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The Future of Naval Postgraduate School - Setting the Stage

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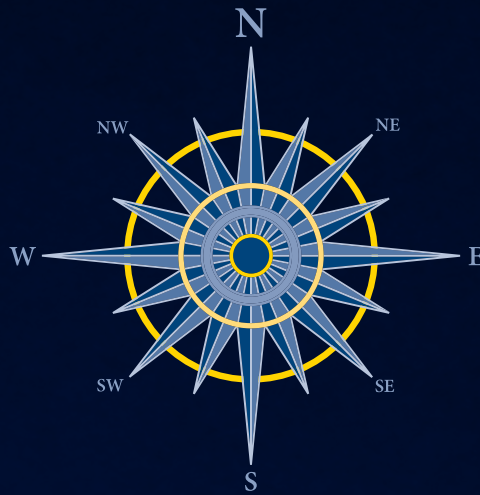
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COMMITTEE ON THE FUTURE

SETTING THE STAGE



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SETTING THE STAGE

SEPTEMBER 2011



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Acknowledgments

The work of the Committee on the Future has been inspired and informed by the excellent contributions of the Naval Postgraduate School (NPS) campus community. In addition, the Committee's work was energized by the compelling insights of our Navy's leadership, the leadership of the Department of Defense, the Central Intelligence Agency, Air Force, Marine Corps, Army, Department of Homeland Security, the National Security Agency, as well as the Naval War College and the Air Force Institute of Technology. Each interview contributed new awareness and validated some of the previously conveyed messages.

The Committee would like to express its thanks to NPS President Daniel Oliver and NPS Executive Vice President and Provost Leonard Ferrari for their vision in establishing the Committee. The last year has been a valuable opportunity to learn more about the exceptional capabilities of NPS and the important national security mission it serves.

Finally, a note of gratitude to the staff of NPS who helped the work of the Committee move smoothly from inception to completion. The sense of pride in their institution was evident in the excellence of support they provided.

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Executive Summary

The Naval Postgraduate School embarked this year on a quest to imagine the future and what its place might be in that future. While currently an acknowledged expert in national security, to excel even more in the years to come, NPS must study current trends, estimate the future ones and determine its path. Given sufficient flexibility, NPS has the opportunity to create a future where the talents of faculty, students and staff are fully realized; where the education is unquestionably the best and where research impacts every facet of the security of the world in which we live.

In preparation for updating its strategic plan in 2012, the Naval Postgraduate School established a Committee on the Future to assess national security and academic trends, define future challenges, and recommend actions to ensure continued mission success. Committee members representing industry, academia, government and the NPS Board of Advisors divided their effort into nine working groups: Trends, Education and Research, Faculty, Students, Organization, Funding, Facilities, Information Technology, and Partnerships. The yearlong effort included extensive reviews of government, public policy research groups, and academic studies, as well as interviews with a broad range of military and civilian officials in Washington, D.C., Pacific area commands and locally in California. Each working group developed a report and submitted it to the whole Committee and NPS for review. The report chapters share a common organization and include sections on background, method, observations, considerations, and recommendations.

Across the working groups, Committee members identified several major trends that will require institutional change by the Defense and Navy Departments as well as NPS. Of greatest concern is increasing instability in the geostrategic landscape, growing complexity stemming from globalization, rapidly changing and proliferating technology, significant natural and financial resource constraints, and environmental challenges. All of these contribute to extreme levels of uncertainty in multiple dimensions, and are likely to change organizational planning assumptions as well as the cause and nature of future conflicts. The implications for defense and national security are the same as for NPS: large bureaucratic institutions will need to become more flexible and responsive to emerging requirements, while continuously working to improve the efficiency of their operations.

Operating effectively in this emerging world will require institutions to engage people who are intellectually curious, tolerate ambiguity, embrace abstraction and lifelong learning, and are creative. Those skills will influence curricula development and organizational processes, as well as change the way the military, government, industry and academic institutions select their leaders. Future success must also acknowledge cultural changes that demand near-continuous access to information, and collaboration among internal and external entities. This change in the way people communicate necessitates a robust and secure cyber infrastructure that will be as fundamental to the NPS mission as buildings and classrooms.

In addition to actions implied by these contextual trends, the working groups identified 45 specific recommendations in their areas of expertise, including many internal actions NPS can take immediately. Of greater importance are recommendations for more comprehensive change that may require additional study and liaison with external organizations.

