5.0000000
D5	70	2.1000000	1.4660407	1.0000000	6.0000000
D6	71	3.5070423	0.9691416	0	4.0000000
D7	71	10.0281690	7.7808773	0	37.0000000
D8	71	5.2957746	4.7491183	0	21.0000000
D9	71	7.8309859	5.2153233	1.0000000	15.0000000
D10	71	13.6619718	7.4774779	1.0000000	26.0000000
D11	70	15.0428571	13.1792939	1.0000000	66.0000000
D12	71	24.1830986	16.2263541	4.0000000	90.0000000
D13	71	1.4084507	1.8637709	1.0000000	15.0000000
D14	69	21.7971014	22.5483661	1.0000000	100.0000000
D15	69	31.4637681	24.7003094	1.0000000	120.0000000
D16	66	1.8030303	5.0754907	1.0000000	40.0000000
D17	66	1.8787879	0.3727301	1.0000000	3.0000000
D18	66	1.9848485	0.2142913	1.0000000	3.0000000
D19	55	91.0000000	17.6656184	1.0000000	96.0000000
D20	49	10.2040816	18.2824820	0	95.0000000
D21	9	712.4444444	967.0960541	9.0000000	2002.00
PARTIC	71	1.0000000	0	1.0000000	1.0000000

Summary Statistics

---------- G=4 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
NO	42	153.6904762	35.3805018	101.0000000	223.0000000
Q1	40	3.7000000	0.7232406	1.0000000	4.0000000
Q2	40	3.1250000	0.8529737	1.0000000	4.0000000
Q3	40	3.0500000	0.7493587	1.0000000	4.0000000
Q4	40	3.1750000	0.7120753	1.0000000	4.0000000
Q5	40	3.3000000	0.7909747	1.0000000	4.0000000
Q6	40	3.5500000	0.7828285	1.0000000	4.0000000
Q7	40	1.9500000	0.8458041	1.0000000	4.0000000
Q8	40	1.7000000	0.9391759	1.0000000	4.0000000
Q9	40	2.2750000	1.0124228	1.0000000	4.0000000
Q10	42	1.7142857	0.7741467	1.0000000	3.0000000
Q11	42	2.0952381	0.7589956	1.0000000	3.0000000
Q12	42	2.8095238	0.8621611	1.0000000	4.0000000
Q13	42	2.7619048	0.8207529	1.0000000	4.0000000
Q14	42	2.0714286	1.0215449	1.0000000	4.0000000
Q15	42	2.5000000	1.0418089	1.0000000	4.0000000
Q16	42	2.4761905	0.9169966	1.0000000	4.0000000
Q17	42	2.1190476	0.9160461	1.0000000	4.0000000
Q18	42	1.4285714	0.7696327	1.0000000	4.0000000
Q19	42	1.6428571	0.7593781	1.0000000	3.0000000
Q20	42	2.3571429	1.0317267	1.0000000	4.0000000
Q21	42	1.7619048	0.9320715	1.0000000	4.0000000
Q22	42	2.0238095	1.1579649	1.0000000	4.0000000
Q23	42	1.8571429	0.9770895	1.0000000	4.0000000
Q25	42	3.6666667	0.4771187	3.0000000	4.0000000
Q26	42	2.8333333	0.8530195	1.0000000	4.0000000
Q27	42	2.6428571	0.8211066	1.0000000	4.0000000
Q28	42	2.2857143	0.9182623	1.0000000	4.0000000
Q29	42	2.1190476	1.1519312	1.0000000	4.0000000
Q30	42	2.3095238	1.1579649	1.0000000	4.0000000
Q31	42	2.2142857	0.8125754	1.0000000	4.0000000
Q32	42	2.4523810	1.0169870	1.0000000	4.0000000
Q33	42	2.8333333	0.9348710	1.0000000	4.0000000
Q34	42	2.5952381	1.0833445	1.0000000	4.0000000
Q35	42	2.9761905	0.8692047	1.0000000	4.0000000
Q36	37	1.7567568	1.0383054	1.0000000	4.0000000
Q38	42	2.8809524	0.8890220	1.0000000	5.0000000
Q39	42	3.1666667	1.1024732	1.0000000	5.0000000
Q40	42	3.1190476	0.8611501	1.0000000	5.0000000
Q41	42	3.0714286	0.9973833	1.0000000	5.0000000
Q42	42	2.5714286	1.1506702	1.0000000	5.0000000
Q43	42	2.6428571	0.8211066	1.0000000	4.0000000

Summary Statistics

---------- G=4 ----------

Variable	N	Mean	Std Dev	Minimum	Maximum
Q44	42	2.7619048	0.9320715	1.0000000	5.0000000
Q45	42	2.5476190	0.8025077	1.0000000	4.0000000
Q46	42	2.6428571	0.7908448	1.0000000	4.0000000
Q47	42	2.8333333	0.8811485	1.0000000	5.0000000
Q48	42	2.7857143	0.8420566	1.0000000	5.0000000
Q49	42	2.9285714	1.0451481	1.0000000	5.0000000
Q50	42	2.7857143	0.7501452	1.0000000	5.0000000
Q51	42	2.7380952	0.5868279	1.0000000	3.0000000
Q52	42	2.7380952	0.5868279	1.0000000	3.0000000
Q54	42	3.3571429	0.8211066	1.0000000	5.0000000
Q55	42	2.9523810	0.8821366	1.0000000	5.0000000
Q56	42	3.3095238	0.8111448	1.0000000	5.0000000
Q57	42	3.1904762	0.5942035	2.0000000	5.0000000
Q58	42	2.7619048	0.7904776	1.0000000	4.0000000
D1	39	1.3076923	0.4675719	1.0000000	2.0000000
D2	35	36.7428571	7.5511700	23.0000000	62.0000000
D3	38	1.6052632	1.5860792	0	6.0000000
D4	38	1.8684211	0.7040828	1.0000000	4.0000000
D5	39	2.2307692	1.7238503	1.0000000	6.0000000
D6	39	3.2307692	1.2022247	0	4.0000000
D7	38	10.6052632	8.6977458	0	40.0000000
D8	38	5.7105263	4.9149958	0	28.0000000
D9	40	9.8250000	5.1235379	1.0000000	15.0000000
D10	39	14.5384615	8.3314438	1.0000000	26.0000000
D11	37	15.4594595	12.5937476	0	42.0000000
D12	36	28.0555556	16.8318481	0	60.0000000
D13	38	1.6052632	1.6528350	1.0000000	8.0000000
D14	39	25.5512821	35.1475826	0	200.0000000
D15	36	31.7777778	23.3386389	0	90.0000000
D16	35	1.3142857	0.4710082	1.0000000	2.0000000
D17	33	1.4848485	0.5075192	1.0000000	2.0000000
D18	33	1.8484848	0.3641095	1.0000000	2.0000000
D19	21	87.8571429	9.2535707	62.0000000	97.0000000
D20	21	26.4761905	28.5142404	3.0000000	94.0000000
D21	11	457.9090909	763.2820520	89.0000000	2000.00
PARTIC	42	0	0	0	0

APPENDIX L

SYNTHESIZED SURVEY DATA RESPONSES FOR BARRIERS AND FACILITATORS TO PARTICIPATION OPEN-ENDED QUESTIONS 24, 37, 53, 59, 63

The following data are in response to open-ended survey questions about barriers and facilitators to participation at NTU and to distance education from Participants and Nonparticipants of NTU. These responses will be synthesized and grouped into barrier and facilitator themes for use in discussion in Chapters 4, Data Analysis, and Chapter 5, Conclusions and Recommendations.

The researcher hopes that results of these open ended questions in theme groups or categories might help NTU administrators and leaders of other distance education programs and services in facilitating better distance education for working engineers and other technical professionals.

Verbal Responses to LLL Barrier Question 24 and DE Barrier Question 53.

Following are listings of common barrier themes that evolved from studying the survey responses. These common themes were then listed, and all written responses from those survey questions were correlated under each corresponding theme as one means of processing and synthesizing the data.

Note: Information in [ ]'s are researcher's clarifying comments.

Barriers to Participation in LL and DE:

1. Cost.
2. Time -- Family constraints - family/home/social life.
3. Timing and selection of courses/work conflicts.
4. Poor instructor homework/test review return support.
5. Company provides no study time share during work time.
6. Company bias, or lack of company recognition/support.
7. Poor instructor or TA follow-up communication/feedback on students questions.
8. Student work time/travel conflicts with course schedules.
9. Poor course quality: instruction/presentation/video tape/materials/transmission.
10. Commute distance excessive.
11. Inflexible course schedule/programs.
12. Poor instructor advising/counseling.
13. No NTU downlink course availability.
14. No direct instructor/student contact.
15. No Ph.D. program by NTU DE.
16. Entry level courses too basic.
17. ITV class format not always suitable.
18. NTU name recognition/reputation not comparable to major engineering colleges.
19. No peer/fellow student interaction and study sharing.
20. Lack of library/laboratory facilities.
21. Poor down-link site coordination.
22. Course material not relevant.
23. Entrance requirements for non-traditional engineering DE students to restrictive.
24. No MBA program by DE.
25. Fear of failure -- embarrassment, pay for course from own pocket.
26. Instructor inflexibility w/mature DE engineering students.
27. Lack of motivation when studying alone.

SA-I -- NTU Graduates

Q24. Other barriers that you feel are important? (List all that apply)

The following responses to Question 24 are written comments concerning barriers to participation in LLL. Response numbers match the listing of barrier themes above.

1. Cost.

Active dis-encouragement by local management (or just flat out being told I can't) of use of programs provided at a corporate level.
Cost -- Company requires us to pay up front & be reimbursed; NTU courses are very expensive compared to the local courses.
Our company changed its policy on NTU to where they make us pay up-front and reimburse later; this is a big disincentive!

2. Time -- Family constraints - family/home/social life.

Overall -- Time ("There are not enough hours in the day ---").
Time is the only factor that restricts my learning.
Can only focus on a few major activities.
Family, job, social, misc. + school is a tough load. The stress is a necessary evil while going after a degree. But once I have finished an MS, the stress of grades & a preset pace loses out to independent reading [self-study].
Only significant factor is the time demand on top of a 60 hour work week and need/desire to spend time with family.
It's a matter of priorities, need to trade-off between time allocated to work, education, family & other activities.
Little time for anything other than family -- I don't want to take time away from them (87 NTU grad, started family in 1991).

4. Poor instructor homework/test review return support.

Problems inherent when taking off-campus classes (asking questions, getting graded homework back, etc.

6. Company bias -- or, lack of company recognition/support.

"Risk-reward" evaluation doesn't indicate justification for continued formal education in my company.
No support by companies I have worked for recently.
Absolutely NO relevance of learning opportunities to company recognition or employability.
My company is generally supportive of the program. However, (top) management still has not recognized the value of NTU program or its graduates.
Frequently the pace and nature of the work are such that I am discouraged from applying vigorous analysis and asked to give a best guess or expedient result. Thus, there is reduced value in additional education.

7. Poor instructor or TA follow-up communication/feedback on students questions.

Lack of access to T.E.'s [TA's] when having problems learning course material.

9. Poor course quality: instruction/presentation/video tape/materials/transmission.

The equipment in satellite learning is usually run by people that are unskilled and this causes delays.

12. Poor instructor advising/counseling.

My biggest NTU problem was lack of a good advisor.

13. No NTU downlink course availability.

No NTU access available that I am aware of.

15. No Ph.D. program by NTU DE.

No way to advance past MS degree using distance learning.

16. Entry level courses too basic or pace too fast.

Age -- too often courses are designed for entry-level studies (contains subject matter which is too basic). [age 37, 92 NTU grad]
Courses teach a lot better & may win out if they were about half the pace.

19. No peer/fellow student interaction and study sharing.

Inability to interact with classmates.

22. Course material not relevant.

Studies not designed for the mature/senior engineer .

26. Instructor inflexibility w/mature DE engineering students.

Lack of consideration by professors for distance learners -- we are treated as 2nd class learners by many professors.

27. Lack of motivation when studying alone.

Momentum: once started, it's easier to keep going, but it's hard to get started.

Q53. List other barriers (Please be specific)

The following responses to Question 53 are written comments concerning barriers to participation in DE at NTU. Response numbers match the listing of barrier themes at the beginning of the Appendix.

1. Cost.

Cost of NTU is prohibitive if you haven't finished your degree and leave the company through which you were working. It cost me $7,000 for my last 8 credits out of my pocket!

2. Time -- Family constraints - family/home/social life.

Time required conflicts with children/home.
Burnout, overtime demands at work.

3. Timing and selection of courses/work conflicts.

NTU did not offer many courses I needed at times I could take them.

4. Poor instructor homework/test review return support.

When I attended NTU [1987-1990], E-mail was not as prevalent -- That (communications) was my major barrier.

7. Poor instructor or TA follow-up communication/feedback on students questions.

NTU needs to strongly check the quality of courses it provides. During my degree program, I ended up taking some worthless classes!
For pre-taped courses availability of TA/Professor has occasionally been an issue. (for example, Prof was on sabbatical & TA not sufficiently knowledgeable).

13. No NTU downlink course availability.

My present employer does not provide NTU courses on site.
NTU no longer offered at this site.

14. No direct instructor/student contact.

Don't receive the "hands-on" part of some lab work.

One of the biggest drawbacks was that I had no one to ask questions of during an exam. Local students have better access to instructor and other students. In some cases they [local students] cooperate on homework and take home exams.
Instructors difficult to reach when questions arose.
Instructor interaction getting help difficult remote.

15. No Ph.D. program by NTU DE.

No option to advance past MS degree.

17. ITV class format not always suitable.

Certain type of classes were not conducive to Distance CPE format.

Each school has different DE capabilities, procedures, schedules, etc. [no uniformity]
Timeshift cycle time versus real time class discussion: real lecture--satellite--VCR tape -- self watch -- homework -- campus discussion & questions.

