NAVAL POSTGRADUATE SCHOOL
Monterey, California

19980707 107

THESIS

COSTS AND BENEFITS OF NETWORK BASED INSTRUCTION AT THE NAVAL POSTGRADUATE SCHOOL

by

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June 1998

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DTIC QUALITY INSPECTED 1

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE June 1998	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE
COST AND BENEFITS OF NETWORK BASED INSTRUCTION AT THE NAVAL POSTGRADUATE SCHOOL

5. FUNDING NUMBERS

6. AUTHOR(S)
Sorenson, Brian K.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

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Conversion, hardware, administration and maintenance costs to provide an NBI course are examined in the cost analysis section. The benefit analysis examines benefits of reduced NPS residency, a career learning continuum, online reference, and short course savings in addition to other intangible benefits.

This study finds NBI to be a viable option for future learning at NPS. It is recommended that NPS proceed with conversion of courses into an NBI format. Knowledge gained during conversion of initial courses will be instrumental in the subsequent design of efficient and effective distant education programs.

14. SUBJECT TERMS
Network Based Instruction, Course Conversion, Cost Analysis, Benefit Analysis

15. NUMBER OF PAGES
107

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFI CATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 39-18

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COSTS AND BENEFITS OF NETWORK BASED INSTRUCTION AT THE NAVAL POSTGRADUATE SCHOOL

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Submitted in partial fulfillment of the
Requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

The Naval Postgraduate School's (NPS) Strategic Plan for 1998 addresses the significance of distant education in NPS's future. Network Based Instruction (NBI) utilizes new technology and the Internet to provide education at a distance. This thesis provides a framework which identifies the costs and benefits associated with converting, administering and maintaining a traditionally taught course using Network Based Instruction.

Conversion, hardware, administration and maintenance costs to provide an NBI course are examined in the cost analysis section. The benefit analysis examines benefits of reduced NPS residency, a career learning continuum, online reference, and short course savings in addition to other intangible benefits.

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I. INTRODUCTION

A. PURPOSE

This thesis explores the costs and benefits of converting, administering and maintaining a traditionally taught course at the Naval Postgraduate School (NPS) using Network Based Instruction (NBI) at a distance. This thesis will focus on the costs and benefits of providing a specific course utilizing one of several available technologies. There are many unanswered issues involved in providing graduate education courses and programs utilizing distance technology. However, policy and funding decisions need to be made. This thesis will present an analysis of the available information to assist policy makers in making better decisions.

Additionally, it is hoped this thesis will expose points for further study and generate interest among NPS thesis students in addressing the many unanswered issues and accelerating the process of providing distance education from the Naval Postgraduate School to the fleet and the entire naval organization.

B. BACKGROUND

The Naval Postgraduate School's Strategic Plan for 1998 addresses the need for developing distance education in its Vision statement, Guiding Principles, and five of eight Strategic Initiatives (NPS Homepage, 1998). Diminishing budgets paired with increasing requirements have forced NPS to rethink its current methods of operation and position itself to take full advantage of the potential efficiencies that new technologies offer. To maintain its viability, NPS must develop new programs that appeal to new sources of students, increase its efficiency and effectiveness, and lead the way in its development as the "University of the Future."

As NPS aligns itself for the future, distance education is clearly required to attain success and security in a rapidly changing world.

Numerous issues leave little doubt that distance education must play a significant role in NPS's future.

First, rising costs and decreasing budgets have reduced the ability of both the Department of Defense (DOD) and civilian corporations to fund personnel for periods of extended education. As a result, many institutions of higher learning are quickly developing distance education programs that allow students to earn masters degrees without the inconvenience and expense of leaving their jobs and current locations. If NPS cannot become competitive in providing this service, it could lose a significant number of students to other institutions that are able to deliver comparable academic material more cheaply, using advanced technology. Due to the relevance and uniqueness of NPS degrees, it would be unfortunate to lose those programs that are vitally important to the DoD.

Second, there are many potential students who cannot afford 18 to 27 months away from their professional community to obtain a graduate degree. Distance education could reduce the total time spent in residence at NPS and allow more personnel the opportunity to obtain a graduate education.

Third, conversion of course material to an electronic, NBI format would allow NPS to provide a continuous on-line educational reference tool to NPS graduates. Additionally, it would provide portions of a career learning continuum to naval officers and career Department of the Navy (DoN) civilians who have never set foot on NPS grounds.

Finally, utilizing distance education for short courses could allow savings in travel, lodging and opportunity costs for personnel who could take the same courses at their permanent commands vice traveling to NPS.

C. RESEARCH QUESTIONS

1. Primary Research Questions

a. What is the cost of converting, administering and maintaining a Naval Postgraduate School course that utilizes Network Based Instruction technologies?

b. What are the benefits associated with Network Based Instruction?

2. Secondary Research Questions

a. What types of courses are suitable for the distance learning environment utilizing Network Based Instruction technologies?

b. What constraints affect the conversion of courses into a Network Based Instruction format?

D. SCOPE

Utilizing cutting edge technologies to provide graduate education at a distance is a new and dynamic subject area within the military, corporations, and among academic institutions. Currently, there are more questions than answers as to which technology is better, what the costs of each technology are and what potential benefits each could provide. This thesis will narrow its focus to the conversion, administration, and maintenance of a single course using one technology. The scope of this research will be limited strictly to the costs and benefits of providing "Financial Management in the Armed Forces" utilizing Network Based Instruction. Hopefully, the methodology used for analyzing the conversion of that course will be applicable to other courses both at NPS and other DoN locations.

E. METHODOLOGY

The first objective of this thesis is to present the costs involved in converting "Financial Management in the Armed Forces" into

an NBI format. This was accomplished through a review of sources including, but not limited to, the following:

- Unclassified Department of Defense publications
- Published academic research papers
- References, publications, books and electronic media available at the NPS library
- Internet websites and homepages (DoN, commercial, and academic)
- Interviews with NPS faculty and staff, commercial companies, civilian university faculty and staff, and DoD research personnel

The second objective was to identify any potential benefits associated with providing an NPS course through NBI. The primary sources of information were Internet searches and personal interviews. NPS faculty and staff and DoN staff personnel were interviewed.

F. ORGANIZATION

This study includes seven chapters. Following the introduction in Chapter I, Chapter II provides a background for the thesis that includes the status of current traditional education and distance education at NPS, impetus for new directions in education at NPS and the status of distance training within the Navy. Chapter III defines the theoretical framework that is utilized by this thesis, which includes a vision of distance education from NPS and the rationale as to why the course and technology examined within this thesis were chosen.

Chapter IV presents the methodology, assumptions and limitations of the thesis. Chapter V provides a cost analysis broken down into conversion, hardware, administration and maintenance costs. Chapter VI examines potential benefits of reduced residency, an educational continuum, an on-line reference tool, elimination of a short course and other benefits. Chapter VII summarizes the findings of prior chapters and presents recommendations for further research.

G. BENEFITS OF THE STUDY

This research will provide a comprehensive overview of the costs and benefits of providing courses through distance education at NPS utilizing Network Based Instruction. It will provide unique insight into extremely relevant issues facing the DoN, and NPS in particular. This will be beneficial to NPS in providing an integrated picture of the costs involved in converting and providing a course through Network Based Instruction. A comprehensive simulation will consider many uncertainties in providing a cost analysis that can be utilized to budget funds for development of NPS's distance education program. Potential internal and external benefits will be examined as well.

II. BACKGROUND

A. INTRODUCTION

To properly understand the research questions at hand, the reader must understand the current state of education at the Naval Postgraduate School and the motivations for changing the status quo. This chapter will begin by describing the status of education at the Naval Postgraduate School. Next, it will outline new directions that NPS is examining in education and explore the reasons why this is so. Following that, current methods of distance learning being utilized at NPS will be examined. The chapter will conclude by reporting the status of distance learning with regard to training within the Department of the Navy.

B. STATUS OF EDUCATION

The Naval Postgraduate School is a unique academic institution that focuses its study and research programs in areas that are relevant to the Navy and the Department of Defense. The school provides a traditional graduate education by using specially tailored academic programs that tie academic disciplines to naval and joint warfighting applications. (NPS Catalog, 1998)

1. Students

The school maintains a diverse student body that includes officers from all branches of the uniformed services, civilian employees of the federal government, and military officers and government employees of foreign countries. Approximately 1500 students attend NPS, representing more than 30 countries. The students pursue programs of instruction that are both relevant to their respective service and that prepare them for future career assignments. (NPS Catalog, 1998)

The focus of the student body and the school as a whole is best summarized by NPS's stated mission:

> Increase the combat effectiveness of U.S. and Allied armed forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future. (NPS Homepage, 1998)

2. Faculty

The school's faculty represents a prestigious collection of scholars who are drawn from a broad diversity of educational institutions. Over 99% of the tenured faculty have a Ph.D. The majority are civilians. (NPS Catalog, 1998) A member of the faculty directly teaches every class, with student/faculty interaction being high. Within each program, the faculty includes numerous subject matter experts who maintain real world expertise by teaching for six to nine months and researching within their professional specialty for the remainder of the year (Euske, 1997).

3. Elements of Instruction

The instruction provided is traditional. An instructor typically provides a classroom lecture to a section that ranges from 6 to 30 students. Instructors will use any and all methods of instruction that facilitate the students' education. Typical methods used are classroom discussion, reading assignments, writing assignments, computer and scientific laboratories, group projects, in-class student presentations, guest lectures, seminars, examinations, research and the writing of a thesis. The faculty utilize a full range of media to convey the learning objectives for their particular subjects. Media include whiteboards and chalkboards, overhead and computerized projectors, movies, and multimedia presentations.

C. NEW DIRECTIONS IN EDUCATION

The Naval Postgraduate School has come a long way since its founding over 88 years ago in an attic at the Naval Academy in

Annapolis, Maryland. (NPS Homepage, 1998) Past days of ten students and two faculty members are long gone; the present is upon us and the future is just around the corner. NPS, like the world, has undergone significant change in the last eight decades. Technology is advancing at a previously unfathomable rate. It is obvious to even the casual observer that NPS must continue to advance at the same pace as society or its utility will become obsolete.

Forward thinking reverberates throughout the halls of NPS and is prevalent in NPS's Vision, Guiding Principles and Strategic Initiatives. One of three components of the Vision statement is "to lead the way in developing the University of the Future." A Guiding Principle is "investing in the technology and facilities needed to fulfill our mission." Additionally, most of the strategic initiatives address the significance of distance education in NPS's future. (NPS Homepage, 1998)

The Superintendent, RADM Robert C. Chaplin, summarizes one of his goals that will lead NPS in a new direction of education:

> We must exploit Information Technology for the 21st Century. We will develop further education on the Internet. We will look to have prerequisite studies available for distance learning so officers can have this completed prior to arrival (at the NPS). Officers will spend less time at Monterey working on the core curriculum. Likewise, we will develop post-curriculum studies for the Internet to support the requirements for continuing education, in an environment characterized by constant change and uncertainty. We need to bring education to the fleet, in an asynchronous manner; taking advantage of today's and tomorrow's information technology. We need to better recognize that our Navy is indeed 'forward,' that we are truly global, and that diminishing resources mean that we bring the classroom to the Fleet. We need to make education more accessible to all of our people, including our career civilians; that we recognize the need to be more customer (career force) oriented, more sensitive to their dynamics of deployments and the traditional naval lifestyle. (Chaplin, 1998)

NPS is experiencing an era of diminishing budgets and increasing requirements that necessitate reassessment, in some cases reengineering current methods of operation. NPS must position itself to take full advantage of the potential efficiencies new technologies offer. To

maintain its viability, NPS must develop new programs that appeal to new sources of students, increase its efficiency and effectiveness, and lead the way by developing itself as the "University of the Future."

As NPS positions itself for the future, distance education is a requirement for the institution's success and security in a rapidly changing political arena. This is made clear by the following issues, leaving little doubt that distance education must play a significant role in NPS's future.

First, rising costs and decreasing budgets have reduced DoD's ability to fund military personnel for periods of extended education. As a result, many academic institutions are developing distance education programs that allow students to earn masters degrees without leaving their regular jobs or locations. If NPS does not enter and win the race to provide this service, the potential exists to lose a significant number of students to other competing programs. This will be especially true if other academic institutions are able to deliver comparable academic material that is cheaper, more technologically advanced, and more accommodating to the student. Due to the relevance and uniqueness of NPS degrees, it would be unfortunate to lose NPS programs, as they are tailored for and therefore vitally important to DoD.

Second, there are many potential students who cannot afford 18 to 27 months away from their professional communities to obtain a masters degree. The required residential period in Monterey makes a graduate education at NPS unrealistic for many officers and more difficult for other officers given the military downsizing. For example, the flying skills of aviators diminish appreciably through inactivity while these students attend NPS. After graduation, these aviators require a longer period of requalification in Fleet Replacement Squadrons than an aviator who only spent 12 months away from a flying billet. (Haupt, 1998) Distance education could facilitate a reduction in total time spent in residence at NPS, therefore allowing more personnel the opportunity to obtain a graduate education.

Third, conversion of course material to an electronic, NBI format will allow NPS to provide continuing education to NPS graduates and also to provide career education to naval officers and career DoN civilians who never attend NPS.

In a perfect world, all officers who graduate from NPS would immediately complete a "payback tour" using the specialty they acquired at NPS.[1] Unfortunately, many graduates must wait years before they will be assigned to a payback tour. If core courses were provided on the Internet or through any other accessible means, NPS graduates would be able to refresh their knowledge of specialty skills using the latest academic material in a "just-in-time" manner. Additionally, personnel who never attend NPS would be able to acquire nondegree graduate education by taking applicable courses at a distance. In either case, both sets of personnel would be able to perform their jobs better if they had easy access to the latest academic courses in their required subject areas.

Fourth, utilizing distance education for some of the short courses currently taught at NPS could provide cost savings. Several short courses taught at NPS require that students and some instructors travel from locations throughout the world. Providing these courses at a distance could potentially save travel, per diem, lodging and opportunity costs for personnel taking courses at their permanent command vice traveling to NPS.

Finally, NPS should be an institution of creativity and innovation for the Department of the Navy. NPS, along with the U.S. Naval Academy and the Naval War College, make up a triad of education for the Navy's officer corps. (NPS Homepage, 1998) NPS should utilize its resources to continually improve the unified education process within this triad and export proven ideas to the numerous other training components within the

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[1] A payback tour utilizes the specialty code (professional code within an area of graduate study) that was acquired while completing a masters degree at NPS.

Navy. NPS could best serve the interests of the Navy by becoming the "expert" in distance education.

D. STATUS OF DISTANCE LEARNING

The Naval Postgraduate School currently offers courses from three masters degree programs through distance learning. The programs are offered through the Aeronautics and Astronautics, Computer Science, and Electrical and Computer Engineering Departments. Additionally, the Department of Systems Management offers courses via distance learning to a variety of customers. They range from graduate-level courses, to senior-level executive education short courses, to Defense Acquisition Workforce Improvement Act (DAWIA) mandated courses. (NPS Catalog, 1998)

Students participate in the Distance Learning Program via PictureTel 4000 Video Conferencing Systems using Integrated Services Digital Network, Basic Rate Interface (ISDN BRI) lines. This setup allows two-way, interactive audio and video between the distant sites and NPS classrooms. The NPS owned video bridge makes multipoint classes possible. (NPS Catalog, 1998)

At NPS, two 26-student classrooms are equipped with VCRs, electronic whiteboards, document cameras, facsimile machines, and PC's for computer generated presentations.

The student's site must have a standards-based (H.320-compatible system) connection to a dial-up network (FTS2000). Commercial networks may be used when FTS2000 is not available. NPS uses AT&T Accunet for commercial calls. NPS is currently establishing a program to lease equipment to sites to provide the highest degree of compatibility and fidelity that the technology offers.

NPS's Distance Learning Program provides several advantages to students at distant locations. First, the material is DoD relevant. The programs are designed to meet current and future DoD needs in the areas of advanced military technology and operational capability. Second, the courses and curricula may be and are customized. NPS designs curricula to meet an agency's specific graduate-education needs in engineering, applied sciences, operational research, or management.

Third, the courses are presented in a manner that minimizes job interference. Although students are not physically on campus, they are virtually in residence at NPS through the latest in real-time, interactive-video-teleconferencing technology. Courses require only three to five hours per week of classroom participation and are conducted during normal working hours. Courses are conveniently scheduled to accommodate the distant students' work schedules.

Fourth, quality instruction is incorporated into every course offered. Students participate simultaneously with resident NPS students. "Office hours" with the professors allow a student to further clarify course concepts and homework assignments. Finally, the courses are cost effective. The cost per student is highly competitive with local universities or other distance-learning options. Courses are paid for by the sponsoring agency on a negotiated, fixed-fee basis. (NPS Catalog, 1998)

The NPS Distance Learning Program was established in 1994. It currently offers its degree programs at five different locations. Various nondegree courses have been taught at eighteen different locations. Three hundred forty-seven students have completed nondegree courses; 130 students are enrolled in degree programs. The NPS Distance Learning Program has already graduated 20 students. Two students have received masters degrees in Aeronautical Engineering and eighteen students have received masters degrees in Computer Science (Software Engineering), one of which was awarded with distinction. (Hammond, 1998) Figure 2.1 contains a summary of the NPS Distance Learning Program.

