NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

MBA PROFESSIONAL REPORT

A Cost-Benefit Analysis of Security at the Naval Postgraduate School

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December 2003

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13. ABSTRACT *(maximum 200 words)*

This project was a cost-benefit analysis of security at Naval Postgraduate School. The objective was to determine if the reduction in the probability of a risk of attack would be worth the costs. The product is a comprehensive cost-benefit analysis of increased security measures at NPS following the September 11th terrorist attacks.

The present value approach was used as a guide to compare the cost of preventative measures against a physical attack and the value of benefits preserved by a deterred attack. Often, cost is simply measured in outlays, while other major cost items such as the opportunity cost of time and intangible costs are excluded. This analysis assigned a monetary value to opportunity and intangible costs, in addition to actual dollars spent. Benefits included the replacement cost of buildings and computer hardware. Additionally, the value of life is measured based on marginal values placed on marginal reductions in life span.

The results of this analysis showed that the school is receiving almost negligible benefits for the substantial incurred costs to reduce the risk of attack. This fact is largely due to the near zero risk before and after the post-September 11 security measures were implemented.

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A COST BENEFIT ANALYSIS OF SECURITY AT NAVAL POSTGRADUATE SCHOOL

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ABSTRACT

This project was a cost-benefit analysis of security at Naval Postgraduate School. The objective was to determine if the reduction in the probability of a risk of attack would be worth the costs. The product is a comprehensive cost-benefit analysis of increased security measures at NPS following the September 11th terrorist attacks.

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I. INTRODUCTION

A. BACKGROUND

After the terrorist attacks of September 11, 2001, U.S. military bases tightened security. The heightened measures included increased ID checks, raising security force numbers, and restricted parking and use of certain roads and previously common areas. The logic behind the increased security may seem apparent, but what is striking is how little analysis has been done on the costs and potential benefits. This project weighs the costs and benefits of security at the Naval Postgraduate School (NPS) in Monterey, California.

The Security Officer for NPS, Captain Simeral, provided initial data for this project and was pivotal in helping the researchers discover and collect the remainder of the information. He derives his authority from the Navy Physical Security instruction[1], which outlines, in general terms, the standards for basic physical security. While many specifics are not mentioned due to the inherent and obvious differences between bases, most are standard throughout the force structure. The instruction does not discuss computer security, nor does it mention information security.

The chain of command for security at NPS progresses as follows: at the national level, the Chief of Naval Operations (CNO) determines the overall threat to the naval fleet, facilities, and personnel; the Commander, United States Fleet Forces Command (CFFC) further delineates the setting of Force Protection Conditions (FPCONs) and Threat Conditions (THREATCONs) to the Regional Commanders; and the Commander, Naval Region Southwest, is responsible for ordering NPS into the appropriate security posture. The security posture may be increased at any level, but may never be lowered from what the echelon above orders.

The FPCONs described in the Navy Physical Security instruction are based upon the THREATCON in effect at the time and location. Each THREATCON has an associated FPCON to protect against the particular nature and severity of potential attacks

[1] Navy Department, Navy Physical Security, OPNAVINST 5530.14C (Washington, DC: 2001).

specified in the THREATCON. The instruction also requires a comprehensive review of base security every three years to ensure that local conditions have not changed. The changes could include higher-risk activities that have developed at a base and require additional protection, increased threats in the community surrounding the base, or previously undiscovered practices that need to be improved. Likewise, the assessment should identify a decrease in previously high-risk activities, or a lower threat level in the community that would allow the base to lower or change the focus of security.

Based on the periodic reviews, each base has Standard Operating Procedures (SOP) that cover the prescribed actions for each FPCON. Below are listed some of the definitions of the FPCONs used at NPS[2]:

FPCON NORMAL - A general threat of possible terrorist activity exists but warrants only a routine security posture. FPCON NORMAL is always in effect unless a more specific threat or incident warrants the transition to a higher FPCON. Under FPCON NORMAL, expect:

- Only routine security measures, similar in nature to a civilian campus.

FPCON ALPHA - A general threat of possible terrorist activity against personnel and facilities exists, the nature and extent of which are unpredictable. Circumstances do not justify full implementation of FPCON Bravo measures but certain measures from higher FPCONs may be necessary based on intelligence reports, or as a deterrent. NPS must be able to maintain this FPCON indefinitely. Under FPCON ALPHA expect:

- Delays at installation gates.
- Tightening of visitor entry procedures.

FPCON BRAVO - An increased and more predictable threat of terrorist activity exists. The measures in this FPCON must be capable of being maintained for weeks without causing undue hardship affecting operations capability or aggravating relations with local authorities. Under FPCON BRAVO expect:

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2 Andy Anderson, "Force Protection Conditions," Navy Postgraduate School Command Security Manager, 12 November 2002, <http://intranet.nps.navy.mil/security/NPS Force Protection Conditions.htm> [30 November 2003].

- Additional delays at installation gates, possible gate closures.
- Further tightening of visitor entry procedures.
- Implementation of a flextime work schedule.
- Increased internal security and be prepared to comply with instructions.
- Parking restrictions around facilities away from facilities.

FPCON CHARLIE - An incident occurs or intelligence is received indicating some form of terrorist action against personnel and facilities is imminent. Implementation of this measure for more than a short period has a high probability of creating hardship and affecting the peacetime activities of the installation and its personnel. Under FPCON CHARLIE expect:

- Significant delays at installation gates.
- Only the minimum number of gates to be open.
- Tightening of visitor entry procedures, or denial of visitor access.
- The release of non-essential personnel.

FPCON DELTA - Implementation applies in the immediate area where a terrorist attack has occurred or when intelligence has been received that a terrorist action against a specific location or person is likely. Examples include a credible threat communicated to NPS officials, or an attempted attack discovered at a local base, based on which it is reasonable to assume other attacks may be planned. For the purpose of force protection, the definition of 'likely' is purposefully left ambiguous for two reasons.[3] The first reason is to ensure that going to FPCON DELTA does not reveal to terrorists the specific threat being guarded against. The second reason is to allow leeway for the command to make a decision, rather than react from a script that may not cover all eventualities. Under FPCON DELTA expect:

- The closure of all installation gates to non-emergency personnel.
- The cessation of any routine administrative trips on base by all personnel.

[3] Brian Van Cleef, Special Agent, United States Naval Criminal Investigative Service, telephone conversation with author (McCarthy), 26 November 2003.

B. SCOPE AND OBJECTIVES

The various preventive measures have costs and benefits, and economic analysis can be used to assign values to these costs and benefits. The costs are not just the added manpower to enforce ID checks, parking, and other restrictions. The costs also include the lost time and convenience that the users of the facility bear in their daily lives. Although this second category is often not considered, it is often large.

CAPT Simeral referred the researchers to the comptroller's office, the public works department, and base engineers to discuss the budgets for base security and the valuation of buildings and equipment. Additionally, Captain Simeral identified the Naval Criminal Investigative Service (NCIS) representative for NPS, Special Agent Brian Van Cleef, and the NPS Chief of Police, Robert Baity, for information concerning the threats to NPS and measures taken both before and after the terrorist attacks of September 11, 2001.

The Naval Postgraduate School Chief of Police identified the threat of a terrorist bomb attack as the most severe attack that could be encountered. While other attacks are certainly possible, and more likely (i.e., vandalism, theft), the security measures in place will help deter those as well as a bomb attack. Therefore, the benefits associated with the base security are assumed to be the damages that are not incurred by a worst-case terrorist bomb attack. Also, because the project evaluates only the cost of a physical attack, information security and cyber-security are not included.

In developing a worst-case scenario for a terrorist bomb, it was assumed that the target would be a building with a high capacity of occupants, at a time when a large number of people were present. This describes several academic buildings on the base. To avoid unintentionally assisting any possible future attacks, this project refrains from naming specific buildings. Instead, a standard based on average figures is assigned. Thus, the value of the building not destroyed and the value of the lives not taken are the two main benefits.

The calculation of the cost of the security measures takes into account both the actual fiscal value of measures implemented (manpower, construction, and procurement costs) and the opportunity costs (value of the time of affected personnel). Data for the valuation of buildings were obtained from the NPS General Engineer/Planner, Allyn McGuire. Additional data, including the contracted cost of security forces, and the procurement and construction of additional security measures, were gathered with assistance from the NPS Comptroller's office and NPS Public Works.