18. NTU name recognition/reputation not comparable to major engineering colleges.

NTU does not have a recognized name; e.g. MIT, Georgia Tech,---This takes time & marketing to build, nevertheless it is an impediment.

At time of my studies, NTU was largely an unknown -- still is in its infancy.

19. No peer/fellow student interaction and study sharing.

Interaction with other students limited. Difficult to achieve team learning opportunities.
No interaction w/ other students, should provide E-mail address of other students.

20. Lack of library/laboratory facilities.

Library facilities and availability.

Local library [engineering] availability. In most courses, there was a project requiring a good engineering library. Duke Univ. allowed residents to check out from library. Even Duke library was limited. I wound up ordering papers from the Internet to use as reference at around $10-$20 each. Some of them I ordered were of little use.

21. Poor down-link site coordination.

Our on-site facilitators [site coordinator] that do not believe in the program.

22. Course material not relevant.

Would recommend not taking coursework from University of Alaska. Time/distance too great for feedback & advising.

23. Entrance requirements for non-traditional engineering DE students to restrictive.

My age was 45 when at NTU. Undergraduate GPA was low (below 2.7) but was accepted conditionally pending establishing a higher GPA for graduate studies.

24. No MBA program by DE.

Looking for management courses/education & courses no longer offered @ work.

NTU needs to offer an MBA program; there is nothing available for non-engineering or engineers wanting to switch to a business focus.

SA-II -- Admitted

Q24. Other barriers that you feel are important? (List all that apply)

1. Cost.

Admin. overhead of taping classes at NTU.
Also costs are shifted to the employee/student.
Taxes on reimbursed education.
Cost of education;

2. Time -- Family constraints - family/home/social life.

Who can work 60 hours per week & then drive more than an hour each way to attend school? That was my option before NTU. NTU made a M.S. degree possible.

3. Timing and selection of courses/work conflicts.

I need flexibility in scheduling and the variety of different courses at different schools.
Taking course while having to travel due to job, time impacts school schedule.

6. Company bias -- or, lack of company recognition/support.

Motivation/Payback.
Company policy may support higher education, but immediate supervisor may not.

7. Poor instructor or TA follow-up communication/feedback on students questions.

Turn around time on question asked & responded to for remote students.

9. Poor course quality: instruction/presentation/video tape/materials/transmission.

Workload for courses different than what is described in catalog.

13. No NTU downlink course availability.

Company downsizing has limited or eliminated many options.
Company support for NTU participation withdrawn in 1996.

14. No direct instructor/student contact.

Reduced live student/teacher interaction.

18. NTU name recognition/reputation not comparable to major engineering colleges.

Few engineers at Boeing have even heard of NTU -- Need more publicity. There's over 20,000 engineers here! and only about 10 in NTU program!

19. No peer/fellow student interaction and study sharing.

Lack of colleagues or friends interested in non-traditional education systems such as NTU (i.e. -- it's too lonely!)

20. Lack of library/laboratory facilities.

[Lack of] Access to needed resources to achieve success (i.e. Internet, College type libraries, study hall area).
Proximity & access to colleges/universities.

22. Course material not relevant.

Job related courses are difficult to find. Corporate & Government downsizing (i.e. Training fund reduced.)
Availability of courses that will provide me with relevant information in my job that I can relate to @ my work place.
Field survey to see what the real world needs!

23. Entrance requirements for non-traditional engineering DE students to restrictive.

With the onset of using PC's & the Internet, often professors are using computer technology that students don't have the background in; i.e. FTPing & WINCODING, etc.
Insufficient detail of material.

25. Fear of failure -- embarrassment, pay for course from own pocket.

Fear of never finishing.

26. Instructor inflexibility w/mature DE engineering students.

Lack of flexibility of professors to needs of distance learning students.

Q53. List other barriers (Please be specific)

1. Cost.

Cost to student($$), little/no recognition by employer of the time required to pursue degree in addition to full time job.

2. Time -- Family constraints - family/home/social life.

Finding time (Family).
Depends on projects; last semester I was working 10-14 hour days including weekends.

3. Timing and selection of courses/work conflicts.

Work schedule/travel.
NTU does not offer many desirable courses often enough.
Not enough web-related topics!

4. Poor instructor homework/test review return support.

Lack of HW-Test receipt confirmation when submitted electronically.

7. Poor instructor or TA follow-up communication/feedback on students questions.

Professors & TA's are only available by phone for 1-3 hours per week. I tend to have many meetings during the day and can't call during those limited hours. Therefore, weeks would go by before I could get help with interactive (telephone) communication. E-mail is NOT real-time interactive.
Conversations with professor are limited to verbal (phone). Diagrams (visual aids) cannot be used to explain concepts. This makes communications and learning far more difficult.
The instructor did not return (or grade) even 1 of my assignments!

9. Poor course quality: instruction/presentation/video tape/materials/transmission.

Occasionally, the downlink failed.
Some very poor professors -- no teaching skills.
Poor tape quality many times.
Technical difficulties when portions of the tape loses audio, video, or both. Some instructors took too long to respond to e-mail questions (most were excellent!)

12. Poor instructor advising/counseling.

Depends on accessibility of instructor for questions, etc. Some don't have office hours at times you can contact them. Some also won't answer e-mail!

13. No NTU downlink course availability.

I moved and didn't have a site where I moved to. One college wouldn't mail the tapes to me and wanted to charge $45 per tape to mail them. I have to ask a secretary where I used to work to record tapes off the network & mail them.

18. NTU name recognition/reputation not comparable to major engineering colleges.

Many people are not aware of NTU: What it stands for or what they do.
The corporate knowledge about NTU and its accredited programs needs to increase.
NTU is generally unknown!

19. No peer/fellow student interaction and study sharing.

Lack of interaction with other students.
Peer pressure/support not present in this learning experience.
Access to other students in the classroom is not easy -- professor's hours are not meant for NTU students.
No peers to discuss concepts and homework with.
I don't see other students studying or stressed during exams as in std. universities.

21. Poor down-link site coordination.

Coordination of texts, broadcasting, receiving, weather interference has been a logistics nightmare!

22. Course material not relevant.

Current relevance of courses offered!

26. Instructor inflexibility w/mature DE engineering students.

One instructor at Colorado State was inflexible in dealing with off-site students. He changed required text book after course began, and Oak Ridge, TN students had a 3-4 week delay in getting new text from publisher. No concessions were made by instructor.
Some instructors I have had do not take into account the working student and his particular job constraints. However, with NTU most were very supportive and accommodating.

27. Lack of motivation when studying alone.

Lack of motivation when studying alone.

SA-III -- Taking

Q24. Other barriers that you feel are important? (List all that apply)

1. Cost.

I can work around family, job, and scheduling constraints, but the cost of the class is the largest barrier.

I must be able to show my management that they also get return for their investment in me taking courses. Particularly at $1500-$2,000 per 3 credit hours.

The extremely high cost of continuing education.
Corporations have tuition reimbursement programs to pay tuition costs if you are working toward a degree. However, if you are taking classes for the purpose of continuing education (i.e. you already have your Masters Degree) ;it is difficult to get corporations to pay for the class.

2. Time -- Family constraints - family/home/social life.

Poor health of family members.

Home life --- house, cars, kids, spouse -- (not in any order).

I completed my masters while working. It was tuff, working 50+ hours per week.

The majority of my barriers are personal/social (i.e. time) related.

3. Timing and selection of courses/work conflicts.

Travel requirements with current job. 2). Concern of credibility with certain extension opportunities.
Inconvenient times & /or locations.
OSU canceled class I really needed!! COMSC 3375.

5. Company provides no study time share during work time.

The work place encourages education but doesn't always allow time for it.

6. Company bias -- or, lack of company recognition/support.

As a general note: in some of these above such as #22 my company really doesn't do much recognition about learning activities but that is still not a barrier to me participating in life long learning.
There appears to be no advantage to having a Masters as compared to a B.S.
Lack of company's financial contribution to continuing learning.

7. Poor instructor or TA follow-up communication/feedback on students questions.

With the video tapes, if I have questions, even with e-mail its usually a two day response time. By the time I get the answer, I've lost the connection/motivation I had from class.
Don't feel comfortable with the instructor/TA. There is no understanding of each other.

9. Poor course quality: instruction/presentation/video tape/materials/transmission.

The NTU classes I have taken aired in the middle of the night. It took my education center 3 weeks to realize their recorder was broken, and so every class tape had to be ordered, and I ended up far behind in my class.

17. ITV class format not always suitable.

After 2 graduate level courses, I've decided I learn more from undergraduate courses. They give me the basic understanding I need in a variety of subject areas. Also I prefer lots of little assignments to one or two big tests or projects. It forces me to stay on top of the subject matter.
I've decided remote learning doesn't agree with me. I'm used to asking a ton of questions in classes.
NTU's resistance in providing closed captions for taped/broadcast classes for hearing impaired students.

22. Course material not relevant.

I need very targeted learning that is hard to find in any course. College courses do not emphasize certain subjects. They tend to be more like survey classes.

23. Entrance requirements for non-traditional engineering DE students to restrictive.

Meeting prereq's, relearning prereq's after 10 years, i.e. calculus, face to face support of instructor or TA, study groups.

25. Fear of failure -- embarrassment, pay for course from own pocket.

Fear of taking courses that may result in a failing grade often prevents others (engineers) from participation.

Q53. List other barriers (Please be specific)

1. Cost.

Most major barrier for me with NTU is the very high cost -- although I get reimbursed, I must pay the money up-front & pout it at risk if I do not get an A or B.

2. Time -- Family constraints - family/home/social life.

Personal time constraints -- full time job/small children.

3. Timing and selection of courses/work conflicts.

Airing classes in middle of night makes student rely on taping, which is not always successful.

4. Poor instructor homework/test review return support.

DE always suffers with a delay in feedback with home work/tests/etc.
Time it took to mail course material back & forth was excessive; using e-mail would have been easier & faster.

5. Company provides no study time share during work time.

Work should allow time.

7. Poor instructor or TA follow-up communication/feedback on students questions.

Some instructors are more intolerant of DE students. A DE is often delayed in getting assignments in. Some instructors are less flexible.
Incomplete instructions. For example analysis material sent w/o description of analysis to be performed; video tapes of lectures delayed or sent blank.
You cannot communicate w/profs!
Difficulty in contacting professors & difficulty/inconvenience in trying to solve problems w/professor over phone/fax/e-mail.
The amount of time to receive input back from a professor.

9. Poor course quality: instruction/presentation/video tape/materials/transmission.

Some non-USA native instructors are extremely hard to understand!
Tape quality sucked!

15. No Ph.D. program by NTU DE.

I was trying to earn Ph.D.; cannot currently do that w/NTU.

SB-IV -- Nonparticipants

Q24. Other barriers that you feel are important? (List all that apply)

1. Cost.

My problem is time/money -- I have 3 jobs & a family -- I'd like to fit school in there somewhere -- if I had more money from my primary job -- I could get one job and go to school part time.

2. Time -- Family constraints - family/home/social life.

Basically, time constraints are the major obstacles.
Family, time, no recognition for completion of study.
The main barrier is struggling to balance professional, family, community, and personal obligations in a 24-hour day!
Basically, -- time shortage is main problem.
I work 13 hr. days 40-60 hrs a week. This leaves little time for outside activities. I am also on rotational shift work.

6. Company bias -- or, lack of company recognition/support.

Management will encourage participation, but then is viewed negatively when it impacts on work-related tasks.

Only certain individuals are selected to be truly supported in their effort. Motorola still has much of the "Boys Club" mentality to overcome.
Neither a master's or Ph.D. yields any financial rewards. Advanced degrees don't increase job security.

10. Commute distance excessive.

My 42 mile each way commute to & from work.

11. Inflexible course schedule/programs.

Inflexible courses -- (i.e. only certain courses offered per semester). Inflexible program that allows participant to customize his/her learning.

12. Poor instructor advising/counseling.

Can't obtain appropriate information. Person responsible for providing information not adequately trained. Unable to contact relevant administrators.
Unsure which learning activity to pursue.

17. ITV class format not always suitable.

Need one-on-one learning due to English being second language.

23. Entrance requirements for non-traditional engineering DE students to restrictive.

Don't meet qualifications. NTU & other grad programs require min. 3.1/4.0 GPA, so anyone who may have potential, but not the GPA, is automatically discouraged from applying.

Q53. List other barriers (Please be specific)

1. Cost.

Cost. My only and greatest barrier, plus I was nearly complete with course work in another program. Although reimbursed by the company, I'd have had to pay up front and receive a "C" or better. If I had to drop class (due to work load, travel, health, difficult class) I'm out $1,500 or more.
COST (2 responses)
Price is too high!
Cost too high.
Cost is too expensive -- for me out of my pocket.
Employer will reimburse for courses of study through less expensive schools -- refused to reimburse for NTU.
Started into a program[CPE], then school [not NTU] dropped program -- result is wasted dollars -- not all credits will transfer -- no end in sight!
Prohibitively expensive compared to locally offered evening courses.

2. Time -- Family constraints - family/home/social life.

Chews up too much time.
Need to be able to take courses at home.

3. Timing and selection of courses/work conflicts.

NTU course work conflicts with work schedule.

11. Inflexible course schedule/programs.

Program needs to be flexible.

12. Poor instructor advising/counseling.

Requested information on a specific class -- never received any feedback.

13. No NTU downlink course availability.

No public access to [NTU] downlink.
No written procedures on how to select, enroll, and pay for courses at my work site.

14. No direct instructor/student contact.

I really like the atmosphere of a real classroom with face-to-face interactions.

18. NTU name recognition/reputation not comparable to major engineering colleges.

This is most important barrier: Management recommended VPI Engineering Administration Masters Degree for me to get. Therefore, I was semi-strong armed into the major. NTU was viewed negatively by management as a "glorified correspondence course". i.e. Sally Struthers adds on TV.
Don't know about NTU.

