NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

COST EFFECTIVENESS ANALYSIS OF CONVERTING A CLASSROOM COURSE TO A NETWORK BASED INSTRUCTION MODULE

by
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December, 1997

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1997	Master's Thesis

4. TITLE AND SUBTITLE
COST EFFECTIVENESS ANALYSIS OF CONVERTING A CLASSROOM COURSE TO A NETWORK BASED INSTRUCTION MODULE

5. FUNDING NUMBERS

6. AUTHOR(S)
Green, Samantha J.

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 unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

The Superintendent of the Naval Postgraduate School (NPS) presented a State-of-the-School address that profiled the university of the future. This futuristic university included Network Based Learning (NBL) to provide training to a dispersed audience. Through a Jackson Foundation Grant, the NPS Institute for Education and Analysis (IDEA) is funding two contractors to convert two Executive Management Education (EME) classes into NBL modules. This thesis performs a cost effectiveness analysis on converting the two modules and discusses the intangible costs and benefits associated with converting traditional classroom courses. Using data collected from IDEA and the Bureau of Medicine and Surgery, this thesis analyzes the total cost per student as a greater number of courses are converted to NBL modules as compared to an EME conference format with no NBL modules. The findings revealed that converting only two modules is by no means cost effective in the short term. However, cost savings can be realized by converting more modules. As the same modules are used repeatedly, the high start-up costs eventually become cost effective. The many intangible benefits of NBL also add to the effectiveness of this endeavor.

14. SUBJECT TERMS
Cost Effectiveness Analysis, Executive Education, Network Based Learning, Network Based Instruction

15. NUMBER OF PAGES
52

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. 239-18

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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
December 1997

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ABSTRACT

The Superintendent of the Naval Postgraduate School (NPS) presented a State-of-the-School address that profiled the university of the future. This futuristic university included Network Based Learning (NBL) to provide training to a dispersed audience. Through a Jackson Foundation Grant, the NPS Institute for Education and Analysis (IDEA) is funding two contractors to convert two Executive Management Education (EME) classes into NBL modules. This thesis performs a cost effectiveness analysis on converting the two modules and discusses the intangible costs and benefits associated with converting traditional classroom courses. Using data collected from IDEA and the Bureau of Medicine and Surgery, this thesis analyzes the total cost per student as a greater number of courses are converted to NBL modules as compared to an EME conference format with no NBL modules. The findings revealed that converting only two modules is by no means cost effective in the short term. However, cost savings can be realized by converting more modules. As the same modules are used repeatedly, the high start-up costs eventually become cost effective. The many intangible benefits of NBL also add to the effectiveness of this endeavor.

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I. INTRODUCTION

The Superintendent of the Naval Postgraduate School (NPS) presented a State-of-the-School address that profiled the university of the future. This futuristic university included Network Based Learning (NBL) to provide training to a dispersed audience. The NPS Institute for Education and Analysis (IDEA) is the organization that is propelling NPS to Network Based Instruction (NBI). Through a Jackson Foundation grant, IDEA is funding two contractors, the Stanford Technologies Group and Arista, to convert two Executive Management Education (EME) classes into NBI modules.

This thesis will perform a cost effectiveness analysis on converting the EME courses and provide a preliminary discussion concerning the intangible costs and benefits associated with converting traditional classroom courses to NBI modules.

A. BACKGROUND

This section provides background information on the programs analyzed in this study and discusses learning types and introduces network based learning.

1. Executive Management Education (EME) Program

The EME program is a joint effort between NPS and the Bureau of Medicine and Surgery (BUMED). This program is in response to the 1992 congressional mandate that prospective Medical Treatment Facility (MTF) commanders demonstrate professional administrative skills. The purpose of the EME program is to educate senior military health care executives to achieve those skills that have been identified as prerequisites for commanding major DOD MTF's or other complex health care delivery systems. The curriculum consists of 49 course modules and 410 hours of instruction.

To minimize the disruption to MTF operations, teams of NPS faculty previously traveled to MTF's to teach the EME courses. However, due to fiscal constraints, this mode of teaching was deemed too costly. Presently, prospective Commanding Officers

and Executive Officers of MTF's travel to the Monterey, CA area to attend a three week conference presented by guest speakers and NPS faculty members. [Ref. 1]

2. Standard Mode Of Training

All of us have experienced the traditional mode of training. An instructor lectures a room full of students and uses standard visual aid materials consisting of transparencies, chalk boards or white boards. The students take notes on their own paper or in a paper guide provided. This is a very effective means of teaching, however, there are limitations to this training medium. Namely, the media does not show motion which is key to understanding mechanical and electrical operations. There is limited access to electronic resource data. There are high costs associated with revising and printing paper based course materials and there is also lag time between new technical documentation and revision of the paper based materials. New technology has paved the way for alternate forms of learning. [Ref. 2]

3. Distance Learning

When there is a discussion of alternate learning, the phrase Distance Learning is generally included. Distance Learning is an all encompassing term that implies formal, institutionally based training and educational activities where the instructor and student are separated from each other by location. The Distance Learning objective is to extend the leaning environment to students at remote locations through various media.

There are two types of instruction associated with Distance Learning: Synchronous and Asynchronous instruction. "Synchronous instruction requires the simultaneous participation of all students and instructors...interaction is done in real time." This type of learning can be accomplished in a traditional classroom or through video teletraining. "Asynchronous instruction does not require the simultaneous participation of all students and instructors. Students do not need to be gathered together in the same location at the same time." This mode can be accomplished by television, video tapes, CD-ROM's and the Internet. [Ref. 2]

4. Network Based Instruction

Internet based instruction or network based instruction is a form of distance learning where course modules are posted on the Internet. Students have the ability to access the courses at their convenience. The course presentations are not limited to text, because the Internet allows for multiple media types, including sound, graphics and videos. Each media can activate a different human sense allowing for a greater opportunity for learning and retention. A more notable advantage of the Internet is hypertext links. These links can move the student to related web pages providing more in depth information in a specific area. These web pages are not developed by the instructor and can provide an "infinite expansion of instruction; however, they are out of teacher control, and under direct learner control ... individual learners are able to control their own paths through complex subject matter, independently of the guidance provided by the courseware designer". [Ref. 2]

5. Learning Types Facilitated by Distance Learning

Different types of learning require distinct kinds of instructional interactions. Specialists in the field of instructional design, R.M. Gagne and L.J. Briggs, have defined five general classes of learned capabilities: intellectual skills, cognitive strategies, information, motor skills and attitudes.

The first two, intellectual skills and cognitive strategies, deal with the symbols used to communicate (words, numbers and the characters typically thought of as symbols) and the internal process the student uses to learn, remember and think.

Information covers the facts and organization of meaningful knowledge that is gained by searching for the answer when needed or more often stored in memory. Factual information are the building blocks required to learn increasingly complex subject matter.