Program	Requirements/ Length	Degree Offered	Sites	Start Date	Degrees Awarded	Students Enrolled
Aeronautical Engineering	BS in Aero or Astro Eng or equivalent/12 courses or 3 yrs	MS in Aeronautical Engineering	Crystal City Patuxent	Jul-94	2	19
Computer Science (Software Engineering)	BS in CS or equivalent/16 courses or 2 yrs	MS in Software Engineering	NRaD	Oct-95	18	35
Electrical and Computer Engineering	BS in EE or equivalent/12 courses or 3 yrs	MS in EE (Digital Signal Processing)	Dahlgren NSA	Oct-95		56

Figure 2.1. Summary of NPS Distance Learning Program
From (Hammond, 1998)

E. DISTANCE TRAINING IN THE NAVY

The Department of the Navy is eagerly awaiting the rewards which new training technologies offer. As increasing budgetary constraints affect the entire Navy, funds expended on training are increasingly scrutinized because new training efficiencies are expected to provide much needed cost savings. There are several areas of savings that distance training technologies can provide. (CNO, 1995)

First, distance training can reduce or eliminate travel costs associated with training. The lost opportunity cost of multiple students' and/or instructors' travel time can be avoided. Beyond that, serious savings could result from reduced travel, lodging and per diem expenses.

Second, some training technologies compress the time required for training. Reducing required training time generates cost savings by reducing the students' opportunity costs of training.

Third, potential savings result from miscellaneous efficiencies that new technologies provide. For example, reduced facility and maintenance costs or the reduction/elimination of paper and printing costs can be substantial, given a course's annual throughput.

Acknowledging the many justifications for utilizing technology to provide training at a distance, various components of the Navy are actively utilizing different technologies to provide training. The following subsections describe the current state of Navy distance training, and they draw heavily from the Chief of Naval Operations' Office of Training Technology (OTT) Seamless Product Information, Data Exchange and Repository (SPIDER) at [www.ott.navy.mil].

1. Video TeleTraining (VTT)

Video TeleTraining has demonstrated its usefulness and effectiveness within the Navy. VTT uses a transmission network between originating and receiving sites that utilize either land lines or satellite links. The instructors are able to interact with their students simultaneously through either one-way video/two-way audio or, preferably, two-way video/two-way audio.

The Chief of Naval Education and Training (CNET) Electronic Schoolhouse Network (CESN) provides much of the VTT training today. First proposed in 1988, CNET network operations began in March 1989 with four sites on the East coast. Today, the network consists of 16 sites nationwide including a site on board the USS GEORGE WASHINGTON. (OTT, 1998)

Future expansion plans call for additional continental U.S. (CONUS) and shipboard sites. Additionally, out of continental U.S. (OCONUS) sites and improved technological capabilities are being implemented.

The following description was taken from the OTT SPIDER.

> CESN is a two-way video and audio multipoint, secure distance learning network. It allows simultaneous instruction to multiple shore and shipboard sites where individuals can interact both verbally and visually in a real-time mode. Its purpose is to provide effective training to a large number of personnel at or near their duty stations, eliminating the need for travel to distant schoolhouses, thereby reducing travel and per diem costs.

2. Network Based (Internet/Intranet) Training Distribution and Delivery

Computer networks offer tremendous opportunity for distributing and delivering multimedia training to personnel located around the world. The rapid proliferation of Local Area Networks (LANs) and Wide Area Networks (WANs) has created the technological framework necessary to distribute multiple applications, including those required for distant training.

To better understand the benefits and capabilities of Network Based Training, the underlying advantages of Interactive Courseware (ICW) must first be known. The following definition was taken from the OTT SPIDER.

Interactive Courseware is defined in two parts:

> a. ICW is computer controlled courseware that relies on trainee input to determine the pace, sequence, and content of training delivery using more than one type of medium to convey the content of instruction. ICW can link a combination of media, to include but not limited to; programmed instruction, video tapes, slides, film, television, text, graphics, digital audio, animation, and up to full motion video to enhance the learning process.
>
> b. ICW is a term referring to any type of computerized instruction characterized by the ability of a trainee to respond through an input device. ICW may be an integral part of a computer based instruction (CBI) program, a computer assisted instruction (CAI) program, or a computer based training (CBT) program.

The Navy has years of experience developing ICW for military training applications. These applications were designed for stand-alone computers. The task at hand is to incorporate previous experience creating ICW with the new forms of instructional delivery allowed by new technologies. For example, many major corporations are turning to "Transport Control Protocol/Internet Protocol (TCP/IP) based Intranets as a key instructional delivery platform using commercial-off-the-shelf hardware and software." (OTT SPIDER, 1998)

The potential for training on networks is substantial. Rapidly advancing technology is quickly creating more potential benefits and

applications than formerly envisioned. Additionally, current bandwidth limitations will be lessened by expected technological improvements over the next few years.

The Navy currently has very few operational Internet or Intranet training programs. Most programs of note are Intranet systems. One example is a prototype network-based training delivery capability using a web browser. The program, "Shipboard Training, Education, Advancement, and Morale" (STEAM), provides the primary student the interface to access other training courses from a file server operating on a TCP/IP network aboard ship. STEAM is currently deployed aboard the USS Yorktown (CG 48) as a "Smart Ship" demonstration project.[2] (OTT, 1998)

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[2] Smart Ship is a program designed to explore and implement advantages new technologies provide in reducing manpower requirements on naval ships.

III. THEORETICAL FRAMEWORK

A. DISTANCE LEARNING VISION

The origins of this thesis were founded within the conceptual vision of distance education. This vision consists of a flexible, hybrid graduate education program administered at and through the Naval Postgraduate School.

The vision began to develop after numerous discussions with current NPS students and about potential NPS students. For many reasons, some naval officers have difficulty attending NPS to earn a graduate degree. Naval aviators often are cited as examples of those naval officers who find it difficult to set aside time in their careers to attend NPS. For the purpose of this discussion, I will use naval aviators to illustrate how distance education will provide numerous benefits for all communities of naval officers.

Naval aviators have many career gates and required billets that they must complete to maintain their career and promotion potential. Sequence and timing of these requirements often preclude many officers from pursuing an advanced education at NPS. (Haupt, 1998) One obvious reason that hinders an aviator's ability to attend NPS is the serious degradation of specialized flying skills the longer he/she is assigned to a non-flying billet. With some NPS masters programs lasting as long as 27 months, aviators face not only a degradation of flight skills, but a longer flight requalification period and several "non-observed" fitness reports away from their community.

Utilizing junior naval officers as a baseline, the quest was to define an optimal graduate education program. This program would provide an officer with the flexibility to earn an NPS masters degree while limiting the negative effects of obtaining that NPS degree within the officer's community. One means to this end is a hybrid program where the refresher, preparatory (undergraduate level) and basic core courses would be available for the officers to complete prior to

attending NPS. The officers would then attend a reduced period of residency at NPS to complete the higher level courses within their selected program.

Using an 18 month Systems Management Curriculum as an example, completing four courses at a distance prior to attending NPS would reduce the Curriculum by three months in residence. Completing just eight courses, less if the student validated any courses, would reduce the Curriculum to only 12 months. Several factors were considered with regard to possible time reductions.

First, a 12 month residential program was considered the goal. A period of less than 12 months was considered sub-optimal due to the negative impact on the graduate learning process and numerous quality-of-life issues. The general consensus of students and faculty at NPS is that 12 months are required for students to become completely integrated into the academic environment and realize the full potential of the highly interactive graduate courses and the thesis process. Additionally, most naval officers attend NPS between operational tours. Family dynamics and the opportunity for quality time spent with family in a beautiful location require a minimum one year assignment.

Second, many students validate core courses based on their college transcripts and subject validation exams. Validation of courses could contribute to a reduced distance education workload prior to reporting to NPS. Current practice has validation occurring after a student has reported to NPS. A mechanism would have to be devised to pre-validate students before they enrolled in a distance education program, if the validation program were to help reduce the students' residential time at NPS.

Third, a major shift in cultural attitudes toward graduate education would be required. Without support from all levels of the Navy, the concept of education at a distance and reduced residency at NPS would fail. Firm commitments from community detailers for follow-on orders to NPS would be required. Without assurances of a follow-on tour to NPS, it would be difficult to convince officers to commit to the extra work required to complete distance courses.

Command support and the proper opportunity to complete distance courses within the officer's current job are a critical necessity. Additionally, postgraduate education would have to be viewed positively from the most senior officer down through the most junior officer within each community. This pro-graduate education point of view would also have to be evident in career advancement/promotion discourse and in promotion board results.

Fourth, the courses offered at a distance should provide the student with intrinsic motivation to complete the course. Ideally, courses would be beneficial even if an officer failed to receive follow-on orders to NPS to earn a masters degree. Most officers will likely require this extra motivation to "pull" them through distance education courses. Respecting the many time demands placed on naval officers, short-term benefit is a motivator that compliments the benefits of a graduate degree years in the future.

Given the proper incentives and attainable benefits, many officers would agree to participate in a program shaped in this fashion. (Appendix A) The program would not only benefit students who normally would not have time to obtain an NPS degree, but it could also increase NPS's customer base.

B. TECHNOLOGY SELECTION

Having envisioned a hybrid graduate education program including both distance and traditional classroom education, the next step is to define the technology required to deliver NPS courses at a distance. Several criteria were used in selecting Network Based Instruction (NBI) over other technologies for delivering NPS courses to students at distant locations.

First, the technology would have to provide the distant students complete flexibility to work on courses at any time of the day or night. The ability to work around current job and time requirements is a crucial factor. Potential users are spread throughout most of the world's time zones. The differences require most, if not all,

components to be asynchronous (non-simultaneous participation of all students and instructors). NBI easily accomplishes this requirement.

Second, the user would require extreme flexibility in the locations where instruction could be obtained. Using the aviation officer example, the distance education users should be able to work on courses at home, at their squadron base, or deployed on an aircraft carrier in the middle of the Persian Gulf. This requirement ruled out Video TeleConferencing (VTC) as a viable distance technology, but left NBI and other options available.

Third, the technology would have to facilitate ease of distribution. With potential users located around the world, timeliness and efficient distribution costs were a major consideration. CD-ROM computer based instruction and NBI remained the best technologies available.

Fourth, the technology would have to allow faculty the ability to maintain and update the course material in a timely manner. This requirement ruled out CD-ROMs due to the expense of producing and distributing new CD-ROMs, but left NBI as a good choice.

Network Based Instruction (NBI) appears to be the obvious choice considering the dynamics of the anticipated user population. NBI offers tremendous benefits; but also has some limitations. The most notable limitations are connectivity and bandwidth problems. Internet access is becoming more common throughout the Navy and within individual homes. As the Internet popularity continues to grow at staggering rates, Internet access (connectivity) problems should become essentially non-existent. Limited bandwidth is another issue that time and new technologies are likely to cure. NBI requires more bandwith and quicker data transfer speeds as levels of interactivity and types of media (text, graphics, audio, video, etc...) are increased. Current NBI must effectively utilize today's capability. However, new technologies under development indicate bandwidth will not be as significant a problem in the near future. (OTT, 1998)

C. COURSE SELECTION

Having conceptualized a hybrid graduate program and the technology to implement the distance education portion of the program, an illustrative course was selected for analysis. After analyzing the Systems Management Curriculum, "Financial Management in the Armed Forces" was selected for this thesis.

The Systems Management Department includes thirteen curricula. Ten of the thirteen curricula award a Master of Science in Management degree. There are nine core courses that are required in all of the curricula. Additionally, there are four courses that are required in five or more of the curricula. See Table 3.1.

The significant number of core courses spread across the ten curricula provided a list of potential courses to convert into an NBI format for instruction. With fourteen candidate courses, the goal was to select the course that provided the greatest benefits from being the first NPS graduate course converted into an electronic, NBI format.

To realize the goal of reducing the time required in residence at NPS, four courses need to be converted for every three month time reduction. Being realistic, the first course to be converted would be a test to examine the feasibility and potential cost of the undertaking. Assuming the four courses would not be converted simultaneously, there would be an extended period of time before distance education could reduce residency at NPS. Therefore, the first course converted is expected to offer additional insights and propel movement down the learning curve for future course conversions.

The first course to be converted should involve subject matter that possesses "stand-alone value." In other words, it should involve a subject that potential students want to study and learn because it benefits their current work, thereby offering additional value beyond the credit towards a masters degree.

A second consideration was the difficulty of the instructional outcomes the course required (Crawford & Suchan, 1996). Using first hand personal experience as a student who had taken the potential

	Transportation Logistics Management	Transportation Management	Acquisition & Contracting Management	Systems Acquisition Management	Defense Systems Analysis	Defense Systems Management (INT)	Systems Inventory Management	Material Logistics Support Management	Financial Management	Manpower Systems Analysis
Management Information Systems IS3183	X	X	X	X	X	X	X	X	X	X
Mathematics for Management MA2300	X	X	X	X	X	X	X	X	X	X
Economic Decision Making MN2031	X	X	X	X	X	X	X	X	X	X
Financial Accounting MN2150	X	X	X	X	X	X	X	X	X	X
Organization and Management MN3105	X	X	X	X	X	X	X	X	X	X
Microeconomic Theory MN3140	X	X	X	X	X	X	X	X	X	X
Financial Management in the Armed Forces MN3154	X	X					X	X	X	
Management Accounting MN3161	X	X	X	X	X	X	X	X	X	X
Public Policy and Budgeting MN3172	X	X	X	X	X		X	X	X	X
Managerial Communication Skills MN3333	X	X	X	X	X	X	X	X	X	X
Strategic Management MN4105	X	X	X	X	X	X	X	X	X	X
Operations Research for Management OS3006	X	X	X	X	X		X	X	X	X
Statistical Analysis for Management OS3101		X	X		X	X		X	X	X

Table 3.1. Commonality Between Systems Management Courses and Curricula

conversion candidate courses, the field of potential courses to research was narrowed. To maximize the value of the first course converted, it should also be beneficial to naval officers even if they never earn an NPS degree. Additionally, a course conversion candidate is more attractive if the Navy benefits by having more officers become subject matter experts in that particular area. Finally, it is important to consider the different learning outcomes each course requires (Crawford & Suchan, 1996) and how difficult the course material would be to convey asynchronously at a distance.[3]

Those considerations narrowed the potential list from fourteen courses down to a few potential courses. Further investigation revealed that one course, "Financial Management in the Armed Forces," was also taught as a short course, the "Practical Comptrollership Course," for the Navy Financial Management Career Center. Both the graduate course and the short course are taught from the same syllabus and by the same instructor. Converting a course with two user populations provides significant additional benefit for the first conversion.

Based on the above criteria the decision was made to examine the costs and benefits of converting "Financial Management in the Armed Forces" (MN3154), also known as the "Practical Comptrollership Course" (PCC), into an NBI format. The additional benefits of converting this course made its selection for analysis extremely logical. Converting this course would provide a stream of useful information to aid in further conversions, as well as moving NPS a step closer to reducing student residency at NPS. Additionally, it would provide immediate benefits both to the students and the Navy, as well as potentially realizing cost savings from reducing or eliminating the on site Practical Comptrollership Course.

Although "Financial Management in the Armed Forces" was selected for the initial conversion course, later courses selected for conversion

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[3] A learning outcome is the performance that is expected as a result of a learning experience.

would most likely be courses that maintain a consistent body of knowledge that require less effort to update on a reoccurring basis.

IV. METHODOLOGY, ASSUMPTIONS AND LIMITATIONS

A. BASIC METHODOLOGY

The methodology used to research and write this thesis effectively encompassed two separate areas. The first area explains the methods used to determine the costs involved in converting "Financial Management in the Armed Forces" into an NBI format and the cost information and data required to predict the total cost. The second area describes the methods used to formulate the benefits associated with converting the NPS course into a widely accessible NBI course.

1. Cost Analysis

Analyzing the cost of providing a graduate level course through NBI, or any course for that manner, is extremely difficult. The first step in analyzing the cost is to identify the various expense areas. This information was gathered through numerous sources. Library and Internet searches were first conducted. The most current information was obtained from DoN and educational websites on the Internet. Numerous personal interviews were conducted with NPS faculty and staff, DoD research personnel, the California State University Director of Research Projects and knowledgeable industry experts in course content conversion.

Understanding the major expense categories, the next step was predicting the expenses for each category. This proved very difficult. Literature searches through the library and Internet provided some reference material, but it was mostly hypothetical and/or out of date and, therefore, irrelevant. Difficulty in obtaining good cost data was best described by the California State University Director of Research Projects who stated, the question "is not how much does it cost, rather there is no upper limit on course development cost." (Jewett, 1998)

The cost data that were available were collected from several sources. They included the TRADAM (Training Delivery Assessment Model)

report, CNET course development references and NPS's Institute for Defense Education and Analysis (IDEA). The best possible cost estimates were then forecast by building a simulation model that encompasses all the various data sources.

2. Benefit Analysis

The benefits of converting and providing a course utilizing NBI were analyzed independently of the cost analysis. This was thought to be the most prudent approach, considering the vague and indirect relationships between the costs and benefits.

The benefits of NBI are difficult to quantify. The effect of reducing residency and increasing opportunities for an NPS graduate education, as well as providing courses for continuing and career education, were described more qualitatively than quantitatively. With little historical data on which to base educated assumptions, it is impossible to assign a dollar value to these benefits.

Internet searches, as well as personal interviews with several organizations were used to research the potential benefits of Network Based Instruction.

The course researched in this thesis, "Financial Management in the Armed Forces," has an added benefit: it has a closely related short course. Using NBI to provide the short course, "The Practical Comptrollership Course," provides a quantifiable direct cost savings. The savings predicted were based on the actual 1997 calendar year enrollment utilizing February 1998 per diem, airfare, and lodging rates. Additionally, the opportunity costs of all students and faculty were calculated using the 1998 Navy and Marine Corps Composite Standard Pay and Reimbursement Rates and the 1998 General Schedule Pay Scale.