Based on this information, the direct financial impact of the heightened measures is low. While there was a short-term manpower cost associated with the Reserve military units that were called into active duty, this activity was used as a short-term fix and is regarded as a sunk cost, defined as a cost incurred in the past that does not change in response to a present decision.[4] Additionally, several construction and procurement projects were associated with base security. Many of these projects were scheduled for the near future and, in fact, were not originally intended for security reasons; rather, added security was an unintended benefit of the projects. Therefore, these projects also have minimal effect on the cost of security.

The opportunity cost to the students, faculty, and staff is the single most significant factor, however. There is an extra amount of time spent at the gates, driving the circuitous route around the base, and walking from parking that is a greater distance from the buildings. This time does not directly cost the government anything, but it is a cost borne by those individuals it affects.

For example, at the on-base speed limit of twenty miles per hour, an average driver will spend a total of over a minute of extra driving time coming on the base. Because the parking spaces within eighty feet of buildings are now restricted, the person will then walk thirteen extra seconds to cover that ground (four miles per hour for eighty feet). Thus, for every time a person comes to and subsequently leaves the base, there is about two and a half minutes of extra time spent traveling. Multiplied by the daily number of people that come on base and the number of days they come to the base, the total additional time spent traveling is upwards of 25,000 man-hours or the equivalent of greater than a dozen full-time employees. This example does not even include the added

4 Marc Lieberman and Robert E. Hall, Introduction to Economics, (Cincinnati: South-Western, 2000), 124.

delays at gates during peak hours; however, it illustrates the substantial loss of time that must now be translated in financial terms. Using a realistic average salary for the population that works and studies at NPS, the total cost of this time is over one million dollars per year.

II. PHYSICAL SECURITY AND RISK ANALYSIS

A. PHYSICAL SECURITY

Security at NPS is the responsibility of all service members and employed civilians. A police department is required only if the population exceeds 500 military and civilian personnel. This department fills the role of provider of physical security and law enforcement. The primary responsibilities include: detection, deterrence, and defeat of terrorism; prevention and deterrence of theft and other losses; protection of life and property; and enforcement of rules, regulations, and statutes.[5] The stated mission of the NPS Police Department is: *to provide quality customer oriented force protection, physical security, law enforcement and emergency management services to our customers so they may enjoy a safe and secure living, working and learning environment.*[6]

In an effort to gain insight to any significant changes in the role of base security, our team interviewed Chief Baity, head of NPS base police. Chief Baity has been serving in this role for nearly six years. The most interesting fact that came out of the interview was that he perceived an increased ability to accomplish his department's mission, rather than an alteration in security focus. Prior to the September 11, 2001 terrorist attacks, enforcement of a strict security policy appeared to be deemed less important than maintaining a relatively open campus environment. Following the attacks, NPS security became an increased priority of the administration. Heightened measures quickly resembled those typically associated with a military base. The increased recognition of this need is seen by Chief Baity as a major asset to him and his team in their attempt to meet the increased security requirements.[7]

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5 Ken Bench, "Police Department Duties and Responsibilities," Law Enforcement Training, 3 July 2001, <http://www.nps.navy.mil/police/phase_training/lesson_101.doc> [30 November 2003].

6 T. Burton, "Mission," Naval Postgraduate School Base Police Department Mission, Vision and Guiding Principles, < http://www.nps.navy.mil/police/mission.htm> [30 November 2003].

7 Robert Baity, Chief of Police, Naval Postgraduate School, interview by authors, 31 October 2003, Naval Postgraduate School, Monterey, CA.

Three major efforts currently exist for the NPS security force to increase physical security: Defense Biometric Identification System (DBIDS), Electronic Identification System (EIDS), and increased manpower. DBIDS is a program devised to improve physical security through ensuring the authentication, control, and accountability of individuals with access to U.S. military installations. The system uses the latest bar code scanning technologies in the registration of personnel, vehicles, weapons, and guests. The plan features a remote, wireless scanning device to aid gate security forces to determine the identity and access privileges of persons attempting to access a base.[8]

EIDS is similar to DBIDS but is centered on contractors and vendors at NPS. Companies supporting NPS, whether through supplying cleaning equipment and chemicals or soft drink vendors, are subjected to vehicle searches that consume both the delivery individual's time and that of the gate guard. This system would rely on thorough background checks of drivers and the civilian company maintaining vehicles sanitized from threats. Alleviating the need for screening at entry gates, the precious commodity of time is saved. The value of EIDS has been judged to be great enough that civilian companies have agreed to pay for the system's implementation. But the cost should be considered because the companies will price this cost into their bids for a government contract.

Manpower is considered a major shortcoming for security at NPS. For nearly a year and a half after September 11, the security force was augmented by reserves to meet the stringent requirements. Base security has maintained a civilian workforce of fourteen for at least four years before 9/11 to the present. Despite budgeting for an increased security force of twenty-one and a CNO validation report recommending forty-two, there has been no increase in funding to support new hiring.[9] CAPT Simeral stated that NPS is strengthening active duty security by increasing the number of Masters-at-Arms (MA) to

8 Bill Rhine, "Frequently Asked Questions," BIDS Information, 28 October 2003, <http://www.nps.navy.mil/bids/BIDSFAQ.htm> [30 November 2003].

9 Baity.

nineteen. Until that goal is reached, gate security personnel will be subsidized with enlisted staff of various ratings assigned to various departments at NPS.[10]

In addition to these three ongoing endeavors, a crime prevention program assists the police department in reducing criminal opportunities, protecting potential victims, and preventing property loss. Crime prevention is defined as the anticipation, recognition, and appraisal of a crime risk and the measures used to reduce or remove that risk. Additionally, efforts are made to raise the general awareness of personal and command security concerns. These goals are achieved through awareness briefings, publicity campaigns, and patrol by walking around (PBWA). Although the focus of these programs primarily relates to criminal activities such as theft, assault, rape, robbery, and burglary, the reduction in the risk of a terrorist attack is another definite benefit.[11]

B. RISK ANALYSIS

With a general understanding of Force Protection and Physical Security and some specific implications for NPS, a risk analysis for the area is required. For this data, Special Agent Brian Van Cleef of NCIS was interviewed. Special Agent Van Cleef, who has been assigned to NPS for approximately one year, provided a Local Threat Assessment for Naval Postgraduate School. The report states that no current information indicates the targeting of NPS for a terrorist attack, despite the Defense Intelligence Agency setting the terrorist threat level for the United States as significant.

Combined with the facts that several suspects of the September 11 attacks traveled through the San Diego area, certain reporting speculates that major attractions in Southern California may have been considered. However, no terrorist activity has been identified in the vicinity of Monterey. Although the port of Monterey is only a few miles from NPS, the port handles no large commercial or cargo vessels. The deep-water ports of San Francisco or Port Hueneme present a more attractive target due to their strategic and economic significance. Additionally, the report states that there is no developed

10 Robert Simeral, Security Officer, Naval Postgraduate School, interview by authors, 2 October 2003, Naval Postgraduate School, Monterey, CA.

11 Ken Bench, “Crime Prevention Programs,” Law Enforcement Training, 3 July 2001, <http://www.nps.navy.mil/police/phase_training/lesson% 114.doc> [30 November 2003].

information indicating an imminent threat from terrorist organizations employing weapons of mass destruction (WMD).

Local law enforcement states that no specific individual, organization, or criminal enterprise has demonstrated intent to target Department of Defense (DoD) members in the greater Monterey area. The primary criminal threat to DoD personnel is inadvertent involvement in a street crime. More specifically, ongoing gang activity around the city of Salinas has led to NPS encouragement of command personnel to take several preventive measures: using the buddy system, stopping one's automobile for only easily identifiable police vehicles, and carrying limited amounts of cash and jewelry. Finally, the Foreign Intelligence Service Threat (FIST) has been measured as moderate due to the combination of Research and Development projects at NPS and the large number of foreign national students hosted at NPS and the Defense Language Institute (DLI).[12]

Chief Baity concurred with the NCIS assessment. He reported that the most likely criminal activity at NPS would be theft--more specifically, computer theft. Both he and Special Agent Van Cleef maintain that the well-trained and equipped security force at NPS, in addition to the complete perimeter fence and controlled points of entry, helps reduce an already minimal risk of a physical terrorist attack. However, Chief Baity contends that, although unlikely, the worst-case scenario of a physical security lapse would be a bomb attack against an academic building.[13] For this reason, close cooperation is preserved with local, state, and federal agencies for the reporting and exchange of threat information.[14]

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12 Brian Van Cleef, Naval Criminal Investigative Service, Local Threat Assessment For NPS, (Naval Postgraduate School, CA: 11 July 2003).