20. Lack of library/laboratory facilities.

Lab classes may not be as effective.

FACILITATORS TO PARTICIPATION IN

LLL AND DE SURVEY QUESTION RESPONSES

Verbal Responses to Facilitator LLL Question 37 and DE Questions 59, 63.

To learn more from survey respondents about their views and concerns about facilitators to participation in continuing professional education (CPE) at NTU, LLL and DE open ended facilitator questions 37, 59 and 63 were added to major survey sections.

Following are listings of common facilitator themes that evolved from studying the survey responses. These common themes were then listed, and all written responses from those survey questions were correlated under each corresponding theme as one means of processing and synthesizing the data.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.
2. Supervisor and company support/encouragement/recognition.
3. Strong family support and company financial and moral support.
4. Company flex-time or paid class time.
5. Convenient down-link classroom or direct delivery to engineering work stations.
6. Self-scheduled learning coursework program (work or home video).
7. Guaranteed option of switching to desired field after earning M.S. degree.
8. Company financial incentives for earning advanced technical degree.
9. More course variety from NTU in same discipline.
10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.
11. DE oriented instructors and TA's that are accessible by phone or e-mail.
12. Highly skilled advisors/counselors that are accessible by phone or e-mail.
13. NTU degree reputation comparable to major engineering universities.
14. Joint NTU/University degree w/40% of courses taken from one NTU University.
15. Business courses and MBA program offered from engineering managers.
16. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.
17. Up-to-date, technical leading edge courses/instruction
18. NTU down-link classroom @ small non-NTU company worksites.
19. Take NTU classes live during workday with work flex-time.
20. Company pays NTU fees up-front/eliminate income tax on reimbursed fees.
21. Lower tuition & fees.
22. Highly knowledgeable nationally known, reputable leading university instructors .
23. More grading emphasis on homework and projects, less on exams.
24. Home satellite ITV delivery of NTU courses.
25. In-company promotion of NTU.
26. NTU operate like a "real" university with real university ID's that are accepted.
27. Distribute/access NTU class notes and courses on Internet/www sites.
28. Published NTU instructor evaluations, regardless of how good/bad.
29. Ph.D. program through NTU downlink sites/Internet.
30. Marketing NTU programs with expanded satellite coverage w/Internet interface.
31. Option of testing out of prerequisite courses based on experience and intial probationary enrollment.
32. Lower cost auditing and CPE short curriculum package, 2-5 course, 6-15 hours.
33. Offer all NTU courses at least once per year.
34. Other.

SA-I - NTU Graduates

Q37. Other facilitators you feel are significant? (List all that apply)

The following responses to Question 37 are written comments concerning facilitators to participation in LLL. Response numbers match the listing of facilitator themes at the beginning of the Appendix.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Convenience of viewing courses @ off hours. A must for a parent w/ 3 kids!

2. Supervisor and company support/encouragement/recognition.

Direct management boss.

3. Strong family support and company financial and moral support.

Family support, environment, or personal situation.
Company is sponsoring the program.
Moral support & sponsorship by immediate boss & mentors
Job competition and to a degree, family competition to set an example to children, nieces & nephews on importance of lifelong learning.

6. Self-scheduled learning course format (down-link @ work or home video).

Choice of "on-line" or via videotape (study when most conducive);
If training/education could be downloaded to my desktop & used at my convenience.

8. Company financial incentives for earning advanced technical degree.

Extra incentive from participating/computing in course helps; very difficult to complete major independent study effort;

10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.

[Being able to] talk professionally with peers [about a class or course].
More peers taking classes would be a good incentive;

22. Highly knowledgeable nationally known, reputable leading university instructors.

Competency of professors;
Excellence of some of the professors.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Very visible communications.

31. Option of testing out of prerequisite courses based on experience and intial probationary enrollment.

Not having to take "basic" entro courses --- recognition of value of employment experience.

34. Other.
A great (and very helpful) reference librarian -- who, unfortunately got fed up with not being appreciated, and retired.
Current job need.
[NTU MS degree] Helps in obtaining new jobs.
Choice of same course from multiple institutions.
Stimulation of the brain.
Assistance and encouragement of the NTU staff.
Desire to finish something I started full time (i.e. a graduate degree).

Q 59. List additional factors that you feel would act as facilitators to enrollment at NTU?

The following responses to Question 59 are written comments concerning facilitators to participation in DE. Response numbers match the listing of facilitator themes at the beginning of the Appendix.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Ability to "time shift" -- tape satellite broadcasts & view after work, especially [review tapes] several at once.
Ability to freeze frame tape & copy notes at my leisure.
Video classes allowed me to view lectures multiple times.
I enjoyed the ability to rewind a portion of a tape and watch it again.
Flexibility when traveling w/job.
Can play [course] tapes at home.
Courses can be videotaped and watched when convenient.
No travel time to/from class.
Classes taped/can be viewed at my convenience
Convenience!
Availability at work or other locations.

4. Company flex-time or paid class time.

Flexibility in scheduling exactly when I do my work (e.g. "attend" the classes).

6. Self-scheduled learning course format (down-link @ work or home video).

Flexibility of class schedule (I watch the tapes if I can't be at the live broadcast)
Flexibility when traveling w/job.
Ease of class viewing.
Convenience!
Availability at work or other locations.

9. More course variety from NTU in same discipline.

Wider selection/better schedule at NTU [would help].
Selection of courses at NTU better than at local colleges.
Breadth of course offerings greater than any local school.
NTU has better selection than local college, offers more classes to choose from -- often same topic offered at a number of schools.
Larger selection of classes than local engineering college.

10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.

Student mentors (fellow students who've been through);

13. NTU degree reputation comparable to major engineering universities.

Improved Recognition/reputation of NTU (PR on successful grads).
Marketing -- get NTU noticed.
Increasing visibility & recognition.

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

Ability to get a degree from a specific college.

15. Business courses and MBA program offered from engineering managers.

Offer business programs.

16. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.

Education can be continued if you have to move, without losing credits. This was very important to me and proved to be the difference between getting and not getting a degree.
The ability to transfer classes from member schools also helped greatly influence my participation.

18. NTU down-link classroom @ small non-NTU company worksites.

NTU program is very convenient for us full time employees.
Availability at work or other locations.

19. Take NTU classes live during workday with work flex-time.

Live classes with phone-in capability [clarifying questions/comments].
NTU program is very convenient for us full time employees.

20. Company pays NTU fees up-front/eliminate income tax on reimbursed fees.

[Be placed] On approved list for company paid [NTU tuition/fees]
Tuition/fees paid by company.
Delay billing until after semester (many companies pay reimbursement at that time).
My company pays tuition and fees.

22. Highly knowledgeable nationally known, reputable leading university instructors.

Best courses from best instructors.
More "name brand" institution participation (MIT, Stanford, Cal-Berkeley, G-T, ---);

24. Home satellite ITV delivery of NTU courses.

No local institution [engineering college],

27. Distribute/access NTU class notes and courses on Internet/www sites.

Greater use of Internet resources (i.e., grades, homework, etc. ---)

31. Option of testing out of prerequisite courses based on experience and intial probationary enrollment.

NTU advisor let me take any course I felt prepared for.
Utilize experience in allowing entrance as part of requirements.
I was able to test my resolve in doing grad. studies with low risk -- Most Important!
[Researcher's Comment -- Give them a chance -- continue using probation process at NTU -- he was a 45 year old engineer in 1991, now a 94 NTU grad, and NTU supporter!]
Easier enrollment.

34. Other.

Fear of obsolescence!

Was able to take 1 course in MOT program before engaging full course load.

Q63. What new services or changes in existing services from NTU do you feel would better enable you to meet your lifelong learning CPE goals and needs?

The following responses to Question 63 are NTU graduates' written comments concerning their suggested changes in services supplied by NTU that might help them meet their lifelong learning goals and needs.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

With video tapes, NTU could go out of sync with other universities and still remain current. NTU doesn't really need semesters. Classes could start in March for example.
On-line (www) updates of short course offerings -- maybe as CD-ROM courses, that are self-paced.
Very targeted self study courses on specific technology would be useful.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Course delivery to my work station.
Ability to view classes from my PC.
Real-time viewing of instructor's visuals on P.C. (e.g. slide show using Persuasion Player).

6. Self-scheduled learning course format (down-link @ work or home video).

Being able to access [NTU] at home.

9. More course variety from NTU in same discipline.

Expanded course offerings, better quality courses from more colleges and universities.
Sign up more schools for participation, different programs.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

All instructors on e-mail (they weren't when I participated).

13. NTU degree reputation comparable to major engineering universities.

NTU needs to be more well known -- more advertising, more visibility.

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

Getting a degree from one university.

15. Business courses and MBA program offered from engineering managers.

NTU should expand into other education areas that are difficult for working professionals to access while still working, such as law.
More emphasis on business in MS curriculum.
Offer MBA.
MBA program.
Executive MBA.

16. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.

Offer courses/programs to students not associated with a participating company (I no longer have access to NTU courses).
It is unlikely that I will be able to participate in NTU programs as my new company doesn't participate.
Have regional locations for access to NTU.
More access/easier access for smaller businesses.

17. Up-to-date, technical leading edge courses/instruction.

Keep a technical focus.
Continuous monitoring of classes and instructors to make sure the best classes from the best instructors.

18. NTU down-link classroom @ small non-NTU company worksites.

Accessibility at smaller companies.

19. Take NTU classes live during workday with work flex-time.

More live classes.

21. Lower tuition & fees.

Lower cost.

26. NTU operate like a "real" university with real university ID's that are accepted.

NTU needs to be more directly involved with the student; also they need to become more efficient at their interface role between student and college.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Reference info availability (~search engine [Internet]) thru NTU focused on advances in discipline contributed to by NTU instructors.
It would be neat to get classes over the net [Internet] or over DSS.
Better access.

29. Ph.D. program through NTU downlink sites/Internet.

Ability to get Ph.D. courses from NTU and then complete research at local university.
Ph.D. program.
Ph.D.
NTU could offer a few Ph.D. level courses so that I can do as many as possible, then transfer to a local college to complete.
Ph.D. service.
Inception of a M.S. & Ph.D. program in Environmental Engineering.
Offer Ph.D. programs.
Ph.D. program.
Ph.D. program??
Ph.D. program!!
Ph.D. programs;

30. Marketing NTU programs with expanded satellite coverage w/Internet interface.

NTU needs to be more well known -- more advertising, more visibility.
Frequent, small direct mailings with availability information instead of few, large.

32. Lower cost auditing and CPE short curriculum package, 2-5 course, 6-15 hours.

Lower costs for course auditing or something between a 6-hour and 40-hour class.
NTU already offers auditing classes.
CD or Internet based seminars/training --- not for formal degree but "for keeping current/sharp".
Take subject courses to keep up-to-date without being in a major.
Short term -- 3-4 hour programs on specific topics.

34. Other.

What about financing/scholarships?
Reduce the cost.
All 4 course certificate programs still available.
Sometimes you have to wait more than 1 year for a particular class to be offered; i.e., I took 3 semester courses before they offered TM722N again.
Undergraduate refresher course.
Degree programs in "hard" sciences as well as engineering.

SA-II - NTU Admitted

Q37. Other facilitators you feel are significant? (List all that apply)

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Self paced formats available.

2. Supervisor and company support/encouragement/recognition.

Support/encouragement by my direct supervisor.
Encouragement by employer.

3. Strong family support and company financial and moral support.

Company support is provided.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Less traveling than university, convenience.
Convenience, close proximity to work, flexible hours to participate in classes.

6. Self-scheduled learning course format (down-link @ work or home video).

Ability to schedule my own time for learning.

7. Guaranteed option of switching to desired field after earning M.S. degree.

Requirement to obtain new job skill due to obsolescence of current job market.

8. Company financial incentives for earning advanced technical degree.

My current employer does not regard education. However, financial reward will come if I change jobs --- with this understanding,

Q 59. List additional factors that you feel would act as facilitators to enrollment at NTU?

The following responses to Question 59 are NTU Admitted students' written comments concerning facilitators to participation in Lifelong Learning. Response numbers match the listing of facilitator themes at the beginning of the Appendix.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Flexibility in rewinding/reviewing taped classes.
I view the videos at home, e-mail work to professor.
Flexibility of when I can review class tapes.
I can watch video tapes in my living room.
Flexibility in viewing the course because it was videotaped!
Convenience of taking tapes home.
Allow people the option of receiving the tapes by mail (at same cost)

2. Supervisor and company support/encouragement/recognition.

Recognition.

3. Strong family support and company financial and moral support.

Cost not a factor. Company paid.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Taking class without driving to local university.

9. More course variety from NTU in same discipline.

More variety of courses from NTU.
The variety of courses offered.
Variety of courses in same discipline.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Very accessible professors & TA's!

12. Highly skilled advisors/counselors that are accessible by phone or e-mail.

High quality/knowledgeable advisor, who both cares about students & knows the system.
Easier access to advisors.

13. NTU degree reputation comparable to major engineering universities.

NTU reputation relative to local [available engineering] colleges.

15. Business courses and MBA program offered from engineering managers.

Masters of Business Administration program.

16. Option of participating in NTU degree program when moving to NTU company division without NTU downlink or to non-NTU company.

Ability to continue at NTU even if moved to new site/city/company; i.e. not local.

17. Up-to-date, technical leading edge courses/instruction.

Some instructors are very current and the classes are very interesting -- better than local instruction.

20. Company pays NTU fees up-front/eliminate income tax on reimbursed fees.

NTU is 100% paid by Motorola.
Local university fee is only about 78% reimbursed due to federal tax for tuition reimbursed.

21. Lower tuition & fees.

Lower tuition costs.
Classes very expensive.
Lower tuition.

22. Highly knowledgeable nationally known, reputable leading university instructors.

Subject taught, teachers better known nationally.