B. RESEARCH ASSUMPTIONS

This research investigates the costs and benefits of NBI. There are several assumptions that are contained within this research. The first is that the Naval Postgraduate School will continue to exist into the distant future and NBI will become a primary function of the school.

"Many military thinkers are predicting a Revolution in Military Affairs (RMA) based on information, communications systems and precision weapons." (NPS Homepage, 1998) New technology will and is changing the face of current military operations; likewise it will transform the current academic structure. It is presumed that NPS will participate heavily in the Revolution in Military Affairs as well a lead the "Revolution in Academic Affairs."

It is assumed that NPS will develop the ability to distribute its collective intellectual content and scholarly information through several distance technologies, primarily Video TeleConferencing (VTC) and Network Based Instruction (NBI). As well, it is assumed that NPS courses provided at a distance through NBI and/or VTC will receive the same equivalent credit a traditional residential course would receive. It is also envisioned that NPS will use these distance technologies to expand its base of customers (students) beyond its traditional population, to include career minded DoN civilians and naval officers unable to spend time in residency at NPS.

Considering how rapidly computer and electronic communication technology are advancing, it is assumed that current bandwidth limitations will become less of a problem in the near future and facilitate rapid expansion of NBI.

Computers and access to the Internet are growing by leaps and bounds as the Information Age settles upon the Navy and the world. It is assumed that all potential students will have ready access to the necessary computer hardware and the Internet to access NPS's NBI courses.

The thesis also assumes that all parties involved will view distance education as a requirement in NPS's future and devote their collective effort to fulfilling that requirement. However, this may not be the case. There are skeptics that believe distance education will be the downfall of NPS and the academic environment. Certain academic faculty may need meaningful incentives to embrace new technologies within their academic environments. For instance, untenured faculty may be more concerned with publishing material within their area of

professional expertise than pursuing non-traditional forms of education. It is beyond the scope of this thesis to examine these factors; however, they must be considered for distance education at NPS to be successful.

Finally, it is assumed that distance education will find coexistence with traditional residential education at the Naval Postgraduate School. It is unrealistic to believe that all or even most naval officers will be able to utilize distance education technologies to reduce their residential period at NPS.

The Navy continues the process of downsizing with the mindset that its people should do more with less. This concept will not work for distance education. Prospective students cannot be expected to complete a number of rigorous academic courses at a distance in addition to their current duties. The DoN leadership needs to accept the fact that their officers do have limited time in which to complete all of their requirements. Education of its members is beneficial to the naval service in addition to being a superior retention tool. That education must be administered in a manner that does not overload the distant students and have a detrimental impact on their quality of life. The naval organization as whole will need to develop an official policy towards graduate education and the use of distance technologies to facilitate its distribution. When this policy is set and enforced, it will become easier for prospective students to complete their requirements at a distance while conducting their official duties.

C. RESEARCH LIMITATIONS

Initial exploration into any venture brings direct and indirect costs, as well as direct and indirect benefits. It is often difficult and impractical to directly relate the costs to the benefits. In many cases, the best approach is to identify all the costs and benefits without attempting to tie them together for a more cohesive analysis. Later, after initial experience is gained in the venture, it becomes possible to more closely relate the two in a cost-benefit analysis.

This research occurs too early in the developmental process of NBI to directly relate costs and benefits in a cohesive cost-benefit

analysis. Therefore, the thesis will contain separate cost and benefit analyses. Correlations between the two will be drawn when appropriate, but there are insufficient cost data to directly link the two.

The scope of this thesis is limited due to poor cost and benefit data concerning Network Based Instruction. There are currently many corporations, universities and colleges, and components within DoD that are converting traditional training and educational material to an NBI format. Unfortunately, the technology is so new and revolutionary that little data has been collated and published by any of parties involved. In the case of universities and colleges pursuing NBI, most are expending resources as necessary to quickly develop a usable product and gain market share. They have not taken the time to document and analyze resources consumed to date.

Although data were limited, that did not preclude the development of a useful cost analysis model. Data were collected from numerous sources and used to build a simulation model that overcame the many uncertainties and forecast the various probable costs involved in converting a course to NBI.

Benefits are mostly theorized, but not yet researched and well documented. Video TeleConferencing (VTC) has been utilized for distance education for a longer period of time and provides a similar framework for reference. Analyses of VTC benefits are currently being published. Some of the benefits may be similar to those gained from NBI. Unfortunately, there is a waiting period with revolutionary technologies before observing and critiquing the results. NBI falls in that category.

V. COST ANALYSIS

Providing a course using Network Based Instruction (NBI) involves numerous associated costs. A significantly larger initial investment is required in preparing a course for NBI than for traditional instruction. There are at least four major cost components associated with presenting a course through NBI. The first component is the course design and conversion costs. Second is the hardware cost required to distribute and provide the course on a network. Third is the administrative cost involved in facilitating the course of instruction. Finally, there are maintenance costs associated with course content software and hardware.

Upon making the best estimation of the NBI course's cost, it would be practical to compare the per student NBI cost to the per student cost of providing the course in the traditional classroom manner. Presently, there is not an accurate forecast of the distant student population to be able to make that comparison possible. However, John Eckardt (1997) developed a model for calculating a traditional per course cost in his 1997 thesis, "A Methodology for Determining the Marginal Cost Per Student at the Naval Postgraduate School."

A. DESIGN AND CONVERSION COSTS

Network Based Instruction course design and conversion costs represent, by far, the largest portion of the cost to provide a course at a distance. Key cost elements are the faculty time required to prepare a course for conversion and the actual cost of converting a traditional course into a multimedia format that can be presented electronically over a network.

Prior to course conversion, the faculty instructor/course facilitator must determine what instructional media is appropriate for the course material. Both the needs of the student and the organization must be analyzed to determine the appropriate instructional content. The instructional content must then be matched with the desired learning outcomes. The learning outcomes will vary throughout the different

sections of the course. Gagné and Briggs (1979) defined five categories of learning capabilities that must be considered. They are intellectual skills, cognitive strategies, verbal information/verbal knowledge, motor skills, and attitudes. Having identified the desired learning outcomes, the third step is to select instructional techniques that support those specific learning outcomes. Fourth, instructional media must be chosen to support the varying levels of interactivity required by the selected instructional techniques. (Crawford & Suchan, 1996)

While accomplishing the aforementioned steps, the instructor is challenged with ensuring the alignment of student learning needs, required learning outcomes, and instructional techniques with an appropriate choice of instructional media. The media selection should be based on cost considerations and the expected stability of the instructional content for the duration of the course (Crawford & Suchan, 1996). This effort ensures efficient expenditure of resources in converting the course into an NBI format. This in-depth analysis requires a significant investment of the faculty/instructor's time.

Once the faculty member has matched the specific learning objectives with different levels of media (text, graphics, audio, video, etc), it is time to convert the course material utilizing the appropriate technology. Unless the organization possesses the technical ability in house, a design expert must be contracted to convert the course.

1. Contracted Design and Conversion Costs

NPS does not currently possess the in-house technical ability to convert course material into an NBI format. This requires NPS to contract out the design and conversion process. The outsourced design and conversion cost and the faculty member's salary represent significant up-front conversion costs.

The use of NBI to facilitate distance education is still in its infancy. Therefore, little corporate knowledge or cost data are available to accurately predict course conversion costs. What is known, however, is that costs increase exponentially as the levels of media are

increased. Incorporating streaming video is tremendously more expensive than providing a simple electronic text page-turner.[4] (Green, 1997)

Most conversion costs are related to a "nominal hour of learning," which is considered to be one hour of instruction based on an artificial construct in which the student utilizes every screen and therefore all the program's interactivity. (Jenkins, 1998) Contracted design and conversion costs range from approximately $10,000 to $20,000 and significantly higher per nominal hour of instruction. (Hyer, 1998 and Whipple, 1998) Current per hour conversion costs are high, however economies of scale and contractor learning curves may reduce the expense significantly in the future. (Hazard, 1998)

The range is extremely broad and relates to subject matter and, more specifically, level of media incorporated within the course. Text conversion is comparatively easy and inexpensive; integrating streaming audio and video is more difficult and much more expensive. Higher levels of media (audio and video) also require more bandwidth, which currently increases user download times (OTT, 1998).

2. Faculty Cost

Faculty time required to convert one hour of material depends on the instructional technique and media selection incorporated into the course design. Limited project experience indicates five to eight days of faculty effort per converted hour. (Whipple, 1998) It is reasonable to assume that the faculty instructor will experience a learning curve during the course conversion.

The basic theory of a learning curve suggests that the more often an operation is repeated, the more efficient the worker becomes. Assuming the same instructional technique and media selection are used, what may take 40 hours of instructor effort at the beginning of the project should take less effort at the end of the project. Wright's model for learning curves was utilized to predict possible design and

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[4] Streaming video incorporates video presentation into multimedia courseware.

conversion costs later in this chapter[5] (Smith, 1989). Since no data are available to provide an actual learning curve, various learning curves will be simulated to forecast the actual learning curves for both faculty and contractor effort. Figure 5.1 gives examples of various learning curves with respect to 40 hours of initial faculty effort per converted course hour.

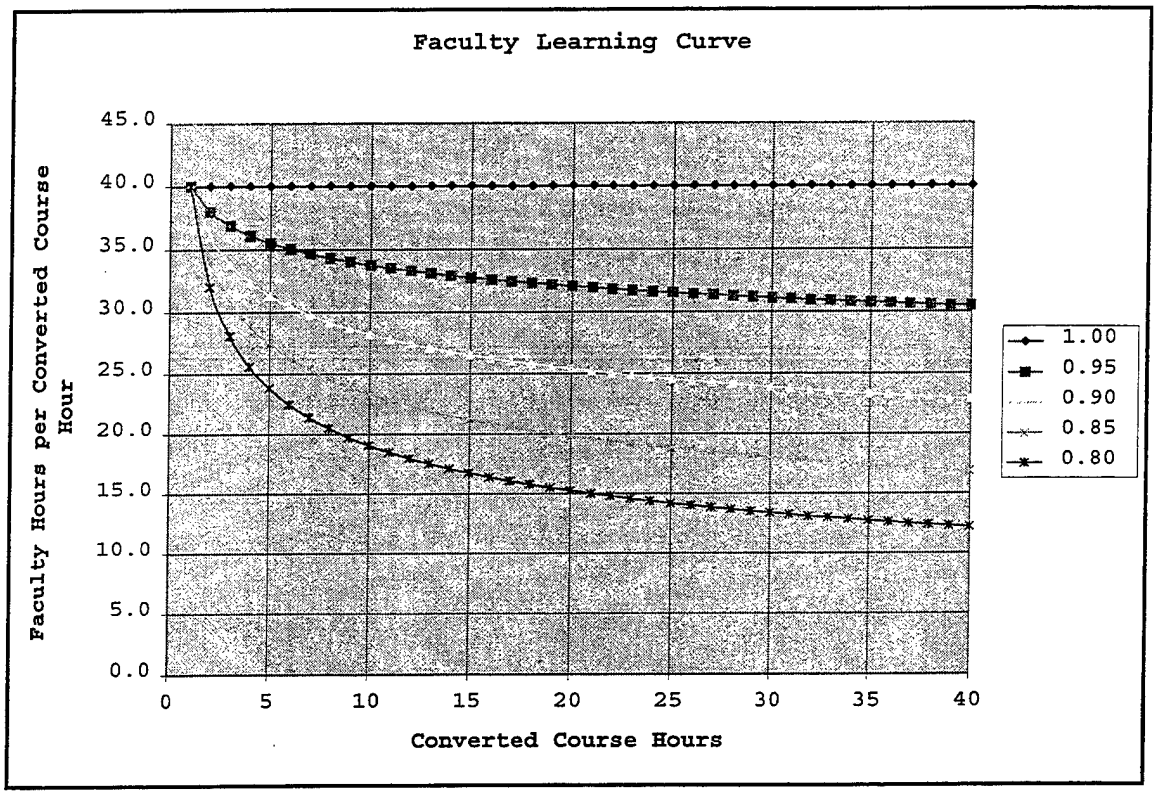

Figure 5.1. Faculty Learning Curve

Faculty salary costs during the design and conversion process are significant. NPS faculty are paid on a step scale ranging from 1-73. A faculty salary diagram shows that the majority of Associate Professors and Professors are within steps 45-65. The modal step is 55, which has a base salary of $82,616 based on a 10 month scale. Extending the scale

[5] Wright's Model suggests that as the cumulative number of converted course hours double, the cumulative average of faculty hours/converted course hour will decrease at a constant rate.

to a yearly salary increases base pay to $99,139. The current escalation rate for benefits and leave is 43 percent, which increases the yearly salary to $141,769. The per hour wage is based on the Federal Government definition of a full time equivalent job which is equal to 2,080 hours per year. This provides a per hour faculty rate of $68.16. (Faculty Handbook, 1998)

3. Institute for Defense Education and Analysis Cost

The Institute for Defense Education and Analysis (IDEA) is located at NPS and serves as DoN's lead agent for developing, delivering, and managing distributed graduate education and learning opportunities. (Whipple, 1998) IDEA is the critical link between faculty instructors and contracted content designers. IDEA functions as the program manager and ensures the product is properly developed and implemented. IDEA charges a 10 percent overhead support fee to all contracted amounts as well as anticipated IDEA salary costs. The estimated salary cost for converting 40 hours of course content is $21,780. This is broken down into 100 hours of program manager time at $56/hr, 250 hours of principle investigator time at $48/hour, and 60 hours of internal information technology support to ensure the courseware is properly installed and operational. (Hazard, 1998)

4. Design and Conversion Combined Cost Model

Given the wide range of uncertainty among the various cost factors, Crystal Ball simulation software was utilized in conjunction with Excel spreadsheet software to run detailed simulations to analyze probabilities and forecast probable costs[6]. Use of a sophisticated simulation model allows this thesis to embrace the many cost uncertainties in accurately forecasting costs, rather than be hindered by the uncertainties.

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[6] Crystal Ball is a graphically oriented forecasting and risk analysis program that considers uncertainty in decision-making. Crystal Ball utilizes the Monte Carlo simulation technique which predicts numbers based on assumed probability distributions.

A spreadsheet model was built to predict content design and conversion costs. The model uses a Monte Carlo simulation to model uncertain faculty and design and conversion costs. First, the contracted design and conversion costs were simulated using a uniform distribution between $10,000 and $20,000 per hour converted hour. Second, a contractor learning curve was simulated using a triangular distribution between 80 percent and 100 percent, with a conservative 95 percent being the most likely value. Third, the initial number of faculty hours required per converted course hour was simulated using a uniform distribution between 40 hours (five work days) and 64 hours (eight work days). Fourth, a faculty learning curve was simulated using a triangular distribution between 80 percent and 100 percent, with a conservative 95 percent being the most likely value. Appendix B includes the Crystal Ball report that defines all assumptions and provides all simulation results.

100,000 iterations were used in the simulation analysis. Figure 5.2 provides the model's initial assumptions.

The model is relatively straightforward because there are insufficient data for more refined initial assumptions. However, the model could easily be expanded into an extremely useful cost predicting tool as more data are collected on faculty and contractor learning curves and contracted cost per converted course hour.

The Crystal Ball simulation was used to forecast three cost categories and the combined total cost of those three categories. Appendix B includes detailed results from the 100,000 iteration simulation for all four forecast categories. Each forecast will be summarized in the following paragraphs.

The first forecast category is contractor design and conversion cost. The cost range is between $172,549 and $784,062. The mean value is $432,564 with a standard deviation of $112,814.

The second forecast category is faculty cost. The cost range is between $47,787 and $172,355. The mean value is $102,241 with a standard deviation of $22,355.

The third forecast category is Institute for Defense Education and Analysis cost. The cost range is between $39,035 and $100,186. The mean value is $65,036 with a standard deviation of $11,281.

Number of Course Hours	40
Faculty Hourly Salary Rate	$68.16
Faculty Hrs/Converted Hour	
Low	40
High	64
Faculty Learning Curve	
Low	80%
Most Likely	95%
High	100%
Design and Conversion Cost/Converted Hour	
Low	$ 10,000.00
High	$ 20,000.00
Contractor Learning Curve	
Low	80%
Most Likely	95%
High	100%
IDEA Support Costs	
Labor Charge	$21,780
Overhead Based on Contract	10%

Figure 5.2. Spreadsheet Model Assumptions

The final forecast category is the combined total of the previous three categories. It provides the most accurate forecast possible of the initial expense involved in developing the software portion of "Financial Management in the Armed Forces" for Network Based Instruction. The cost range is between $290,517 and $1,014,296. The mean value is $599,841 with a standard deviation of $126,202. These

results are based on the best available information and provide the most accurate forecast on which decisions need to be made to budget required funds. Figure 5.3 provides the probability distribution for the combined total cost of converting a traditional course into a NBI course. Individual forecast category probability distribution graphs are included in Appendix B.