The following recommendations distill the most important themes of the Committee's deliberations and imperatives for action that include an external reach with actions that require DoN engagement:

1. Implement a special charter status for NPS with the Department of the Navy that provides flexibility in hiring faculty and staff, funding and fund-raising, facilities, student markets, advertising/recruitment, and partnerships.
2. Capitalize on the need for innovation across capabilities, operational concepts, personnel policies and organizational structures.
3. Continue NPS' responsiveness to national security priorities and accelerate development of hybrid resident/distant programs to improve responsiveness to DoD/DoN and federal agency requirements. Investments in this area should consider the establishment of conference facilities.
4. Make the following visible and aggressive institutional priorities: classified research and education capabilities, energy, government acquisition, cyber, modeling and simulation, regional studies, and unmanned systems. Investments will have to include expansion of classified facilities.

5. Expand the NPS research portfolio and rebalance to increase 6.1/6.2 research.
6. Maintain technological flexibility with a robust cyberinfrastructure and services.
7. Consolidate base operations with local community and other local Department of Defense assets.
8. Work with SECNAV to modify promotion board precepts to value quality graduate education in the selection process. Request the CNO designate NPS and NWC as the major contributors to the Navy's Graduate Education Strategy with objectives that place them at the core of providing graduate education for the Navy and other Services (and civilians).
9. Promote the NPS value proposition with DoD, DoN and federal agency leaders through programs, events, publications, and media.

The overwhelming message in each of the chapters is flexibility. NPS requires flexibility for its future.

- **Enrollment Flexibility** Include civilians and more international students to maximize existing capacity in selected programs
- **Curriculum Flexibility** Expansion of hybrid programs that include resident and non-resident elements
- **Revenue Flexibility** The ability to do fund-raising, accept and keep tuition and accept GI Bill support for veterans and spouses
- **Hiring Flexibility** Ensure hiring the best faculty and staff talent to continue quality improvement in all areas of NPS
- **Technological Flexibility** Maintain a robust cyberinfrastructure and services including the .edu capability
- **Facility Flexibility** The ability to lease property, build and renovate facilities
- **Communication and Outreach Flexibility** The ability to engage in recruiting and advertising and more expansive outreach to increase NPS visibility
- **Partnership Flexibility** Make it easier for NPS to engage in strategic partnerships with other universities, laboratories, and industry
- **Organizational Flexibility** Having the flexibility, where appropriate, to adapt to the most cost efficient and effective organization as significant changes occur in the world or the Department of Defense

Like the Defense and Navy Departments it serves, NPS faces a future defined by complexity and uncertainty. Its mission and the tools it uses to educate students and conduct research are likely to change more rapidly than ever before, and its sponsors will be relentless in their search for operating efficiencies. These macro trends have implications for nearly every aspect of NPS operations. The next Strategic Plan will have to account for specific adjustments related to the above. More difficult perhaps will be the need to assess carefully some fundamental but difficult changes in organization and leadership selection, so that NPS has the agility and flexibility to meet 21st century challenges.

The crucial element for the future is flexibility — not continued requests for additional resources or building on existing programs using the same historical patterns for program growth. The successful institutions of the future will be adaptable to changing conditions or newly discovered information. Speed of responsiveness will be another defining factor. Both require the flexibility to recruit and retain the best talent, expand and reduce physical capacity as needed, raise funds, reallocate resources, publicly communicate intentions and accomplishments, expand student markets, maintain technological currency and flexibility, increase international enrollments and engage in partnerships with other institutions and industry.

NPS cannot rely solely on the unique nature of its operations to obtain the much-needed regulatory relief the Committee recommends. Rather, it will have to take persistent action to demonstrate the cost savings and related advantages of implementing them. However, there is cause for optimism because maintaining the status quo will not allow Defense and Navy Department leaders to achieve their objectives — they will have to seek alternative solutions. NPS possesses an abundance of talent among its faculty, staff and students — it has the proven capability not only to adapt to current trends, but also to become a leader among the Navy's flagship institutions as it prepares for the next five years.

The Naval Postgraduate School is a superb institution which provides a unique and valuable education to future leaders in the national security arena. It contributes significantly to scientific and scholarly inquiry that addresses the most difficult of national and international problems. NPS and the Navy have a responsibility to ensure NPS' future vitality and contributions by taking the actions the committee has recommended.