Motor skills are learned capabilities that deal with the accuracy, force and smoothness of body movements. The final class deals with learning or adjusting a person's behavior towards people, things or events.

To design an instructional module, one must first determine the objectives of the learning. Once determined, the use of various media can be employed. Instructors and verbal communication, books, videotapes, computers etc., stimulate the human sense organs differently either by the eye, ear and so on. The more appropriate the stimulus, the greater probability of learning and retention. Each of the five classes can be developed with NBL, however, with varying degrees of success. [Ref. 3]

6. Why Now?

Network based learning has been available for some time. However, the recent developments of low-cost, high-bandwidth switch networks, improvement in video quality and the increased comfort level of the population using the Internet, have enabled universities to seriously undertake this endeavor. [Ref. 4]

For the Naval Postgraduate School, this is an opportunity to be a technology leader. As an institution of learning and academia, NPS wants to be a pioneer in distance education. IDEA is charged with developing strategic partnerships with select universities, government agencies and private organizations to foster opportunities for innovative collaboration. There are multiple civilian and military initiatives to identify resources and share lessons learned concerning NBI. [Ref. 5]

7. Cost Effectiveness

Presentation of an NBL course can take many avenues. With the present Internet capabilities for providing text, sound bytes and streaming video, a course can be as media rich or lean as deemed appropriate. The exponentially increasing costs, as media richness improves, can be a factor in the cost effectiveness of implementing an NBL course. A course with only plain text would have minimal costs, but the experience would be similar to reading a book. Adding sound bytes would improve the presentation and at the same time add costs of up to $100/minute of sound. To have both the visual and sound in a streaming video, costs would increase to $1,500/minute. [Ref. 6]

8. Contractors

Preliminary expectations for each contract are distinctly different. The first group to work on a module is the Stanford Technologies Group. The firm is expected to provide a very basic presentation. The second firm, Arista, gave the impression of being more familiar with the NBL field. During the preliminary sessions, Arista asked very detailed questions and suggested presentation options to NPS. The Arista group outlined a framework that would include an orientation of the module, a pretest to allow learners to customize their own learning path and a comprehensive learning assessment. [Ref. 7]

9. Rules of Thumb

Due to the new nature of NBL technology, concrete rules of thumb have not been established. However, there are three preliminary rules that many in the field discuss and use as a starting base. For a traditional classroom course that is providing skills training, generally 70 percent of that course can be suitable for NBI. Conversion of the course from the traditional training mode to NBI can reduce the class time by 30 percent. This decrease reflects eliminating classroom administrative requirements and testing periods. Finally, the cost of converting a lesson to NBI is in the range of $20,000-$25,000/hour. As discussed earlier, this range can be extremely fluid depending on how media rich the developers decide to make the module. [Ref. 8]

10. Learning Curve Theory

"Learning Curve is a mathematical, graphical or tabular representation of how resources are reduced as production of a product or service is repeated." [Ref. 9] As a worker repeats a task, the repetitiveness induces learning and the worker becomes more efficient. The amount of time to complete the task is decreased. Learning Curve theory can be applied to NBL. As the contractors plan, design and convert one traditional course to NBI, they are developing a template for further courses. While the contractors continue to convert additional courses, they will learn the presentation preferences of NPS and improve the template. At the same time, NPS will learn what new technology is

available to them and will develop a style preference adding more input to improve the template. As the template of the first module is improved to build new modules, the contractor will require less and less preliminary work. This decrease in contractor labor over the course of many modules can generate substantial cost savings.

11. Opportunity Cost

When resources (time, money and supplies) are limited, decisions must be made as to where these scarce resources are to be used. To expend the resources in one avenue, diverts the resources from an equally desired use. When determining the cost between various alternatives, the highest cost of the option that is not to be chosen is the Opportunity Cost of the decision. [Ref. 10]

B. RESEARCH QUESTIONS

Primary question: What are the associated costs and benefits of converting a classroom course to an Internet based instruction module?

Secondary question: What intangible costs and benefits are incurred by converting a module to Internet based instruction?

C. SCOPE AND LIMITATIONS

The main thrust of this thesis is to develop a Cost Effectiveness Model for converting traditional course modules to Internet based instruction. The two EME courses providing the baseline are: Module 24 - Budgeting for Defense Health, and Module 51 - Medical Readiness.

D. ORGANIZATION

This study includes five chapters. Following the introduction and background in Chapter I, Chapter II gives a detailed methodology of how all costs were calculated and explains any underlying assumptions. Chapter III analyzes the cost data. Chapter IV

assesses the intangible benefits and disadvantages from this endeavor. Finally, Chapter V provides conclusions for this analysis.

II. METHODOLOGY OF DATA COLLECTION

A. EME

The IDEA lab coordinates the EME conferences and collates the conference costs. The 1997 EME conference costs were collected from Mr. Ben Roberts, Adjunct Research Associate Professor in IDEA. Travel, per diem and miscellaneous costs are paid by the Bureau of Medicine and Surgery, not NPS, and must be included for an accurate analysis. Cost data was collected from HM2 Ferguson at the BUMED EME Program Office. The contractor bids to convert the traditional modules to NBI were collected from Mr. Tom Hazard, Research Assistant in IDEA.

B. ASSUMPTIONS

To allow for an analysis of similar variables, the following assumptions have been adopted.

1. Conference Specifics

The 1997 EME conference presented 30 course modules and was attended by 35 students. These numbers will be used as the number of modules presented per conference and the number of students per conference. Military personnel are considered to be on duty 24 hours a day, 7 days a week; however, for this analysis, time away from primary job will only include weekdays and will not include weekends.

2. Length of Training Module

As discussed earlier, a crude rule of thumb states converting a traditional classroom course to NBI can decrease class time by 30 percent. Since the EME modules are a small part of a larger program, there is time set aside for administrative requirements. The time allotted to the modules are for full educational teaching. Therefore, the length of training sessions will be equal across all alternatives. The

conference sets aside time for 4 hour modules, but it is understood that some courses will not run the full time.

3. Opportunity Cost of Student Salaries

This section will look at the opportunity cost of EME student salaries. When the students are away from their primary jobs and in a classroom, what happens to the work for which they are responsible? In a perfect world, a replacement would be brought in and work would continue unaffected. However, this is usually not the case. Generally, many will prepare for the three week interruption and work hard to clear their schedules beforehand. When they return, some work will have accumulated and the students will again have to spend extra time to bring the work level down. While the student is away, colleagues will usually have to increase their work loads to fill the void left by the absent worker. Many of the students are doctors, so there is also an opportunity cost to their patients who may have to wait for treatment. Determining the opportunity cost of the extra work performed by the students and their colleagues and the opportunity cost to the patients, is beyond the scope of this thesis. As a proxy, this thesis assumes the opportunity cost to be the replacement cost for the student. A replacement would be a colleague of the same rank, qualifications and residing in the same location.