13 Baity.

14 Van Cleef, Local Threat Assessment For NPS.

III. DATA AND ANALYSIS

A. COST-BENEFIT ANALYSIS MODEL

The cost-benefit analysis model selected for our research is the basic model used by virtually all economists who do cost/benefit analysis. A particularly clear statement of the principles can be found in Dr. Harvey S. Rosen's textbook, *Public Finance*. Dr. Rosen earned his undergraduate degree from the University of Michigan and his Ph.D. from Harvard University. He has served as both a member and chairman of Princeton's Department of Economics since 1974. Dr. Rosen's main field of research is public finance and he is currently on hiatus from Princeton at the Council of Economic Advisers in Washington, D.C.[15]

Cost-benefit analysis is a tool that establishes practical procedures to assist in the direction of public spending decisions. Any project or policy results in the increase and decrease of scarce resources; however, since governments do not typically operate in a well-functioning market, officials must rely on a cost-benefit analysis to establish the values of gained and lost commodities and determine if the bottom line of the overall project is beneficial.[16]

Executive Order 12866, developed by the Office of Management and Budget (OMB), states: *(I)n choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits … Each agency shall assess both the costs and benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs*. However, a structured analysis, in the format of a Regulatory Impact Analysis (RIA), is required only for "economically significant" regulations. "Economically significant" is defined as likely to "have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition,

15 "Biography," Harvey S. Rosen, <http://www.princeton.edu/~hsr/bio.html> [30 November 2003].

16 Harvey S. Rosen, Public Finance, 6th edition, (McGraw-Hill/Irwin, 2001), 220.

jobs, the environment, public health or safety, or state, local, or tribal governments or communities."[17] Despite this measure being limited to "major" rulings as described in the Congressional Review Act, it establishes a governmental framework for using a cost-benefit analysis in decision-making.

There are several ways in which a cost-benefit analysis can be approached: internal rate of return (IRR), benefit-cost ratio, and present value criterion. IRR (ρ) is based on a project's costs (C) and benefits (B) over a set number of time periods (T) in the following equation:

$$B_0 - C_0 + \frac{B_1 - C_1}{1+\rho} + \frac{B_2 - C_2}{(1+\rho)^2} + \dots \dots + \frac{B_T - C_T}{(1+\rho)^T} = 0$$

Criteria to accept a project is if ρ exceeds the opportunity cost of funds. Selection between two projects is based on a comparison of the projects' ρ. However, IRR yields poor guidance when deciding between two projects of varying size.

Benefit-Cost Ratio assumes a project produces a stream of costs and benefits. Taking the present value of both and establishing a ratio defines the benefit-cost ratio.

$$B = B_0 + \frac{B_1}{(1+r)} + \frac{B_2}{(1+r)^2} + \dots \quad \dots \frac{B_T}{(1+r)^T}$$

$$C = C_0 + \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \dots \quad \dots \frac{C_T}{(1+r)^T}$$

Benefit-Cost Ratio = B/C

To be considered, a project must yield a ratio greater than one. A decision between two or more projects is based on the highest ratio figure. Unfortunately, there is an inherent ambiguity when determining benefits and costs, in that benefits can be assigned as "negative costs" and vice versa. Therefore, arbitrary decisions concerning the assignment of costs and benefits will adjust the ratio value, rendering this method useless in comparing projects.

17 President, Executive Order, "Regulatory Planning and Review," Federal Register 58, no. 190 (4 October 1993), 12866, <http://www.whitehouse.gov/omb/inforeg/eo12866.pdf> [30 November 2003].

It is concluded that both internal rate of return and benefit-cost ratio are poor methods of choice for a cost-benefit analysis. The present value criterion used to evaluate a project is defined by two guiding principles. First, the admissibility of a project (is it worth doing?) is affirmed by a positive present value. Second, the choice between two mutually exclusive projects is decided by the higher present value.

$$PV = R_0 + \frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \ldots \quad \ldots \frac{R_T}{(1+r)^T}$$

From this equation, it is evident that the invalid ratio shifts associated with the benefit-cost ratio are not a factor because the present value criterion is based on the difference between benefits and costs. Also, the varying scales of projects do not invalidate the present value criterion as it does with IRR.[18]

Figure 1 shows the real rates used for discounting real (constant-dollar) flows as published by OMB.[19] A discount rate (r) is used because a single dollar today, regardless of inflation, is worth less in the future. Discounting this dollar is based on the interest rate and amount of time over which it is discounted.

3-Year	**5-Year**	**7-Year**	**10-Year**	**30-Year**
1.6	1.9	2.2	2.5	3.2

Figure 1. Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

Before these guidelines were implemented in 1993, a 10 percent real rate of return was used. The researchers use each rate and compare the results.

Our analysis compares the cost of the incremental increase in security since the September 11 terrorist attacks to the additional benefits gained from that security increase. The figures for costs and benefits are based on a terrorist bomb attack against

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18 Rosen, 226.

19 "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," Office of Management and Budget Circular Number A-94, 31 January 2003, <http://www.whitehouse.gov/omb/circulars/a094/a94.html> [30 November 2003].

an academic building. Although some security costs produce additional benefits by preventing other crimes, such as theft, the focus of this paper is on the worst-case attack scenario.

B. ATTACK SCENARIO

With an established blueprint for a cost-benefit analysis, it is necessary to estimate the magnitude of a specific attack. This is the first step to begin calculations of the benefits of increased security that are in place to prevent such an attack. For the purposes of this project, the worst-case scenario is a truck bomb parked adjacent to, or driven into, an occupied building.

The bomb used in the Oklahoma City Federal Building is the basis for this analysis for several reasons. First, there is more available and accurate information about this attack than exists in other cases. Second, the building is similar in construction, size, and occupancy. Third, the bomb used is widely available and could have been used in a similar attack on NPS with little or no hindrance from security prior to September 11, 2001.

On April 19, 1995, the Alfred P. Murrah Federal Building in Oklahoma City, Oklahoma was bombed, causing extensive damage to the structure, the loss of 168 lives, hundreds of non-fatal injuries, and substantial property damage in the vicinity.[20] The cause was identified as a bomb consisting of 4,800 pounds of ammonium nitrate, transported to the location in a rental truck and parked in front of the building.[21]

The Murrah Federal Building was a concrete structure approximately 220 feet long, 90 feet wide and nine stories tall, with large open spaces for offices. In comparison, the academic building in question is 250 feet long, 110 feet wide, and three stories tall with large open spaces for offices and classrooms. Though the height of the building may seem like an obvious difference, the footprint of the building is similar. The Oklahoma City bomb blast created a crater along the length of the building, reaching

20 "Chapter I Bombing of the Alfred P. Murrah Federal Building," Responding to Terrorism Victims: Oklahoma City and Beyond, 19 April 2001, <http://www.ojp.usdoj.gov/ovc/publications/infores/respterrorism/chap1.html> [30 November 2003].

21 Benton K. Partin, "Bomb Damage Analysis of Alfred P. Murrah Federal Building," 30 July 1995, <http://www.intellex.com/~rigs/page1/okc/report.htm> [30 November 2003].

deep into the structure. The crater would have been even larger had the truck been detonated near the center of the building rather than the corner. This crater was on the lower floors, causing the upper floors above the damaged area to collapse. Hence, the footprint of the building is more important for determining the proportional damage.

When the catastrophe occurred, roughly 600 federal and contract workers and 250 visitors were in the building.[22] This means that almost twenty percent of the occupants were killed in the blast. Based on the reasonable occupancy of the examined NPS academic building being one-third that of the Murrah Federal Building and one-third the height, a similar blast should create a proportional loss of life. Because the footprint of the Murrah Federal Building was only 72 percent the size of the academic building being examined, a crater the same size will destroy less of the academic building. Therefore, a reasonable estimate is that the casualty rate in the academic building would be 72 percent of the casualty rate in the federal building. The fatality rate in the Oklahoma City attack was 19.8 percent; therefore, the fatality rate in the academic building is expected to be 14.2 percent.

The damage in the Oklahoma City bombing was not limited to the one building. The explosion damaged an additional 324 surrounding buildings, countless cars, and other property in a 50-block radius.[23] This damage is not well defined or documented enough to estimate a value with any accuracy. The setting of the Murrah Building downtown in a metropolitan area is not comparable to that of the relatively open NPS base and residential neighborhoods. Although the inevitable collateral damage is not quantified in this project, it certainly would exist but would be proportionally smaller than in the Oklahoma City case.

C. BENEFITS

As discussed in the Attack Scenario Section above, there would be obvious damage from a successful attack. Preventing an attack prevents the associated damage

22 "Chapter I Bombing of the Alfred P. Murrah Federal Building."