Introduction

Naval Postgraduate School President Daniel Oliver established the Committee on the Future in August 2010 to frame the future context of the NPS' next five-year strategic plan. The current NPS strategic plan, *Vision for a New Century*, is nearing the end of its fourth year of implementation. NPS uses its plan dynamically and measures its progress on a regular basis. The importance of the Committee on the Future's work is directly linked to the centrality of NPS' strategic planning to the life of the institution. The membership of the Committee is provided in Appendix 1, together with the Committee's Charter.

The Committee on the Future was asked to look beyond the boundaries of the present and into the possibilities of the future. Since the world continues to change quickly on a variety of different dimensions, higher education institutions must challenge themselves to stay current with the frontiers of knowledge creation and scientific inquiry.

The Committee on the Future was asked to identify and consider some of the important changes in the Department of Defense/Department of the Navy, national security, and higher education and provide insights on how the Naval Postgraduate School can fully realize its own potential as an indispensable resource to the nation — a center of academic quality, in research and graduate education, and a source of efficiently-educated military and civilian leaders and relevant, leading-edge information on national security issues.

The NPS mission is to provide high-quality, relevant and unique advanced education and research programs that increase the combat effectiveness of the Naval Services, other Armed Forces of the U.S. and our partners, to enhance our national security.

A university is more than a collection of curricula and projects, faculty and students — it is an intellectual enterprise that fuels inquiry and provokes the status quo. One of the ways an institution ensures its competitive edge is by asking thought leaders to comment on how the future will be shaped. Specifically, NPS needs to hear what academic areas are crucial to national security, what technologies must be developed, what multidisciplinary synergies must be cultivated, and what focused areas of research must be supported. At the same time, NPS needs to hear about alternate resourcing strategies, possible improvements to use of existing resources, and methods for priority-setting.

The Committee was asked to take a full year to develop its report and to consider the voice of the campus community as well as opinion leaders in the Departments of Defense and the Navy, other federal agencies, higher education institutions, and industry. Two major questions drove the work of the Committee:

1. *What are the major national and global trends that will define the future?*
2. *How might NPS position itself to respond to those trends?*

The response from the campus community was uniformly positive and informative. The response from national and community leaders has been generous and engaging. The Committee is grateful for their contributions and ongoing support of the Naval Postgraduate School. This report will be used to inform the next NPS strategic plan.

“We all recognize that we are living in a global world. We are all interconnected; what NPS does is train people to look at the world, to understand changing technologies and cultures. If we are going to succeed and provide leadership in that kind of world, we have to understand what global is all about.”

The Honorable Leon Panetta
Secretary of Defense

The Naval Postgraduate School is a diverse community. Students at NPS come from all of the U.S. uniformed services, from the armed forces of partner nations across the world, and civilians from throughout the defense enterprise. In today's globalized society, where better to prepare for the future than on a global campus?



Approach

The Committee on the Future included both NPS representatives and external members representing industry, Department of the Navy (e.g. a representative of the Secretary of the Navy (SECNAV)), other higher education institutions, and the NPS Board of Advisors. The Committee gathered three times for all-day meetings in August 2010, January 2011 and May 2011. Its final meeting with the President and Provost occurred September 13, 2011, when the final report was submitted.

The Committee on the Future divided its work into nine working groups: Trends, Education and Research, Faculty, Students, Organization, Funding, Facilities, Information Technology and Partnerships. The nine groups each had a lead with two other Committee members designated to assist. The nine groups worked primarily through email and telephone conferences, and the results of their efforts were posted to a collaborative project site.

Extensive consultation occurred throughout the year. The chair and vice chair met with over 100 faculty members, students and staff on campus and in the Honolulu, San Diego, and D.C. NPS office sites. They also interviewed external stakeholders and opinion leaders in the Washington, D.C. area: Department of Defense, Department of the Navy (e.g. Chief of Naval Operations (CNO), VCNO, OPNAV Staff, Under Secretary of the Navy), civilian and military leaders, and other federal agency leaders. The chair and vice chair also traveled to the Air Force Institute of Technology, the Naval War College, the Pacific Fleet headquarters, and the Joint Pacific Command headquarters to conduct interviews. Finally, local and regional leaders were interviewed: county administrator, city managers, and the region's congressional representative. Over 50 external stakeholder interviews were conducted.