23. More grading emphasis on homework and projects, less on exams.

Grading weighted less heavily on exams, more heavily on homework & projects.

34. Other.

No local engineering college.
Media -- available on audio tape to play during drive to work.
There IS no local engineering college.
Lack of local engineering college.
We have no other choice -- we have no university here.

Q63. What new services or changes in existing services from NTU do you feel would better enable you to meet your lifelong learning CPE goals and needs?

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Program is convenient for my work & home situation.
Tape [video tape] sent directly to house.

4. Company flex-time or paid class time.

More time off work to perform NTU activities.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Have NTU site within my company (We buy service from Honeywell).

9. More course variety from NTU in same discipline.

More variety of courses. Availability is not very good.
Increased selection of classes.
More classes available.
Flexibility and variety of courses -- ask real customers.

10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.

Better access to other NTU students in the courses, for "team-work" with peers.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Some teachers still do not have sympathy for our work & family requirements which sometime get in the way.
Better screening of instructors; require prompt feedback and distance learning support.
Teachers could be more understandable to students.
Better communications between professor & students.
Better access to communicate with instructors and T/A's,
Easy communication from professors to help when a student is struggling.
Higher expectations from professors in areas such as class notes, clarity of overheads, timely return of homework.
Teachers could be more understandable to students.

12. Highly skilled advisors/counselors that are accessible by phone or e-mail.

One-on-one talk to all new students before taking a course about what is to be expected.
Closer counseling toward degree goal.
Have general [NTU] advisors available to talk [about] learning opportunities.

13. NTU degree reputation comparable to major engineering universities.

A better NTU rank among other universities.

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

I would like to have an option of receiving a diploma from the University that I took the classes with (i.e. University of Arizona with 23 credit hours, etc.)

15. Business courses and MBA program offered from engineering managers.

MBA program if reputation is comparable.
Coursework outside the engineering disciplines -- (Varied).
"Softer" curriculum -- i.e. more business courses.

17. Up-to-date, technical leading edge courses/instruction.

Keep the leading edge classes. Perhaps more counseling in preparing courses.
More current classes -- not as much theoretical.
Survey students & companies for Hot Topic/Technology areas.
There should be more courses in IC design, especially analog signal processing.
Periodic review of lesson plans, curriculum.

19. Take NTU classes live during workday with work flex-time.

More interactive capability w/courses on campus.
Easy access to Continued Ed. courses, enrollment and funding.

20. Company pays NTU fees up-front/eliminate income tax on reimbursed fees.

Easy access to Continued Ed. courses, enrollment and funding.

21. Lower tuition & fees.

Lower tuition and fees.
Lower tuition costs.
Lower costs.
Lower tuition costs,
Lower costs.

23. More grading emphasis on homework and projects, less on exams.

Having pre-defined expectations & deadlines at the start of class.
More classes that are project (not writing papers) oriented instead of test oriented.

24. Home satellite ITV delivery of NTU courses.

Bring education to home satellite systems.

25. In-company promotion of NTU.

Needs promotion at the corporate level.

26. NTU operate like a "real" university with real university ID's that are accepted.

NTU should act like a real university and not just a s satellite-broadcast time seller!

Issue the Id's from NTU that are valid. (i.e. library, research data bases, etc.)
Access to college libraries via Internet with NTU account.
Better coordination, services, response time, interaction w/instructor & on-site students.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Distribute/access of class notes on Web.
Grant NTU students on-line access to a participating university, local on-line resources via the Internet.
All course notes/homework being Internet accessible.
Web interaction for the classes.
More support for classes on the Web -- reference library, class materials, etc.

28. Published NTU instructor evaluations, regardless of how good/bad.

Access to instructor evaluations whether good or bad.
Providing course evaluations after each course.

29. Ph.D. program through NTU downlink sites/Internet.

Ph.D. level degree.
Ph.D. program.
Addition of doctoral programs.

30. Marketing NTU programs with expanded satellite coverage w/Internet interface.

Market actively their MOT program for long term credibility!

33. Offer all NTU courses at least once per year.

Have course available more frequently, not just once/year.
Offering more summer courses.

34. Other.

Involve more undergraduate studies.
Reduce site coord. burdens.
Better equipment.
Transfer of credit from other Univ.. w/o having to pay high tuition costs.
Media -- available on audio tape to play during drive to work.
More bridging classes.
The new "Technical Shorts" on new technology.
Longer period than 7 years for degree program.

SA-III - NTU Taking

Q37. Other facilitators you feel are significant? (List all that apply)

The following responses to Question 37 are NTU Taking students' written comments concerning facilitators to participation in Lifelong Learning. Response numbers match the listing of barrier themes at the beginning of the Appendix.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Tapes when miss live classes.

6. Self-scheduled learning course format (down-link @ work or home video).

Ability to schedule coursework (lectures & homework) when it is convenient to me.

10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.

Peer pressure -- others within dept. taking courses.
At our work place it would be helpful to talk to someone who had taken the course before or at least preview course materials.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Helpful instructors.

13. NTU degree reputation comparable to major engineering universities.

Good schools.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Good notes.

Q 59. List additional factors that you feel would act as facilitators to enrollment at NTU?

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Video tapes allow multiple viewings.
View videotapes of classes @ my leisure.

Workplace support -- $$ & time.

3. Strong family support and company financial and moral support.

Workplace support -- $$ & time.

4. Company flex-time or paid class time.

Accredited college w/ flexible class hours.
Work allow time.
Company needs to allow workers 6 hours per week to participate.
Workplace support -- $$ & time.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Convenience of not having to leave the worksite.
Availability of instruction at worksite.
Better site facilities for viewing tapes/broadcasts.
No travel required.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Weed out "video challenged" instructors!!

13. NTU degree reputation comparable to major engineering universities.

Lack of name recognition is biggest drawback of NTU).

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

Recognition/acceptance of NTU credits by degree-conferring institution.
#1 -- Give option to gain degree from most attended school
Ability to get a degree from a specific participating university (i.e.: degree from OSU [or Stanford, MIT, Purdue, etc.] rather than NTU).
More colleges to choose from.
Accredited college w/ flexible class hours.
Additional degrees via NTU media; i.e. SMU degree via NTU.

17. Up-to-date, technical leading edge courses/instruction.

Best school in country for optics.

18. NTU down-link classroom @ small non-NTU company worksites.

Convenience of not having to leave the worksite.

19. Take NTU classes live during workday with work flex-time.

Airing all classes during day.

21. Lower tuition & fees.

Lower prices for course materials.
Lower tuition prices -- classes are overpriced for what one is getting!

22. Highly knowledgeable nationally known, reputable leading university instructors.

Weed out "video challenged" instructors!!
Excellent faculty -- well known profs.

34. Other.

Closed captioning for classes.
No local college.
Less hardware reliability problems.

Q63. What new services or changes in existing services from NTU do you feel would better enable you to meet your lifelong learning CPE goals and needs?

3. Strong family support and company financial and moral support.

More company acknowledgment.

4. Company flex-time or paid class time.

The flexibility of class time.

5. Convenient down-link classroom or direct delivery to engineering work stations.

More direct feeds at Corporate locations.

8. Company financial incentives for earning advanced technical degree.

More company acknowledgment.

9. More course variety from NTU in same discipline.

A more extensive offering of optics-specific courses from U of Arizona!
Add more "basic understanding" classes (i.e. undergraduate level classes).
More course offerings.
Expand courses in Mechanical Engineering.
Continue to increase # of offered courses.
Offer more variety of classes in Optics from Univ. of Ariz.
Keep a wide range of courses related to wireless technology.
More Chemical Engineering!
More circuit design courses.

10. NTU organized peer support network at NTU companies with Internet site to encourage fellow engineers to take NTU courses or degrees.

Take full advantage of Internet technology.

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Better coordination, services, response time, interaction w/instructor & on-site students.
Instructor flexibility & ease of rescheduling is highly appreciated.
Better use of E-mail would help.
Better/more efficient live interaction w/professor for homework help, etc.

13. NTU degree reputation comparable to major engineering universities.

NTU is not as recognized/rated (Barons/US News) in real world.
More recognition of NTU.

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

I'm transferring directly to the University for my degree work -- not thru NTU.
The University also has DE program thru video tapes -- so the extra cost to go thru NTU is at no benefit.

15. Business courses and MBA program offered from engineering managers.

MBA.
Offer MBA not Engr. Mgt.

17. Up-to-date, technical leading edge courses/instruction.

My needs are less academic and more specialized technical skills. Maybe some good short courses or seminars, especially if these were 'hands-on' options.

18. NTU down-link classroom @ small non-NTU company worksites.

More direct feeds at Corporate locations.

19. Take NTU classes live during workday with work flex-time.

Don't think too highly of video programs -- of communications problem b/w instructor & student.

21. Lower tuition & fees.

Very expensive. If company wasn't paying tuition, I could not afford.

22. Highly knowledgeable nationally known, reputable leading university instructors.

Get more schools w/reputable advanced graduate classes involved.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Make all "Management of Technologies" courses available "al a carte"!

Take full advantage of Internet technology.

29. Ph.D. program through NTU downlink sites/Internet.

Take full advantage of Internet technology.

30. Marketing NTU programs with expanded satellite coverage w/Internet interface.

Course Catalog on-line!

Take full advantage of Internet technology.

Take advantage of a video teleconference through the Net.

32. Lower cost auditing and CPE short curriculum package, 2-5 course, 6-15 hours.

My needs are less academic and more specialized technical skills. Maybe some good short courses or seminars, especially if these were 'hands-on' options.
Short courses directed towards professionals, not students.
Shorter (day-long) seminars on "refresher" topics. e.g. Statistics for Engineers--Refresher.
Make all "Management of Technologies" courses available "al a carte"!

33. Offer all NTU courses at least once per year.

Better semester to semester course selection. Took an intro. class -- oil/gas -- the follow-on class has not been offered yet!
Continue to increase # of offered courses.
Commitment from NTU participating universities that classes won't be canceled.

34. Other.

More time (from start of a degree program) to complete program. It's hard to take more than 1 or 2 classes/year.
Problem is not enough video classrooms.
Have Pass/Fail classes instead of A, B, C, D, Fail. You either know the material well enough or not. GPA's are a pain.

SA-IV - NTU Nonparticipant

Q37. Other facilitators you feel are significant? (List all that apply)

The following responses to Question 37 are NTU Non-participants' written comments concerning facilitators to participation in Lifelong Learning. Response numbers match the listing of barrier themes at the beginning of the Appendix.

2. Supervisor and company support/encouragement/recognition.

Employer pays for education in engineering, business, science & computers.

3. Strong family support and company financial and moral support.

Employer pays for education in engineering, business, science & computers.

20. Company pays NTU fees up-front/eliminate income tax on reimbursed fees.

Company willing to reimburse for cost of classes through NTU.

34. Other.

Dr. Deming -- intrinsic motivation.
Personal satisfaction and intellectual growth experienced from "learning something new."

Q 59. List additional factors that you feel would act as facilitators to enrollment at NTU?

Q63. What new services or changes in existing services from NTU do you feel would better enable you to meet your lifelong learning CPE goals and needs?

The following responses to Questions 59 & 63 are NTU Non-participants' written comments concerning facilitators to participation in Lifelong Learning. Response numbers match the listing of facilitator themes at the beginning of the Appendix.

1. Self-paced courses --home viewing of video tapes with e-mail/fax homework.

Instead of satellite courses, NTU should have 100% correspondent study.
If courses/programs were available in VHS format.

5. Convenient down-link classroom or direct delivery to engineering work stations.

Convenience/location of NTU.

6. Self-scheduled learning course format (down-link @ work or home video).

Instead of satellite courses, NTU should have 100% correspondent study.
If courses/programs were available in VHS format.

9. More course variety from NTU in same discipline.

More management classes (Industrial).

11. DE oriented instructors and TA's that are accessible by phone or e-mail.

Better guidance, counseling.

14. Joint NTU/University degree w/40% of courses taken from one NTU University.

Cross-over or transfer to SPU ISM program.

15. Business courses and MBA program offered from engineering managers.

MBA offered through CPE.

18. NTU down-link classroom @ small non-NTU company worksites.

Public downlink.

21. Lower tuition & fees.

Lower cost.
Lower the price.
Lower costs.
Much reduced cost -- It is difficult to ask approval for a course that costs $1500 to $2000.
Lower cost.
Lower the cost.

23. More grading emphasis on homework and projects, less on exams.

Some practical mech. systems or design courses, not theoretical stuff.

27. Distribute/access NTU class notes and courses on Internet/www sites.

Public downlink.
Possibly a web-based curricula.
It would be nice to have Internet classes which do not require specific time attendance -- I've attended a few classes this way and they were successful.
A clear description of what is available, when and how to access it.
Web based class.

29. Ph.D. program through NTU downlink sites/Internet.

Addition of a Ph.D. EE program.

30. Marketing NTU programs with expanded satellite coverage w/Internet interface.

Public downlink.
Strongly advertise its programs in the market and how it can be equal or better than the competition, i.e. VPI.
It would be nice to have Internet classes which do not require specific time attendance -- I've attended a few classes this way and they were successful.
A clear description of what is available, when and how to access it.

32. Lower cost auditing and CPE short curriculum package, 2-5 course, 6-15 hours.

Specific short certification programming -- Windows, Telecommunications, etc. -- 4 to 5 classes = certificate.

APPENDIX M

RAW DATA SURVEY RESULTS FROM QUESTIONS 60-62, 64-65

Section 1. Participants Verbal Response Raw Data, Questions 60-62, 64-65, CPE Learning Goals and Resulting Change.

To learn more from NTU graduates about their continuing professional education (CPE) interests and concerns, several open ended questions were developed about their short-term and long-term goals.

The following questions relate to how NTU programs helped you achieve your CPE learning goals, and NTU services that would facilitate your success in meeting your goals.