23 Ibid.

from occurring. Damage that does not occur does not result in economic loss. Therefore, the benefits of security are equal to the economic loss not experienced.

The areas that need to be examined are the physical damage, the loss of life, and loss of intellectual property. The physical damage includes the building and its contents. As described above, collateral damage is not quantified in this project, though some would certainly exist. Also, there would be resources used that would be unavailable elsewhere for the duration of the rescue effort, such as rescue vehicles, medical supplies, and manpower. Because of the degree of uncertainty that the resources would be needed for another event, this is not quantified.

The loss of life includes the lives lost as a direct result of the attack. Not included are injuries, pain and suffering, and other related issues. While these may occur, they are also not predictable enough to be quantified with accuracy.

Finally, the intellectual property that is contained within the building can be estimated. There are hundreds of computers in the building, including larger servers for the NPS Local Area Network (LAN). While many people save data on the hard drives of their computers, it is assumed that most work is backed up to the LAN or that the individuals have back-ups at a site outside the building. The LAN servers that are located in the building are backed up routinely and the back-ups are stored in different locations to prevent loss to physical attacks.[24] Therefore, no significant loss of intellectual property is quantified for this project.

1. Physical Damage

The bulk of the physical damage would be the damage to the building. While there may not be complete destruction of the building, it is relatively certain that the building would be demolished and rebuilt rather than repaired. For this reason the original construction cost of the building was not used. The cost of demolishing and removing the existing structure, combined with the cost of replacing the building with a similar structure, is more reasonable.

24 Bob Gentry, Director, Information Technology Operations Center, Naval Postgraduate School, interview by author, 24 November 2003, Naval Postgraduate School, Monterey, CA.

The current replacement value of the building is $17.7 million.[1] This includes the teardown and removal of the old structure, rebuilding the structure, and re-wiring all electrical, LAN, and telephone lines. Lockers, blackboards, and other installed equipment are also considered part of the building replacement value. A reasonable estimate of the physical contents of the building includes computers and related equipment (projection equipment, printers, copiers, etc.), books and supplies, desks and chairs.

The current estimated replacement value of the computers and related equipment is $7,021,600. The total figure for all computer user hardware is $336,100, including desktop computers, laptop computers, and printers. The value of miscellaneous equipment (projectors, copiers, etc.) totaled $85,500. The 60 LAN servers cost a total of $1,500,000. Finally, the Uninterruptible Power Supply costs $100,000 and the mainframe hardware costs $5,000,000.[2]

The replacement cost for other physical equipment in the offices and classrooms is estimated at $100 per office desk (classroom desks are installed equipment), $25 per chair, and $500 worth of books per office. Office and classroom furniture total $104,700.

Unfortunately, there is a portion that is not accurately estimable. In this case, there would be a large amount of labor in installing a new computer network. Even though parts of it would be rebuilt with the new building, the network would need to be temporarily set up elsewhere because of the integrated nature of the network at NPS. After the building is repaired, the workstation configuration would also take time. It is difficult to estimate a value to place on the labor, because the set up of a computer network can encounter a large number of time consuming obstacles, or almost no obstacles at all.

As shown in Appendix A, the total value of the contents of the building is $7,126,300. The total replacement value of benefits from property not having to be repaired or replaced is estimated to be $24.9 million, including the building.

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[1] Allyn McGuire, General Engineer, Naval Postgraduate School, interview with authors, 23 October 2003, Naval Postgraduate School, Monterey, CA.

[2] Bob Gentry.

2. The Value of Life

There are several methods of valuing human life. There is the obvious trade value, which any rational person would set at infinity for himself, making it a useless number for analysis. A popular method is to determine the future income flow that a person would generate based on current salary, age, and several other factors. This approach is also flawed. Take a sixty-five-year-old retiree, for example. Since the retiree neither works nor generates income, his or her value would be absolutely nothing.

The preferred method of valuing a human life is by measuring the marginal values people assign to marginal reductions in life span. When people knowingly engage in risky behavior for some gain, then that gain is worth more to them than the risk of losing their life. For example, a person has a choice between two similar occupations, one with a low fatality rate and low pay or a job with a high fatality rate and high pay. If he chooses the higher risk for the higher pay, then the analyst can impute the value to him of a change in the probability of losing his life. This imputed value can then be used to estimate what economists call "the value of a statistical life." The value of a statistical life, therefore, is not really the value of a life. But it is the relevant measure to use in estimating the value of increased safety because increased safety does not save the lives of specific people whose identities are known in advance, but, instead reduces the probability of death slightly for a large number of people.

Therefore,

$$\frac{V_L}{100\%} = \frac{\Delta_E}{\Delta_R}$$

where:

$$V_L = \text{Value of Life}$$
$$\Delta_R = \text{Marginal Change in Risk}$$
$$\Delta_E = \text{Marginal Change in Earnings}$$

therefore,

$$V_L = \frac{\Delta_E}{\Delta_R}$$

a. Fatality Rate Comparison

The Bureau of Labor Statistics publishes an annual report containing the number of work related deaths by profession, including the military. The historical figures are available through 2001. Deaths related to the September 11, 2001 terrorist attacks are not included because they were not considered work-related deaths; rather, they were classified as the result of acts of war. Additionally, there is no historical data on the number of workers by profession before 2001. Prior to this year, one can determine how many firemen died in a given year, but not how many firemen there were total that year. So while fatality numbers can be shown for a specific profession, fatality rates can be determined only for the entire civilian population. But for 2001, data shows how many workers were in each field and how many workers were in each category (middle management, specific manual labor descriptions, etc.).

The number of deaths per 100,000 civilian workers was determined for the years 1992-2001, and then averaged. Likewise, the most recent year for middle management (equivalent to a military member at the O-3 pay grade) was calculated. The 2001 data for middle management was slightly higher, but well within the range of the ten years of general work force data. Thus, it is assumed that while the long-term death rate for middle managers is not available, it is reasonable to use the 2001 data for this project. Thus the civilian fatality rate used for comparison in this project is 5.24 deaths per 100,000 full-time workers.[27]

The number of military deaths from the same ten-year period is available from the Bureau of Labor Statistics (again, not including the September 11, 2001 terrorist attack fatalities). The number of military personnel during those years was determined

27 "Census of Fatal Occupational Injuries," Bureau of Labor Statistics, <http://www.bls.gov/iif/oshcfoi1.htm> [24 October 2003].

from the Department of Defense website.[28] A fatality rate for the entire military population was then generated, 7.46 deaths per 100,000 active duty personnel.[29]

Unfortunately, no data is available on the number of military deaths by either job description or rank. There is no reason to believe that the fatality rate in the military is different between rank or pay grades; however, certain jobs may be more dangerous (special forces vs. administrative assistants). Because all jobs are represented in the fatality data and in the NPS population, the data should be reasonably accurate.

The numbers of deaths per 100,000 workers for the years 1992-2001 was compared for the military and civilian workers. The military death rate for that period was approximately 7.46 deaths per 100,000 workers, while the civilian death rate was 5.24 deaths per 100,000. This equals a difference of 2.22 deaths per 100,000, or a .00222-percentage-point higher risk for military managers than their civilian equivalent.

b. Pay Comparison

A military member is paid more than his civilian equivalent to undertake a more dangerous job, just as a welder will make significantly more money for work on the fortieth story of a construction site than on the ground floor.

For the analysis of the pay data for civilians and military members, year 2002 data was used. This is one year after the last year that the data was provided for the fatality rates. Because the people choosing jobs would look at the historical data, it is reasonable that 2002 pay rates account for the risk of the previous ten years. Since this project looks at personnel currently at NPS, they would most likely have signed on for the additional duty in 2002. Also, this is the last year that data is available for the civilian earnings in middle management. When the final number for the value of life is reached, it is in 2002 dollars. That value is then adjusted forward to 2003 dollars using the inflation rate for 2002.

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28 "DoD Active Duty Military Personnel Strength Levels," Military Personnel Statistics, <http://web1.whs.osd.mil/mmid/military/ms9.pdf> [24 October 2003].

29 "Census of Fatal Occupational Injuries."