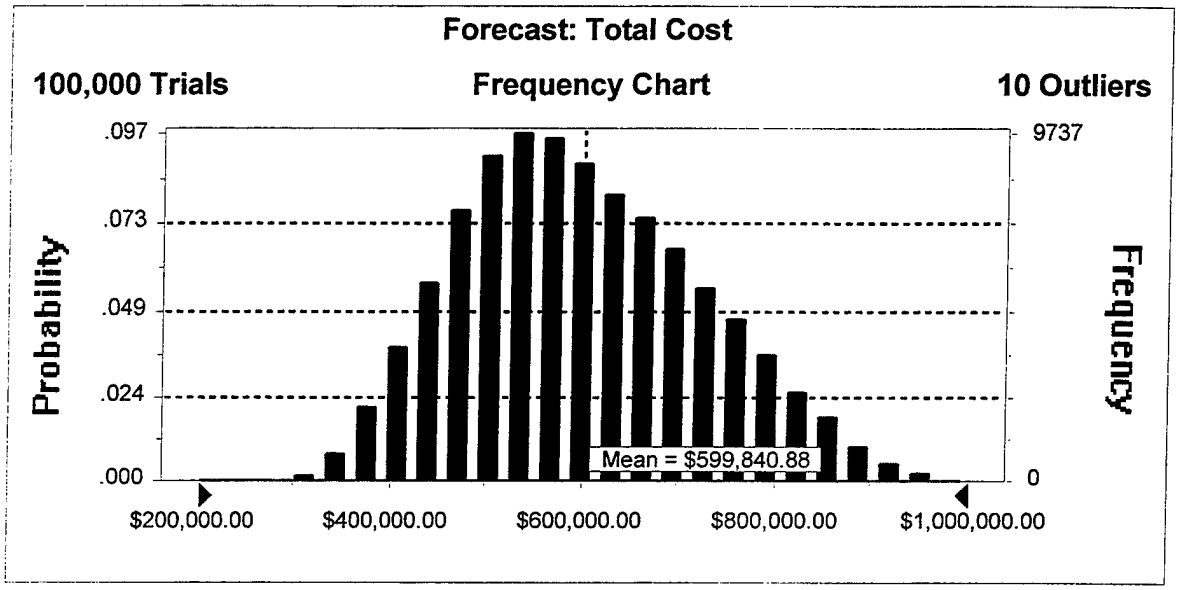

Figure 5.3. Forecast Total Cost

The following cost calculation example is provided to put the probability distribution graph in Figure 5.3 into perspective. A midpoint contractor cost of $15,000 per converted hour is assumed. The faculty learning curve is assumed to be a conservative 95 percent based on 40 hours of initial faculty effort per converted course hour. The contractor learning curve is assumed to be 90 percent. A greater learning curve is assumed for the contractor because work is being completed within their area of expertise. Combining these point assumptions produces a total cost of $548,844. Comparing this total to the Crystal Ball total cost forecast, there is a 40 percent probability the total cost will be equal to or less than $548,844. While this example is fairly conservative, it is believed that actual costs may be

less due to economies of scale and more efficient learning curves by both faculty and contractor.

B. HARDWARE COSTS

The required hardware costs depend on user demand and are difficult to accurately predict until the course has been designed and effectively prototyped. NPS currently possesses limited in-house capacity to prototype the first conversion course.

The first step in reducing potential hardware costs is to incorporate efficient design specifications into the conversion process. More efficiently designed course architecture will greatly affect a network server's ability to simultaneously interact with multiple users.[7] This will provide significant benefits downstream during the course distribution (Norris, 1998).

There are several key factors that contribute to server/network hardware costs. The entering argument is the number of students accessing the course. Based on the estimated number of student users, the maximum number of simultaneous users must be predicted. This provides peak capacity. Peak capacity combined with the level of interactivity designed into the NBI course will determine the server performance requirement. Higher server capability translates directly to higher costs.

Hardware requirements should be estimated as accurately as possible during the courseware prototyping. Given the best estimates of required server performance, excess capacity should not be procured because hardware costs are slowly decreasing, even as performance and capability are increasing. (Norris, 1998)

NPS currently possesses enough server capacity to perform a prototype requirements analysis on the first course converted. (Norris, 1998) Based on information gained during course prototyping, the

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[7] A network server is the computer on which a network application is operated and provided to the user.

required hardware capability can then be procured. NPS also possesses Internet access. Although more access may be required in the future, depending on user demands, this expense does not have to be realized immediately. Based on NPS's current network design, hardware costs will probably range between $10,000 and $15,000 per course depending on the prototype requirements analysis. (Norris, 1998)

It is currently not feasible to predict the required hardware costs of providing multiple courses through NBI due to potential savings from using a portion of NPS's current capacity and unknown demand requirements. The initial prototype hardware expense will be minimal, given NPS's current capacity and capabilities. However, future expenses are inevitable and will be based on experience gathered from the conversion and distribution of the first NPS Internet based course.

C. ADMINISTRATION COST

The addition of any new program or service will increase overhead and support costs. Providing NPS courses over the Internet will incur a number of related administrative costs. These costs can be divided into several categories. The first cost area is faculty salary and expense. Second is program overhead and support costs. Third is the cost of administering the server/network that provides the course.

1. Faculty Cost

Faculty cost will comprise a large portion of the course's overall expense. The amount of faculty expense depends on several factors. The primary factor is the instructor to student ratio designed into the course. Courses can be designed in many ways. As courses incorporate increasing levels of instructor/student interactivity, faculty administrative costs will increase.

Courses that are designed to be synchronous typically have higher faculty costs. The faculty instructor facilitates each class over a network, much like a traditional setting. Courses that are asynchronous provide faculty instructors more freedom, but could easily result in more students. The student feedback loops that are designed into the

course must be given careful consideration. It is critical to provide students an appropriate feedback loop to the instructor to maximize their learning potential. However, the mechanism must be efficiently designed during the conversion process to avoid overburdening the faculty instructor.

In a traditional setting, an instructor answers multiple questions during a class for the benefit of all students. In contrast, if every student were to e-mail each question individually to the instructor, it could quickly consume all of the instructor's time.

Different instructional techniques or pedagogies require varying levels of interaction between the student and instructor. "Financial Management in the Armed Forces" was chosen for this study because the pedagogy used within this course is less interactive and more conducive to network based instruction. The pedagogy designed into the NBI version of "Financial Management in the Armed Forces" will presumably be one that minimizes required interaction between the students and instructor. The significantly large, potential customer base for this course drives this assumption. Officers and DoN personnel in any position who control resources or any personnel who interact with comptroller organizations could utilize this course in its NBI format. The course should be designed with this constraint in mind.

Without prior experience, it is difficult to accurately predict additional faculty expense. Until instructor/student feedback loops are designed into the course and accurate student populations predicted, forecasting instructor time demands is troublesome. It is assumed that the instructor will initially be able to incorporate the incremental instructional workload associated with the NBI course within his/her current instruction schedule. Once the student population and the degree of instructor/student interaction within the course are determined, the amount of reoccurring instructor expense can then be calculated. It may become necessary to consider the expense of an additional instructor.

2. Administrative Overhead and Support

Providing "Financial Management in the Armed Forces" at a distance will incur additional overhead and support costs. It is assumed that the Systems Management Department will absorb most additional support costs within its current budget until a student population and the extra overhead and support costs have been determined. It should be possible to administer the course with current staff while it is being prototyped and functioning as the only NBI course. One exception is support staff required to assist students resolve any configuration problems at their distance computing sites. The extent of this potential problem is unknown and often underestimated.

It is assumed that one help desk (GS-9) person would initially be required. (Norris, 1998) This requirement may increase depending on the number of NBI course users and difficulties encountered accessing the courseware. Utilizing 1998 pay schedules for Monterey, this amounts to $54,953 per year (OPM, 1998). This assumes a full salary for a GS-9 at step 5 and includes the 43 percent escalation rate for leave and fringe benefits.

There are opportunity costs associated with providing all administrative functions in-house at NPS. For a price, administrative services are available from private industry. It is assumed that a company that specializes in providing a service will be capable of providing better service than NPS can initially develop and provide in the near future.

For example, Arista Systems, Inc., a local Monterey company, offers such a service through their Accredix software product. The software platform could deliver NPS instructional material and manage the network-based learning environment. The software platform is built in three layers to provide maximum functionality. (Munks, 1998)

Layer 1 is built on an object database foundation. Object architecture provides efficient, flexible support for large, complex files that contain many types of data. NPS could benefit by achieving ease of instructional delivery and lower maintenance costs.

Layer 2 combines powerful data search, indexing, retrieval, course cross-referencing, reference management tools, and unique tools to provide full copyright protection, royalty collection, and payment. Copyright protection and royalty payments for intellectual property rights are key issues that NPS will have to explore in the near future.

Layer 3 provides students a management system for their network-based learning environment. This layer provides virtual registrar, bursar, guidance counselor, and librarian with round the clock support, learner tracking, and records management functions.

Although using administrative software such as Accredix will introduce additional expense, the services provided may be worth the expense when comparing the quality of service to the cost. Table 5.1 provides the cost for utilizing the administrative software platform.

Initial Site License	
1 - 500 (users)	$2500 per site
501 - 1000	$5000 per site
1001 - 5000	$7500 per site
5001 or more users	$10,000 per site
Delivery fee	$0.10 per learner per hour
Service and Support fee	Cost plus 10%
Training	Cost plus 10%

Table 5.1. Accredix Fee Structure (From Munks, 1998)

The following example will illustrate the potential expense associated with using a private company such as Arista Systems to provide administrative services. One site fee will be required for NPS to utilize the Accredix platform. It will be assumed that initially annual usage will be between 1001 to 5000 student users, resulting in a one time $7500 fee. This is a liberal assumption that considers persons who access the "Financial Management in the Armed Forces" courseware site for a reference tool, as well as those students who are taking the NBI course for credit. When the actual number of student users increases above 5001, a pro-rated portion of the initial fee will be assessed.

Assuming 400 students take the course for credit and 1000 additional users access the course as a on-line reference tool, the annual delivery costs shown in Figure 5.4 would be incurred.

400 Students	X	40 hours X $0.10	=	$1600.00
1000 Users	X	3 hours X $0.10	=	$ 300.00
		Annual Expense		$1900.00

Figure 5.4. Accredix Delivery Fee Example

3. Network Administration

Initially, network administration costs will be absorbed into the current NPS computing budget. However, it is reasonable to budget for a network support position after the initial courseware prototyping. It is assumed that one GS-11 computer technician working one-half time could administer the network and maintain the course homepage. (Norris, 1998) Utilizing 1998 pay schedules for Monterey, this amounts to $33,243 per year (OPM, 1998). This assumes one-half salary for a GS-11 at step 5 and includes the 43 percent escalation rate for leave and fringe benefits.

The Computer technician should maintain the course's network server and be trained to assist the faculty instructor in maintaining and updating the course software as required.

D. MAINTENANCE COSTS

There will be maintenance costs associated with the network/server hardware and the NBI courseware. Maintenance costs can be expected to run as high as 10% of initial equipment and courseware costs per year. (TRADAM, 1996) It is assumed that the course will be designed and converted to allow the faculty instructor flexibility to update the course and reference material. If the course is properly designed to be "instructor friendly," the maintenance cost of updating the course on an annual basis will be minimized. However, if the courseware is not

properly designed, significant costs can be expected for maintaining and updating the course material. It is anticipated that the software cost burden will be split between the instructor's salary and the half-time computer technician's salary.

E. COMBINED COSTS

The combined cost of providing a course through NBI becomes significant when the four major cost areas are considered together. The most significant cost occurs in the design and conversion of the NBI course, followed by the administrative and support costs of the course. Secondary are the maintenance and hardware costs.

The single, most important factor that affects the combine cost of converting, administering and maintaining a traditionally taught NPS course is the efficient design of the course and its student instructor feedback loops.

Based on the assumptions previously mentioned in this chapter, Table 5.2 provides a summary of NBI cost for a NPS course. The faculty cost in Table 5.2 ranges from no additional cost to the cost of hiring one additional faculty instructor at a step 55 pay level.

Design and Conversion Costs	$290,517 to $1,014,296
Administrative Costs	
Faculty Instruction	None to $141,769/year
Help Desk	$54,953/year
Computer Technician	$33,243/year
Out-sourced Administration	$7500 initially, ±$1900/year
Hardware Costs	$10,000 to $15,000
Maintenance Costs	Up to 10% of Hardware and Courseware Cost

Table 5.2. Combined Cost

VI. BENEFIT ANALYSIS

Network Based Instruction (NBI) provides a plethora of benefits to numerous interested parties within the NPS and naval organizations. Benefits are realized at the NPS student level, NPS institutional level and even the Department of the Navy organizational level. Even though start-up costs of providing courses through NBI are high, potential benefits appear to justify the additional initial expense. Although it is difficult to directly relate NBI benefits to cost, the collective benefits of providing a course through NBI can be weighed against the course's projected costs.

As the aggregate levels of education and knowledge increase within the Department of the Navy, the Navy's collective well-being will be enriched. Distributed learning can effectively function as a force multiplier. Properly utilized, NBI will provide more enlisted personnel, career DoN civilians and naval officers with the opportunity to gain critical information and knowledge and to improve their contributions to the naval organization as a whole. Distance education benefits both the individual and the organization in several ways.

First, distance education could provide more naval officers and government civilian personnel an opportunity to earn a masters degree by reducing time requirements at NPS. If students complete courses prior to reporting to NPS, their required time of residency at NPS will be reduced. Students who normally would not have time within their careers to attend NPS for a conventional time period may now have an opportunity for advanced education. Reduced residency at NPS could also facilitate increased student throughput. This would allow NPS and the Navy to increase the number of naval officers receiving graduate level education every year.

Second, providing courses at a distance will change the shape of career education for naval officers. Currently, naval officers receive noncredit learning at various points in their career, with a fortunate few receiving a graduate degree during a period of residence at NPS or a

comparable civilian institution. Providing courses at a distance would create a learning continuum where naval officers could take courses in a "just in time" manner. This would better support their careers. Utilizing distance education to institutionalize a learning continuum that is spread over an officer's career has the potential to provide increased efficiencies and effectiveness within the naval organization. Not only will the number of officers that are able to receive education increase and their time away from the fleet decrease, but the return on educational investment will also increase. This will occur due to improved relevancy and timeliness of education that is tailored to the learner. Additionally, it will expand the aggregate knowledge base within the naval organization.

Third, utilizing technology to provide education at a distance would provide the Navy with a tremendous resource. The knowledge individuals receive through education benefits the entire organization. Many components of education are provided "just in case" the student needs that particular bit of knowledge later in life. However, most students do not retain enough knowledge to effectively utilize all elements of their education. Leveraging network based instruction (NBI) to distribute advanced courses and reference material conveniently on-line would provide the Navy with a substantial reference tool. NBI will allow on-line courses to be utilized by naval personnel as a timely reference in solving current problems.

Fourth, in certain cases, NBI could provide quantifiable cost savings to individual naval commands. Using advanced technologies to provide courses at a distance could reduce or eliminate the need for personnel to travel to receive education and/or training. This could provide significant savings in per diem, airfare and car rental, lodging, and lost opportunity costs during travel.

A. REDUCED RESIDENCY

One of the most significant potential benefits of utilizing NBI to provide distance education is a reduction in the required residential period at NPS. Reduced residency at NPS will provide both cost savings

and other less quantifiable benefits. Each of the benefits will be examined below.

1. Opportunity Cost Savings

The most immediate savings to be realized from reduced residence requirements at NPS are in student opportunity costs.[8] For every quarter reduction in residency at NPS, there is an associated opportunity cost savings related to the student salary. While the Navy does not save in real dollars, it effectively gains up to three months of that officer's time to perform another job for no additional expenditure, depending on how much of the distance coursework the officer completes outside of work hours. Table 6.1 shows a breakout of potential cost savings for students utilizing 1998 Navy and Marine Corps Composite Standard Pay and Reimbursement Rates (DFAS, 1998). Although three months are saved at NPS, it is assumed that prospective students will complete some of their distance courses during the tenures of their current jobs. It is beyond the scope of this thesis to predict the opportunity cost of that effort.

	3 MONTHS	6 MONTHS
Lieutenant (O-3)	$19,485	$38,942
Lieutenant Commander (O-4)	$22,839	$45,678
Commander (O-5)	$26,754	$53,508

Table 6.1. Officer Opportunity Cost at NPS

It is realistic to assume that distance education can be effectively utilized to eliminate the refresher quarter requirements and some first quarter requirements for a small percentage of students. It may even be possible for some students to take enough accredited courses through distance learning to eliminate two complete quarters from a

[8] Opportunity cost is the lost benefit between action actually taken and the best alternative course of action.

given curriculum. The courses that a prospective student validates based on undergraduate experience will reduce distance requirements.

For example, if a prospective student validates two courses based on undergraduate coursework, only two courses will need to be completed through distance education to eliminate one quarter (three months) of residency. However, it must be noted that no mechanism is in place to perform the validation function at a distance. Current practice has course validations occurring after the student has reported to NPS. A system would have to be developed to provide potential distance students with approved validations prior to their arrival at NPS to optimize savings gained through distance education.

It is, however, completely unrealistic to assume that every student coming to NPS will have the ability and the time available to complete a specific number of courses prior to arrival. Many students come to NPS from highly time-intensive operational billets. Not all prospective students will have enough time available to complete one to eight graduate courses while fulfilling the needs of their current billets. Until experience is gained, it is safer and more reasonable to assume that only a limited number of prospective students will be able to complete coursework prior to reporting to NPS.

Fortunately, distance education need not be applied to everyone to provide a benefit. Many naval officers come to NPS from billets that could provide the flexibility needed to complete coursework in conjunction with their current obligations. Any prospective student needs support from his/her superiors to provide time to devote to distance education coursework. It is fair to assume that NBI will provide some time efficiencies by allowing students to proceed at their own paces (TRADAM, 1996 and IDEA, 1998). However, there will still be a substantial time commitment required to complete a course. It is also fair to assume that students will complete some of the coursework in their personal time. However, it is unrealistic to assume that potential students will complete all requirements on their own time.