SA-I -- NTU Graduates

The following are NTU graduates' responses to Questions 60-62, 64-65 .

Q60. Please describe your current short-term (<12 months) goals with respect to lifelong learning (e.g., no goals; meet licensure requirements; seek specific learning opportunities, etc.)

The following responses to Question 60 are written comments concerning short-term goals.

* No short -term goals: still trying to leverage knowledge gained from NTU/MOT.
* Ph.D. proposal.
* Starting new position so learning will focus on reading and self-study.
* To learn Spanish.
* Learn C++, learn more about SQL, learn more about Windows NT.
* Select Ph.D. program.
* Non in short term, just took new assignment.
* Specific opportunity; acquire additional skills in EMC engineering discipline.
* Maintain high-tech employment until I can get low-tech company off the ground.
* Maintain skills in the area of computer science & information technology.
* Learn about new software technology through non-credit courses.
* New job opportunities, new career.
* A Master's level course in telecommunications.
* Currently considering an MBA or getting more specific computer training.
* Sensitizing, MFG, calculus.
* Start home-based business.
* I will seek product training and certification.
* No preconceived goal -- will seek specific courses as need becomes evident.
* Local certification program in project mgmt.
* No specific goals. May take individual courses if they seem interesting.
* No goals except to maintain licensure certification.
* Get courses necessary to apply to Med. School.
* Seek specific learning.
* I moved from engineering track to a business track --- my goals relate to bus. mgt.
* Learn industry specific things -- not just course work.
* Complete 1st 3 courses in Engineering Management Masters Degree.
* Seek business learning.
* Currently enrolled in ED320, Educ. Psych., at local university.
* Learn Small Talk programming language and environment.

* Increased knowledge of networking.
* Read current industry practices in engr. journals.
* Refresh on CMOS, R&C Circuits, and synthesis.
* Learn details of ATM & switching theory.
* Expand knowledge in EE, CS.
* Keep up-to-date.
* Stay current in technical field. Continue to satisfy my need & desire to learn.
* Take in-house classes related to software & systems to use in future programs.
* Learn Win95 programming using Microsoft Foundation Class Libraries (Self-study)
* Seek certification.
* Looking for a new job.
* Specific engineering course work, registration exam review.
* Completion of a certificate to allow me to change job classification at work.
* Learn more about software testing and defect prevention.
* Internal training for expected project change for new development starting.
* Seminars specific to current & relevant technology.
* Technical proficiency, content.
* Help in job hunt.
* Meet a current job requirement.
* Continuing education in areas of interest.
* CAE -- Pro Engineer Training.
* Keeping up with new technology in field.
* NTU gave me education burn-out. Thanks for the survey -- will work on goals.
* Complete NTU MOT degree.
* Maintain certification req.'s; continue to broaden abilities.
* Learn material I need in my job, circuit design.
* Seek specific learning opportunities as needed for new job.
* Specific learning opportunities to learn skills that I need to advance in my job.
* Stay current on where my field is going.
* Certain business & language classes.
* Acceptance for Ph.D. program at local university.
* Labor Grade Increase ($$)
* Complete MBA at local university (I finished my NTU MS degree in '93.)
* Enhanced knowledge of current job skills.
* Shifting career to Oracle DBA. Quick ramp-up on new skills.
* There are too many good courses to pass up.
* Boost technical skills in specific areas, grow parenting skills.
* Learn about Internet.
* 1 specific goal -- sales training.
* Seeking specific learning opportunities in my profession.
* O.J.T. of Internet Tech., JAVA, HTNU, Web Servers ---
* Earn degree.
* Become increasingly technically competent in my new job.
* At the current time, I wish to finish a major project at work.
* Learn to be a good parent.
* 40-80 hours job specific training (e.g. Seminars and vendor training).
* Seek specific learning opportunities.
* Rotational assignments for experience.
* Learn as much new development in science & technology as possible.
* Specific learning opportunities -- C++ programming.

* Short term goals are personal, not professional as I am contemplating career change.
* Participation in forums/conferences.

Q61. Please describe your current long-term (>12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.)

The following responses to Question 61 are written comments concerning long-term goals.

* I have a B.S. in engineering , an MOT M.S. I'm considering pursuing a law degree.
* Ph.D., then teaching/research.
* Pursue Ph.D.
* No goals -- just keep usable skills current.
* Obtain teaching credential & Ph.D. in Bus. Adm.
* Possible Ph.D. in future.
* Seek certification in EMC Design Engineering; maintain competency and learn new methods and applications in engineering management discipline.
* Get personal, low-tech business started; leave high-tech industry because of age discrimination; Bad for 50 year old engineers; impossible at age 60-62.
* 2nd Masters or Ph.D.
* Ph.D.
* Would consider further formal process that would lead to career advancement.
* Job change.
* Obtain advanced degree (Ph.D.).
* Currently deciding between pursuing an MBA or more specific computer training.
* Keep current enough to be valuable in many employment scenarios.
* Ph.D. in computer science -- Neural Nets/PDP.
* Start home-based business.
* Remain current in management of technology field.
* No direct goals, other than to keep learning new things.
* 2nd M.S. in MOT, or, once family is grown, seek engrg/telecommunications Ph.D.
* Take courses as needed to stay current.
* I'm seeking another M.S. degree (geological engineering) from the Univ. of Idaho.
* Med. School; MBA as alternative.
* Possible MBA.
* Considering MBA.
* Start Ph.D. program (and complete it).
* Continue being up to date by doing reading.
* Complete Engineering Management Master's Degree (~4 years).
* MBA.
* Currently working on Teacher Certification in Math & Physics at local university.
* Unsure of long term goals; job/career change 4 months ago from NTU degree. Considering advancement, another job change or becoming expert/mentor here.
* Prepare to own my own business; Ph.D.
* More EE courses.
* MS in Telecomm Engineering.
* Additional degree.
* Additional degree, MBA. Also, keep up-to-date.
* Prepare for continuous changes in the corporate environment that are inevitable.
* Continue taking short courses to help current position; learn new technologies.

* Seek Microsoft Certified Solution Provider status.
* Perhaps another M.S. at a nationally recognized school if I got a good job nearby. If not & I have access to NTU, get an M.S. in a different engineering discipline.
* Certification in specialty.
* Ph.D. in education, if I can find a program.
* More formal SW Engineering Course work.
* Technical proficiency, content.
* Future career.
* Remain a strong technical contributor for life.
* Ph.D. (maybe) -- continuing education in areas of interest.
* Becoming expert w/in field.
* Within 7 months I will obtain second NTU M.S. degree. I will take a break.
* Better leverage talents to do "fun" work.
* Eventually Ph.D. in engineering management.
* Possibly MBA or Ph.D., maybe not though.
* MBA?
* Continuing education, but no additional degree.
* To stay challenged while at work.
* MBA or Ph.D. in engr.
* Ph.D.
* Prepare for career advancement/job change.
* After MBA, probably only occasional course work, conferences, etc.
* Career advancement, personal fulfillment, possible Ph.D.
* Pursue Oracle's DBA certification. Long term goal, management in new company.
* I plan to take at least 3 courses/year as long as company supports NTU program.
* Prepare for potential career change; Increase productivity in current position.
* Generally keep current with what is going on.
* Additional innovative management techniques.
* Obtain Ph.D.. to enhance/advance career.
* Obtain advanced or additional degree.
* Upward movement & increased marketability.
* I would like to continue and specialize further in communications systems/IC's.
* Keep current in my work.
* Get current in programming technology; then career change from test engineering to systems development.
* Prepare for career advancement/job change.
* Ph.D.
* Obtain another degree.
* Get doctorate in M.E. Become manager of my department in the next 3-5 years.
* Mid/Sr. mgmt./leadership.
* Maybe get a JD degree.
* Career advancement/job change.
* Enroll in MBA program at Stanford if I can do course work w/out relocating.
* Prepare for job change.

Q62. What major learning goals have you achieved as a result of your participation in academic courses at NTU or completion of your degree from NTU? (Explain)

The following responses to Question 62 are written comments about major learning goals.

* NTU/MOT degree helped me broaden tech. perspective to managing technology.
* Filled in CS background, learned about areas of interest, built textbook library.
* M.S. in Computer Engineering at NTU helped me get a better job in my company.
* A Masters degree in an engineering related field at age 50.
* Master's degree -- just something I wanted.
* Obtain M.S. - MOT.
* Broadened knowledge, especially in R&D Mgt. and international business.
* Well equipped to lead project/program development; help others with career goals.
* Moved into company management, then took the NTU training, then was laid-off.
* 1st Masters.
* M.S. degree.
* Became knowledgeable about software development processes.
* Completed Masters degree.
* A Masters degree with the recognition and financial reward as a result.
* Career evolution from Chemical Engineering (making Kodak film) to computer science (digital imaging).
* Finish my MS degree. There was a strong emotional desire to finish what I started.
* MSCS
* MSME
* I achieved attaining a Master's degree.
* M.S. in MOT.
* Master's degree.
* Organization, project mgmt., optimization techniques, economic analysis.
* Obtained M.S. degree -- may not have pursued M.S. without flexibility of NTU.
* Understanding of hazardous waste treatment.
* Computer programming.
* Received MSCS.
* MSCE
* I often use what I learn in specific classes.
* Got my degree and used it to get patent at work and start my own company.
* Developed a good, broad understanding of computer engineering.
* Achieved recognition, got a better job in an R&D lab, promoted to project mgr.
* Completed MS Comp. Eng.
* Received MS, Computer Engineering, then transitioned from Mech. Engineering.
* M.S., Engineering Management. Now understand business + project management
* MSCE; Expanded knowledge of CE.
* Have had CAD s/w development project.
* Cache Memories, Communications Protocols, Graphics (ray tracing), etc.
* Career advancement, expand knowledge.
* Expand knowledge, keep up-to-date. Better prepared for job.
* Satisfied a personal need to excel in an academic/learning environment.
* Continue advancement of myself & the knowledge that I bring to my company.
* Earned MS in Computer Science, which has opened some career opportunities.
* Completion of M.S.
* M.S.
* Obtain M.S. degree.
* M.S. Computer Engineering in Summer of 1995. That was my goal
* I got my M.S. degree in Software Engineering.
* Received Masters.

* Masters Degree
* Technical proficiency, new thing & way to problem solving.
* Keeping academic skills fresh.
* I have been able to keep current, just not to the degree I desire to.
* Broader academic background (MOT degree)
* Masters degree in complimentary discipline.
* Learned how to be a better manager plus degree in engineering management.
* Reached goals of thorough knowledge of computer science, tech. management.
* Formalized a significant amount of self taught information creating legitimacy.
* I was able to obtain my masters degree in computer science.
* M.S. engr. mgmt.
* Got my M.S. degree.
* Receive MS degree -- added to consideration for promotion.
* M. S. degree.
* Master's in Engr.; Remote studies helped me be focused, improved communication.
* M.S. of Electrical Engineering -- tremendous help in completing job assignments.
* Obtained M.S. degree.
* Academic background for project management work that I perform;
* NTU classes applied as prerequisites for MBA program.
* M.S.E.E. through NTU. Additional knowledge in areas of interest.
* My NTU M.S. helped me land a supervision job for a systems team, my LLL goal
* Completion of M.S. MOT.
* Proved to myself that I could still effectively learn in an academic atmosphere.
* I am well exposed to all types of (modem) digital communications in my work.
* M.S. MOT -- Broad understanding of business & ability to apply myself better.
* I have fun learning about graphics & imaging.
* M.S. in Mgmt.
* Ability to mesh environmental /haz. waste mgt. training with chemistry experience.
* M.S. Computer Engineering.
* Masters Degree in Computer Engineering.
* Masters degree in Computer Engineering.
* I obtained my MSEE and all of my coursework directly applied to my job.
* Master's Degree -- Broad knowledge base.
* NTU helped me complete several projects (gained significant knowledge).
* Developed understanding of the analysis & design of motion control systems.
* Coupled chemistry (B.S.) with metallurgical training.
* A better understanding of computer engineering and computer architecture.
* Moved to 1st level management.
* Broader knowledge.
* Wanted to improve management skills and I have done that through MOT degree.
* Computer science fundamentals.

Q64. What professional career/employment changes have resulted from your participation in academic courses or completion of academic distance education program at NTU?

The following responses to Question 64 are written comments about career/employment changes experienced as a result of completion of one of NTU's DE degree programs.

* Management seems to be better recognize my managerial capabilities, rather than viewing me only as a technical specialist.

* Quit job, went back to school full time to pursue Ph.D.
* Able to move from support position to a development/research position.
* Career change -- Retired & started new career & also started teaching.
* Aided me in obtaining a new assignment in procurement.
* Management position.
* M.S. Engineering Mgmt on resume, gets me a few more interviews than without it.
* I was able to change jobs from a technician to consultant with current company.
* I don't feel any changes have resulted from my degree.
* NTU M.S. enabled me to be more competitive in job market. I will probably take a new position within 3 months.
* I was promoted sooner than I would have been if I did not have a Masters degree.
* Career evolution from Chemical Engineering (making film at Kodak) to computer science (digital imaging).
* I have remained more technical than my peers and I have specialized in RDMBS.
* None. Didn't help my career one bit, but helped me keep a job.
* Recently hired at a much higher grade (position) & salary.
* Became MTS at Bell Labs, due to Masters degree.
* Corporations don't (& shouldn't) award promotions based on a degree. But, prior to achieving MSCE in '90, I was a systems analyst. I'm now VP, Business Devel.
* No changes but I do my current job better.
* I was able to mover into a hardware design job at IBM w/my degree.
* Became expert in image processing/became key technical person at work for this.
* Improved interactions w/software company.
* Got promoted to project mgr.
* I switched careers from mechanical engineering to computer/software engineering.
* Promotion with increased management, planning responsibilities.
* Increased confidence in self, for better leadership.
* 2 advancements since degree.
* Ability to lead choice projects like Cable & Controllers; Network Controller Asics.
* Career advancement.
* Better qualified for my job. More job opportunities.
* Better prepared to fulfill/expand challenges of current position, deal with change.
* It helped me grow more knowledgeable & advance more rapidly at my company.
* The MSCS degree helped open career options; gave me more confidence at work.
* Advancement, salary increases.
* One step closer to a promotion.
* Moved to a SEPA Group after completing my degree program.
* Degree helped in promotion to R&D project manager.
* Degree completion was strongly recommended for my current job position.
* More job opportunities outside current employer. Currently making a job change.
* Helped me to form a company.
* None-- quite disappointed in this.
* I am a better ranked engineer, but no promotional changes.
* None. Brief change in job; now back to product development (engineering job)
* Moved from lead engineer to program manager.
* New career.
* I've not changed jobs but have new challenges, higher pay from my NTU courses.
* Went from engineer to manager for a short time.
* Let me keep my current job -- meet company requirements.