The average student at NPS was determined to be in the O-3 pay grade (Naval Lieutenant, or a Captain in the Army, Air Force or Marines) with eight years of active duty service and at least one dependent. While many people get special pay or allowances in the forms of proficiency pay and specialty bonuses, these were not included in the analysis. Only pay and allowances that all members receive were included in the analysis, at 2002 rates. Basic Allowance for Housing (BAH), Basic Allowance for Subsistence (BAS), and Basic Pay were included. BAH varies depending on the cost of civilian housing in the region where the member is stationed. An average 2002 BAH for an O-3 is $13,065 per year, based upon an un-weighted average of all BAH rates. Basic Pay and BAS do not vary between members; they were $48,841 and $1,996 per year, respectively. The total for an O-3 was $63,902 in 2002.[30]

The pay for the average civilian middle manager was the 2001 rate given by the Bureau of Labor Statistics.[31] The average rate was given for the entire United States regardless of locality or industry. The average pay rate of $26.87 per hour was multiplied by a 40-hour week and 52 weeks per year for an annual earning of $55,890.

The difference in earnings between a middle manager in the military (O-3) and an average middle manager in American society is $8,013. This number reflects only monetary compensation. Bonuses for both civilians and military members are ignored, as are military retirement and medical benefits, and any other fringe benefits.

c. Comparison of Pay Difference with Increased Risk

The difference in risk from 1992-2001 was 2.22 deaths per 100,000 workers (.00222 percentage points higher for the military). The trend was very steady for the ten years evaluated; therefore, the difference in risk for the current year should be the same. The difference in pay was $8,013 in 2002, or $8,240 higher in the military in 2003 when adjusted for the national inflation rate of 2.83 percent in the United States.

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30 "2002 Military Pay," Defense Finance and Accounting Service Military Pay Prior Rates, 23 October 2003, <http://www.dfas.mil/money/milpay/priorpay/01-2002.pdf> [30 November 2003].

31 "Employment, Hours, and Earnings from the Current Employment Statistics Survey," Bureau of Labor Statistics, <http://data.bls.gov> [24 October 2003].

In order to determine the value one places on his or her own life, the marginal increase in earnings must be divided by the corresponding marginal increase in risk, as shown in the model:

$$V_L = \frac{\Delta_E}{\Delta_R}$$

therefore,

$$V_L = \frac{\$8,240}{.00222} = \$3,711,515$$

Thus, the average Value of Life for our standard O-3 in this project is $3,711,515.

Note that, although many assumptions had to be made to compute this number and although the data used to compute it were gross data rather than the fine individual data typically used by labor economists to compute the value of a statistical life, this number is close to the typical finding of about $5 million for the value of a statistical life.

d. Number of Lives Lost

For the building in question, there are numerous classrooms and offices. The maximum use of the classrooms is ten at a time. Assuming that approximately 25 seats are occupied per class, 250 students can be expected in the building at peak usage. This does not include students who are not in class, for example, those in the lounge or working in a computer lab.

About 138 faculty and staff work in the building. Assuming that half of them are present at peak usage, the total increases by another 69 people, making the total number of people present in the building 319.

The population density of the building is roughly the same as the Federal Building in the Oklahoma City terrorist attack, as described in the section detailing the nature of the attack. Thus, 14.23 percent fatalities are expected, as was the case in that attack. This means that 45 people would lose their life in the attack

3. Total Benefit

Valuing the lives of the 45 people at $3.7 million each, the economic value of the loss of life would be $167 million. Combined with the property damage of $24 million, the total is $192 million in property not damaged and lives not lost.

D. PREVENTION

The major preventative measures associated with post 9/11 security at NPS are greater limitation and control of access to base entry. The number one step in accomplishing this feat was gate closures. Prior to 9/11, there were four main gates open at NPS. Since the attacks, gate access has been limited to one primary gate, and during peak hours a second gate is opened. Increased manning at access points has been another measure implemented to strengthen security. The future implementation of DBIDS will assist gate guards in their further efforts to limit base access to authorized individuals. These efforts are designed to thwart plans before any destructive missions are conducted on base.[32]

If base access is gained, parking restrictions around buildings are intended to reduce the likelihood or damage associated with a bombing. A vacant car in a restricted area will more likely raise suspicion than if it is parked among other vehicles. Therefore, if left within eighty feet of a building, a car bomb is more likely to be discovered. If camouflaged among other cars outside the restricted building perimeter, the damage to the intended target (an academic building) will be greatly reduced. Despite the seemingly obvious benefits of increased security, there are associated costs that may not be so apparent.

The counter to this thinking argues that unless the parking restriction is strictly enforced, it actually raises the risk to property and lives. Presently, construction and contractor crews are allowed to park within the 80-foot perimeter; therefore, most people assume any vehicles within the restricted area belong to these companies. If security is alerted, and there is no obvious reason to suspect anything other than a parking violation, a ticket is simply issued. Another opposing point is the parked cars present an obstacle to

[32] Robert Baity.

a suicide bomber's attempt to drive a car bomb into the building. Based on these arguments, the parking restriction is an ineffective security measure and actually raises the risk.

E. COSTS

Three major areas largely encompass the breakdown of costs associated with increased security at NPS: fiscal, opportunity, and intangible. From a private sector perspective, costs are simply monetary outlays for required inputs based on market prices.[33] However, relative to the increased security at NPS, this approach would neglect the most substantial expenditures, social costs--more specifically, opportunity and intangible costs. Alternative methods for measuring each type of cost attempt to include these externalities, by-products of a good or activity that affect individuals not directly involved in the original action.[34]

1. Fiscal Costs

Analysis of actual fiscal costs was focused on the NPS base police force. These costs were divided into three categories. First, non-labor costs include standard supplies, maintenance, and training. Next, contract costs are associated with the leased security vehicles. Finally, labor costs are the sum of salaries for the fourteen individuals employed as base police. Additionally, attention was given to counter terrorism allocated during FY02 and FY03.

Active duty personnel assigned to security at NPS were not factored into the analysis. For nearly eighteen months following the September 11 attacks, reserve forces augmented security at NPS to ensure the increased demands were met. This action was a temporary fix and, as stated in Chapter One, is a sunk cost. NPS does incur cost with the future addition of 19 Master-at-Arms. Assuming the productivity of each individual is equal to his pay, the cost is the individual's annual salary. Based on the average salary of second-class petty officer at the ten-year mark, each individual adds a cost of $45,000, for an annual total of $855,000.

33 Rosen, 230.

34 Lieberman and Hall, 281.

Appendix B shows the cost of NPS base police from FY00 to FY04. Due to changes in budget record keeping, the FY00 bottom line is the only available number with no associated breakdown. Although the number of personnel has remained constant at fourteen, variations in labor cost are the result of overtime pay, cost of living increases, and a special salary rate for base police. There has been no incremental increase in labor cost stemming from the heightened security. Significant increases in the non-labor and contract sections of the budget for FY02 and FY03 are the result of a counter terrorism expenditure, designed to improve the overall security. However, many of the purchased items listed in Appendix C had no bearing on physical security, but were directed toward IT security. Additionally, the funded physical security measures, highlighted in yellow on Appendix C, had already been committed to. The counter terrorism funding merely accelerated the process. In fact, we have found no increased budgetary commitments into the future due to actions taken in response to the September 11 terrorist attacks.

2. Opportunity Costs

Opportunity cost is defined as "the cost of making an investment that is the difference between the return on one investment and the return on an alternative."[35] In the case of time, the opportunity cost is the value of the next best use of that time. One good measure of that is a person's wage. If a person earns twenty dollars per hour, the next best use of his or her time must be worth less; otherwise it is assumed he or she would undertake the other alternative.

For a person to spend extra time in traffic, he or she gives something up, possibly an extra few minutes at work. Over the course of a year, the few daily minutes in traffic may total a large amount of time. If one values that time at the same rate as the person's wage, then that is the opportunity cost of that person sitting in traffic.

While this is a good measure, it can be argued that the extra minutes may not have been used at work. The person could use that time for a leisure activity instead, such as a last cup of coffee at home with the family every day, during which he or she would not be paid. By that reasoning a person's time would be worth nothing. In reality, if that

[35] "Opportunity Cost," Merriam-Webster Dictionary, <http://www.m-w.com/cgi-bin/dictionary> [28 November 2003].

person were asked to work above his or her normal time at work, he or she would be paid extra, overtime. Thus, a person's leisure time may be worth more than his or her working wage rate. For this reason, the more conservative average yearly wage is used in this project.

Given the numbers of personnel that commute daily to and from the base, and their average annual earnings, it is possible to find the Weighted Average Annual Earnings of commuters on the base (Appendix D). Assuming a 240-day work year, at eight hours per day, the Weighted Average Hourly Earnings would be $41.24 per hour. For all calculations it was assumed that everyone commutes to and from the base once per day, 240 days per year.