The greatest difficulty in determining a service member's salary is the individualization of the categories used in the calculation. Five categories are based on rank, years of service, whether or not the member has dependents and location of homeport, as shown in Table 1. If the member lives in military housing, BAQ and VHA are forfeited.

CATEGORIES	BASIS
Military Base Pay	Rank and years in service
Basic Allowance for Subsistence (BAS)	Enlisted or Officer
Basic Allowance for Quarters (BAQ)	Rank and dependents
Variable Housing Allowance (VHA)	Rank, dependents and location
Cost of Living Allowance (COLA)	High cost areas

Table 1. Basis For Determination of Pay Categories

Special pay and bonuses also add to a service member's salary. They are based on technical skills and are incentives to keep highly trained personnel in the service. They include, nuclear bonuses, sea pay, flight pay and medical pay.

Medical Officers receive up to five types of special pay. Variable Special Pay is paid to all physicians while Additional Special Pay is paid to all physicians only after their initial residency. Board Certified Pay is paid to those who have achieved certification in their specialty. Multi-year Special Pay varies by specialty and by length of service commitment. Incentive Special Pay is paid to all specialists who are not in an internship or residency.

Not all EME students are doctors who receive special pay. To gear the salary to the average student, special pay and bonuses were not considered. To allow for a military pay baseline, the average EME student is defined as follows: A Navy Captain with 18 years of service who resides in the Washington, DC area and lives in civilian housing with his spouse and children. The Captain's military pay is shown in Table 2.

CATEGORY	MONTHLY PAY
Base Pay	$5,361.30
BAS	$154.16
BAQ w/ dependents	$914.10
VHA w/ dependents	$469.81
Monthly Military Pay	$6,899.37
Yearly Military Pay	$82,792.44

Table 2. Breakdown of Military Pay for Baseline Illustration

To allow for analysis, an hourly rate must be determined. Due to the volatile military work schedule, the hourly rate is based on a more typical 8-hour workday during a 5 day work week and in line with the Federal Government definition of a full time employee; this equals 2,080 hours per year.

4. Initial Course Preparation

The initial time to develop the content, administrative and testing requirements of the course will be equal across all alternatives and consequently will not be added to the analysis. The Network based alternatives will incur an initial requirement of the professor's time as he/she works with the contractors to develop the module.

5. Instructor Preparation Time per Module

Many instructors teach multiple sections of the same course, so one class presentation may be taught again the same day or the following day. Once the presentation is completed for the initial class, there is little preparation required for follow-on classes. The EME courses on the other hand are repeated after some length of time, so an amou f preparation may be required each time the class is taught. The amount of time will vary depending on how much the information base has changed and how motivated the instructor is to rework the course. An educated assumption for the number of preparation hours would be 40 hours of work on the high end of the scale and zero hours on the low end.

6. Quality of Learning and Retention

This thesis assumes that the quality of learning and retention are equal with either synchronous or asynchronous teaching. Therefore, the amount of time spent with an instructor outside the classroom will be approximately equal across all alternatives. Extra instruction was not included in the analysis.

7. Instructor Salary

Instructor Salary is based on the Naval Postgraduate School faculty salary schedule. Faculty are paid based on a step scale ranging from 1-73. A faculty salary distribution chart shows that the majority of Associate Professors and Professors fall within steps 55-65. The modal point, step 60, has a base pay of $86,074.00 on a 10 month scale. Extension of the scale to a yearly scale increases base pay to $103,288.80.

To find the true instructor rate, benefits, sick leave and vacation time must be added. The escalation rate is a 44 percent increase of base pay which equals $148,649.47. The per hour wage is based on the Federal Government definition of a full time job which is equal to 2,080 hours per year. This rate will be used to determine the cost of the instructor's preparation time.

A slightly different number will be used to determine the instructor's cost to teach the modules. IDEA adds a teaching tax to the instructor's salary. This sum is added to run the NPS research office. IDEA has determined the faculty labor costs to be $2100/day for two modules.

8. Grouping of Course Modules

The modules for the first week of the EME conference were provided by speakers outside of NPS. The modules were of varying length with some modules lasting for 1hr 30 min, 2, 3 or 4 hours. An average day of training lasted for 7hrs 30 min. The training time does not include breakfast, lunch, breaks and the registration, welcome and overview times. The second and third weeks of the EME conference were provided by NPS faculty. Each day was broken into two, 4 hour course modules with one module in the morning and the second in the afternoon. To allow for analysis, the first week of course modules will be grouped into two 4 hour modules similar to the final two weeks. Although some days in the first week had up to five speakers, only two speakers will be assumed for each day. The number of separate speakers is not important for the analysis, only the amount of training time spent.

9. Travel Cost per Student

Students traveled to the EME Conference in Monterey, CA from all over the world. Some students were as near as San Diego while others traveled from as far as Guam and Italy. To allow for analysis, all travel costs were totaled and the average cost per student, $579.28, was used.

10. Per diem

Per diem is provided to Temporary Active Duty (TAD) personnel to cover hotel and food expenses. The students received $199.80 per day. Though training did not occur on Saturday and Sunday, students remained in a TAD status throughout the weekend and collected per diem.

11. Miscellaneous Costs

Each student received $50.00 for miscellaneous costs. Approximately 25 percent of the students received an extra $868.00 for car rental. Since the baseline illustration is for the average student, the car rental costs were not included.

12. Discounting

Discounting is computing the present value of future costs and benefits. All costs and benefits are worth more if they are experienced in the near term, so discounting is necessary to reflect the time value of money. By bringing all terms to their present value, like figures can be compared. According to the Office of Management and Budget Circular No. A-94, discount rates for evaluating government projects are 2.7% - 2.8%. The lesser of the two, 2.7%, was used for this analysis.

13. Decrease of Administrative Costs

Administrative costs for the three week conference totaled $23,683.00. This cost covered a wide range of administrative duties to include data input, simulation, on site support and conference coordination. This thesis assumes that as the length of the conference decreases the administrative costs will also decrease. A conservative 5 percent decrease per day will divide the total administrative costs to 45 percent variable costs and 55 percent fixed costs.

14. Operation Maintenance and Support Costs

Once a course is converted to NBI, administration and maintenance of the course begins. Administrators must determine whether the system support will be completed by the instructor or a full or part-time system administrator. The extra salaries and time of maintenance and support may be a detriment to NBI.

Costs can be grouped into two categories: system software maintenance and course administration. Like the computer industry as a whole, technology will improve NBI software and system administrators will be required to upgrade NBI systems. Managing the paperwork and upkeep of an NBI course will take time away from other instructing endeavors. Student records must be maintained to track progress and completion of courses. NBI courses must be periodically updated to incorporate current information.