In order to provide consistency, each chapter has five common elements: Background, Method, Observations, Considerations, and Recommendations. The Conclusion section is more than a compilation of the chapter recommendations — it is a distillation of the common themes expressed in the various sections and a consolidation of recommended actions.

Once the initial report was written, the draft was shared with the campus community for comment. Comments from the review were shared with the Committee on the Future, and changes to the draft were incorporated after discussion and agreement by the Committee. The Committee's work was expansively consultative and the report is informed by those valuable interviews and meetings.

“NPS taught me how to frame very difficult problems, how to look at big challenges in different ways ... It was the total experience that taught me what education was all about.”

*Adm. Michael Mullen
Chairman, Joint Chiefs of Staff*



Trends

BACKGROUND

The Naval Postgraduate School provides advanced education and research to increase the combat effectiveness of the naval services and other armed forces of the U.S. and its partners, in order to enhance U.S. national security. Given the central roles the Department of Defense (DoD) and Department of the Navy (DoN) play in setting national security requirements, NPS strategic planning must include the needs of those departments and other relevant agencies. NPS must also consider the contextual conditions those departments establish in terms of threat assessment, funding, and policy initiatives, as well as how global trends will influence each of those areas.

OBSERVATIONS

Global Trends The working group identified one trend that by itself defines the future environment — “uncertainty.” Defense and NPS planners will have to consider the impact of numerous global trends, especially those that have potential for destabilizing nations or regions, or complicating U.S. strategic planning efforts or defense. A range of old and new forces are buffeting the status quo and making it more difficult for defense and civil planners to develop long-term coherent plans and policies. Increasing uncertainty will place a premium on a nation’s ability to detect new patterns and innovate quickly in order to maintain areas of economic, technical, and military advantage, especially as they become more fleeting in a globalized world. In addition, higher levels of uncertainty have clear change implications, including the need for organizing differently so that large bureaucratic institutions can become more flexible and responsive to emerging requirements. Moreover, organizations will need more people who work better with abstract concepts and who are more creative. People who manage and lead transformation will be in high demand. These needed skill sets will influence curricula development at all levels of education and change the processes by which the military, government and industry selects its leaders.

Noteworthy global trends include:

Instability Fundamental changes in the geostrategic landscape, such as the shift of power away from the U.S. toward a multi-polar world, are likely to stress relations between nations.

Uncertainty Rates of change in nearly every area of human endeavor are accelerating, which challenges our ability to identify new patterns and adapt to their organizational, legal and ethical implications. In the most recent IBM survey of leading Chief Executive Officers, respondents noted for the first time that “uncertainty” has replaced “change” as their top challenge. (Ref. 20).

Complexity Globalization is complicating strategic planning because it is interconnecting organizations and societies in a way that broadens the scope and ramifications of decisions. The larger number of variables affecting decisions also increases the likelihood of miscalculation or unanticipated consequences. In addition, our global society requires human and electronic networks to move information among relevant entities. As our reliance on these networks increases, they become critical infrastructure whose protection further complicates national security planning and increases cost.

Technology Development in many areas is proceeding at a dizzying pace, especially in information technology. Information networks and mobile access to them are increasingly important to governments and militaries, but are also having profound effects across a range of societal activities. Low-cost mobile communication devices are widely available and they are fundamentally changing the way people communicate, collaborate and organize their