The opportunity cost rate of people's time was applied primarily in three areas: extra time lost waiting at the gate, the extra time it takes to drive around the perimeter of the base, and the extra time it takes to walk from parking spaces eighty feet further away.

By the estimate of Chief Baity, the time spent waiting at the gates during peak hours is seven to eight minutes. This is the combined effect of greater congestion at access points due to gate closures and increased security and identification checks not conducted prior to September 11, 2001. This entire amount of time is an increase over the original baseline. However, it does not affect everyone. Some personnel do not arrive or depart at the peak hours. We use a conservative estimate that only half the NPS population arrives during these peak times. Therefore, the seven-minute wait applies to only 1,320 of the commuters, as shown in Appendix F. Seven minutes per day for 240 days equals 28 hours, multiplied by 1,320 people at $41.24 per hour equates to $1,524,409 per year in opportunity costs.

Extra time spent driving includes the longer route that people must follow from the gate to their normal parking areas. This is longer because the gates that many people previously used are now closed, and they must drive further to reach the gate and parking area. It was assumed that the increased distance affected half of the commuters because the gate originally used was still open or the new gate was the same distance from the parking lot. Only the increased distance inside the base was calculated, because people are arriving from or departing to any number of locations.

The perimeter road that must be followed from the Tenth Street gate to the furthest parking area is 4,000 feet further than from the Del Monte gate, and must be traveled twice--once arriving and once departing. The base speed limit is 20 miles per hour, at which speed it takes an extra 136 seconds each way. This equates to 18.2 hours per person each year for 1,320 people. At $41.24 per hour that is $989,976 in opportunity costs.

Appendix E outlines the recently lost and gained parking spaces. Although parking spaces within eighty feet of buildings have been restricted to common use, newly created spaces have offset the total loss to a mere 53 spaces, or 2.7 percent. There is now a necessity for every commuter to walk an extra eighty feet, since the parking spaces nearest the buildings have been closed. Initially, this loss appears to affect only people who park in the first eighty feet, but the cumulative effect as they park farther away is that everyone has the extra eighty feet.

The average human walks at three miles per hour.[36] This means the extra eighty feet takes the average commuter 18 seconds each way, or 2.4 hours per year. Because the parking issue affects all personnel on base, the annual increase is multiplied by 2,640 people at $41.24 per hour. The resulting opportunity cost is $263,967.

Combining the opportunity cost of gate delays, increased driving distance, and lost parking, the total equals $2,778,251.27 (Appendix F). This sum is the equivalent of 280 full time employees at the average earnings rate. This time is obviously a cost, but the government seldom considers it. The cost to the government is indirect and long term. With the marginal increase in time spent, the level of job satisfaction and moral will also decrease marginally. This can hurt retention and cost the government more money in the long run.

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[36] "Measuring Outcomes," Polio Bracing, <http://www.polio-bracing.com/pages/measuringoutcomes.html> [28 November 2003].

3. Intangible Costs

Finally comes the task of addressing intangibles. We have identified two intangible commodities: public opinion and "think-tank time (intellectual capital)." These costs are impossible to value, and three points must be considered when intangible items are considered important. First, inflating or underestimating the value of intangibles can pervert the entire cost-benefit analysis. Claiming that increased security at NPS has destroyed public relations with the local community, while valuing public relations at an exorbitant $1 billion, for example, would distort the entire equation. Second, calculating the difference between measurable costs and benefits can force limitations in valuing intangibles. For example, if the measurable benefits of increased security at NPS exceeded costs by $50 million, the question then becomes whether the costs of lost public opinion and "think-tank time" are really worth $50 million. Lastly, although certain intangibles may be impossible to value, a cost-effectiveness analysis of various alternatives may allow the valuing of other options.

In our case, we related public opinion to specific interaction between NPS and the community to determine if there had been a consequential decrease in public opinion. Our primary concentration was on the Labor Day "Concert on the Lawn," which was reinstituted for the first time since base security was increased. It had previously been a long-standing tradition that had opened NPS to the public to enjoy an afternoon of music from groups ranging from the Monterey Bay Symphony Association's Monterey Pops Orchestra to the DLI Navy Choir. With a returning crowd of approximately 1500, and no incidents, we concluded that there has been little, if any, cost incurred due to loss of public opinion.[37] Special Agent Van Cleef's assessment concurs that NPS has historically enjoyed excellent relations with the local community, and residents tend to be extremely pro-Navy.[38]

Another intangible that needed to be addressed was the "think-tank time." Although we were unable to value this cost, it is a relevant factor. Through the process

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37 Kevin Howe, "Labor Day Symphony Returns to NPS," The Monterey County Herald, 30 August 2003, <http://www.montereyherald.com/mld/montereyherald/news/local/6655881.htm> [30 November 2003].

38 Brian Van Cleef.

of our research, several professors have commented that the delays and parking costs resulting from increased security have curbed their efforts to venture on base. Specifically, certain individuals stated that if they had no class or other scheduled obligation, they would perform other necessary duties at home. Initially, there actually seems to be a decrease in opportunity costs and all direct academic activities are still accomplished. But as many professors will attest to, a great deal of academic stimulation occurs during interaction between professors. This activity may generate future research theories or resolve ongoing questions in various fields. We have labeled this lost brainstorming process as "think-tank time." Determining the amount of unexplored ideas and then assigning a cost of the lost research dollars or possible increased reputation to the school is undeterminable; however, it does remain a cost that needs to be addressed.

4. Total Cost

So, while there are intangible costs, only fiscal costs and opportunity costs incurred on the faculty, staff, and students of NPS are valued. Therefore, the total annual cost is \$3.63 million. Taking the Net Present Value of \$3.63 million over the next five years at a 1.9 percent discount rate (see Figure 1) equals \$17.16 million. Using a 10 percent real rate, the Net Present Value equals \$13.76 million. Opportunity and increased manpower costs are continual through the years, and the researchers assume that risk and current security measures will be in effect for the next five years. Attempting to assess the changes in risk and corresponding reaction in security measures past this time frame is beyond the scope of this project.

F. RISK

Determination of risk at NPS proved to be a task of accumulating a list of other comparable targets. Although terrorist actions are typically attempts to attack political authority, victims tend to be overwhelmingly innocent civilians. This targeting strategy is based on vulnerability and more dramatic consequences. Therefore, both possible civilian and military targets within the borders of the United States were accounted for. Terrorist attacks are aimed at undermining a population's faith in the ability of the government to protect civilians and infrastructure or maintain peaceful conditions in society. These effects are gained by targeting a multitude of sites: government buildings, military bases, airplanes and airports, trains, bridges, tunnels, banks, economic centers and major businesses, symbolic public monuments, civilian gatherings and congested population centers, power plants, water supplies and pipelines, communication centers, and computer networks. Appendix G lists targets comparable with academic buildings at NPS.

For the purpose of this analysis, it was assumed that each of the 317,385 targets shared an equal likelihood to be attacked. This approach was deemed the most conservative due to the inability to assess any terrorist capabilities and motivations. Having established the total number of possible targets, the Department of Homeland Security Advisory System was reviewed to determine the risk of an attack within the United States. The current Elevated Condition (yellow) declares there is a significant risk of terrorist attacks; however, there is no publicly quantifiable figure associated with this condition. Noting that it is positioned as the center of five possible settings, we assigned a 50 percent risk.[39] This valuation is supported by recent studies that place the United States in the top four countries worldwide most likely to be targeted by terrorists.[40]

These two figures combined equate to a 1.576×10^{-6} chance of being attacked. This is the risk of one attack, in a given year. Beyond the 9/11 attacks, current events throughout the world have illustrated the increased capabilities of terrorist to conduct coordinated attacks. If four targets were attacked, as on September 11, the risk of attacks would increase to a 6.3×10^{-6}, in a given year. The researchers assume that this level of risk will be constant over the next five years. Therefore the risk of attack over a five-year period is 7.88×10^{-6} for one attack, and 3.15×10^{-5} for four attacks. Assuming that the implemented security measure at NPS reduce the chance of an attack in a five year period by 30 percent, the change in risk (ΔD) of attack equals 9.46×10^{-6}.

39 "Homeland Security Advisory System," Threats and Protection, 12 March 2002, <http://www.dhs.gov/dhspublic/display?theme=29> [30 November 2003].

40 Elise Labott and Associated Press, "Terrorism Now Key Business Risk," 24 August 2003, <http://www.cnn.com/2003/BUSINESS/08/19/global.terror.biz/> [30 November 2003].