At this time, life cycle costs for NBI courses are not available. The compilation of operation maintenance and support costs is recommended for further study.

15. Cost of Internet Modules

Two contractor price quotes and one Rule of Thumb estimate to convert a classroom course to NBI were collected. The price quotes are as follows: Stanford Technologies Group quote of $77,321 and the Arista quote of $58,300 - $68,300. The actual length of the module is 3.5 hours, so the Rule of Thumb range is $70,000-$87,500. Due to the framework outline presented by Arista, this thesis regards the Arista quote as the most sophisticated quote of the three; this quote was used for analysis.

The cost of converting a module to NBI must not only include the contractor's cost, but also the opportunity cost of the instructor's time. It is expected that the instructor will spend time with the contractors to assist in the module conversion. This thesis assumes 120 hours of work per module.

16. Learning Curve

There are various learning curve equations, but one of the most common is the Wright curve or the cumulative average curve. This curve is based on a learning rate that can be determined by historical data from similar endeavors. Due to the new nature of this technology, a learning rate has not been determined. The writer utilized the Wright model to determine the curves of probable learning rates.

The Wright Model:

Cumulative Unit Cost = FX^n $\qquad n = \frac{\log(\text{learning curve rate as a percentage})}{\log 2}$

F = the cost of the first unit produced

X = the cumulative quantity of units produced

n = the learning rate

As the Learning Curve rate decreases (i.e. the benefits of learning accrue more rapidly), the cost of cumulative modules also decreases, as seen in Figure 1.

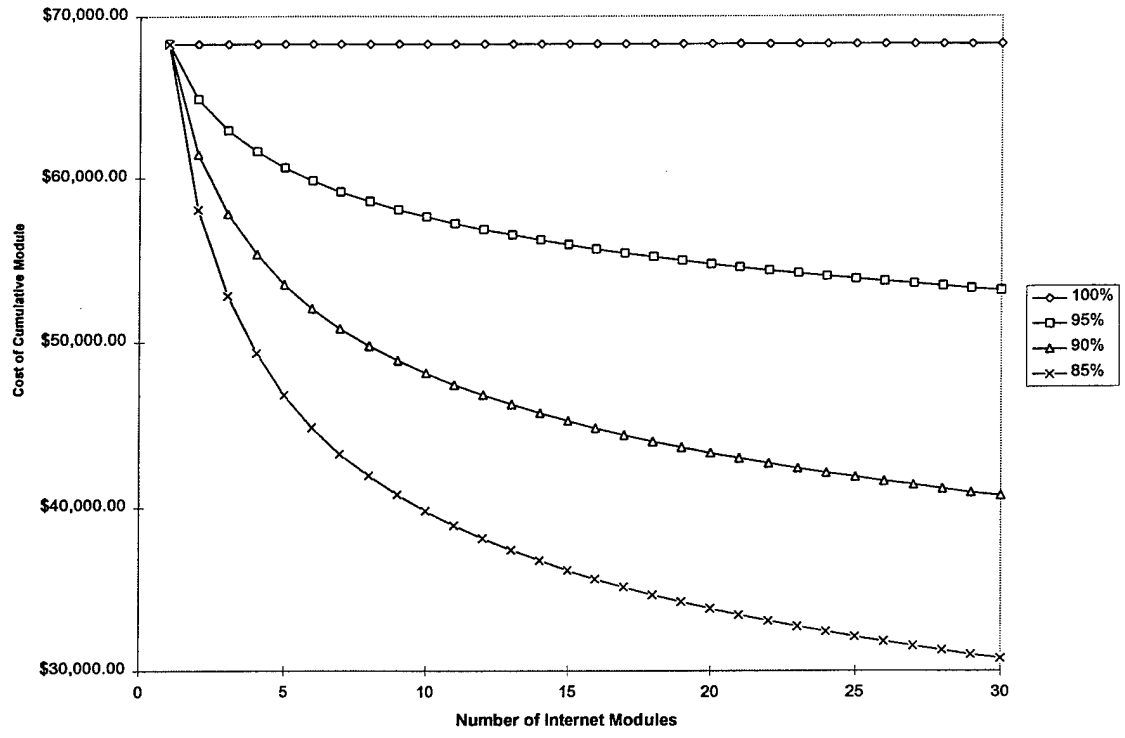

Figure 1. Cost of Cumulative NBI Modules as Learning Curve Decreases

17. Summary of Variables

Table 3 summarizes the costs used in this analysis.

VARIABLE	BASELINE	RANGE
Number of Students/ Class	35	10 - 35
Student Yearly Salary (less special pay)	$82,792.44	$56,000 - $97,000
Travel Cost/ Student	$579.28	$174.00 - $1,854.00
Miscellaneous Cost/ Student	$50.00	$50.00 or $918.00
Instructor Yearly Salary	$148,649.47	$67,639 - $168,578
Instructor Preparation Time/ Module	40 hours	0 - 40 hours
Instructor Time Spent to Convert Module	120 hours	0 - 120 hours
Admin. Cost Decrease/ Day	5%	0 - 6.6%
Cost of Initial NBI Module	$68,300.00	$58,300 - $87,500
Discount Rate	2.7%	2.7% - 2.8%
Learning Curve	95%	80% - 100%
Per Diem Cost/ Day	$199.80	
Classroom Costs/ Day	$648.20	
Audio Visual Costs/ Day	$75.00	
Printing Costs/ Student	$65.00	
EME Total Administrative Costs	$23,683.00	

Table 3. Summary of Variables

III. COST DATA ANALYSIS

Some costs cannot be pinpointed to a specific number, but only to a range of numbers. This section performs sensitivity analysis on those costs. As additional courses are converted to NBI and a greater number of conferences are coordinated, the total cost for the EME program will continue to increase. By utilizing a cost per student ratio, the various sensitivity analyses can be compared.

A. WHEN DOES CONVERTING MODULES BECOME COST EFFECTIVE?

After a module is converted to NBI, theoretically that module can be used repeatedly with only occasional updates. As the cost to develop the module is allocated over the total number of students that use it, converting the module will eventually become cost effective. At the same time, the converted modules eliminate the need for classroom courses and the EME conferences become shorter, providing further cost savings.

The cost per student to present one EME conference is $13,348.37. The total cost per student increases for each module converted to NBI, until four EME conferences have been held (total cost per student includes both EME conference and NBI conversion costs). When 20 modules are converted to NBI and four EME conferences have been held, the cost per student for an EME conference with converted modules becomes lower than the cost per student for an EME conference without converted modules. The savings are minor at $143.22 per student. As discussed in the following section, cost savings vary depending on whether an even or odd number of modules are converted. The savings continue to increase for each even number of modules converted to NBI until all 30 modules are converted. If all modules are converted, a savings of $1,234.12 per student is realized. Cost savings are not realized for converting any odd numbered module until five EME conferences have been held. From this point on, a greater number of converted modules and greater number of conferences decreases the cost per student.