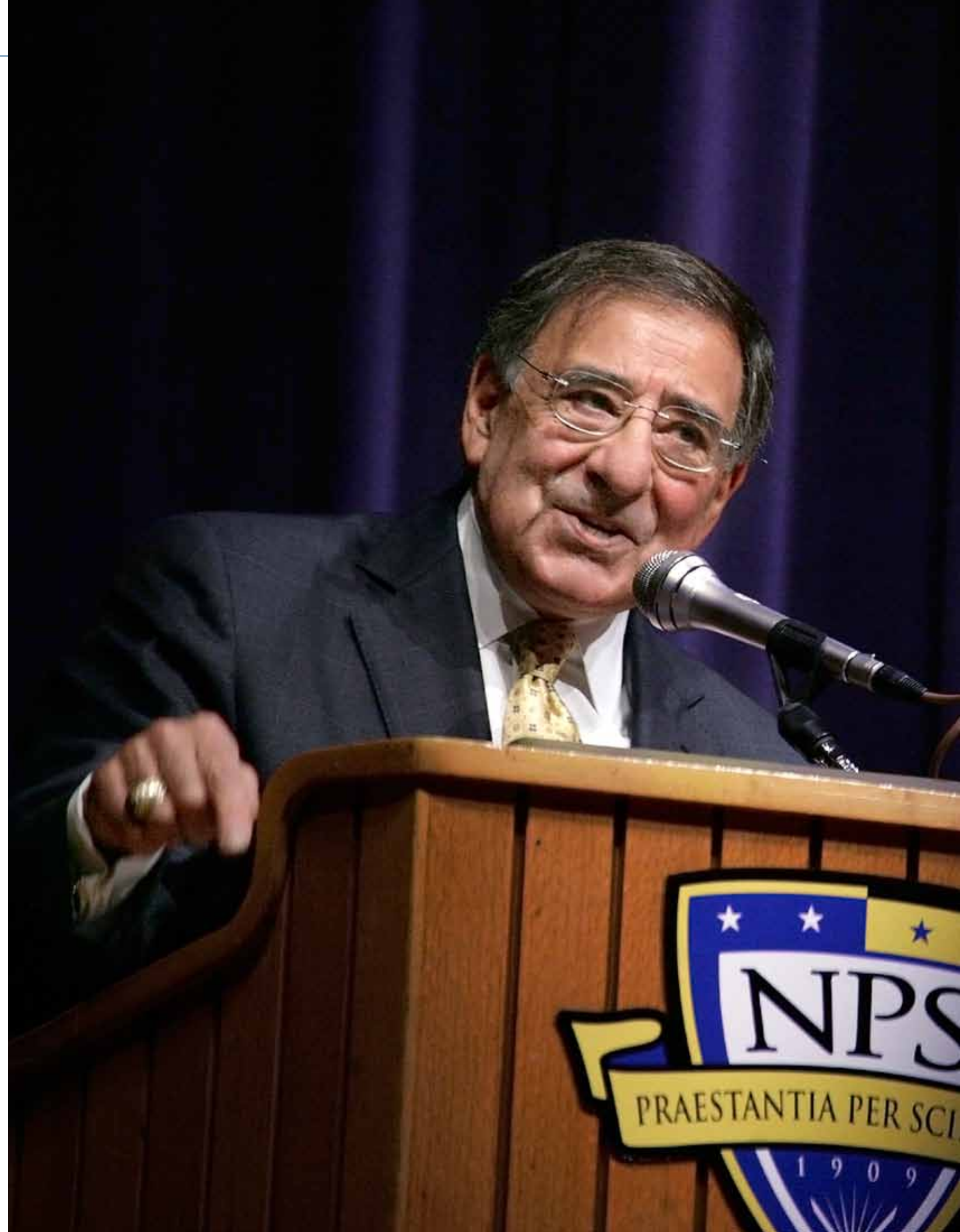
METHOD

The Committee on the Future reviewed DoD and DoN plans as they relate to three specific areas of concern: (1) future direction of the DoD and DoN; (2) new military capabilities and areas of interest to the DoD and DoN; and (3) positioning NPS to support future DoD and DoN priorities.

The working group approached its task by:

- Identifying and reviewing studies sponsored by public policy think tanks, industry and U.S. government departments (including DoD and DoN);
- Interviewing government and defense industry personnel, as well as influential individuals from public policy think tanks and academia;
- Assessing the trends and plans those studies and interviews identified that provide context for determining what new combat skills or capabilities NPS could help develop, and how NPS should position itself to meet DoD and DoN needs in future budget-constrained environments.

U.S. Secretary of Defense Leon Panetta addressed students, faculty and staff in a standing-room-only King Auditorium during his Secretary of the Navy Guest Lecture in August 2011 following a meeting with senior Naval Postgraduate School leadership. In his address, Panetta touched on the current budget challenges facing the Department of Defense, the value of NPS to national security, and the invaluable roles of the men and women in uniform to DoD’s mission.



efforts. “Flash Mobs” are a recent example: coordinated via mobile phones and social media, they have helped depose long-time autocrats in Tunisia and Egypt.

Resource Constraints The earth likely contains adequate supplies of protein, fresh water and energy for many decades. However, the uneven, inefficient, or corrupt distribution of those resources is likely to remain a *casus belli*, especially in underdeveloped areas. Conflicts will probably be over the “basic necessities of life.”