G. MODEL AND RESULTS

Our cost-benefit analysis model reveals the value of associated benefits for the incremental cost of increased security. Benefits include saved lives and prevented property damage, while incremental costs were solely opportunity costs.

Total Cost (@ 1.9 percent discount rate) = $17,160,000

Total Cost (@ 10 percent discount rate) = $13,760,000

$$\text{Risk } (\Delta D) \text{ x Total Benefits} = (9.46\text{x}10^{-6}) \text{ x } \$192{,}000{,}000$$

or

$1 of Cost (@ 1.9 percent discount rate) yields $.00011 of Benefit

$1 of Cost (@ 10 percent discount rate) yields $.00013 of Benefit

From the analysis, it is obvious that there is essentially no benefit gained from the increased security since 9/11. This result is primarily the product of minimal risk of attack, before or after the September 11 terrorist attacks. With the threat near zero, any increased cost of security yields vastly diminished returns or benefits, and the use of different discount rates to calculate opportunity cost proved inconsequential. Based on the total cost at a 1.9 percent discount rate, pre-security risk would have to be over 2800 times our estimated worst-case risk to justify the cost to achieve the current benefits. Even then, it is only $1 of cost for $1 of benefit.

The benefit of security and force protection is unquestionable. The issue is at what cost. Heightened security measures at NPS were obviously enacted without a clear assessment of the risk or opportunity costs. The school is receiving a tiny benefit, at a very high cost. As ‘transformation’ efforts are made throughout DoD to institute more business-like practices, serious thought and effort must be made to ensure the benefits of projects justify the costs.

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IV. CONCLUSIONS

A. CONSIDERATIONS

The researchers made various considerations and assumptions throughout the entire analysis process. In each instance, the effort was made to maintain the most conservative approach, thereby preventing unjustifiable conclusions.

Several benefit values were considered undeterminable by the researchers. There is no doubt that any bomb would create damage beyond the intended target, but accessing the magnitude of the collateral damage was beyond the available means of the researchers. Additional benefits of uncertain value included the amount of labor to install a computer network in a new academic building and the administrative effort to relocate activities that had previously been performed in a targeted building.

Despite these omitted figures, the total value of benefits is dominated by value of life. Although numerous studies take differing approaches concerning how to assign a dollar figure to a life, most methods reach a value between $3 million and $5 million. The calculated figure in this analysis falls comfortably within the acceptable range. Additionally, it is not likely for the $167 million total value of life to increase substantially. Following the theme of worst-case scenario, we assumed the targeted academic building would be attacked during peak usage. Although we did not include possible students in computer labs or lounges, NPS is near 90 percent capacity for students, so the building population is considered to be as dense as possible.

There are two considerations that would decrease the number of lost lives, thereby lowering the benefit of saved lives. First, if a car bomb were detonated outside the eighty foot restricted area, the effect on the academic building would be greatly diminished. Secondly, as the Navy increases the availability of distance learning through NPS, it is possible that the total number of students in Monterey could decrease.

Intangible costs were also left undetermined, but they do exist. Both students and professors limit the number of trips to NPS due to gate delays and parking. For students, the cost is a lessened academic experience. They may consider the effort to get on base too great and forego studying at the library or group meetings. As previously stated, professors have less professional interaction, decreasing the intellectual capital at NPS.

The surprising discovery on the cost side of the equation was that annual budget numbers for security were decreasing. Although there had been a two-year influx of funds under the heading of "counter terrorism," the portion allotted to physical security simply accelerated previously approved projects. An NPS budgeter stated a future possibility to decrease the budget was to disband NPS security and contract it out to local law enforcement; only gate security would be continued. Despite the efforts to increase fiscal responsibility, opportunity cost proved to be the real expense.

The most difficult factor to calculate was risk. Although Chief Baity and Special Agent Van Cleef agreed that the threat of a terrorist attack was low, neither would venture a quantitative possibility. It was clear that targets other than military buildings within the United States had to be considered. Again, the researchers attempted to maintain a conservative approach by determining the number of targets susceptible to similar attack. This method eliminated millions of miles of roads, hundreds of thousands of miles of pipelines and rail track, and millions of annual travelers and commuters (planes, trains, and automobiles). With no good way of assigning varying degrees of probability of attack, the researchers assumed each target to have an equal chance of being struck.

Although the assumed 30 percent reduction in threat of attack may seem arbitrary, the researchers had little guidance for a more valid number. However, the nearly insignificant initial risk was so low that the magnitude of reduction in risk was inconsequential. The risk factor proved to be the most critical, and debatable, factor. As calculated, barring any major changes in risk, the benefits of increased security are not even close to justifying the incremental costs. Attempts can be made to prevent every possible means of attack. For example, CAPT Simeral stated that fuel trucks for the base gas station are now escorted by security. But as the marginal returns rapidly decrease, a decision must be made to limit the very real costs of these measures.

B. CONCLUSION

Opportunity cost must be addressed to reduce cost although it is rarely considered. The researchers are not security experts and have attempted to avoid comment on the effectiveness of the increased security measures. Despite our lack of expertise in security matters, it is evident they create a high opportunity cost that equates to lost dollars. Measures should be implemented with consideration of the costs, even though direction on security is dictated from the CNO down through the chain of command. At NPS, gate delays create the most significant opportunity cost. Since certain parking lots have been designated for car pool vehicles, one possible solution is a gate for shared rides only. Another possibility is to distribute class hours more evenly through the day to limit congestion at gates during peak times.

Another means to reduce cost to students, faculty and staff is remove the 'no parking' areas that surround campus buildings, until mandated by the national chain of command. This would save over $260,000 in opportunity costs, as well as opening nearly 400 parking spaces on base. As there are currently no physical boundaries to prevent a vehicle from entering the restricted area around a building, and cars are routinely checked at the gates, there would be no more risk than there is now of an attack.

C. RECOMMENDATIONS FOR FURTHER STUDY

The researchers have several recommendations for future study. First, this project focused on the worst-case scenario--a bomb attack against an academic building. However, the costs of the increased security do not merely reduce the threat of a terrorist attack. As stated by Chief Baity, theft is the most likely crime to be perpetrated at NPS, and the restricted parking around academic buildings is a major deterrent. Prior to this particular security measure, computer components could simply be carried out an exit into an awaiting car. Now, the thief must transport the stolen equipment across an open area, increasing the risk of being caught.

To compare the costs and benefits of various physical security measures and crimes, the researchers recommend an Activity Based Costing project. Determine the total costs of security at NPS and the risk of the top ten most likely criminal activities on base. Designate proportional values of security expenditures used for the prevention of these ten crimes. This study will yield a breakdown of the security focus and the cost-benefit of those measures.

Next, our analysis was restricted to physical security. The researchers recommend a cost-benefit analysis of IT security at NPS. This recommendation was spurred by several events and discoveries. First, current news continually reminds us of the vulnerability of computer systems. The threat of a virus or worm is a constant concern, while hackers and foreign nations gain increasing ability to probe most systems. Second, a large portion of counter terrorism funds was used for IT security, which is a decision that seems to illustrate the primary security concerns. Third, during numerous interviews for this project, the researchers were repeatedly asked if our analysis would include IT security. It became very apparent IT security was an issue many people believed significant.

Research into the effects and unintended consequences of security measures could be undertaken. The security measures in this project were looked at from an economic standpoint, but not for effectiveness. For example, in addition to the opportunity costs of a no-parking zone surrounding a building, there is the issue of what that boundary accomplishes. If there is a physical boundary that prevents vehicle transit, then there may be a reduced risk of vehicle bombs approaching. If there were no boundary, simply a no parking zone, then there would be a relative certainty of a terrorist driving up to a building unimpeded by cars that would ordinarily have parked there. This is particularly amplified if a no parking zone is not enforced, enforced with nothing more than parking tickets, or selectively enforced for contractors or administrators. In that case the benefit of raised suspicion when a vehicle is in the no parking zone decreases. Much as the deterrence of theft is a positive unintended consequence, there could be severe negative consequences.

Finally, a cost analysis of several other security measures could be undertaken. While a number of activities are undertaken, there may be a better, more cost-effective, means to accomplish them, such as routine security patrols on base. Parking patrols and security patrols currently take place in light trucks or medium to large sized sedans.

Given the low rate of crimes on base, there could be a car used for prisoner transport that is kept on-call at the police station, while golf carts or other economical vehicles could be used for routine duties.