A shift in cultural beliefs is required within the naval organization to create an environment that will allow widespread use of

distance education to succeed. Some argue it is in the best interest of the naval organization to educate as many personnel as possible to the highest degree. (Quinn, Anderson & Finkelstein, 1996) Increasing the aggregate level of knowledge in a shrinking naval force is required to implement the Chairman of the Joint Chief of Staff's Joint Vision 2010. For distance education to work effectively, senior officers within both naval and joint commands need to demonstrate their collective belief in the advantages of graduate education and show their support by providing officers under their supervision with the ability to complete courses prior to transferring to NPS.

2. Educational Opportunities

It is extremely difficult for many naval officers to obtain a masters degree at NPS. The reasons vary, but often involve stringent timing requirements and career considerations. Using the previously mentioned example regarding naval aviators, it is difficult for them to maintain their flying proficiencies, fill promotion essential billets and find 18 to 27 months within their careers to attend NPS to earn graduate degrees. Utilizing distance education to eliminate three to six months of residency at NPS could provide many officers the opportunity necessary to obtain graduate degrees. Opportunities arising from distance education will apply to officers across all naval communities. Additionally, the potential also exists to provide graduate education opportunities to career DoN civilians and enlisted personnel.

Results from an "Interest in Graduate Education Survey" performed by a recent NPS graduate and Strategic Studies Group officer provide interesting insight into opinions of potential NPS graduate students concerning distance education (Cowan, 1998). The survey was conducted at NAS North Island in San Diego, CA in both a fixed wing and a helicopter squadron. Although the survey (Appendix A) was small, with only 79 participants, and focused within the naval aviation community, it indicates a positive interest in distance education from at least one group of potential NPS students.

When asked, "Are you interested in an education that will lead to a graduate level degree," 73.4% were highly interested and 20.3% were somewhat interested. When asked, "If Naval Postgraduate School (NPS) graduate programs were made available to you on your own time through the Internet and/or other computer-based technologies, would you use them," 51.9% were highly interested and 27.8% were somewhat interested. Asked the question, "Would you be interested in graduate programs that could be accomplished through a combination of both 'traditional' (classroom) and 'non-traditional' (distance learning) methods," 53.2% were highly interested and 36.7% somewhat interested. Finally, and of critical importance to the Navy, over 51% responded positively to the question, "Would the opportunity for a graduate level education using both non-traditional and traditional methods impact your decision to remain in the Navy?" The highly positive responses to these questions indicate potential students are receptive to the idea of a hybrid graduate education program utilizing both traditional and non-traditional methods. It should be noted, however, that survey participants sometimes answer questions to reflect the answer they believe the survey is seeking, vice the answer that reflects their decisions in the course of their personal lives.

3. Increased Student Load

A third benefit of reduced residency is the opportunity to increase student throughput at NPS. As NPS residency requirements are reduced, more students may be able to attend NPS. The following example is provided to show the potential benefit. Table 6.2 shows the average number of students on board NPS during academic year 1997.

	FALL QUARTER	WINTER QUARTER	SPRING QUARTER	SUMMER QUARTER	AVERAGE AY 1997
USN	882	869	774	864	847
USMC	150	137	122	196	151
Other Services	201	173	165	191	183
Foreign	154	187	166	163	168
Total Onboard	1387	1366	1227	1414	1349

Table 6.2. Academic Year 1997 Students on Board From (NPS Registrar's Database, 1998)

Table 6.3 shows the number of graduate degrees awarded at NPS during academic year 1997.

	FALL QUARTER	WINTER QUARTER	SPRING QUARTER	SUMMER QUARTER	TOTAL AY 1997
DEGREES AWARDED	190	191	168	192	741

Table 6.3. Academic Year 1997 Degrees Awarded From (NPS Registrar's Database, 1998)

From Table 6.2, an average of 998 Navy and Marine Corps Officers were on board NPS during 1997. For every five percent of the Navy and Marine Corps Officers on board that used distance education to reduce their residencies by one quarter, a 49.9 quarter savings would be realized. See Figure 6.1.

Average Number Navy & Marines Onboard		Percent Savings		Total Quarters Saved
998	X	5 Percent	=	49.9 Quarters

Figure 6.1. Example of Quarter Savings

Table 6.4 shows that a 49.9 quarter savings is translated into additional annual student throughput depending on the length of residential period in which the additional students are enrolled.

TOTAL QUARTER SAVINGS AVAILABLE	49.9	49.9	49.9	49.9	49.9
LENGTH OF RESIDENTIAL PROGRAM	4 Quarter	5 Quarter	6 Quarter	7 Quarter	8 Quarter
NUMBER OF ADDITIONAL STUDENT THROUGHPUT	12.5	10	8.3	7.1	6.2

Table 6.4. Potential Annual Throughput Benefit

This example is simplistic because it assumes that the current faculty will be able to administer both distance and current traditional courses. As well, it also assumes the naval organization will send additional officers to NPS to maintain the current number of students onboard. The example shows the potential benefit of added throughput at NPS. It does not imply any savings will actually be realized or that more or less than five percent of Navy and Marine Corps Officers will be able to utilize distance education to reduce a quarter of their residency at NPS.

B. LEARNING CONTINUUM

Providing graduate courses at a distance would allow NPS to expand its customer base. Students would no longer be confined to the grounds of NPS in Monterey, but could receive NPS's intellectual content and scholastic information resources anywhere in the world. In a similar fashion, students of a particular course need not be enrolled in a specific curriculum in which the course is a requirement. NPS could significantly expand its sphere of academic influence by offering its courses at a distance and independent of a degree program. This would provide naval officers and career minded DoN civilians with the opportunity for education over the span of their careers in areas related to their work. This would increase the Navy's return on investment for education.

"Financial Management in the Armed Forces" offers an excellent example of the way that an NPS graduate level course would fit into the

"new" continuum of naval officer education. The following describes "Financial Management in the Armed Forces."

> Focuses on DoD financial management practices and concepts in DoD, with an emphasis on the Department of the Navy. Topics include appropriations, PPBS, budget formulation, review and execution, flow of funds, and accounting terminology and systems. Current financial management issues such as DFAS, DBOF [sic], and unit costing are reviewed. IN-class exercises and case studies are used to develop the students ability to apply financial management concepts to real world situations. (NPS Catalog, 1998)

"Financial Management in the Armed Forces" provides core knowledge that every naval officer should possess if he/she controls resources. It is applicable to department heads, executive officers and commanding officers. Additionally, the course material is essential to any naval officer working as a comptroller or in any financial management billet. (Kerber, 1998)

It is quite reasonable to assume that many naval officers and DoN civilians would take "Financial Management in the Armed Forces," without receiving credit towards a masters degree, for the extremely useful knowledge they would gain to assist them in performing their jobs more effectively and efficiently.

C. ONLINE REFERENCE TOOLS

NBI is a tremendous medium to provide easily accessible material to a wide and diverse audience of users. Carefully designed graduate courses and on-line reference material indexing can provide a wealth of information that is just a few keystrokes away from any potential user.

"Financial Management in the Armed Forces" is a course that could be adapted as a superb on-line reference tool. An underlying assumption is that the course will be indexed to allow non-students to access the learning modules and associated on-line reference material. There are many subject areas that would be useful for naval officers to review. Each course module will provide descriptive and interactive material with access to on-line reference material.

One example would be the module on unfunded requirements. An officer could access and complete that particular module and review its associated reference material to learn the principles of unfunded requirements. Armed with that information, the officer would be able to better prepare and justify unfunded requirements and perhaps receive additional funds for his/her command.

D. SHORT COURSE SAVINGS

Reducing or eliminating short courses taught at NPS would provide significant cost savings. Any course that requires students to travel away from their permanent duty stations will be considered a short course for the purpose of this research. The opportunity for significant cost savings results from eliminating per diem, lodging, airfare and car rental expenses, and lost student opportunity costs during a student's travel to attend a short course.

Most of NPS's graduate courses do not have short courses associated with or directly related to them. "Financial Management in the Armed Forces" does, however, have a directly related short course, "The Practical Comptrollership Course." Both courses share the same instructional material, technique and instructor. Combining two separate student populations under the same course provides added benefits. In this case, a significant expense could be avoided by providing the "The Practical Comptrollership Course" at a distance with NBI. Although there is considerable expense to be saved, it is spread throughout the Navy and not recognizable as a collective savings within a single command.

"The Practical Comptrollership Course" is a nine day course that is offered six times per year. In 1997 the course was offered five times in Monterey, CA and once in Pensacola, FL. Students reserve a seat in a specific course through the Naval Financial Management Career Center in Pensacola, FL. The students who attend the course come from naval commands located throughout the world. Most students arrive on the Sunday before the course starts and depart for their home duty stations the evening of or the day after the ninth class day. Including

travel days and the weekend between class weeks, the typical student spends 13 days attending the "The Practical Comptrollership Course" (PCC). The student's command must pay for airfare, car rental, lodging and per diem expenses during this period. There is also opportunity cost that is lost while the student is away from the command. (Kerber, 1998)

Appendix C provides the actual student breakout costs for each PCC during 1997. 1997 student information was obtained from the Naval Financial Management Career Center. Table 6.5 provides a summary of each expense category by course session.

Month	Per Diem	Lodging	Travel	Opp Cost	Total
January	$13,572	$32,712	$27,956	$38,991	$113,231
February	12,636	30,456	24,014	36,310	103,416
May	14,040	33,840	28,590	40,538	117,008
July	23,296	39,648	47,612	75,411	185,967
September	15,444	37,224	29,651	47,959	130,278
October	14,976	36,096	29,700	42,420	123,192
Total	$93,964	$209,976	$187,523	$281,629	$773,092

Table 6.5. 1997 Practical Comptrollership Course Costs

The following assumptions were used to calculate potential cost savings if the course was offered at a distance utilizing NBI. Per diem and lodging costs were taken from the DFAS website (OPM, 1998) and based on January 1998 rates. Based on course surveys, approximately 80 percent of the students received a rental car during their course. The rental car expense assumes 80 percent of the students rent a car for the duration of the course at $30 per day (Miller, 1998). Each student's paygrade or general schedule (GS) level was used to calculate the opportunity cost of each student attending a traditionally taught course, vice taking the course through NBI.

The traditional course involves 40 hours of in-class instructor lecture time. Class projects, study time and guest lectures augment the 40 hours of lecture resulting in the nine day PCC duration. "Expert" guest lectures provided during the PCC are considered "value added" to

the course, but not necessarily a portion of the course's core material. (Kerber, 1998) There is not a current solution to provide these lectures to students at a distance. One method would be to make "expert" guest lectures available on video tapes for those students who are interested in particular subject areas. This method would probably be too unwieldy. As technology continues to advance, and bandwith becomes less of an issue, the lectures could be provided over the Internet.

Historically, NBI technology for course conversion compresses the required time for a student to complete a course by 20 percent (TRADAM, 1996) to 30 percent (IDEA, 1998). It is assumed that NBI conversion will provide a 25 percent course compression (time savings) for the PCC. This could effectively reduce the NBI course work time from 40 hours to approximately 30 hours (40hrs X [1-.25]).

The short course requires an average of 13 days to complete, including travel time. Completing the PCC using NBI will require approximately 30 hours not including student study and reading time. Being conservative, it is assumed the student will require four workdays (≈ 30 hours) to complete the course at a distance. Discounting travel days, because they occur on weekends, the student in a residential PCC is unavailable to his/her command for 10 working days for the current course. Subtracting the four days to complete the NBI course from the 10 days of lost opportunity provides six days of potential savings. It is assumed the students will complete required study hours during their personal time, much as they would if they had traveled to complete the traditional course. See Figure 6.2.

10	Days Lost Opportunity to Command
- 4	Days to Complete PCC Utilizing NBI
6	Days of Opportunity Cost Savings

Figure 6.2. Opportunity Savings

The dollar value of the savings were calculated using the 1998 General Schedule Pay Scale for civilians assuming each student's GS level is at a step 5, and the 1998 Navy and Marine Corps Composite

Standard Pay and Reimbursement Rates for the active duty student's paygrade. (OPM, 1998) and (DFAS, 1998) Opportunity cost savings shown in Table 6.5 and Appendix C were estimated based on the calculation shown in Figure 6.3.

Annual Salary 2080 FTE Hrs/Year	X	Work Days Saved	=	Opportunity Cost Savings

Figure 6.3. Opportunity Cost Savings

Providing "The Practical Comptrollership Course" through NBI and eliminating the need for students to travel to attend the course could save per diem, lodging and travel expenses and some lost student opportunity cost for each student's command. These cost savings cannot directly offset the cost of designing and providing the course for NPS because the savings are spread throughout many Navy commands. However, the cost savings could positively affect the bottom line of the naval organizations which provide students for the PCC.

There are potential disadvantages to providing the "Practical Comptrollership Course" at a distance. First, many students feel that their commands would not allow them the time necessary to complete the course unless they actually traveled away from their commands to attend the course. This is a real concern since it is difficult to keep from utilizing personnel in other ways if they are physically present at the command. As distance education becomes more common, organizational leaders will have to learn to preserve a student's ability to be free of obligations while completing coursework.

Second, students will not have the opportunity to interact in a classroom environment with the instructor and other students. This results in the lost experience and knowledge gained from asking questions and sharing responses with other students. As well, the students will lose the benefits gained from developing relationships with other students and sharing their many lessons learned from their various work environments.

E. OTHER BENEFITS

1. Revenue Generators

As NPS designs and converts courses into NBI formats, potential revenue streams will develop. Many courses that can be converted are applicable for student populations at regular universities and colleges. It may be possible for NPS to market some of the courses it develops, or portions of courses to other interested schools and universities across the country and throughout the world.

Additionally, some courses may be suitable, in whole or part, for other branches of the military service. "Financial Management in the Armed Forces" is one such course. Much of the course is standard throughout every branch of service within DoD, and differences would be relatively inexpensive to accommodate compared to the original cost of the course design and conversion. NPS may be able share development and administration expenses of the course, or applicable portions, with the Army or Air Force, and/or even provide the course for the given service.

2. Standardization

Network Based Instruction provides multiple students with the opportunity to learn utilizing the same, standard course material. Not only are more students learning from the same material, but the material will also have been prepared by the most knowledgeable and competent instructors.

3. Student Participation

NBI forces many students to be active participants in the learning process, vice being passive recipients of knowledge in the classroom environment. Students completing distance education are challenged to take initiative and be responsible for their own learning process.(Rudenstein, 1997) Students become not only responsible for their own education, but also have the increased flexibility of learning at their convenience and at their own pace.(Green, 1997)

VII. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The objective of this thesis was to present the costs and benefits of converting, administering and maintaining a Naval Postgraduate School course using Network Based Instruction at a distance. The result is a framework in which distance education can be implemented at NPS and an analysis of the resulting cost and benefits of providing an NBI course within that framework. This last chapter will discuss some of the conclusions developed in earlier chapters and provide recommendations for further study in this area.

B. CONCLUSIONS

It has become quite evident that the military is undergoing a Revolution in Military Affairs. Likewise, it is true that the Naval Postgraduate School must undergo a Revolution in Academic Affairs to be able to provide continued and valued service to the Navy and the Department of Defense.

Distance education will be an integral portion of NPS's Revolution in Academic Affairs. Distance education will allow NPS to leverage technology to educate more personnel throughout the world in an effective and more efficient manner. Network Based Instruction is one form of distant education that will facilitate this revolution.

1. Course Costs

The costs of converting, administering and maintaining an NPS course were difficult to estimate due to significant data limitations. It is quite difficult to make predictions based on others' experiences when attempting to blaze new trails. Using the best information available and conservative assumptions, several conclusions were reached. The assumptions utilized provide a cost range that covers both initial expense, as well as reoccurring expenses in the following years.

The cost estimates for designing and converting a course ranged between $290,517 and $1,014,296. Although the price range was broad, the mean value of $599,841 was quite conservative. The actual cost could easily be lower due to contractor learning curves and the contractor's ability to reuse the courseware's architectural structure within the later course modules.

Until the course is actually prototyped, hardware costs are also difficult to predict. However, $10,000 to $15,000 is a reasonable assumption for the first course converted.

Likewise, administration and maintenance costs are difficult to predict. A framework for these costs was outlined, even though costs will depend on the actual course design in the NBI format. Although the cost range is dependent on course design, the following costs were defined in Chapter V. Administrative costs for faculty ranged from no additional expense to $141,769 per year if one additional faculty instructor is required to handle the distance student load. Help desk and computer technician costs are expected to initially be $88,196 per year. If out-sourced administration of the course is elected, the initial cost will be $7500 with an annual user fee of approximately $1900 depending on user load.

2. Course Benefits

Providing NPS courses through an NBI format would provide many benefits. Chapter VI explored these benefits. The most significant benefit of distance education utilizing NBI is the ability to bring education to more students. NBI will allow more naval officers and personnel the opportunity to obtain education throughout the continuum of their careers, as well as allow more students to obtain degrees at NPS due to reduced residency requirements.

The accessibility of NPS courses, such as "Financial Management in the Armed Forces," also provides a substantial reference tool to assist naval officers and other personnel in performing related portions of their jobs.

The graduate course examined in this thesis also had a directly related short course. An example in Chapter VI shows that approximately $773,000 of expense in travel, lodging, and opportunity cost could have been avoided in 1997 if the "Practical Comptrollership Course" (PCC) had been provided using NBI. However, several intangible benefits would be lost if the students took the PCC using NBI vice attending the short course.