B. DECREASE IN CONFERENCE LENGTH

The most significant cost savings will be realized by decreasing the length of the EME conference. As the number of Internet modules increases, the conference length in days decreases. Correspondingly, EME cost per student decreases in a stair-step manner as seen in Figure 2.

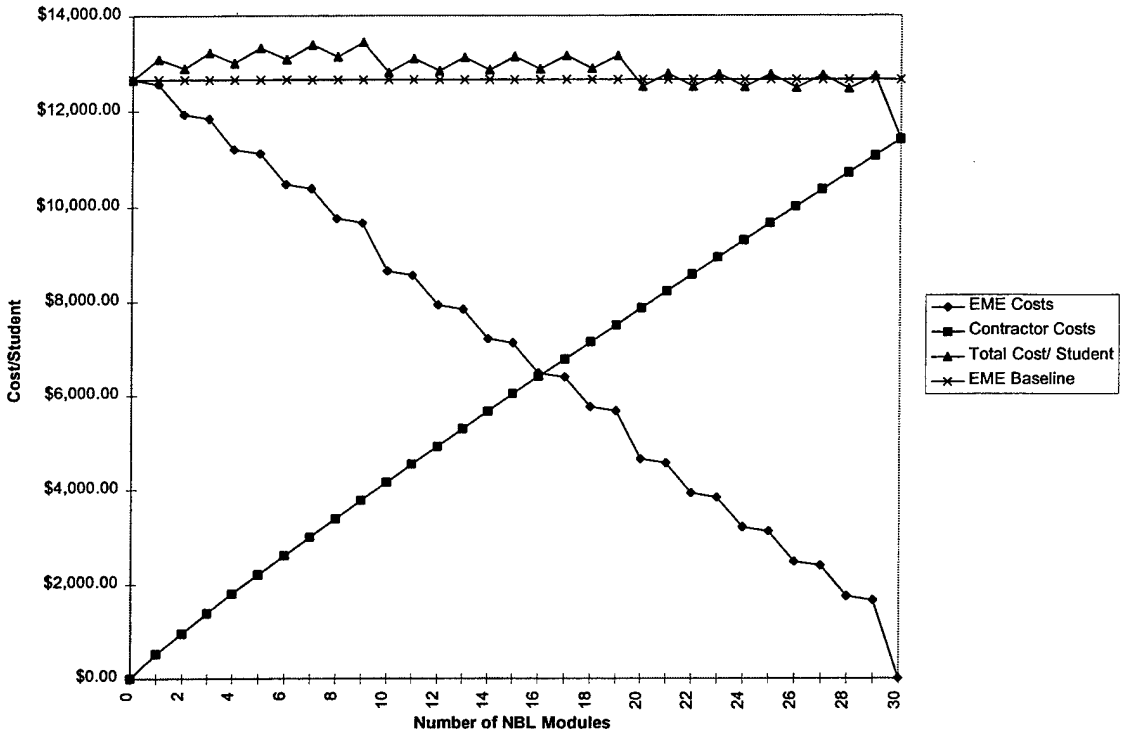

Figure 2. Baseline Graph for Four EME Conferences

The stair-step phenomenon is a function of deleting training days from the conference. For every two modules that can be converted to NBI, one less conference day is required. The conference room costs, opportunity cost of student salaries and per diem costs are avoided as conference days decrease. There are minimal cost savings in converting one additional module; cost savings are more significant by converting two modules and reducing the number of conference days. There is a slightly greater

decrease after the 10th and 20th modules are converted, because weekend travel costs are eliminated.

C. BASELINE GRAPH

Figure 2 shows the contractor's costs with a 95 percent learning curve rate. The flat, horizontal line at the top of the graph is the EME baseline. This line shows the cost per student for coordinating four EME conferences without NBI modules. The baseline is a reference point to compare to the total cost per student. If less than thirty course modules are converted, an EME conference will be required; total cost per student combines the cost per student for converting modules and the cost per student for the EME conference.

Figure 2 depicts the EME, contractor and total cost per student for coordinating four separate EME conferences. The total cost per student does not fall below the EME baseline costs for less than four EME conferences.

D. LEARNING CURVE

The cost to convert a course to NBI is a one time fee. For any given number of students, as each module is converted the cost per student increases dramatically. Figure 3 depicts the effects of the learning curve on total conversion costs for various learning rates. When the learning curve rate is equal to 100 percent, there is no learning. As learning increases and the learning curve percentages decrease, the NBI module cost per student also decreases. Since an NBL learning curve has not been established, a very conservative learning curve rate of 95 percent was used as the baseline for this analysis.