* Able to move into marketing & be a more effective technical leader.
* My M.S. degree broadened me a lot, got a better job.
* Possible career promotion.
* MSE qualified me for a new job.
* Opened door to job's not possible before M.S. Degree was earned.
* A move into a job that is more rewarding personally.
* NTU masters degree helped me land a supervision job for a systems team.
* I am one of most well-rounded technical consultant in my department.
* Job change and a stronger commitment to balancing work & home life.
* Change of jobs within my company.
* Have moved into management position.
* Left company which paid for NTU courses; 50% pay increase in 2 years.
* Because of Materials Science Degree, I was assigned to failure analysis group.
* Recently appointed IS/IT manager for large manufacturing organization.
* I have been able to be more involved in the technical work at my company. I also believe that [M.S. degree] completion led to a promotion.
* I have become a division wide resource in systems design and analysis.
* Increased my knowledge in many ways.
* I've decided I prefer management to engineering.
* Felt I was becoming obsolete; now I feel competent and more flexible in my work.
* Better understanding of imbedded system development.

Q65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

The following responses to Question 65 are written comments concerning major life changes experienced as a result of completion of one of NTU's DE degree programs.

* Quit job, went back to school full time to pursue Ph.D.
* Career change -- Retired & started new career & also started teaching.
* Improved belief that I can learn even if "out of formal education" loop for a time.
* Better equipped to help others & locate specific info through research.
* Nothing major. I achieved a goal and moved on to other goals.
* I don't feel any changes have resulted from my degree.
* New positions/career will result in a major shift in my lives and my family's life.
* I switched jobs to receive a major increase in pay.
* Career evolution from Chemical Engineering to computer science.
* I started Ph.D. at GA Tech, left school to work, moved to NC & was able to finish an MS. Emotionally, I feel like I finished something that needed finishing.
* I realized that I do not want more formal education (too hard w/family and work).
* I am a more effective manager.
* I am a distance learning advocate. I talked 2 others into getting NTU degrees.
* Feeling of accomplishment in earning M.S. degree; more confidence in my abilities.
* I am well skilled in PC programming.
* (1) I have moved from engineering to a business track; (2) additional empathy & support for spouse in her pursuit of MBA; (3) with spouse, celebrated with first child (smile)!
* I think I am more confident.
* Personal satisfaction from receiving my degree.

* I quite my job and started my own company.
* Personal sense of pride, accomplishment.
* I switched careers from mechanical engineering to computer/software engineering.
* 2 more kids.
* Improved self esteem, confidence, feeling of self-worth & ability to contribute/lead.
* I am more confident in the decisions I make.
* After completing my degree, I had free time. (I got a life).
* I am in the process of changing careers from software development to teaching.
* I recently accepted a new job with another company for more money.
* Formed a company.
* More free time now that I'm done.
* Better job satisfaction.
* Considering Ph.D.
* Burned out -- never want to take another class while in the work force. Negatively affected my marriage and relationship with children.
* I have greater confidence and I have greatly increased my breadth of knowledge -- although my wife left me for a time largely due to my NTU efforts.
* I feel much more confident taking advanced engineering course.
* I gained understanding of industry management; it opened advancement doors.
* I spent so much time doing homework that I stopped working overtime. I never working overtime again when I finished NTU; now I use that time to play.
* More money & have access to better jobs w/my MOT Degree.
* No real life changes (except 2 kids). Just a feeling of accomplishment.
* I've moved to a new IS/IT engineering management position, better career.
* I feel more confident, and no longer am afraid of taking challenging coursework.
* More career opportunities.

SA-II -- NTU Admitted

Q60. Please describe your current short-term (<12 months) goals with respect to lifelong learning (e.g., no goals; meet licensure requirements; seek specific learning opportunities, etc.)

* Learn skills needed in new project at work.
* In the next 12 months, would like to take a few refresher courses in electronics engineering.
* Complete masters degree this year.
* Take a course or two a year as time permits.
* Complete MS degree.
* Complete Masters Degree in Eng'g Mgm't w/ certificate in Economics & Finance.
* 3 NTU classes completed toward degree.
* Complete M.S. in Manufacturing Engineering.
* None -- take a bread. Degree program took 6 years.
* Completing Masters Thesis.
* Participation in company courses only, no advanced degrees programs at this time.
* I'm trying to use my recent MS degree to advance my career.
* Seek learning directly related to job responsibilities.
* Take a 2 semester break from NTU, I'm burned out!
* Obtain engineering management degree.
* Complete 2-3 NTU courses; complete 3-4 work related courses.
* Graduate!

* Department change. Learn more on JAVA and working with people.
* Take courses towards MSEE.
* Increase knowledge of Window NT 4.0 through training & application. Also increase knowledge of IBM DB2 through training & system support.
* Earn masters degree.
* Start on masters in CS to keep skills up-to-date.
* (1) Complete current NTU courses. (2) Learn JAVA.
* Working towards PE, 6 Sigma blacubgve (sp) certification, continuing to work on MSEE (I am an M.E.)
* Obtain my professional engineering license.
* First goal is to finish masters degree.
* Seek specific technical & personal improvement that will benefit job performance.
* Taking 2 more courses on degree path.
* Obtain M.S. degree.
* Learn.
* Taking individual course of specific need or interest.
* Continue with M.S. program (1 course per term).
* No goals due to lack of company support.
* Take 1-2 courses as tuition is available.
* Finish MSEE degree with NTU.
* Keep in practice, keep up-to-date on technology changes.
* Complete 3 courses for this year.
* Complete one semester course @ a time and blend in computer engineering courses w/biomedical courses @ a local university.
* Finish Master's thesis, participate in company taught management/people courses.
* Continue to learn objectt oriented concepts.
* Complete last course for MS degree -- break.
* Continue to pursue MS degree in Engineering Management.
* No goals now -- wind down before starting another Master's degree.
* Continue with MTU couse studies.
* Continue school.
* Learning material which is closely related to my field (integrated circuit design). * Complete degree.
* Would like to squeeze in a class.
* Work related courses on current technology HTML, WWW, SONET, etc.
* Apply education on newly acquired job; gain experience from current job.
* Learn more about subjects I am interested in.
* Occasional study in any areas of interest- w/o desire to become highly specialized.
* Take supervisory courses.
* Seek specific learning opportunities.
* MSEE
* Take another course throught NTU next fall.
* CMOS design, C++ improvement.
* Update my engineering skills.
* Develop strong understanding of information systems.

Q61. Please describe your current long-term (>12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.)

* Masters in computer science.
* I would like to earn a masters degree in electronics engineering.
* MBA or Ph.D. -- Haven't decided yet.
* Obtain advanced degree.
* Refresh technical knowledge (specific).
* Take courses for personal reasons.
* Complete Masters in Software Eng. -- 2 1/2 yrs. Start Project Manager certificate.
* Prepare for Plant Mangers position. Possibly prepare for entrance to a Doctorate program.
* Additional classes, no additional degree programs. Classes will be started towards hands on experience -- homework & labs -- not proofs & tests.
* MBA degree, certificate of accomplishment in courses specific to telecommunications.
* Preparing for a career advancement.
* Seek learning directly related to job responsibilities.
* Complete my CE masters.
* Continue advanced learning branching into other/new technical areas.
* Complete Masters degree; Obtain Masters certificate in other field.
* Class in telecom.
* To obtain MSEE via NTU.
* I would like a masters degree in computer science.
* Career advancement.
* Obtain MSCS for possible career advancement.
* (1) M.S. Comp. Sci. (2) Stay "current" to improve job security.
* Working towards MSEE for managing advancement in future.
* Learn more about power systems in industrial facilities.
* Look to obtain more specific courses, perhaps certificate in specialized area.
* Advanced degree, probably MBA, not technical.
* Obtain M.S. in computer science to go with my Ph.D. in chemistry for career in scientific computing.
* Maintain job skills.
* Get master's.
* Seek a non-technical, less technical degree (i.e. MBA).
* Obtain M.S. degree, job function to follow using new skills.
* Complete M.S. degree or obtain certification.
* Obtain advanced (M.S.+) degree in specialty or another MS in another field.
* Work toward Ph.D. degree to enhance career opportunities.
* No current goals -- other than upkeep.
* Advanced degree.
* Complete my master's degree.
* Job change to Computer engr. medical sciences environment, complete Masters in Computer Engineering, continue studies in Biomedical Engineering.
* Obtain marketing and management experience, own business.
* MBA
* Complete EE or EM Masters degree.
* M.S. Degree.
* Work on another Master's Degree, rest for few yeares, resume cycle.
* Prepare for career advancement and advanced degree.
* MSEE.
* To complete Ph.D. in Chemical Engr.

* Obtain MSEE Degree.
* Begin work on Ph.D., or perhaps apply/enter law school.
* Obtain degree for personal satisfaction.
* Seek certification in a specialty outside of what NTU can offer.
* Would be nice to get adv. degree, will try to take more classes to finish.
* Executive MBA.
* Maybe MBA or take EIT.
* Master's & job change.
* Seeking P.E. Registration (Studying for Exam).
* I plan to take more management courses
* Prepare for career advancement.
* MBA; PE.
* MSEE degree from NTU.
* MBA, library science.
* Pursue a Ph.D. in Operations Mgmt.
* MBA (International focus).

Q62. What major learning goals have you achieved as a result of your participation in academic courses at NTU or completion of your degree from NTU? (Explain)

* I have received a masters degree in engineering management from the NTU. Also completed two courses in IC -- IC 701& IC 702.
* Masters degree almost done.
* Increase knowledge of corporate finance (as relates to engineering).
* Nearly completed my Master's degree.
* Over the hump (midpoint) in obtaining Masters degree in MSE.
* Understanding of Strategic Planning goals w/in most all companies.
* Updated skills, broadened background on current technology.
* Better understanding of the business aspects of engineering companies.
* (1) Proof that I could continue education successfully.; (2) Additional skills as an Engineering Manager (MSEM).
* Financial understanding of the business, mgmt. of people with emphasis on engineers.
* Received M.S. as of Fall '96.
* Graphics and genetics knowledge.
* Almost have masters degree.
* Business related degree.
* M.S. in software engineering.
* None -- NTU course turned out to be more than I could handle due to not taking prereq.
* Stay current with technology issues.
* Completion of several NTU classes.
* I've stayed w/ NTU.
* Received my masters degree.
* Working on my masters degree (personal goal) technical enrichment.
* Completed course that gave overall view of type related to current assignment.
* Have gotten some really great instructors and broadened my knowledge base.
* Exposure to management courses.
* Learn computer architecture.
* Ability to further my expertise in my field faster & with less personal time impact than peers.

* Completed 1/3 of M.S. program.
* Earned M.S.
* More knowledgeable of engineering methods and practices.
* While working I feel I have better insight into course objectives in terms of applications.
* Obtain variety of information for course selections.
* Availability of real-time and embedded courses that were not available via local university.
* Masters in MOT provides better insight into technical business activities.
* Preparing for programming job.
* Ability to get Masters of Science degree with the job requirement of traveling.
* Simply getting my Master's so I could take classes my undergrad. degree did not allow.
* Completed Masters Degree in Hazardous Waste Mangement.
* Update my knowledge in several areas.
* Passed Ph.D. entrance qualifier.
* Some course material has helped me with my job assignments.
* Staying abreast of current techologies in my field, broadening foundation in my field.
* NTU degree is expensive and is not well recognized by the rest of the World.
* Valuable learning, as it directly applies to my career.
* M.S. Computer Engineering.
* At the time, NTU course was the only source to understand my job (Electronic packaging)
* Completion of my MSME -- personal achievement goal.
* I just completed my primary goal to get a Master's Degree; I'm still capable of learning new areas at my age [55].
* MSEE 1996 -- NTU.
* MSEE; better chance at MBA admission; technical knowledge.
* Only took 1 class so far.
* NTU MSCE @ IBM, Tucson, resultin in new job here in Austin (IBM).
* Have successfully updated some of my engineering skills.
* Developed better understanding of information systems.

Q64. What professional career/employment changes have resulted from your participation in academic courses or completion of academic distance education program at NTU?

* Much better understanding of Mgmt & software engineering.
* Skills obtained in "Operations Research Courses" helped me contribute in a major contract.
* Raised confidence in marketing for career opportunities.
* Promotion to staff position for Vice-President @ AMP.
* I understand and can participate in business decisions in the engineering field.
* Interest in further CPE activities.
* I have a better understanding of the business aspects in the engineering field.
* Easier to complete degree requirements.
* Looks good on annual review.
* Better understanding of IC(integrated circuit) design.
* I have become more technically competent. When I decided to leave my employer for no recognition, I had not trouble finding another position.
* Better understanding of topics.
* None yet -- but I am working in scientific computing now.