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APPENDIX A. BUILDING CONTENTS

FURNITURE			Quantity		Value
Desks	$	13,800	138	$	100
Chairs	$	21,900	876	$	25
Books	$	69,000	138	$	500
	$	**104,700**			
IT USER					
Laptop Computers	$	45,000	30	$	1,500
Desktop Computers					
Offices	$	165,600	138	$	1,200
Labs	$	93,500	85	$	1,100
Classes	$	22,000	20	$	1,100
Printers	$	10,000	5	$	2,000
	$	**336,100**			
IT CORE					
Servers	$	1,500,000	60	$	25,000
UPS	$	100,000	1	$	100,000
MAINFRAME	$	5,000,000	1	$	5,000,000
	$	**6,600,000**			
OTHER					
Copiers	$	8,000	4	$	2,000
Projectors	$	62,500	25	$	2,500
Plasma Screens	$	15,000	3	$	5,000
	$	**85,500**			
SUB-TOTAL	$	7,126,300			
BUILDING	$	17,731,115			
TOTAL	**$**	**24,857,415**			

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APPENDIX B. BASE POLICE EXPENDITURES

	FY00	FY01	FY02	FY03	FY04*
Non-Labor		$ 65,748	$ 87,544	$ 175,583	$ 23,000
Contracts		$ 16,158	$ 112,394	$ 2,823,753	$ 6,000
Labor		$ 671,312	$ 751,737	$ 632,000	$ 717,000
Total	**$ 751,000****	**$ 753,218**	**$ 951,675**	**$ 3,631,336**	**$ 746,000**

Non-Labor: Supplies, maintenance, training
Contracts: Leased Vehicles, Counter Terrorism
Labor: Civilian Security Force (constant 14 individuals)
* Estimated
** Includes $103,000 spent by Command Admin and Student Services

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APPENDIX C. MAJOR SECURITY PROJECTS

Upgrade Security Lighting/Sidewalks		$ 227,068
SCIF Remaining work, IT work		$ 168,612
Improve Gate Security/9/10th St.		$ 175,000
Unclassified Educational Network		$ 696,695
Program Management Support to ITACS		$ 53,000
Keying system, Electronic		$ 49,980
Perimeter Road, Parking Lots		$ 662,662
Replace Existing Power Panel		$ 15,567
Materials (CT)		$ 10,102
Materials (EOC)		$ 30,297
Provide A/C to additional rooms, bldg 330		$ 35,000
Labor (PW shops before changeover) plus 6/14		$ 1,855
Designs		
	Upgrade Security Lighting, Sidewalks	$ 36,031
	Perimeter Road/Parking Lot	$ 97,881
	Perimeter Fence/Improve 9/10th St. Gate Security	$ 54,412
S3 Network Security Group Contract		$ 194,708
		$2,508,870

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APPENDIX D. AVERAGE ANNUAL EARNINGS

	Number	% Of Total	Average Annual Earnings
Students	1445[41]	54.73%	$ 79,724.40[42]
Military Staff	174[43]	6.59%	$ 70,000.00
Civilian Employees	1021[44]	38.67%	$ 80,000.00
Total	2640	100.00%	
Weighted Average			$ 79,190.06
Weighted Hourly Average			$ 41.24 / hr

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APPENDIX E. PARKING SPACES BY PARKING LOT

LOT	Lot Location	No. Spaces Prior to 9-11	Current No. Regular Spaces	Current No. Permit Spaces	No. Handicap Spaces	No. Motorcycle Spaces	Comments
A	Herrmann Hall, front	95	66	-	1	-	9 Reserved
A1	Upper Tennis Courts	15	-	20	-	-	**Permit only**
A2	The Old Maze site	111	150	-	-	-	open
B	Herrmann Hall, west	45	-	42	2	13	**Permit Only**
C	Chapel	39	4	-	4	-	**Handicap only**
D	Bldg 222, east	63	12	-	5	-	open
E	Bldg 221, west	30	-	-	-	-	CLOSED
F	New Post Office	12	33	-	2	-	open, short-term (24 min.)
G	New Gym	25	22	-	2	-	open
H	BEQ	21	-	*21	-	-	***Resident only**
I	Lake Tennis Courts	9	30	-	-	-	Unpaved
J	Ingersoll/Halligan	38	-	13	1	-	**Permit only**
K	Boiler Plant, north	103	104	-	-	1	open
K1	Bldg 203, north	13	14	-	-	-	open
K2	Bldg 203, NW	7	12	-	-	-	open
K3	Boiler Plant, east	42	41	-	-	-	open, 1 Gov't vehicle
L	Glasgow Hall, north	177	192	-	2	-	open
L1	Overflow, Glasgow	-	54	-	-	-	*unpaved*
L2	Overflow, B224	-	45	-	-	-	*unpaved*
M1	Criscuolo Hall, north	-	50	-	-	-	*unpaved*
M2	Criscuolo Hall, NW	7	14	-	-	-	*unpaved*
N	Bldg 203	-	50	-	1	-	*unpaved*
O	Bldg 203, south	160	160	-	1	10 open	
P	Boiler Plant, south	88	86	-	-	-	open
Q	Library, east	67	-	31	3	9	**Permit only**
Q1	Ingersoll/Library	59	-	31	-	-	**Permit only**
R	Halligan/ME Bldg	189	-	95	6	26	**Permit only**
S	Spanagel Hall, east	48	-	43	4	-	**Permit only**
T	NEX, south	56	33	-	4	-	open
T1	NEX, east	74	86	-	-	-	open
T2	NEX, west	14	-	-	-	-	CLOSED
T3	Gas Station	32	27	-	-	-	open
U	Ballfield, south	11	11	-	-	-	open
U1	Ballfield, leftfield	20	10	-	-	-	open
V	Trans'n Yard, North	45	87	-	2	3	open
W	10th Street Gate	25	25	-	-	-	open
X	Trans'n yard/ Morse Dr	20	16	-	-	-	open
Y	Lot A-2/Morse Dr	11	14	-	-	-	*unpaved*
Z	Public Works	-	29	-	2	-	open, *partially unpaved*
Z1	Ballfield, north	-	12	-	-	-	*unpaved*
	Dyer Road	9	-	7	-	8	**Permit only**
	Meneken Loop	50	-	53	3	10	**Permit only**
	Butler Road	18	13	-	-	-	open

LOT	Lot Location	No. Spaces Prior to 9-11	Current No. Regular Spaces	Current No. Permit Spaces	No. Handicap Spaces	No. Motorcycle Spaces	Comments
	Tisdale Road	5	-	-	4	-	**Handicap only**
	Other Lots (now closed)	86	-	-	-	-	CLOSED
Total		**1939**	**1502**	**335**	**49**	**80**	
			Current Total Spaces:		**1886**		

APPENDIX F. OPPORTUNITY COST

Increased Distance		4000	feet
Speed		20	MPH
		29.3	FT/Sec
Time per person		136.4	sec
Time/person/trip		272.7	sec
Days per year		240	days
Time/person/year		65454.5	sec
		1090.9	min
		18.2	hours
% people affected		50%	
People coming on base		2640	people
Total number affected		1320	people
Total time/year		24000	hours
Hourly earnings	$	41.24	per hour
Driving Opportunity Cost	**$**	**989,760**	

Time spent at gate		7	min
Days per year		240	days
Time/person/year		1680	min
		28.0	hours
% people affected		50%	
People coming on base		2640	people
Total number affected		1320	people
Total time/year		36960	hours
Hourly earnings	$	41.24	per hour
Waiting Opportunity Cost	**$**	**1,524,230**	

Increased Distance		80	feet
Speed		3	MPH
		4.4	FT/Sec
Time per person		18.2	sec
Time/person/trip		36.4	sec
Days per year		240	days
Time/person/year		8727.3	sec
		145.5	min
		2.4	hours
% people affected		100%	
People coming on base		2640	people
Total number affected		2640	people
Total time/year		6400	hours
Hourly earnings	$	41.24	per hour
Walking Opportunity Cost	**$**	**263,936**	

Total Annual Opportunity Cost **$** **2,777,926**

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APPENDIX G. POSSIBLE TERRORISM TARGETS

Target Description			Quantity
Federal Buildings	Owned		1,800[45]
	Leased		6,500[46]
Dams*			76,000[47]
Drinking Water Systems			54,000[48]
Bridges			162,000[49]
Airports**			2,714[50]
Power Plants[a]			9,351[51]
Major Military Bases°		259[52]	2,590
Major U.S. cities°°		243[53]	2,430
		Total Targets	317,385

* Greater then six feet in height
** Paved runways greater than 1500 meters
[a] Fossil fuels, nuclear, and renewable
° Assuming ten targets per base
°° Population over 100,000, assuming ten targets per city

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