Debt Studies indicate that deficit spending to support social entitlements is creating debt burdens that threaten the long-term prosperity of the U.S. and many of its allies. It also increases their vulnerability to interest rate hikes and coercive strategies by creditors. In a recent testimony, the Chairman of the Joint Chiefs of Staff Admiral Mike Mullen (an NPS alumnus), warned that if left unchecked, mounting U.S. debt would pose an existential threat to national security. Some European nations are already experiencing social unrest as legislators mull entitlement reductions to curb unsustainable spending levels.

“The Navy of tomorrow will still be required to be able to provide the nation the capabilities that have been within our traditions, sea control, power projection, being a deterrent force, being that forward deployed Navy that is in place that can respond to crisis as they arise.”

Adm. Gary Roughead
Chief of Naval Operations

DEFENSE TRENDS

The U.S. government is dealing with the challenges of national debt maintenance, the whole of life social programs and national security. A review of relevant studies revealed the following defense related trends:

- The *2010 Quadrennial Defense Review (QDR)* discusses balancing risks and resources to prevail in today’s wars and build the capability to deal with future threats and irregular operations such as counterinsurgency, stability operations and counter-terrorist operations. (Ref. 116).
- The *2010 QDR* also discusses challenges posed by the following major threats:
 - ~ Deterring and defeating aggression in anti-access environments;
 - ~ Preventing proliferation of and countering weapons of mass destruction; and
 - ~ Operating effectively in cyberspace.
- The *Nuclear Posture Review* outlines a strategy for reducing nuclear dangers, maintaining a nuclear deterrent and pursuing security in a world without nuclear weapons where concern is growing over the ability of a country like Iran to develop nuclear weapons. (Ref. 110).
- The *Naval Operations Concept* suggests that the U.S. is likely to be threatened by a variety of state and non-state adversaries — current and emerging — who are likely to employ a hybrid of conventional and irregular methods to counter the U.S. advantage in conventional military operations. (Ref. 83).
- The *2010 Joint Operating Environment* presents a wide range of challenges that confront the operations of joint forces, including the impacts of changing world demographics, economics, energy, climate change, cyber-threats, weapons of mass destruction, state, failing state and non-state postures, the role of radical ideologies, and many others that could affect both national and world security. The view is that the U.S. faces a dynamic and challenging operational landscape that needs to succeed across a wide spectrum of conflict. Flexibility in every area will be required. (Ref. 57).
- A Congressional Budget Office study (Ref. 61) estimates the Navy’s shipbuilding budget is low by over \$3B per year (18%), which casts doubt on the Navy’s ability to execute or sustain its shipbuilding plan.
- The July 2011 *Department of Defense Strategy for Operating in Cyberspace* describes the vulnerabilities of DoD and the nation in cyberspace. The U.S. reliance on cyberspace stands in stark contrast to the inadequacy of our cybersecurity — the security of the technologies used each day. Moreover, the continuing growth of networked systems, devices, and platforms means that cyberspace is embedded into an increasing number of capabilities upon which the DoD and DoN rely to complete their mission. Today, many foreign nations are working to exploit DoD unclassified and classified networks, and some foreign intelligence organizations have already acquired the capacity to disrupt elements of DoD’s information infrastructure. Non-state actors increasingly threaten to penetrate and disrupt DoD networks and systems. DoD, working with its interagency and international partners, seeks to mitigate the risks posed to U.S. and allied cyberspace capabilities, while protecting and respecting the principles of privacy and civil liberties, free expression, and innovation that have made cyberspace an integral part of U.S. prosperity and security. How the Department leverages the

opportunities of cyberspace, while managing inherent uncertainties and reducing vulnerabilities, will significantly impact U.S. defensive readiness and national security for years to come. The Navy recognizes the importance of addressing these threats and established the Fleet Cyber Command/U.S. Tenth Fleet in January 2010. The Chief of Naval Operations tasked the new command with deterring and defeating aggression and ensuring freedom of action to achieve military objectives in and through cyberspace. The protection of military networks is a primary objective. (Ref. 39)