* Better understanding of comp. arch.
* Change positions in company to an area I'm more productive and comfortable in.
* More interesting technical work (also more challenging).
* Better financial /management understanding from courses taken.
* I am now seriously considered for mgt. positions.
* Possible promotion and career change.
* I believe my options have expanded but nothing beyond that.
* Raised one level in job class.
* Better recognition among peers/management.
* Greater potential for advancement; greater understanding of other perifpheral areas.
* If I get another degree, I would choose a well recognized university.
* More choices in career opportunities.
* Got a new job with the same company. Having MS degree has given me higher status.
* I'm in the same job -- doing same type of work & w/o much effect in compensation -- But personal sense of competency is increased.
* Changes are in negotiation at this time.
* Change in employment and skill set for which I was hired.

Q65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

* Allowed me to understand and appreciate other peoples areas of work.
* Reduced free time (family/friends).
* Met "my husband" who was also taking classes. 3 years marriage -- 4 yr. degree! Wow! * Less time to be social.
* High blood pressure! Realizing many academics are out-of-touch and they think they know more than they really do. They sometimes think that students are not customers.
* More free time due to no long commutes to school.
* Slowed down my pursuit of masters degree.
* Can't spend as much time with family as I would like. There is a lot less free time.
* Less time with family.
* Proved that if I set goals and work hard then I can achieve anything.
* Self-esteem in learning.
* I have a higher education degree, giving me personal satisfaction of accomplishment, new opportunities will follow.
* Less free time for hobbies.
* If anything, it has kept me from moving on w/ my personal life due to the need to put energy outside work into classes.
* Greater stress in marriage & child relationships.
* My stress level has plummeted since I got my degree. Helps that my 1st baby was born a week before my last set of finals.
* Possible larger raise; ability to relocate to better paying jobs.
* Less time with family.
* Greater respect from peers; greater self esteem.
* Lots of hardships: I appreciate my family more; Intensive program like NTU's wreaks havoc in personal lives.
* Respect from society reserved for those with Master's degree.
* I had not time for a social life while participating in cousework in addition to full-time work. Now enjoying a more "normal" balance of activities.
* Move to Austin, new career.
* Moved to a new location with new company due to development of better I/S skills.

SA-III -- NTU Taking

Q60. Please describe your current short-term (<12 months) goals with respect to lifelong learning (e.g., no goals; meet licensure requirements; seek specific learning opportunities, etc.)

* I recently completed a second MS at age 45. I'm taking a break!
* Seek specific learning opportunities (e.g. DSP techniques).
* Work towards Masters in Engineering Management.
* Seeking information on communication circuits and systems.
* Continue education, matriculate in a Master's degree program.
* Seek specialized technical skills where academic courses are not available (e.g. NT drivers).
* Remain current in technology, expand technical knowledge.
* Complete MS in telecommunications.
* My last class burned me out slightly. I'm taking one semester off and then intend to take an undergraduate programming course (something I'm deficient in).
* Job change.
* Continue coursework in fulfilling degree requirements.
* Just finished MS in Engineering. Short/long term goal is to enjoy life!
* Accumulate courses towards Master's degree.
* Continue coursework @ Brown Univ. for MS-Comp. Sci.
* Go to school "full-time" get a recognized & reputable MBA degree.
* Find new job and seek necessary training for future.
* Matriculate in Master's program in Material Science.
* Reinforce (review) basic skills, learn new fundamental skills (breadth of knowledge), learn about recent developments in my field.
* Continue work on Masters; preparation for P.E. Exam.
* I have just completed the first semester of a Masters program at a local college. I hope to graduate in about one year and a half.
* Keeping up-to-date with industry trends.
* Working on doctoral.
* Continue toward MS.
* I would take two more NTU courses in the next two semesters if funding is available.
* Seek specific learning which directly relates to job.
* Continue classes.
* Look for specific learning opportunities related to ICS/computers/communications/IC test technology. My strategy is to find interesting classes taught by "gurus" -- i.e. David Patterson for computers, Paul Gray for analog design.
* Increase knowledge in current job.
* Continue optics education through Univ. of Ariz.
* Take 3-4 NTU courses toward M.S.E. (Mfg. Syst.) degree requirement. 50 + hrs of coursework @ Company Training Ctr.
* Keep up w/state-of-art technology.
* No Goals -- "Surviving deadlines at work" [smile].
* Working towards MS Engr. Mgmt. -- in next 12 months will continue towards this goal.
* Update skills for changing technology.
* Take at least 2 classes!
* Learn more communications theory and IC packaging theory.
* Finish 6 credits.
* Work-time in-house training, followed by possible MBA.

* I seek to broaden my engineering knowledge and to keep my basic skillset from eroding.
* Seek specific continuing education courses.
* Enrich my knowledge base, stay on "cutting-edge".
* Study DSP, modulation theory. Become conversant in trends in wireless communications. * Seek specific information related to work.
* Complete bridging courses from BSEE to BSCS.
* Keep pace with industry changes in field.
* Seek learning in specific areas.
* Obtain Cert. Qualified Engr. (CQE) certification/status
* Obtain knowledge related to current job.
* Finish Master's Degree.
* I just finished my Masters at UW-Madison
* Stay current with technology.
* Enroll in a MBA program if my initial goal fails.
* Seek specific learning.
* Convince my new company to set up NTU courses.
* Would like to stay "In Shape" for P.E. Exam.
* Goal is to take 1-2 courses in electrical engineering/optical engineering (non-degree).
* Get admitted to Business School.
* Seek specific learning opportunities.

Q61. Please describe your current long-term (>12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.)

* Learning new technologies.
* Retain/advance knowledge base & skills w/in my discipline.
* Prepare myself for job change.
* Complete Masters in Engineering Management by mid-1999..
* Seeking information on communication circuits and systems.
* Obtain MS Eng. Mgmt., Learn specific skills/knowledge in a targeted topic (Quality in Education), PE.
* Continued learning in Software Engineering. A degree is not specifically important -- knowledge is!
* Obtain advanced or additional degree.
* Complete MS in telecommunications.
* Broaden my base of technical understanding, review analog circuit basics. Learn more programming. Learn more about UNIX administration so that I can customize my work space a little better. Goal: To improve how efficiently I do my job.
* Career advancement.
* Pursue for career advancement and degree completion.
* Ph.D. in Engineering.
* MS in Telecommunications and job change.
* MS-Comp. Sci. from Brown Univ.
* Obtain M.S. degree.
* Get an MBA from Harvard/MIT/Wharton & seek job in manufacturing.
* I intend to take relevant courses, and adapt as needed. I have no specific degree or certification plans.
* Obtain Masters, obtain Ph.D.
* Reinforce (review) basic skills, learn new fundamental skills (breadth of knowledge), learn about recent developments in my field.

* Get P. E. License, receive Master's In Engineering.
* I have just completed the first semester of a Masters program at a local college. I hope to graduate in about one year and a half.
* Keeping up-to-date with industry trends.
* Job change.
* Achieve MS.
* I would like to continue taking graduate courses in the mfg. field -- until I reach my goal of opening my own small furniture factory.
* Prepare for career advancement, avoid obsolescence.
* Finish degree MSEE.
* Obtain MSEE (through NTU or other institution) to facilitate career advancement. Take classes in non-technical areas that will add to my skills; i.e. project management, other business & management related classes.
* MBA -- prepare to run own company.
* Obtain M.S. or Ph.D. in Optics.
* Finish M.S. Degree w/in 2 yrs; study for E.I.T. & P.E. exams.
* Prepare for career advancement or job change.
* Career change.
* Working towards MS Engr. Mgmt. -- in next 12 months will continue towards this goal.
* Update skills.
* Expand career options.
* Management training.
* Finish M.S.E.E.
* MBA -- via NTU would be a strong possibility if offered!
* I seek to broaden my engineering knowledge and to keep my basic skillset from eroding.
* Take courses to augment marketable job skills.
* Maintain/update knowledge & skills.
* Obtain graduate degree, become senior engineer @ Company; Leader in applicable knowledge @ the Company in wireless technology.
* Keep current with technology changes.
* MSCS.
* Prepare for career advancement.
* MBA or MS???
* Round-out engr. subject knowledge; proceed w/obtain MBA.
* MS in Manufacturing Systems.
* Prepare for career advancement.
* Obtain current technology trends to stay professionally competent.
* Filling in gaps of technical knowledge, especially relating to technical management coverage.
* Anticipate technology shifts.
* MBA
* Obtain an MBA for career advancement.
* Obtain additional degree.
* MBA
* Finish Ph.D. at local university.
* Want a M.S. but w/as many business courses as possible. Maybe MBA or law degree.
* Advanced degree in optical physics/engineering and/or EE.
* Obtain an MBA within 3 yrs.
* Prepare for career change/advancement.

Q62. What major learning goals have you achieved as a result of your participation in academic courses at NTU or completion of your degree from NTU? (Explain)

* Completed M.S. Optics at University of Arizona Dec '95.
* I was able to move to different branch of my profession that offers more future opportunity.
* No major goals achieved thru NTU yet at this time -- only 1 course taken.
* Learned C++; improved knowledge of Software Engineering; increased appreciation for SE.
* Expanding technical knowledge.
* Major learning goal -- Completion of 4 Master's courses while maintaining "B" average.
* I took a computer architecture class that gave a global picture to the project I'm working on.
* The goal is a certificate of completion, which requires 1 more class.
* Technical information on current and future advances in field of semiconductor devices.
* MS in engr.
* Surpassed education requirements in applicable job.
* Personal fulfillment.
* Prepare myself better for my job.
* Able to get my bachelors degree on time (i.e. after only 4 years).
* Was able to explore new research area for department.
* I was not degree seeking with NTU.
* I have only taken one course and am just starting to work towards my goal.
* Acquired proficiency in waste management that I did not possess before.
* Have successfully completed advanced, Master's level courses in IC and computer fields
* Decided did not want to be development EE.
* Increase knowledge in Optics/image processing.
* Better "Systems" understanding of mfgr.
* Learning VHDL.
* Better understanding of logic design -- better understanding of current designing.
* Programming skills. I have a B.S + M.S. in EE but needed C.S. skills for my job.
* Learned a new programming language, updated my skills.
* Taken a course that I otherwise wouldn't have been able to take.
* SMU MS Telecom--Dec. 14, 1996! Well worth the major effort and personal time sacrifice.
* I am considered an engineer who can do many types of work: RF/UW/Analog circuit design/DSP/Imbedded control formware.
* Maintenance.
* Pursuit of knowledge & apply this knowledge to specific jobs, "Big Picture" understanding.
* NTU does help to get up-to-date engineering information, esp. wireless design.
* Completed majority of bridging courses.
* Increased knowledge base for current position.
* Better understanding of business-side (Management Theory, Accounting)
* Partial fulfillment of my Masters in EE.
* Transferred NTU credits to Madison toward MSEE degree.
* Understanding of specialized technologies, applications.
* Began formal grad school level classes.

* My completion of a bachelor's degree. Although it was my last class, I did get special approval to complete it through NTU.
* Received my MSEE with some classes I took through NTU.
* Gained some insight into finance.
* Exposed to coursed not available locally.
* Have kept my head in the "learning more".
* (1) Obtain MS Engineering degree; (2) Obtain basic understanding of areas not directly related to current job.

Q64. What professional career/employment changes have resulted from your participation in academic courses or completion of academic distance education program at NTU?

* Better able to apply many new technologies to work. Improved performance.
* I moved to a different branch of my profession that offers me more opportunities in future.
* Improved technical skills in communications area.
* My software engineering helped me find a better job!
* Have better understanding of the industry issues my company deals with
* I feel more secure while enrolled (& learning) in this program.
* None, except that I have become disgruntled w/my employer for not rewarding my efforts. This and other functions lead me to look for other employment.
* I have taken only one course, no career changes have resulted, however expect positive changes with course completion.
* Raise in salary, promotion pending.
* None. My company does not reward or evaluate employees for NTU courses taken.
* Became project leader due to acquired knowledge in specific projects.
* I feel better prepared to meet the rapid pace of technological change in semiconductor field.
* Opened up opportunities in test engineering.
* Deeper knowledge of optics -- more effective in job.
* MS Engr. Mgmt. will qualify me & prepare me for future Sr. Mgmt. position.
* Object oriented programming experience.
* Limited career change; staying focused on technology important on the "Technical Ladder".
* My knowledge is considerably wider; I'm probably ranked (performance) higher as a result.
* Advanced to new salary ceiling! "Big Picture" Understanding.
* Was a factor in my promotion to VP-Engr.
* Recognition.
* Higher level engineering job in the current position.
* Increased my knowledge base; helped me progress on the technical ladder at work.
* My degree was finalized and I switched jobs.
* Better awareness of other areas not covered by local university.
* Understand concepts better.
* Transfer from Produuct/Test Engineering into Semiconductor Design Engineering.

Q65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

* Self-worth appreciation.
* Besides lack of sleep; I would say a little more pride and self confidence.

* Advanced knowledge will provide job security and personal career satisfaction.
* Peace of mind, financial security.
* Organizing my time and extracting information from texts.
* Usually social activities drop off or stop during NTU classes.
* I've proved that I can be an "A" student (as an undergrad at U of I -- Champaign/Urbana. I was a B-/C+ student.) I've learned how to apply myself better. (The threat of having to pay for the class myself for grades lower than B may also have helped to motivate me!)
* More focus on time mgt. (i.e. Job vs Home/social life vs NTU coursework).
* More confidence in my programming skills, better mastery of my skills.
* Fewer social activities during semester.
* Example to my kids, and fellow workers. Several engineers in my group now attend NTU.
* "Big Picture" Understanding.
* Understand my own capabilites of managing career and learning (First class/eye opener.)
* Major stress.
* My degree was completed giving me the sense of security.
* New found excitement in education fostered by alternate learning opportunities.

SA-IV -- NTU Nonparticipants

Q60. Please describe your current short-term (<12 months) goals with respect to lifelong learning (e.g., no goals; meet licensure requirements; seek specific learning opportunities, etc.)