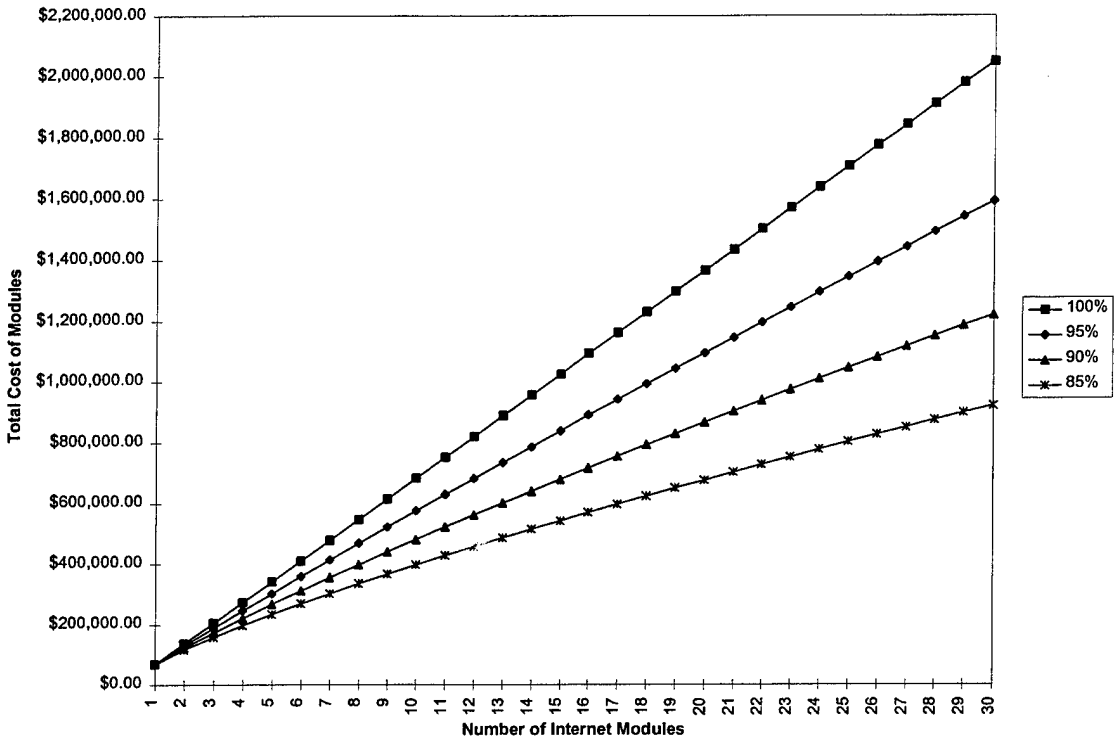

Figure 3. Total Cost for Module Conversion as Learning Curve Decreases

E. OPPORTUNITY COST OF STUDENT SALARIES

Student salaries is the most influential cost within this analysis. When the opportunity cost of student salaries is removed from the analysis, a completely different picture emerges. As the number of Internet modules increases, Figure 4 depicts the number of conferences that must be held before the cost per student falls below the traditional EME cost per student. The figure illustrates the effect that disregarding the opportunity cost of student salaries has on cost savings. NPS and the Navy as a whole may have two distinct viewpoints when considering this cost.

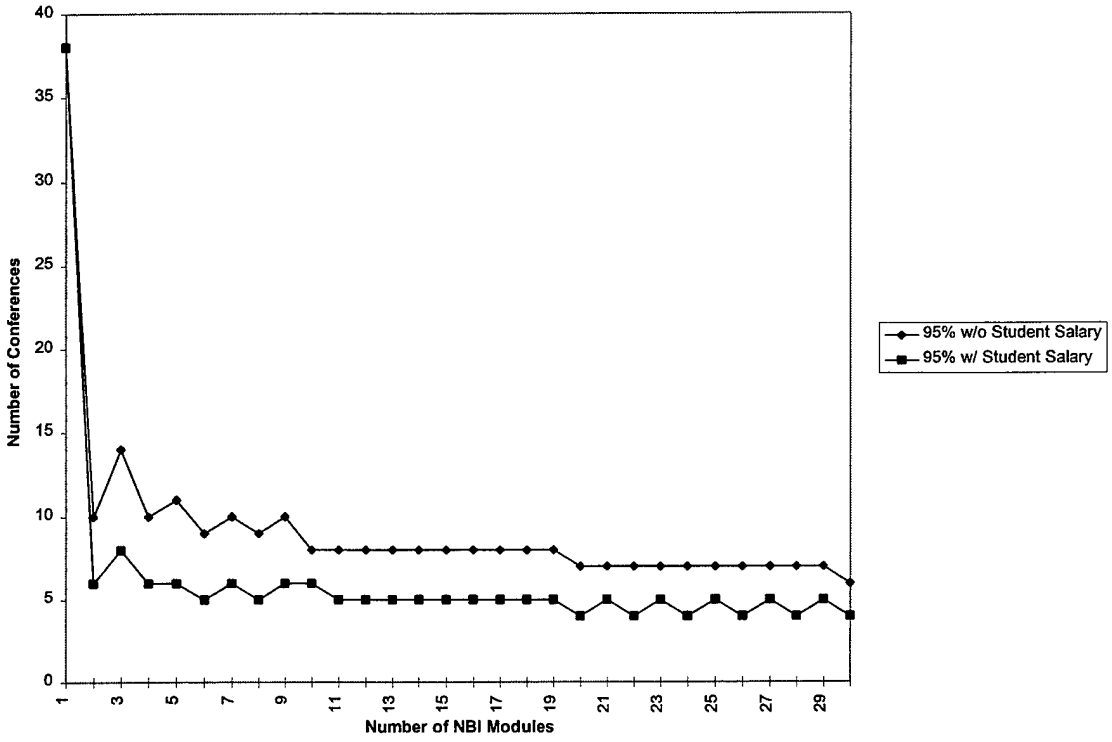

Figure 4. Number of Conferences Required to Realize Cost Savings with 95% Learning Curve

1. NPS Viewpoint

To determine an accurate analysis, all costs must be included. However, many administrators may only be concerned with the costs that are to be paid from their own budgets. Military personnel will be paid whether they are working in their primary jobs or in a classroom. NPS is not required to support this cost. When student salaries are not used in the analysis, cost savings are not as immediate. As seen in Figure 4, more conferences must be coordinated and therefore a greater number of students must utilize the NBI modules for the cost per student to fall below the cost per student of a conference with no NBI modules. If NPS must use its limited EME budget to either convert EME modules to NBI or to conduct EME conferences, it may tend to overvalue the benefits of converting EME modules.

2. Navy Viewpoint

The Navy is ultimately affected by all costs, so the opportunity cost of salaries must be included in the analysis. Due to the seniority of the students, the student salaries are quite high. By increasing the number of NBI modules, the EME conferences will be shorter, reducing the opportunity cost of salaries. With the opportunity cost of salaries included in the analysis, savings realized by the decrease in cost per student are seen twice as early. From the Department of the Navy's viewpoint, the benefits of converting EME modules are much higher than the benefits realized by NPS.

F. INSTURCTOR SALARY

The total cost of instructor salary is determined by the instructor's pay and preparation time. The instructor may be presenting an EME course that varies little over time or may spend many hours researching and collecting up to date information. The NBL contractors may or may not require the instructor's assistance with the conversion process. Adding variance in preparation time to the range of possible salaries yields many plausible values for total salary.

Eliminating instructor salary from the analysis effects the timeliness of realizing cost savings. Figure 5 shows how the baseline results of Figure 2 change. Cost savings do not accrue after four conferences, as seen earlier, but only after five conferences are coordinated.

The impact of instructor salary is noteworthy, but its significance is limited relative to the opportunity cost of student salaries and learning rates. It would be possible to perform sensitivity analysis on all remaining variables, but the impact of the less influential variables would be relatively modest and further sensitivity analysis would be of limited value.