C. RECOMMENDATIONS FOR FURTHER STUDY

Providing quality education at a distance is a new and exciting field. The process requires breaking old paradigms and using new and relatively unknown technologies. There are numerous issues that must be thoroughly explored to help NPS become the "University of the Future."

1. Faculty Incentive Issues

Further research into faculty perceptions of distant education is required. From discussions with numerous NPS faculty, some faculty members perceive their knowledge and instructional material as proprietary and are reluctant to convert them into a format that reduces or takes away their control over its distribution. Additionally, many untenured instructors believe their effort is better spent publishing material within their professional community than converting a course into an NBI format. A better understanding of faculty willingness or resistance to converting courses to distance education formats is essential.

2. Technological Issues

It is extremely important to explore the capabilities of current technologies and how they relate to NPS's current operations. Increased understanding of how new and current technologies will interact to provide distant education is vital to NPS's success.

3. Distant Student Populations

Research into the size and availability of potential student populations is critical. Any good business plan makes detailed customer

forecasts. Upon determining the courses that will be offered and the manner in which the courses will be distributed, NPS must accurately predict its distant student population.

4. Faculty Load Study

Another question that remains unanswered is how many students a faculty member can reasonable instruct from a distance. A detailed analysis of how the instructor to student ratio varies with varying levels of interactivity designed into NBI courses is required.

5. Naval Officer Requirements Study

Distance education is being established to benefit naval officers. Detailed requirements analysis should be conducted on various officer communities to determine if officers in particular communities have the time and ability to complete distant education requirements, or if they already have too many requirements associated with their current jobs.

6. Network Server Performance

Research into network server performance with regard to varying levels of courseware interactivity and number of simultaneous users is of utmost importance to better understanding hardware costs and functionality of courseware.

7. Appropriate Course Material

An analysis of NPS graduate courses that examines course content, instructional techniques and learning outcomes will facilitate the conversion of the most appropriate NPS courses into NBI and other distance education formats.

8. Quality of Education

Once an NPS course is converted to an NBI format, a quality of education analysis should be performed to determine the effectiveness of distance education compared to a traditional classroom education.

APPENDIX A GRADUATE EDUCATION SURVEY

Final Results with Command Breakdowns
Nov./Dec. 1997 - NAS North Island, San Diego, CA
LCDR George L. Cowan, USN

Commands Surveyed = HSL-41, VS-41

Participants = 79 Officers (24 HSL-41 / 55 VS-41)

Rank	O-1	O-2	O-3	O-4	O-5
	7	32	34	4	2

Designators 1310-42
1315-4
1320-25
1325-7
1630-1

Responses: 1 = highly interested
2 = somewhat interested
3 = non-committal
4 = somewhat uninterested
5 = not interested at all

Question (HSL/VS): Are you interested in an education that will lead to a graduate level degree?

total		HSL-41		VS-41	
1	58	1	19	1	39
2	16	2	3	2	13
3	0	3	0	3	0
4	1	4	1	4	0
5	4	5	1	5	3
total	79		24		55

Question (HSL/VS): If you were offered a graduate level education at little or no financial cost to yourself, would you take adantage of this offer?

total		HSL-41		VS-41	
1	65	1	21	1	44
2	9	2	1	2	8
3	1	3	1	3	0
4	0	4	0	4	0
5	4	5	1	5	3
total	79		24		55

Question (HSL): If Naval Postgraduate School (NPS) graduate programs were made available to you through video-teleconference (VTC) facilities, would you use them?

HSL-41	
1	11
2	6
3	5
4	1
5	1
total	24

Question (VS): If Naval Postgraduate School (NPS) programs (Computer Science, Financial Mgt., Information Technologies, etc.) were made available to you at work through video-teleconference (VTC) facilities, would you use them?

VS-41	
1	27
2	14
3	9
4	1
5	4
total	55

Question (VS): If Naval Postgraduate School (NPS) programs (Computer Science, Financial Mgt., Information Technologies, etc.) were made available to you on your own time through video-teleconference (VTC) facilities, would you use them?

VS-41	
1	24
2	18
3	8
4	3
5	2
total	55

Question (HSL/VS): If Naval Postgraduate School (NPS) graduate programs were made available to you on your own time through the Internet and/or other computer-based technologies, would you use them?

total		HSL-41		VS-41	
1	41	1	11	1	30
2	22	2	7	2	15
3	8	3	1	3	7
4	4	4	3	4	1
5	4	5	2	5	2
total	79		24		55

Question (HSL/VS): Would you be interested in graduate programs that could be accomplished through a combination of both "traditional" (classroom) and "non-traditional" (distance learning) methods?

total		HSL-41		VS-41	
1	42	1	14	1	28
2	29	2	5	2	24
3	2	3	2	3	0
4	2	4	1	4	1
5	4	5	2	5	2
total	79		24		55

Question (HSL/VS): Would the opportunity for a graduate level education using both non-traditional and traditional methods impact your decision to remain in the Navy?

total		HSL-41		VS-41	
1	16	1	9	1	7
2	25	2	10	2	15
3	15	3	2	3	13
4	5	4	2	4	3
5	11	5	1	5	10
total	72		24		48

Question (HSL): How highly does your community value a graduate education?

HSL-41	
1	8
2	6
3	7
4	3
5	0
total	24

Question (VS): In your opinion, do you feel the Navy sets a high value on graduate level education in terms of career advancement?

VS-41	
1	11
2	14
3	9
4	10
5	4
total	48

Question (VS): In your opinion, do you feel your community (ie: aviation, surface, submarine) sets a high value on graduate level education in terms of career advancement?

VS-41	
1	11
2	15
3	8
4	9
5	5
total	48

Additional comments:

- Concerning does the Navy / your community value grad ed in terms of career advancement? Yes for O-6 and up, not really for O-3, O-4, O-5. (O-2,1310)

- Once I finish FRP I would like to get my masters. (O-2, 1310)

- I don't think as a FRP my schedule would allow the time right now. I already have enough to study. (O-2, 1315)

- It would have to be a degree of value or it's not worth it (content, prestige). (O-3, 1320)

- Good idea to have educational opportunities while on cruise. (O-2, 1320)

- Very interested in Navy post graduate program. Would like technical / engineering classes. (O-1, 1320)

- An option I would benefit from would be the ability to complete coursework via distance learning and then get TDY orders to PG School Monterey to complete lab and thesis study. A program like this would benefit the Navy and personnel by keeping personnel in their community the greatest extent possible while allowing them the opportunity to complete highly technical curriculums. (O-3, 1310)

- Have completed 3 NPS courses by VTC already. (O-5, 1310)

- I was a participant in the Navy Post-Graduate School distance learning program in 1996 at HSL-41. It was a great program and it was a disappointment when the program was cancelled. (O-3, 1310)

- I believe that the combination of traditional / non-traditional classes would be the best plan of attack. (O-3, 1310)

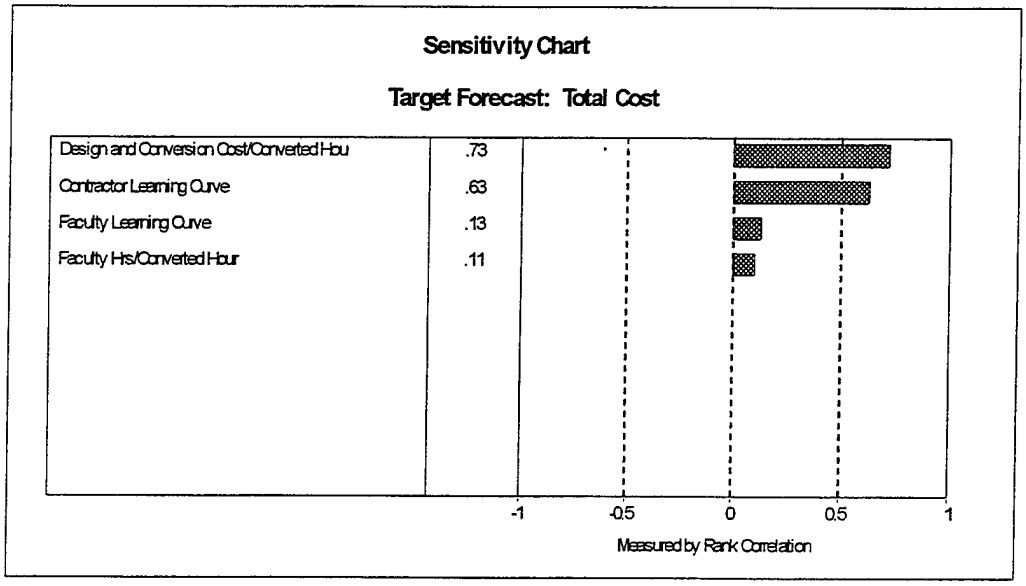
- If graduate education is desired for aviators, then the detailers need to not make the payback tour such a negative job. (O-3, 1310)

- HSL-41 VTC distance learning program was super. Having it cancelled mid-course sent a strong signal to the J.O.'s here about the Navy's concern for graduate education for its pilots. Lack of opportunity means that J.O.'s who want education have to pay and go on their own time. In my experience, those J.O.'s then almost all elect to leave the Navy. (O-3, 1310)

- For pilots going to PG school can be a career killer. Other communities view it as a "plus". (O-3, 1310)

- I would love to attend PG School in Monterey. If the timing does not work out, however, I would happily go the distance learning route. (O-3, 1310)

APPENDIX B CRYSTAL BALL REPORT

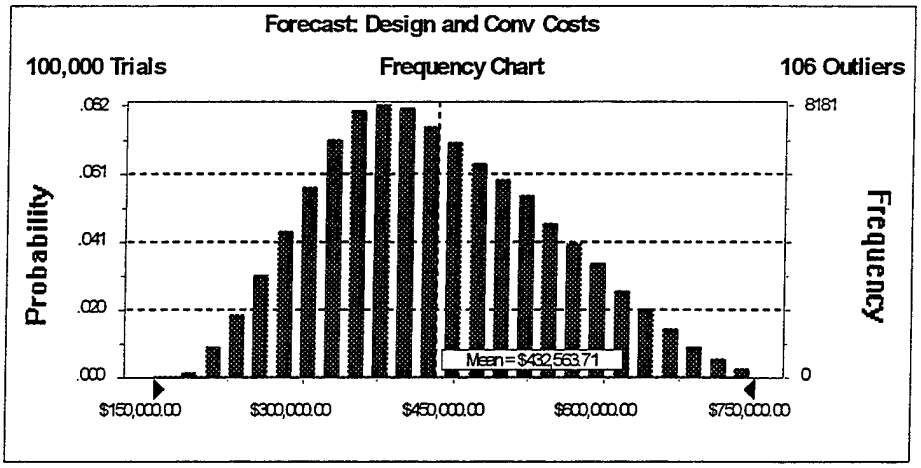


Forecast: Design and Conversion Costs

Summary:

Display Range is from $150,000.00 to $750,000.00
Entire Range is from $172,549.71 to $784,061.93
After 100,000 Trials, the Std. Error of the Mean is $356.75

Statistics:		Value
Trials		100000
Mean		$432,563.71
Median		$421,313.49
Mode		---
Standard Deviation		$112,813.68
Variance	####	
Skewness		0.33
Kurtosis		2.51
Coeff. of Variability		0.26
Range Minimum		$172,549.71
Range Maximum		$784,061.93
Range Width		$611,512.22
Mean Std. Error		$356.75



Forecast: Design and Conversion Costs

Percentiles:

Percentile	Value
0%	$172,549.71
10%	$291,704.80
20%	$331,379.68
30%	$362,004.10
40%	$391,383.63
50%	$421,313.49
60%	$454,197.54
70%	$491,068.96
80%	$533,997.46
90%	$590,933.47
100%	$784,061.93

Frequency Counts:

Frequency:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$150,000.00	0.000000	0
1	$150,000.00	$174,000.00	0.000020	2
2	$174,000.00	$198,000.00	0.001470	147
3	$198,000.00	$222,000.00	0.009260	926
4	$222,000.00	$246,000.00	0.019060	1906
5	$246,000.00	$270,000.00	0.030950	3095
6	$270,000.00	$294,000.00	0.043960	4396
7	$294,000.00	$318,000.00	0.056930	5693
8	$318,000.00	$342,000.00	0.071400	7140
9	$342,000.00	$366,000.00	0.080290	8029
10	$366,000.00	$390,000.00	0.081810	8181
11	$390,000.00	$414,000.00	0.080800	8080
12	$414,000.00	$438,000.00	0.075630	7563
13	$438,000.00	$462,000.00	0.070560	7056
14	$462,000.00	$486,000.00	0.064090	6409
15	$486,000.00	$510,000.00	0.059130	5913
16	$510,000.00	$534,000.00	0.054650	5465
17	$534,000.00	$558,000.00	0.046020	4602
18	$558,000.00	$582,000.00	0.040550	4055
19	$582,000.00	$606,000.00	0.034210	3421
20	$606,000.00	$630,000.00	0.025780	2578
21	$630,000.00	$654,000.00	0.020470	2047
22	$654,000.00	$678,000.00	0.014440	1444
23	$678,000.00	$702,000.00	0.009190	919
24	$702,000.00	$726,000.00	0.005630	563
25	$726,000.00	$750,000.00	0.002640	264
	$750,000.00	+Infinity	0.001060	106
Total:			1.000000	1E+05

Forecast: Design and Conversion Costs

Cumulative:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$150,000.00	0.000000	0
1	$150,000.00	$174,000.00	0.000020	2
2	$174,000.00	$198,000.00	0.001490	149
3	$198,000.00	$222,000.00	0.010750	1075
4	$222,000.00	$246,000.00	0.029810	2981
5	$246,000.00	$270,000.00	0.060760	6076
6	$270,000.00	$294,000.00	0.104720	10472
7	$294,000.00	$318,000.00	0.161650	16165
8	$318,000.00	$342,000.00	0.233050	23305
9	$342,000.00	$366,000.00	0.313340	31334
10	$366,000.00	$390,000.00	0.395150	39515
11	$390,000.00	$414,000.00	0.475950	47595
12	$414,000.00	$438,000.00	0.551580	55158
13	$438,000.00	$462,000.00	0.622140	62214
14	$462,000.00	$486,000.00	0.686230	68623
15	$486,000.00	$510,000.00	0.745360	74536
16	$510,000.00	$534,000.00	0.800010	80001
17	$534,000.00	$558,000.00	0.846030	84603
18	$558,000.00	$582,000.00	0.886580	88658
19	$582,000.00	$606,000.00	0.920790	92079
20	$606,000.00	$630,000.00	0.946570	94657
21	$630,000.00	$654,000.00	0.967040	96704
22	$654,000.00	$678,000.00	0.981480	98148
23	$678,000.00	$702,000.00	0.990670	99067
24	$702,000.00	$726,000.00	0.996300	99630
25	$726,000.00	$750,000.00	0.998940	99894
	$750,000.00	+Infinity	1.000000	1E+05

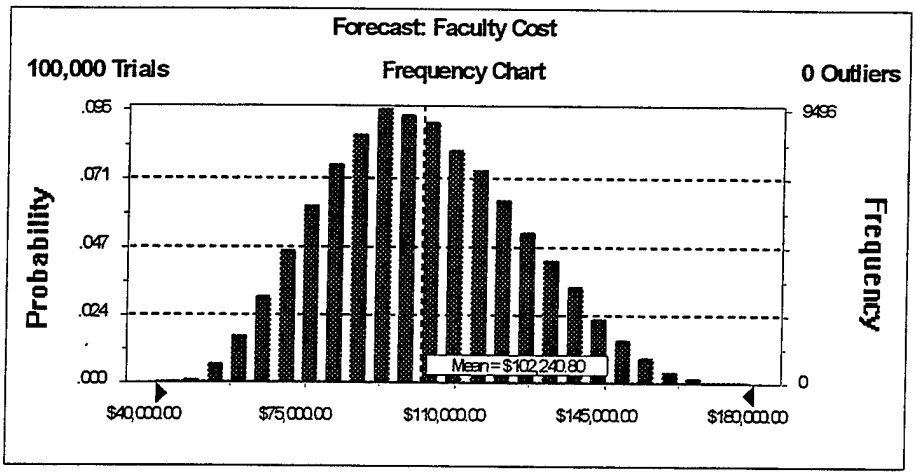
End of Forecast

Forecast: Faculty Cost

Summary:

Display Range is from $40,000.00 to $180,000.00
Entire Range is from $47,787.01 to $172,355.14
After 100,000 Trials, the Std. Error of the Mean is $70.69

Statistics:	Value
Trials	100000
Mean	$102,240.80
Median	$100,898.97
Mode	---
Standard Deviation	$22,354.97
Variance	$499,744,694.78
Skewness	0.23
Kurtosis	2.52
Coeff. of Variability	0.22
Range Minimum	$47,787.01
Range Maximum	$172,355.14
Range Width	$124,568.13
Mean Std. Error	$70.69



Forecast: Faculty Cost

Percentiles:

Percentile	Value
0%	$47,787.01
10%	$73,609.54
20%	$82,142.88
30%	$88,960.05
40%	$94,977.87
50%	$100,898.97
60%	$107,086.18
70%	$114,068.64
80%	$122,083.33
90%	$133,023.14
100%	$172,355.14

Frequency Counts:

Frequency:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$40,000.00	0.000000	0
1	$40,000.00	$45,600.00	0.000000	0
2	$45,600.00	$51,200.00	0.000730	73
3	$51,200.00	$56,800.00	0.006490	649
4	$56,800.00	$62,400.00	0.016290	1629
5	$62,400.00	$68,000.00	0.030380	3038
6	$68,000.00	$73,600.00	0.046020	4602
7	$73,600.00	$79,200.00	0.061530	6153
8	$79,200.00	$84,800.00	0.075640	7564
9	$84,800.00	$90,400.00	0.085950	8595
10	$90,400.00	$96,000.00	0.094960	9496
11	$96,000.00	$101,600.00	0.093420	9342
12	$101,600.00	$107,200.00	0.090570	9057
13	$107,200.00	$112,800.00	0.081080	8108
14	$112,800.00	$118,400.00	0.074050	7405
15	$118,400.00	$124,000.00	0.063360	6336
16	$124,000.00	$129,600.00	0.052440	5244
17	$129,600.00	$135,200.00	0.042450	4245
18	$135,200.00	$140,800.00	0.033280	3328
19	$140,800.00	$146,400.00	0.022420	2242
20	$146,400.00	$152,000.00	0.014740	1474
21	$152,000.00	$157,600.00	0.008660	866
22	$157,600.00	$163,200.00	0.003910	391
23	$163,200.00	$168,800.00	0.001450	145
24	$168,800.00	$174,400.00	0.000180	18
25	$174,400.00	$180,000.00	0.000000	0
	$180,000.00	+Infinity	0.000000	0
Total:			1.000000	1E+05

Forecast: **Faculty Cost**
Cumulative:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$40,000.00	0.000000	0
1	$40,000.00	$45,600.00	0.000000	0
2	$45,600.00	$51,200.00	0.000730	73
3	$51,200.00	$56,800.00	0.007220	722
4	$56,800.00	$62,400.00	0.023510	2351
5	$62,400.00	$68,000.00	0.053890	5389
6	$68,000.00	$73,600.00	0.099910	9991
7	$73,600.00	$79,200.00	0.161440	16144
8	$79,200.00	$84,800.00	0.237080	23708
9	$84,800.00	$90,400.00	0.323030	32303
10	$90,400.00	$96,000.00	0.417990	41799
11	$96,000.00	$101,600.00	0.511410	51141
12	$101,600.00	$107,200.00	0.601980	60198
13	$107,200.00	$112,800.00	0.683060	68306
14	$112,800.00	$118,400.00	0.757110	75711
15	$118,400.00	$124,000.00	0.820470	82047
16	$124,000.00	$129,600.00	0.872910	87291
17	$129,600.00	$135,200.00	0.915360	91536
18	$135,200.00	$140,800.00	0.948640	94864
19	$140,800.00	$146,400.00	0.971060	97106
20	$146,400.00	$152,000.00	0.985800	98580
21	$152,000.00	$157,600.00	0.994460	99446
22	$157,600.00	$163,200.00	0.998370	99837
23	$163,200.00	$168,800.00	0.999820	99982
24	$168,800.00	$174,400.00	1.000000	1E+05
25	$174,400.00	$180,000.00	1.000000	1E+05
	$180,000.00	+Infinity	1.000000	1E+05

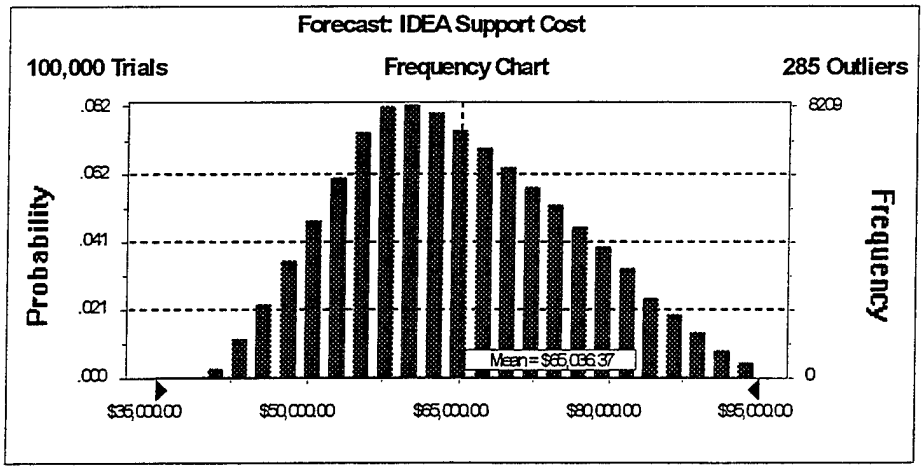
End of Forecast

Forecast: IDEA Support Cost

Summary:

Display Range is from $35,000.00 to $95,000.00
Entire Range is from $39,034.97 to $100,186.19
After 100,000 Trials, the Std. Error of the Mean is $35.67

Statistics:	Value
Trials	100000
Mean	$65,036.37
Median	$63,911.35
Mode	---
Standard Deviation	$11,281.37
Variance	$127,269,273.72
Skewness	0.33
Kurtosis	2.51
Coeff. of Variability	0.17
Range Minimum	$39,034.97
Range Maximum	$100,186.19
Range Width	$61,151.22
Mean Std. Error	$35.67



Forecast: IDEA Support Cost

Percentiles:

Percentile	Value
0%	$39,034.97
10%	$50,950.48
20%	$54,917.97
30%	$57,980.41
40%	$60,918.36
50%	$63,911.35
60%	$67,199.75
70%	$70,886.90
80%	$75,179.75
90%	$80,873.35
100%	$100,186.19

Frequency Counts:

Frequency:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$35,000.00	0.000000	0
1	$35,000.00	$37,400.00	0.000000	0
2	$37,400.00	$39,800.00	0.000060	6
3	$39,800.00	$42,200.00	0.002830	283
4	$42,200.00	$44,600.00	0.011520	1152
5	$44,600.00	$47,000.00	0.021950	2195
6	$47,000.00	$49,400.00	0.034860	3486
7	$49,400.00	$51,800.00	0.046920	4692
8	$51,800.00	$54,200.00	0.060370	6037
9	$54,200.00	$56,600.00	0.074230	7423
10	$56,600.00	$59,000.00	0.081500	8150
11	$59,000.00	$61,400.00	0.082090	8209
12	$61,400.00	$63,800.00	0.079810	7981
13	$63,800.00	$66,200.00	0.074330	7433
14	$66,200.00	$68,600.00	0.069230	6923
15	$68,600.00	$71,000.00	0.063460	6346
16	$71,000.00	$73,400.00	0.056990	5699
17	$73,400.00	$75,800.00	0.051660	5166
18	$75,800.00	$78,200.00	0.045190	4519
19	$78,200.00	$80,600.00	0.039000	3900
20	$80,600.00	$83,000.00	0.032470	3247
21	$83,000.00	$85,400.00	0.023790	2379
22	$85,400.00	$87,800.00	0.019080	1908
23	$87,800.00	$90,200.00	0.013190	1319
24	$90,200.00	$92,600.00	0.007830	783
25	$92,600.00	$95,000.00	0.004790	479
	$95,000.00	+Infinity	0.002850	285
Total:			1.000000	1E+05

Forecast: IDEA Support Cost

Cumulative:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$35,000.00	0.000000	0
1	$35,000.00	$37,400.00	0.000000	0
2	$37,400.00	$39,800.00	0.000060	6
3	$39,800.00	$42,200.00	0.002890	289
4	$42,200.00	$44,600.00	0.014410	1441
5	$44,600.00	$47,000.00	0.036360	3636
6	$47,000.00	$49,400.00	0.071220	7122
7	$49,400.00	$51,800.00	0.118140	11814
8	$51,800.00	$54,200.00	0.178510	17851
9	$54,200.00	$56,600.00	0.252740	25274
10	$56,600.00	$59,000.00	0.334240	33424
11	$59,000.00	$61,400.00	0.416330	41633
12	$61,400.00	$63,800.00	0.496140	49614
13	$63,800.00	$66,200.00	0.570470	57047
14	$66,200.00	$68,600.00	0.639700	63970
15	$68,600.00	$71,000.00	0.703160	70316
16	$71,000.00	$73,400.00	0.760150	76015
17	$73,400.00	$75,800.00	0.811810	81181
18	$75,800.00	$78,200.00	0.857000	85700
19	$78,200.00	$80,600.00	0.896000	89600
20	$80,600.00	$83,000.00	0.928470	92847
21	$83,000.00	$85,400.00	0.952260	95226
22	$85,400.00	$87,800.00	0.971340	97134
23	$87,800.00	$90,200.00	0.984530	98453
24	$90,200.00	$92,600.00	0.992360	99236
25	$92,600.00	$95,000.00	0.997150	99715
	$95,000.00	+Infinity	1.000000	1E+05

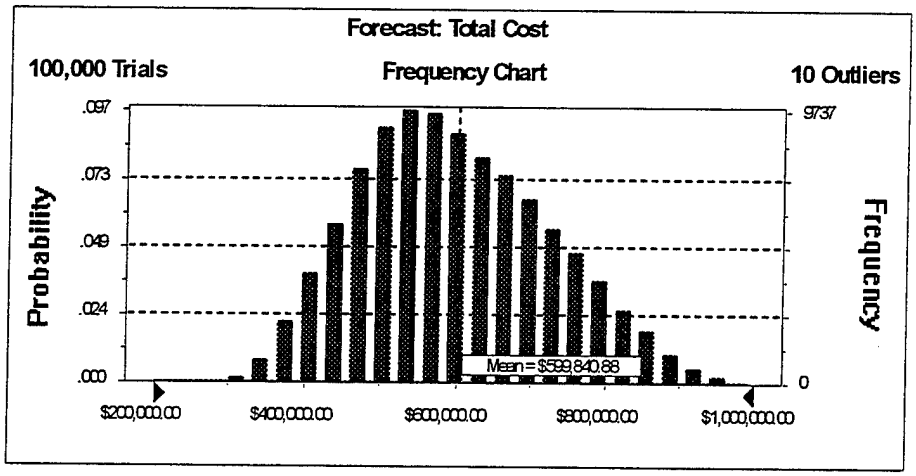
End of Forecast

Forecast: Total Cost

Summary:

Display Range is from $200,000.00 to $1,000,000.00
Entire Range is from $290,516.57 to $1,014,295.53
After 100,000 Trials, the Std. Error of the Mean is $399.09

Statistics:		Value
Trials		100000
Mean		$599,840.88
Median		$588,170.30
Mode		---
Standard Deviation		$126,201.88
Variance	####	
Skewness		0.32
Kurtosis		2.54
Coeff. of Variability		0.21
Range Minimum		$290,516.57
Range Maximum		$1,014,295.53
Range Width		$723,778.96
Mean Std. Error		$399.09



Forecast: Total Cost

Percentiles:

Percentile	Value
0%	$290,516.57
10%	$442,247.90
20%	$486,832.83
30%	$521,839.19
40%	$554,593.57
50%	$588,170.30
60%	$624,628.11
70%	$665,320.15
80%	$712,956.68
90%	$776,092.68
100%	$1,014,295.53

Frequency Counts:

Frequency:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$200,000.00	0.000000	0
1	$200,000.00	$232,000.00	0.000000	0
2	$232,000.00	$264,000.00	0.000000	0
3	$264,000.00	$296,000.00	0.000040	4
4	$296,000.00	$328,000.00	0.001650	165
5	$328,000.00	$360,000.00	0.008150	815
6	$360,000.00	$392,000.00	0.021680	2168
7	$392,000.00	$424,000.00	0.038710	3871
8	$424,000.00	$456,000.00	0.056200	5620
9	$456,000.00	$488,000.00	0.076590	7659
10	$488,000.00	$520,000.00	0.091430	9143
11	$520,000.00	$552,000.00	0.097370	9737
12	$552,000.00	$584,000.00	0.096370	9637
13	$584,000.00	$616,000.00	0.089260	8926
14	$616,000.00	$648,000.00	0.080910	8091
15	$648,000.00	$680,000.00	0.074480	7448
16	$680,000.00	$712,000.00	0.065410	6541
17	$712,000.00	$744,000.00	0.055410	5541
18	$744,000.00	$776,000.00	0.046240	4624
19	$776,000.00	$808,000.00	0.036330	3633
20	$808,000.00	$840,000.00	0.026140	2614
21	$840,000.00	$872,000.00	0.018620	1862
22	$872,000.00	$904,000.00	0.010470	1047
23	$904,000.00	$936,000.00	0.005390	539
24	$936,000.00	$968,000.00	0.002490	249
25	$968,000.00	$1,000,000.00	0.000560	56
	$1,000,000.00	+Infinity	0.000100	10
Total:			1.000000	1E+05

Forecast: Total Cost
Cumulative:

Group	Start Value	End Value	Prob.	Freq.
	-Infinity	$200,000.00	0.000000	0
1	$200,000.00	$232,000.00	0.000000	0
2	$232,000.00	$264,000.00	0.000000	0
3	$264,000.00	$296,000.00	0.000040	4
4	$296,000.00	$328,000.00	0.001690	169
5	$328,000.00	$360,000.00	0.009840	984
6	$360,000.00	$392,000.00	0.031520	3152
7	$392,000.00	$424,000.00	0.070230	7023
8	$424,000.00	$456,000.00	0.126430	12643
9	$456,000.00	$488,000.00	0.203020	20302
10	$488,000.00	$520,000.00	0.294450	29445
11	$520,000.00	$552,000.00	0.391820	39182
12	$552,000.00	$584,000.00	0.488190	48819
13	$584,000.00	$616,000.00	0.577450	57745
14	$616,000.00	$648,000.00	0.658360	65836
15	$648,000.00	$680,000.00	0.732840	73284
16	$680,000.00	$712,000.00	0.798250	79825
17	$712,000.00	$744,000.00	0.853660	85366
18	$744,000.00	$776,000.00	0.899900	89990
19	$776,000.00	$808,000.00	0.936230	93623
20	$808,000.00	$840,000.00	0.962370	96237
21	$840,000.00	$872,000.00	0.980990	98099
22	$872,000.00	$904,000.00	0.991460	99146
23	$904,000.00	$936,000.00	0.996850	99685
24	$936,000.00	$968,000.00	0.999340	99934
25	$968,000.00	$1,000,000.00	0.999900	99990
	$1,000,000.00	+Infinity	1.000000	1E+05

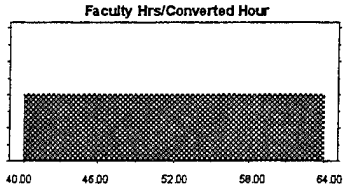
End of Forecast

Assumptions

Assumption: Faculty Hrs/Converted Hour

Uniform distribution with parameters:

Minimum	40.00
Maximum	64.00

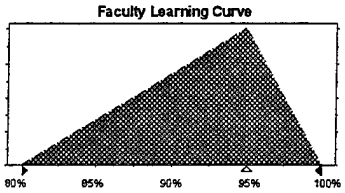


Mean value in simulation was 52.03

Assumption: Faculty Learning Curve

Triangular distribution with parameters:

Minimum	80%
Likeliest	95%
Maximum	100%

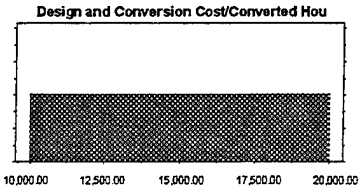


Selected range is from 80% to 100%
Mean value in simulation was 92%

Assumption: Design and Conversion Cost/Converted Hour

Uniform distribution with parameters:

Minimum	10,000.00
Maximum	20,000.00

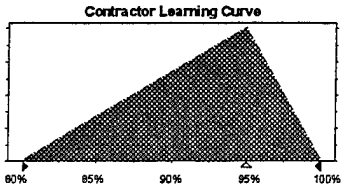


Mean value in simulation was 14,996.01

Assumption: Contractor Learning Curve

Triangular distribution with parameters:

Minimum	80%
Likeliest	95%
Maximum	100%



Selected range is from 80% to 100%
Mean value in simulation was 92%

End of Assumptions

APPENDIX C PCC EXPENSE

The following charts provide the number of students, both officer and civilians, enrolled in each of the Practical Comptrollership Courses in 1997. They also provide the location from which the student traveled, as well as the per diem, lodging, travel and opportunity cost expense for the student travelling to Monterey or Pensacola to take the course vice taking the course utilizing NBI.