* Professional certification & leadership, career development.
* Learn new skills and keep current.
* Expand knowledge in specific areas (ground water remediation and investigation)
* Attend graduate studies by September o 97.
* Have been accepted intc Seattle Pacific Univ's. Ifo Sys Management Masters program -- want to pass!!
* Seek specific skills to meet the market requirements to feed myself.
* Goal -- CIH, CSP.
* Take two graduate classes from VPI -- Economic Evaluation of Industrial Projects and Operations Research.
* I am currently at home raising my children.
* I'm a full time graduate student. Also I work part time as Network Support/Admin.
* Masters in Management -- continue
* Applying for MPH (Masters in Public Health) program at University of New Mexico. Been taking class in program for 3 semesters.
* Seek opportunities to develop expertise in training and organizational development.
* Meet licensure requirements.
* Take 1 professional short term course.
* Get CNA &/or CNE for Novel 4.1. -- meet job req't.
* Meet licensure requirements. Presently starting family.
* Seek specific learning opportunities in areas of interest.
* Learn another language, either Japanese or Chinese.
* Take a few classes to enhance knowledge.
* Seek certification to change short-term job assignments. Too much the same type work.
* Continue to take classes towards master's degree in computer science.
* I want to improve my digital signal processing skills.

* Earn college credits toward computer science degree.
* Improve ME knowledge.
* Enroll in MBA program. Start SRO Class (in-house).
* Need refreshers in specific specialty areas (But not available)
* Keep up with changes.

Q61. Please describe your current long-term (>12 months) goals with respect to lifelong learning (e.g., no goals; prepare for career advancement/job change; seek certification in a specialty; obtain advanced or additional degree, i.e. MBA; etc.)

* Job change. Obtain masters degree and keep current.
* Will be looking to pursue an MBA to enhance my technical skills.
* Prepare for career advancement.
* Possible Ph.D. in Info Sys Management or learn three foreign languages: German, Japanese (or Chinese), and Arabic.
* Seek a Ph.D. to get someone to listen to your ideas.
* Obtain MSEE.
* MBA.
* Seek certification , advanced degree.
* I plan to finish my MEA (Management of Engineering Administration Degree) by Spring 2000. At that point I will make a potential career shift based on "How the land lies."
* Pass PE exams.
* Was interested in MBA or Master's in Chem. Eng.
* I will work after graduation.
* Complete Masters.
* Obtain an MPH (Masters in Public Health) degree.
* Ph.D. in either an area in policy development or corporate strategic planning.
* I am looking to change jobs.
* MBA.
* Complete MBA in technology -- personal goal.
* I have interest in pursing an MBA, perhaps pursue job change.
* Prepare to meet licensure requirements.
* Prepare for career advancement.
* Pursue a degree if necessary for a desired job position (BS or MS).
* Advanced degree.
* Obtain master's degree in computer science.
* I want to earn an MSEE and Ph.D. EE.
* BS &/or MS [in] Computer Science.
* Complete SRO class, MBA program, obtain P.E.
* Satisfy two year Prof. License Continuing Education Req'ts.
* Obtain advanced degree -- not sure what field.
* If time allow, obtain Ph.D. (Teach at university when retired).

Q62. What major learning goals have you achieved as a result of your participation in academic courses at local colleges or distance education programs? (Describe your educational programs)

* Advanced my skills, got closer to advanced degree.
* BS in Design Engineering. Advanced to Mfg. Supt.
* 1 year of German, Algebra classes (prepare for GRE).
* Good foundation of scientific learning, good foundation of analytical thinking, EE.

* MBA.
* MS.
* 3 courses down, 7 to go for masters degree in E. A. This degree teaches how organizations of the future must change to be successful.
* N/A -- Classes for CAD/CAM applications are offered by vendors.
* Have a B.S. in Chem. Eng.
* MSME Thru Univ of Illinois Extramural Program -- mostly video taped lectures.
* I'm more knowledgeable in my area.
* Continue in subjects relating to environmental health.
* Enhanced ability to perform job responsibilities, ideas to keep from becoming obsolete.
* Review courses in basic engineering as preparation for registration.
* Education useful at work.
* Completed BA at UOP.
* I have taken 1 course thru NC State DE program. Helped me realize that their current program is not really what I am looking for in terms of continuing education.
* Spot learning in specific areas -- not necessarily engineering.
* Have not participated in educ. since employment.
* MS coming in May.
* Able to job change into engineer from a computer operations type job.
* NA -- did not take any classes through NTU.
* I've taken a smattering of computer- and EE-related courses: Ada, C, Assembler, DSP, Kalman filtering, Random processes, ---
* 18 credits toward C. S. degree in past 3 years.
* Improve job skills.
* None--Nothing available locally except Environmental Junk!
* BS Electrical Engineering; MS Management.
* Keep up with technology change.

Q64. What professional career/employment changes have resulted from your participation in academic courses or completion of a degree from a distance education program?

* In line for promotion.
* I have gained invaluable knowledge in how to improve the organization that I am part of.
* My employer hardly recognizes my achievement.
* Job change w/in same corporation.
* Improved writing skills -- sense of accomplishment.
* Switched careers within current department after training.
* An in-plant course in Kalman filtering has been extremely helpful; I couldn't do my current job without it.
* Move (Relocate) w/increased work load.
* Better skills.
* Improved self esteem & better self confidence.

Q65. What major life changes have resulted from your participation in distance education academic courses or completion of a degree from a distance education institution?

* Wait and see in 3 1/2 years.
* My wife will soon be divorcing me because of the time I've spent trying to get this degree. I'm serious about what I've just said.

* Sense of accomplishment and confidence that I can work through difficult technical issues.
* Interest in entrepreneurial opportunities.
* Career opportunities more available -- can change jobs without worry about school location.
* Have a steady job/position within division.
* I enjoy taking challenging courses. For me it is like a hobby, like golf for some people.
* More time.

MISCELLANEOUS COMMENTS IN RESPONSE TO THE SURVEYS

SA-I -- NTU Graduates

Miscellaneous Comments of Significance on Specific Survey Questions, and General Comments Concerning Barriers and Facilitators of DE at NTU and Related Matters

* Q44. In the NTU MOT program, I found the academic standards to be very high, but NTU's reputation hasn't yet been well established.
* Q52. NTU/MOT course feedback varied greatly from course to course. Some professors were excellent with regards to feedback. On the other hand, on professor did not give any feedback at all.
* Q57. I took the NTU/MOT program. MOT degree is not available from local universities.
* Q20. Learning activities don't result in career advancement. 20 is often perceived due to lack of immediate advancement following a degree, but long term, a degree opens more doors.
* Q44. 1 out of 15 was unsatisfactory --- not NTU's fault.
* Q38. Advising/counseling -- very bad locally and at NTU.
* Q52 Only 1 course was unsatisfactory.
* Q32. Item 32 just doesn't exist for academic training.
* Q40. Availability of NTU courses does not exist.
* Q46. Don't exist.
* I quit working as an engineer in 1991 and began a more challenging career -- Mom. I just recently returned to work on a part-time basis, but my #1 priority is still my family.
* Q40. Excellent at GE; not available at E-Systems.
* Q44. Not recognized often.
* I think NTU is an EXCELLENT program; I recommend it to everyone.

SA-II -- NTU Admitted

* Lack of support by company was the biggest barrier after company withdrew support.
* Q54. Most did. T. Borak at CSU was totally inflexible!
* Q52. Sometimes I never could get my material, either stolen from student mail boxes, or instructor never got them back in time. This was frustrating, especially when semester exams were close to finals. You were at a distinct disadvantage without that feedback. *
* Q#47. I have had two site coordinators at two locations; one has been excellent, the other was horrible -- not providing course tapes on time or at all!
* I would like a course taught via NTU that would prepare for EIT or PE Exams.
* Q 33. I taped NTU courses enables me to do necessary business travel.
* Q 35. My organization pays the expensive NTU tuition--I could not afford on my own.

* Q52. Some multiple week delay in tests.
* The MOT Degree program was excellent. I was most pleased with the fact that all of us started together and we continued to work together throughout the program. The interaction with students and instructors was far and above any I had at my local college. Q#46. Poor quality of picture was due to my facilities in my office. If we had a classroom site, it would have been clearer picture, but maybe not as convenient.

SA-III -- NTU Taking

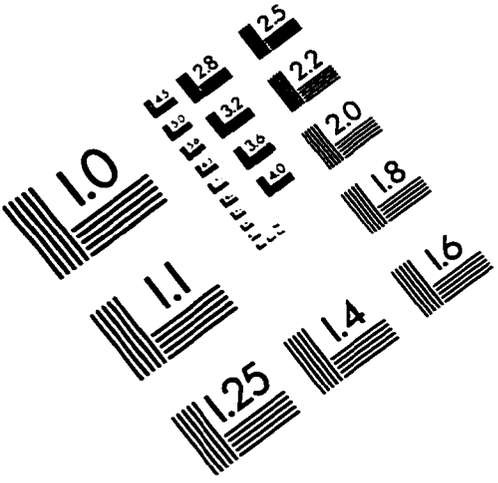
* Related to Q. #17, I find most courses in areas I'm interested in are too basic. However, I know of other University courses, but not thru NTU. NTU needs to expand to specialty courses of advanced graduate classes that may not appeal to a large audience.

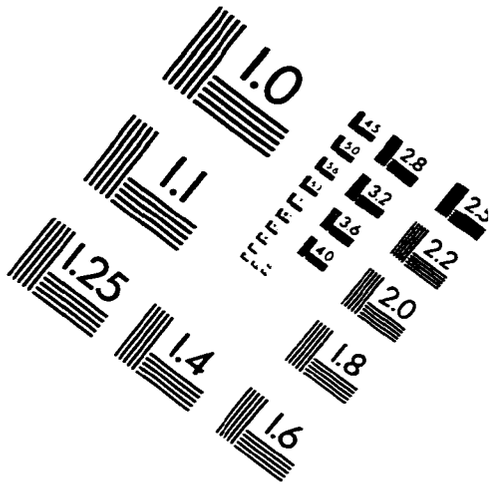
* #39. How many other companies know & accept NTU?
* Q40. Live satellite feed.
* Q41. Time off is allowed by my employer.
* Q46. Tape recipient.
* Q51. Satellite feed sometimes deficient.
* Q52. Real long turn-around time.
* Q29. it could be if there was such a thing.
* Q54 & Q56 above not applicable factors.
* Q31., this was never my purpose.
* Zero. It was one week into the semester that our [site] coordinator discovered we could not receive NTU courses! NTU did fine -- we did not! I have decided to attend ASU & take classes on campus.
* I have no major complaints -- the format works perfectly for me.

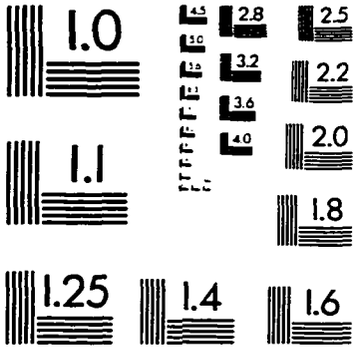
SA-IV -- NTU Nonpartcipant

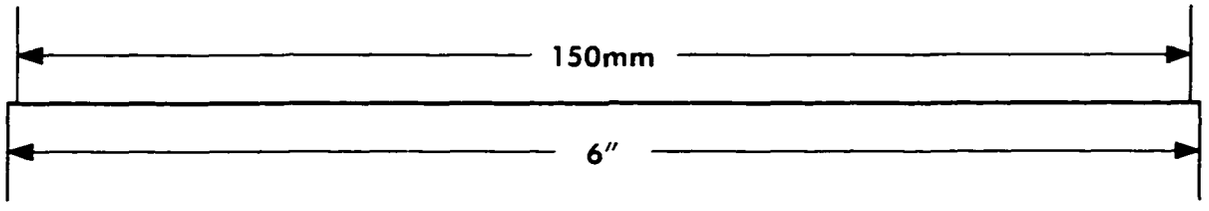
* Note: I did not take a class at NTU. At the time NTU was available at my location I was 85% complete with a MSME degree from Univ. of Illinois Extramural (videotape lectures).
* I wanted a document that said "Management Major -- courses needed: ___ , ___ , ____, etc." I had trouble seeing options.
* I don't know -- has more to do with personal circumstances than your services.

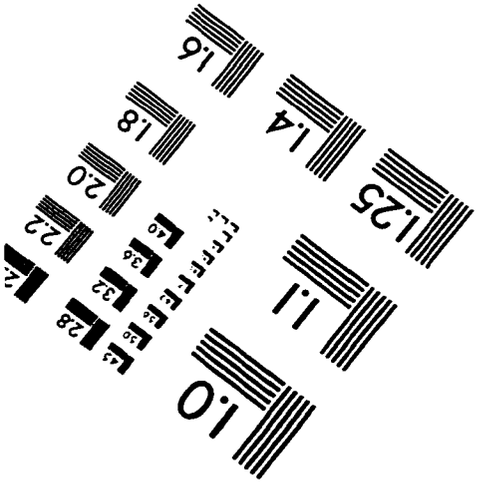
IMAGE EVALUATION
TEST TARGET (QA–3)

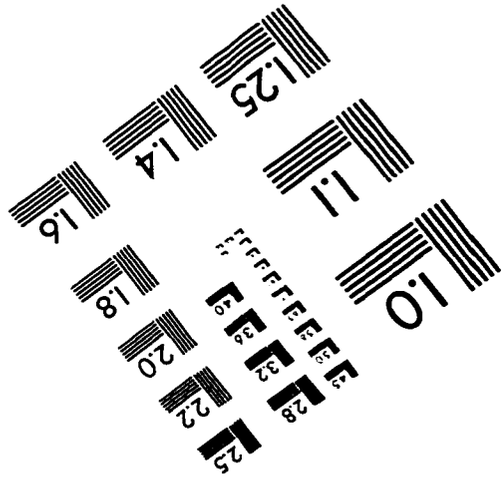












APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989