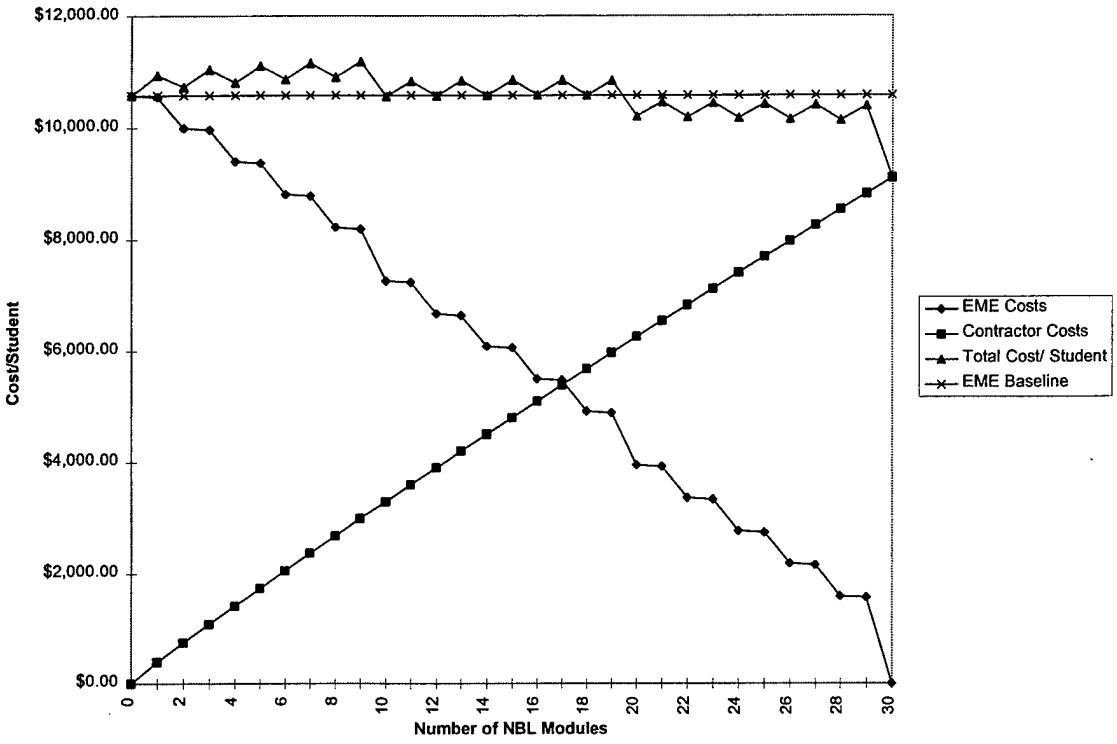

Figure 5. Baseline Graph for Five EME Conferences and Excluding Instructor Salary

G. SUMMARY GRAPH

Figure 4 depicts the number of conferences required to realize cost savings with a 95% Learning Curve. The figure differentiates between results when the opportunity cost of student salaries is included in the analysis and when it is not. Figure 6 extends the graph to include learning curves of 100%, 90% and 85%. No learning occurs along the 100% curve. As the learning curve rates decrease, learning accelerates and cost savings are realized after fewer conferences.

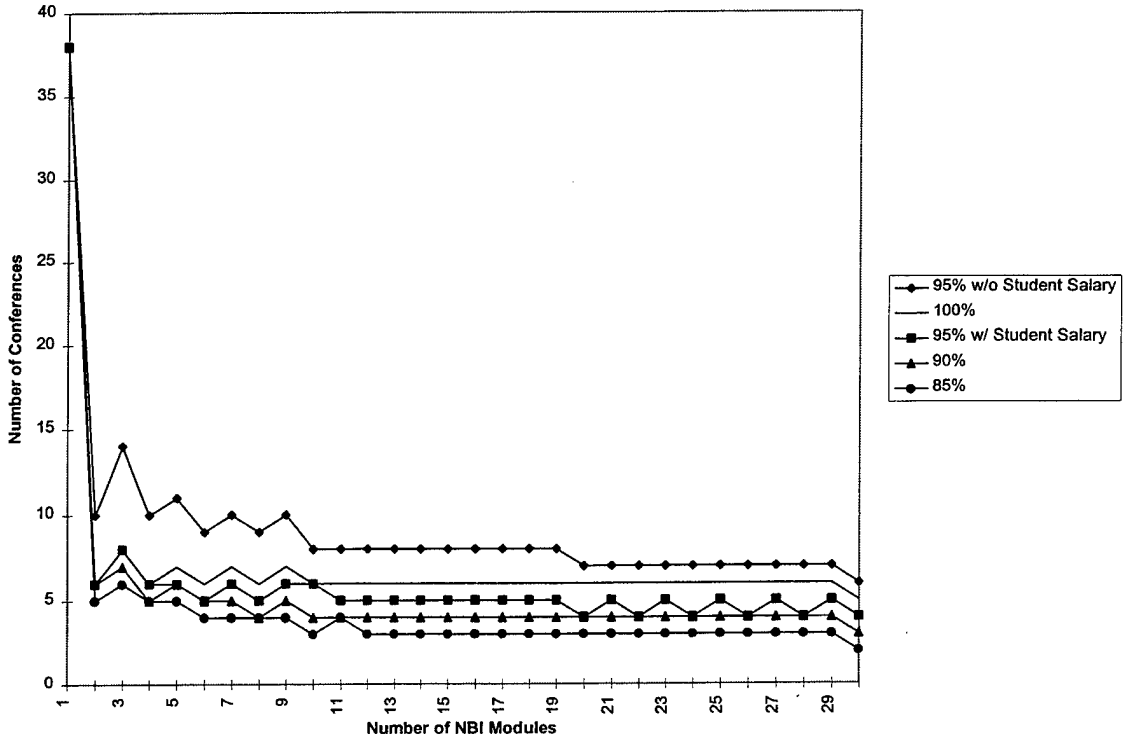

Figure 6. Number of Conferences Required to Realize Cost Savings as Learning Curve Decreases

IV. BENEFITS AND DISADVANTAGES

This section describes benefits achieved by cost avoidance, presents a case for revenue generation, highlights intangible benefits and discusses disadvantages of NBI.

A. COST AVOIDANCE

Cost avoidance is a prime means of achieving benefits. By exporting the training material to a student's personal work site, numerous costs can be saved. Travel time can be decreased or in some cases eliminated, thereby decreasing per diem costs and the opportunity cost of missing work. It is expected that instruction occurring during the student's time (non-work hours) will also reduce salary costs, but increase the students opportunity cost of the course. The training media is presented by computer, so the cost of consumables (paper, textbooks, publishing costs) will decrease.

B. REVENUE GENERATOR

Providing NBI courses may eventually become an income generator for NPS. By charging enrollment fees for access to NBI courses, revenue for the school can be collected. [Ref. 6] This revenue will offset the high conversion costs and make this endeavor more cost effective.

C. INTANGIBLE BENEFITS

There is a wide range of benefits that may not be conducive to estimating monetary savings. They are benefits just the same.