January

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
O-3	Misawa, Japan	$ 468	$ 1,128	$ 1,450	$ 1,799	$ 4,845
O-2	Seoul, Korea	468	1,128	1,574	1,426	4,596
O-3	San Diego, CA	468	1,128	558	1,799	3,953
O-3	Great Lakes, IL	468	1,128	844	1,799	4,239
GS-11	Monterey, CA				957	957
GS-9	Norfolk, VA	468	1,128	782	791	3,169
GS-11	Guam	468	1,128	1,450	957	4,003
O-2	Culter, ME	468	1,128	1,194	1,426	4,216
GS-12	Port Hueneme, CA	468	1,128	670	1,148	3,414
GS-13	Arlington, VA	468	1,128	840	1,365	3,801
GS-12	Arlington, VA	468	1,128	840	1,148	3,584
GS-9	Camp Pendleton, CA	468	1,128	638	791	3,025
GS-9	MacDill, FL	468	1,128	746	791	3,133
GS-14	Arlington, VA	468	1,128	840	1,613	4,049
O-3	Thurmont, MD	468	1,128	1,154	1,799	4,549
GS-9	Newport, RI	468	1,128	796	791	3,183
O-3	San Diego, CA	468	1,128	558	1,799	3,953
GS-12	Norfolk, VA	468	1,128	782	1,148	3,526
GS-12	Arlington, VA	468	1,128	840	1,148	3,584
O-2	Camp LeJeune, NC	468	1,128	1,102	1,426	4,124
O-2	Washington DC	468	1,128	840	1,426	3,862
GS-11	Yokohama, Japan	468	1,128	1,190	957	3,743
GS-14	Norfolk, VA	468	1,128	782	1,613	3,991
GS-11	Camp Pendleton, CA	468	1,128	638	957	3,191
GS-13	Sigonella, Italy	468	1,128	2,350	1,365	5,311
GS-11	Jacksonville, FL	468	1,128	810	957	3,363
GS-11	Camp Smith, HI	468	1,128	876	957	3,429
GS-13	Arlington, VA	468	1,128	840	1,365	3,801
O-4	Kansas City, MO	468	1,128	1,132	2,108	4,836
GS-13	Washington DC	468	1,128	840	1,365	3,801
		$ 13,572	$ 32,712	$ 27,956	$ 38,991	$ 113,231

February

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
GS-12	Patuxent River, MD	$ 468	$ 1,128	$ 788	$ 1,148	$ 3,532
GS-14	Port Hueneme, CA	468	1,128	670	1,613	3,879
GS-13	Pearl Harbor, HI	468	1,128	876	1,365	3,837
GS-15	Mechanicsburg, PA	468	1,128	796	1,897	4,289
GS-3	San Diego, CA	468	1,128	558	416	2,570
GS-11	Guam	468	1,128	1,450	957	4,003
GS-11	New Orleans, LA	468	1,128	1,102	957	3,655
GS-7	China Lake, CA	468	1,128	764	647	3,007
GS-12	Norfolk, VA	468	1,128	782	1,148	3,526
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-11	Norfolk, VA	468	1,128	782	957	3,335
O-5	Annapolis, MD	468	1,128	840	2,470	4,906
O-3	Pt Magu, CA	468	1,128	670	1,799	4,065
O-6	Washington DC	468	1,128	840	2,958	5,394
O-2	Chinhae, Korea	468	1,128	1,574	1,426	4,596
GS-11	Pt Magu, CA	468	1,128	670	957	3,223
GS-9	Washington DC	468	1,128	840	791	3,227
GS-12	Mt Meade, MD	468	1,128	840	1,148	3,584
GS-9	Washington DC	468	1,128	840	791	3,227
O-4	Groton, CT	468	1,128	1,190	2,108	4,894
GS-13	Washington DC	468	1,128	840	1,365	3,801
O-5	Mississippi	468	1,128	1,102	2,470	5,168
GS-11	Puget Sound, WA	468	1,128	682	957	3,235
O-2	Pearl Harbor, HI	468	1,128	876	1,426	3,898
O-2	Soctia, NY	468	1,128	1,046	1,426	4,068
GS-11	Great Lakes, IL	468	1,128	844	957	3,397
GS-13	Pearl Harbor, HI	468	1,128	876	1,365	3,837
		$ 12,636	$ 30,456	$ 24,014	$ 36,310	$ 103,416

May

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
GS-9	Athens, GA	$ 468	$ 1,128	$ 1,890	$ 791	$ 4,277
O-4	Rota, Spain	468	1,128	1,670	2,108	5,374
GS-11	Honolulu, HI	468	1,128	876	957	3,429
GS-12	Pt Magu, HI	468	1,128	670	1,148	3,414
GS-13	Arlington, VA	468	1,128	840	1,365	3,801
GS-12	Arlington, VA	468	1,128	840	1,148	3,584
GS-13	Arlington, VA	468	1,128	840	1,365	3,801
GS-12	Arlington, VA	468	1,128	840	1,148	3,584
O-1	Athens, GA	468	1,128	1,890	1,139	4,625
GS-11	Bahrain	468	1,128	2,870	957	5,423
GS-13	San Bruno, CA	468	1,128	484	1,365	3,445
GS-9	Washington, DC	468	1,128	840	791	3,227
GS-12	Washington, DC	468	1,128	840	1,148	3,584
GS-11	St Inigoes, MD	468	1,128	788	957	3,341
GS-12	Norfolk, VA	468	1,128	782	1,148	3,526
GS-14	Washington, DC	468	1,128	840	1,613	4,049
O-4	Pearl Harbor, HI	468	1,128	876	2,108	4,580
O-3	San Diego, CA	468	1,128	558	1,799	3,953
GS-12	Monterey, CA				1,148	1,148
GS-12	Washington, DC	468	1,128	840	1,148	3,584
GS-12	San Bruno, CA	468	1,128	484	1,148	3,228
GS-11	Washington, DC	468	1,128	840	957	3,393
GS-14	Monterey, CA				1,613	1,613
GS-11	Chesapeake, VA	468	1,128	782	957	3,335
O-4	Norfolk, VA	468	1,128	782	2,108	4,486
GS-11	Lakehurst, NJ	468	1,128	1,050	957	3,603
GS-12	Oakland, CA	468	1,128		1,148	2,744
GS-9	Jacksonville, FL	468	1,128	810	791	3,197
GS-12	Port Hueneme, CA	468	1,128	670	1,148	3,414
GS-11	San Diego, CA	468	1,128	558	957	3,111
GS-7	Monterey, CA				647	647
GS-11	San Diego, CA	468	1,128	558	957	3,111
O-3	Kadena, Japan	468	1,128	1,982	1,799	5,377
		$ 14,040	$ 33,840	$ 28,590	$ 40,538	$ 117,008

July

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
GS-9	Great Lakes, IL	$ 416	$ 708	$ 648	$ 791	$ 2,563
GS-12	Kings Bay, GA	416	708	706	1,148	2,978
GS-9	Norfolk, VA	416	708	680	791	2,595
GS-12	Norfolk, VA	416	708	680	1,148	2,952
GS-11	Norfolk, VA	416	708	680	957	2,761
GS-11	Washington, DC	416	708	598	957	2,679
GS-9	Guam	416	708	2,378	791	4,293
GS-9	New Orleans, LA	416	708	593	791	2,508
GS-12	Pensacola, FL				1,148	1,148
GS-13	Indian Head, MD	416	708	598	1,365	3,087
GS-12	Washington, DC	416	708	598	1,148	2,870
GS-11	Washington, DC	416	708	598	957	2,679
GS-14	Washington, DC	416	708	1,438	1,613	4,175
GS-12	Pensacola, FL				1,148	1,148
O-3	Cherry Point, NC	416	708	954	1,799	3,877
GS-15	Arlington, VA	416	708	598	1,897	3,619
GS-9	Charleston, SC	416	708	646	791	2,561
GS-12	Norfolk, VA	416	708	680	1,148	2,952
GS-11	China Lake, CA	416	708	1,218	957	3,299
GS-11	Pensacola, FL				957	957
O-2	Puerto Rico	416	708	1,240	1,426	3,790
GS-11	Singapore	416	708	2,059	957	4,140
GS-9	Pensacola, FL				791	791
GS-11	Washington, DC	416	708	598	957	2,679
GS-11	Washington, DC	416	708	598	957	2,679
GS-9	Gulfport, MS	416	708	898	791	2,813
GS-12	Norfolk, VA	416	708	680	1,148	2,952
GS-13	Arlington, VA	416	708	598	1,365	3,087
O-3	Camp Smith, HI	416	708	1,604	1,799	4,527
GS-12	Cherry Point, NC	416	708	954	1,148	3,226
GS-13	Mississippi	416	708	636	1,365	3,125
GS-12	Washington, DC	416	708	598	1,148	2,870
GS-11	Dahlgren, VA	416	708	680	957	2,761
GS-9	Pensacola, FL				791	791
GS-11	Philadelphia, PA	416	708	642	957	2,723
GS-11	Mayport, FL	416	708	694	957	2,775
O-4	Millington, TN	416	708	742	2,108	3,974
GS-12	Pensacola, FL				1,148	1,148
GS-11	Kings Bay, GA	416	708	706	957	2,787
O-5	Ft Meade, MD	416	708	598	2,470	4,192
GS-9	Newport News, VA	416	708	836	791	2,751
GS-11	Virginia Beach, VA	416	708	680	957	2,761
GS-9	Keesler, MS	416	708	636	791	2,551
GS-13	Patuxent River, MD	416	708	598	1,365	3,087
GS-12	Washington, DC	416	708	598	1,148	2,870
O-3	Eglin AFB, FL				1,799	1,799
GS-9	Guam	416	708	2,378	791	4,293
GS-11	Pensacola, FL				957	957
O-4	Groton, CT	416	708	1,680	2,108	4,912
GS-12	China Lake, CA	416	708	1,218	1,148	3,490
GS-9	Newport, RI	416	708	824	791	2,739
GS-12	Pascagoula, MS	416	708	892	1,148	3,164
O-2	Newport, RI	416	708	824	1,426	3,374
O-4	Arlington, VA	416	708	598	2,108	3,830
GS-11	Washington, DC	416	708	598	957	2,679
GS-9	Washington, DC	416	708	598	791	2,513
GS-11	Norfolk, VA	416	708	680	957	2,761
GS-12	Pensacola, FL				1,148	1,148
GS-11	Ft Meade, MD	416	708	598	957	2,679
GS-11	Philadelphia, PA	416	708	642	957	2,723
GS-12	Pascagoula, MS	416	708	892	1,148	3,164
GS-12	Virginia Beach, VA	416	708	680	1,148	2,952
GS-9	Kings Bay, GA	416	708	706	791	2,621
GS-13	Yorktown, VA	416	708	836	1,365	3,325
GS-13	San Diego, CA	416	708	804	1,365	3,293
		$23,296	$39,648	$47,612	$75,411	$185,967

September

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
GS-9	Pearl Harbor, HI	$ 468	$ 1,128	$ 876	$ 791	$ 3,263
O-6	Monterey, CA				2,958	2,958
GS-9	Newport, RI	468	1,128	796	791	3,183
GS-13	Indian Head, MD	468	1,128	840	1,365	3,801
GS-12	Ft Meade, MD	468	1,128	840	1,148	3,584
GS-12	Mississippi	468	1,128	1,102	1,148	3,846
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-9	Ft Worth, TX	468	1,128	844	791	3,231
O-3	Santa Ana, CA	468	1,128	638	1,799	4,033
O-4	Norfolk, VA	468	1,128	782	2,108	4,486
GS-11	Norfolk, VA	468	1,128	782	957	3,335
GS-13	Monterey, CA				1,365	1,365
GS-13	Arlington, VA	468	1,128	840	1,365	3,801
GS-12	Bremerton, WA	468	1,128	682	1,148	3,426
GS-11	Yokosuka, Japan	468	1,128	1,190	957	3,743
GS-11	Silverdale, WA	468	1,128	682	957	3,235
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-13	Seal Beach, CA	468	1,128	490	1,365	3,451
O-4	Silverdale, WA	468	1,128	682	2,108	4,386
O-4	Mechanicsburg, PA	468	1,128	796	2,108	4,500
O-3	Arlington, VA	468	1,128	840	1,799	4,235
GS-12	Camp Smith, CA	468	1,128	876	1,148	3,620
O-3	Arlington, VA	468	1,128	840	1,799	4,235
GS-11	Brunswick, ME	468	1,128	1,529	957	4,082
GS-13	Washington, DC	468	1,128	840	1,365	3,801
GS-12	Pensacola, FL	468	1,128	882	1,148	3,626
GS-12	Naples, Italy	468	1,128	1,478	1,148	4,222
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-11	Patuxent River, MD	468	1,128	788	957	3,341
GS-13	San Diego, CA	468	1,128	558	1,365	3,519
GS-13	Monterey, CA				1,365	1,365
GS-15	Philadelphia, PA	468	1,128	1,050	1,897	4,543
GS-12	Alexandria, VA	468	1,128	840	1,148	3,584
GS-13	Monterey, CA				1,365	1,365
GS-12	Groton, CT	468	1,128	1,190	1,148	3,934
GS-11	Korea	468	1,128	1,574	957	4,127
		$15,444	$37,224	$29,651	$47,959	$130,278

October

Paygrade/GS Level	Origin	Per diem	Lodging	Travel	Opp Cost	Total
GS-12	Ft Meade, MD	$ 468	$ 1,128	$ 840	$ 1,148	$ 3,584
E-6	Monterey, CA				1,083	1,083
GS-13	Washington, DC	468	1,128	840	1,365	3,801
GS-9	New Orleans, LA	468	1,128	1,102	791	3,489
GS-12	Pensacola, FL	468	1,128	882	1,148	3,626
GS-11	Arlington, VA	468	1,128	840	957	3,393
GS-11	New Orleans, LA	468	1,128	1,102	957	3,655
GS-9	Monterey, CA				791	791
GS-11	Ft Meade, MD	468	1,128	840	957	3,393
GS-14	Arlington, VA	468	1,128	840	1,613	4,049
GS-13	San Diego, CA	468	1,128	558	1,365	3,519
GS-11	Pearl Harbor, HI	468	1,128	876	957	3,429
O-4	Washington, DC	468	1,128	840	2,108	4,544
O-3	Bahrain	468	1,128	2,870	1,799	6,265
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-12	San Bruno, CA	468	1,128	484	1,148	3,228
GS-11	Pearl Harbor, HI	468	1,128	876	957	3,429
GS-11	Charleston, SC	468	1,128	1,068	957	3,621
O-3	Millington, TN	468	1,128	1,126	1,799	4,521
GS-6	Monterey, CA				583	583
GS-9	East Meadow, NY	468	1,128	1,046	791	3,433
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-13	Yokosuka, Japan	468	1,128	1,190	1,365	4,151
GS-11	Norfolk, VA	468	1,128	782	957	3,335
GS-11	Arlington, VA	468	1,128	840	957	3,393
O-5	Pearl Harbor, HI	468	1,128	876	2,470	4,942
GS-11	San Diego, CA	468	1,128	558	957	3,111
GS-9	Pearl Harbor, HI	468	1,128	876	791	3,263
GS-11	San Diego, CA	468	1,128	558	957	3,111
O-6	Norfolk, VA	468	1,128	782	2,958	5,336
GS-9	Norfolk, VA	468	1,128	782	791	3,169
O-4	Ft Meade, MD	468	1,128	840	2,108	4,544
GS-12	Pensacola, FL	468	1,128	882	1,148	3,626
GS-12	Mississippi	468	1,128	1,102	1,148	3,846
GS-11	Cleveland, OH	468	1,128	850	957	3,403
		$14,976	$36,096	$29,700	$42,420	$123,192

LIST OF REFERENCES

Chaplin, Robert, ADM (USN), Superintendent Naval Postgraduate School, E-mail, 11 February 1998.

Chief of Naval Operations, "Navy Training Requirements Review (OPNAV Inst 1500.69A)", Department of Navy, October 1995.

Cowan, George, LCDR (USN), Telephone Interview, 18 February 1998.

Crawford, Alice M. and Suchan, Jim, "Media Selection in Graduate Education For Navy Medical Officers," Naval Postgraduate School, Monterey Ca, December 1996.

Euske, Kenneth, Presentation, Professor of Accounting, Naval Postgraduate School, Monterey Ca, 10 September 1997.

Faculty Handbook, Naval Postgraduate School, January 1998.

Gagné, R. M., & Briggs, L. J., Principles of Instructional Design, 2nd Edition, New York, NY, Holt, Rinehart, and Winston, 1979.

Green, Samantha, LT (USN), "Cost Effectiveness Analysis of Converting a Classrooom Course to a Network Based Instruction Model," Master's Thesis, Naval Postgraduate School, Monterey, Ca, December 1997.

Haupt, Jeffrey, LCDR (USN), Naval Postgraduate School, Personal Interview, 20 February 1998.

Hazard, Thomas, Research Assistant Professor, Institute for Defense Education and Analysis, Personal Interview, April 1998.

Hyer, Jane, Instructional Technology Group, Chief of Naval Education and Training, Telephone Interview, April 1998.

Jenkins, John, Instructional Technology Group, Chief of Naval Education and Training, Telephone Interview, March 1998.

Jewett, Frank, Director Research Projects, Information Resources and Technology, California State University, Telephone Interview, 2 March 1998.

Kerber, Jim, CDR (USN), Faculty, Naval Postgraduate School, Monterey, Ca, Personal Interview, January 1998.

Miller, Charlotte, Transportation Assistant, Systems Management Department, Naval Postgraduate School, Personal Interview, March 1998.

Munks, Jeffery, Chief Executive Officer, Arista Systems, Inc., Personal Memorandum, 23 February 1998.

Naval Postgraduate School Catalog, 1998.

Naval Postgraduate School Homepage, http://www.nps.navy.mil, 1998.

Norris, Bob, CDR (USN), Electronic Publishing Project Director, Naval Postgraduate School, Personal Interview, April 1998.

Office of Personnel Management Website, http://www.opm.gov/oca/98TABLES/GSANNUAL/index.htm, 1998.

Office of Training Technology (OTT), Seamless Product Information Data Exchange and Repository (SPIDER), http://www.ott.navy.mil, 1998.

Office of Educational Analysis, Registrar, Naval Postgraduate School, Monterey Ca, 23 April 1998.

Quinn, J., Anderson, P., Finkelstein, S., "Leveraging Intellect," *Academy of Management Executive*, Volume 10, Number 3, 1996.

Rudenstein, N., "The Internet and Education: a Close Fit," *The Chronicle of Higher Education*, February 1997.

Smith, J., Learning Curve for Cost Control, Industrial Engineering and Management Press, Georgia, 1989.

Whipple, Dave, Director, Institute for Defense Education and Analysis, Personal Interview, April 1998.

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