1. Standardization

When an NBI course is presented many times, a larger group of students will be taught from identical information. This type of learning will produce standardization in technical areas. [Ref. 4]

2. Instructors

Due to the extra cost and effort required to produce an NBI module, administrators will select the most proficient instructors to be involved in the process. Therefore, larger groups of students will have access to the most competent instructors. [Ref. 4]

3. Active Students

NBI reinforces the concept that students are active participants in the learning process and are not passive recipients of knowledge. When in front of a computer, students are challenged to take the initiative and are responsible for their learning progress. [Ref. 11] This responsibility also allows students the flexibility of learning courses at their convenience and at their own pace. [Ref. 4]

4. Reference Source

Once a course is completed, students will be able to refer to the course at a later date. If the NBI course is updated regularly, the course can become a reference source for current information. [Ref. 8] The Internet also provides access to essentially unlimited sources of information, not conveniently available through other means. [Ref. 11]

5. Administrative Advantages

Courses can be programmed to track students' progress. By monitoring how fast students move through the material or determining where "bottlenecks" occur, the administrators can determine problem areas and correct them. Tracking can also ensure that students are not bypassing fundamental topics. [Ref. 12]

6. Decrease in Training Time

Converting a classroom course to NBI can reduce class time by 30 percent. This decrease reflects classroom administrative requirements and testing periods. (Ref. 8)

7. Higher Levels of Retention

Due to the ability to incorporate graphics, animation, sound effects, narration and video, NBL courses can provide a high-impact learning experience, increasing subject matter mastery and retention. [Ref. 13]

D. DISADVANTAGES

This relatively new technology seems to have limitless potential. However, drawbacks must not be overlooked.

1. Motivation

Not all students have the motivation to learn outside of a classroom setting. Some people are naturally more people-oriented and may be better suited to the human interaction and feedback provided in a classroom. [Ref. 14] For students who are not aware of the self-discipline that would be required for an NBI course, there is a possibility of a greater drop out rate. [Ref. 12]

2. Use of Hypertext Links

The use of hypertext links makes it very easy for students to stray from the course structure. Allowing students to move randomly from one link to another, may eventually leave the student disoriented and frustrated. [Ref. 15]

3. Types of Learning

Depending on the type of learning being presented, NBI provides varying success rates. Focusing on technical skills where there is a "black-and-white, yes-or-no kind of answer" will provide greater success than teaching "soft" courses. The medium "makes it too easy for people not to learn the information because they don't have to practice it live." [Ref. 12] When the training objectives require adjusting behaviors through attitude change, team-building or employee motivation, group interaction is critical. This kind of learning is most effective through the classroom experience. [Ref. 14]

4. Lack of Peer and Instructor Interaction

Human interchange and the professional camaraderie that results from classroom experience cannot be simulated by technology. Experienced managers learn as much from each other as they do from the instructor. Learning that involves problem solving, decision-making and the development of new ideas can be accomplished over the Web, but can only be fostered by an initial face-to-face encounter. [Ref. 16] Besides personal interaction with classmates, certain students may dislike not having an instructor that can provide immediate reassurance or answer questions. [Ref. 15]

5. Technology

Although technology is constantly improving, all networks do not effectively accommodate all media rich content. The result is delivery systems that are too slow to download media intensive files. [Ref. 13] Students may become discouraged when courses require 15 minutes to download.

V. CONCLUSIONS

A. LESSONS LEARNED

The EME baseline example revealed that converting only two courses to NBI was not by any means cost effective. However, converting more modules could generate cost savings. If two classroom courses are converted, one less EME conference day is required. The costs to conduct one conference day are eliminated; the major cost savings is the opportunity cost of student salaries. The example also showed that cost savings will be generated in the future, but only after committing to high start-up costs.

B. IMPLICATIONS FOR RESIDENT GRADUATE EDUCATION AT NPS

The increasing number of students seeking higher education and demanding more courses has placed tremendous pressure on colleges and universities to expand. To accommodate this influx, the tendency has been towards increasing class sizes. Unfortunately, increasing the student to instructor ratio generally has negative consequences on student learning. [Ref. 17] As with other places of higher education, the Naval Postgraduate School has similar pressures and converting classroom courses to NBI may be an option. The results may be both cost savings and an early return of military officers to their primary duties (i.e., a reduction in DOD's opportunity cost of graduate education).

1. NPS Background

Training time at NPS takes officers out of their community pipelines and immerses them in a school environment. The school year is broken up into four quarters with each quarter being 12 weeks in length. The various curriculums range in length from 18-24 months with some curriculums having an additional refresher quarter. Students take an average of four courses per quarter.

Graduate education is an essential addition to any officer's training, but there are drawbacks. For the officer, being out of the operational environment for too long a period

can be detrimental to the career progression. For DOD, the opportunity cost of graduate education increases the longer the officer is out of the operational environment.

2. Types of Classes to Convert

An area requiring close examination is determining which courses to convert. Courses can be grouped into two categories: general introductory and higher level specialized courses. Many curriculums have general introductory course requirements. These courses are taught to a large number of students by multiple instructors. Curriculums also have higher level, more specialized courses which may have only a few students per offering and are only taught every few quarters.

3. Illustration

An illustration will explain the effect of converting either a general introductory or a higher level specialized course has on cost savings. This illustration will compare introductory courses containing 25 students per class with higher level courses containing 12 students.

As with the EME example, greater cost savings will be found by converting groups of courses to NBI, as opposed to only one course. When four courses are converted, a full quarter can be removed from a curriculum. The cost of maintaining the student for the quarter will be eliminated. If less than four courses are converted, the student will take fewer classes during the quarter and collect full salary. No opportunity cost of student salaries will be saved.

The opportunity cost of student salaries and the cost of instructor salary was measured against the cost to convert courses to NBI. For the introductory courses, three groups of students, 75 students, must have a full quarter eliminated from their curriculum to realize cost savings. For the higher level courses, five groups of students, 60 students, must have a full quarter eliminated from their curriculum.

This illustration is a rough analysis of the cost savings available to NPS. Further overhead costs are required for a detailed analysis (i.e., curriculum office staff salaries,

maintenance and cleaning of buildings). However, these additional costs are beyond the scope of this thesis.

4. Recommendations for NPS

By removing full quarters from curriculums, not only will the costs of maintaining the student be eliminated, but the student will have an early return to an operational status. The most cost effective action is converting courses to NBI that reach the greatest number of students. Converting general introductory courses will clearly affect more students, resulting in greater cost savings.

C. SUMMARY

NBI is the wave of the future and NPS is getting on board. NPS will be involved in this new technology for the academic pursuit. The key for NPS is to determine when the program is cost effective and to strive for that goal. As new technology develops and NBI courses become more commonplace, costs for media will decrease, templates will be developed and learning curves will be determined further reducing conversion costs. Costs will decrease and greater cost savings will be seen.

There is a lot to be said about assembling a group of people to discuss an issue. There are benefits to meeting someone face to face, bringing up issues and allowing the discussion to proceed as it may. The professional bonding of peers and discussing lessons learned from student experience are all benefits of traditional classroom courses. This analysis shows that cost savings by themselves are not reason enough to convert courses to Internet media. Cost savings and face to face meetings are the best of both worlds and both can be brought together to ensure the most cost effective and satisfactory learning experience.

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