- Most allied defense budgets are declining. Even the United Kingdom, America’s closest ally, is cutting defense spending by 8%. These reductions undercut the U.S. plan to rely more on allies to meet worldwide defense commitments.
- The Navy and DoD budgets continue to be challenged by the soaring costs of personnel benefits and health care. Any serious attempt to address budget issues must address these factors.
- The *2010 Annual Report to Congress on Military and Security Developments Involving the People’s Republic of China* indicates that the People’s Liberation Army is investing in anti-access and area-denial systems and strategies to counter U.S. power projection forces. Whether these anti-access capabilities prove effective or not, the strategy has imposed costs on the U.S. and its allies. The DoD and DoN are investing in expensive defensive capabilities, especially for non-stealthy U.S. surface combatants and aircraft carriers. In addition, planners must account for these strategies when analyzing and responding to operational risk. (Ref. 9).
- Precision-guided munitions used to be the domain of superpowers, but GPS-guided rockets and mortars helped Hezbollah and Hamas strike Israeli targets with deadly accuracy, demonstrating one example of how low-cost and ease-of-use is migrating high-tech weaponry to unsophisticated armies and non-state actors.
- The proliferation of chemical, biological, radiological, and nuclear weapons, along with advanced cruise and ballistic missile delivery systems, will likely outpace counter proliferation efforts and missile-defense capabilities. The potential for a successful attack with a weapon of mass destruction on U.S., allied or friendly nations is growing, which increases the planning and preparation cost of consequence management.
- Multiple acquisition programs are late and over budget, causing the DoD and DoN to search for contractual and other solutions that provide capabilities on schedule and within budget.
- DoD personnel and O&M costs are increasing in spite of multiple administrations’ efforts to contain them.

U.S. PERSONNEL TRENDS

To remain secure and competitive, the U.S. needs educated citizens in adequate numbers to conduct research and to develop systems required for its security and economic prosperity, and to lead its military forces. However, numerous U.S. demographic and educational trends are cause for concern in this area:

- From 1977 to 2007 in the U.S., the percentage of doctoral degrees awarded by U.S. colleges and universities that were awarded to U.S. citizens fell from 82% to 57%. (Ref. 79).
- Doctoral program attrition rates are between 40%–50%.
- By 2018, 2.5 million new jobs will require a master’s degree.
- U.S. demographic changes and the increased requirement for graduate degrees are changing the way education is structured, supported and evaluated.
- Factors influencing these national trends include less education, lower mathematics and reading skills, non-traditional students, educational assistance and employer-related benefits.
- Distance education has proven to be effective for the evolving student demographic population.
- DoD demographics at the beginning of FY2010 show that female accessions (20.6% of gains) continue to exceed the representation of females in the Active Duty Officer Corps (16.2%).
- The 2010 census indicates minorities now comprise 35% of the U.S. population. However, despite goals to the contrary, they remain under-represented in the Active Duty Officer Corps across the services: Army 25.6%; Air Force 19.3%; Navy 18.2%; and Marine Corps 17.4%.

POSITIONING NPS TO SUPPORT FUTURE DoD AND DoN PRIORITIES

Efficiency will be a major, near-term priority as the Departments balance the conflict between world-wide security commitments and declining resources. NPS should continue to provide consultation to the Department of the Navy in its efforts to seek efficiencies. This situation places a premium on the value an organization adds and its perceived return on investment. The Committee on the Future found that successful organizations have demonstrated superior worth by:

- Highlighting their unique, relevant value to the government in primary and secondary mission areas;

- Benchmarking their contributions relative to other organizations providing similar — but not necessarily identical — functions;
- Involving themselves in Department initiatives and those of other relevant agencies such as states and local communities;
- Proactively managing external perceptions about their mission and the value they add;
- Increasing strategic partnerships and funding to broaden their constituency, and reduce cost to their Department of the Navy sponsors; and
- Identifying and nurturing relationships with government champions — government entities cannot lobby directly, but ad hoc support groups can.



The advanced education NPS provides to future leaders equips them to address this conflict between commitments and resources to meet DoD and DoN priorities.

DIRECTION OF THE DEFENSE AND NAVY DEPARTMENTS

U.S. defense and naval strategy is changing in response to the trends noted above. Major elements of those changes include plans for new military capabilities and areas of interest to the DoD and DoN. The impending decline of defense spending and the proliferation of high-tech weaponry to state and non-state adversaries are the major factors influencing both Departments' interest in new capabilities that include:

- Unmanned systems capable of operating in all physical domains to augment traditional platforms affordably, while reducing risk to personnel;
- Smaller, less manpower-intensive platforms to help maintain force structure and global engagement at a lower total ownership cost during declining budgets;
- A reduced workforce more highly educated and technically proficient to operate new advanced technology platforms and systems;
- Early obsolescence avoidance using modular construction methods, payload modularity, and commercial off-the-shelf, open-architecture combat systems such as software programmable radios;
- Research, development and operational experimentation programs to develop and field advanced war-fighting capabilities at a faster rate, because technology-based advantages will be more fleeting in a globalized world;
- Acquisition programs that meet combatant commander needs quickly with adequate (80%) rather than elegant (100%) — and therefore costly and delayed — solutions;
- Directed-energy weapons including lasers, high-power microwaves and electromagnetic rail guns that have potential for increasing offensive and defensive capabilities without large logistic requirements and with low “per shot” costs;
- Ship-based ballistic missile defense capabilities to avoid political entanglements associated with land-based systems in foreign countries;
- Alternative Intelligence, Surveillance, Reconnaissance (ISR), navigation, communication and precision-timing capabilities as back-ups for vulnerable space-based systems;
- Deception and denial systems to complicate adversary planning and impose cost;
- Hybrid warfare forces capable of conventional combat operations, irregular warfare, and peace-keeping or civil support missions; and
- Robust offensive and defensive cyber capabilities.

CONSIDERATIONS

The Committee identified a range of issues it did not include as recommendations, but were worthy of consideration as NPS develops its new strategic plan.

- As procurement accounts decline, the DoD and DoN will have to manage industrial base consolidation and the challenges associated with a larger number of duopoly and monopoly suppliers. Research might identify new ways to control cost, while providing incentives for companies to remain engaged in defense contracting.

NPS alumnus, Kent Rominger, far left, works with fellow astronauts in NASA's Space Station Processing Facility in preparation for the launch of STS-100. Though the shuttle program is at its end and he is no longer with NASA, Rominger is now part of the ever-evolving commercial space industry.

- As the U.S. completes its mission in Afghanistan, it will need to define new force postures, organizations, and end-strength consistent with its new tasking and available resources.
- As more unmanned systems enter service, the DoD and DoN will need to develop operational concepts and tactics for partnerships with manned platforms to exploit their full, joint operational capabilities fully. NPS' expertise in unmanned systems makes it a potential leader in this field.
- The DoD and DoN operational experimentation programs have been weak. The U.S. needs solutions that support a greater number of developmental programs while constraining cost and minimizing the imposition on operating forces. Surrogate platforms designed and operated by NPS might provide one solution.
- Congress may not countenance a near-term Base Realignment and Closure review; however, the DoD could use other means to achieve similar objectives, as it did with the elimination of Joint Forces Command. Thus, NPS should institute an ongoing review to ensure it remains efficient and relevant.
- Like all large bureaucracies, the DoD and DoN may be ill-equipped to deal with the higher levels of uncertainty and rates of change they will experience. NPS could help address these challenges by exploring a meaningful range of alternative futures in support of an effective strategic planning program.
- Advanced education requirements for enlisted personnel should be reconsidered in light of changing service demographics, technology-dependent systems, and increasing demand for linguistic and cultural expertise.
- NPS should review and anticipate the future role of defense contractors serving beside operational forces.
- NPS should continue exploring a role in retraining wounded warriors or veterans transitioning to civilian service to tackle intransigent problems for the DoD and DoN (e.g. personnel benefits and health care costs).
- International enrollments should be evaluated to ensure the right foreign officers have the educational experience required to support emerging defense partnerships.
- The emergence of robust anti-access and area-denial systems are imposing cost on U.S. defensive systems, which are subject to saturation failure. NPS should research new capabilities, especially for anti-ship cruise and ballistic missile defense.

RECOMMENDATIONS

To meet many of the challenges posed above, NPS should assess itself and make changes that improve its ability to identify new mission requirements, apply needed resources, and update regulatory practices and policies.

1. Catalog and highlight unique and relevant NPS capabilities.
2. Focus research on current and mid-term defense problems and propose affordable solutions with characteristics that lend themselves to changing threats while avoiding premature obsolescence.
3. Establish strategic partnerships with civilian universities, as well as defense-funded institutions such as the Air Force Institute of Technology and the Defense Language Institute.
4. Establish a continuum of educational opportunities that include certificate programs, degree programs for resident and distance learning students, continuing education programs, and executive education programs. Specific opportunities include:
 - Expanding federal graduate education, trainee and fellowship programs;
 - Creating competitive grant programs for innovative new master's level programs;
 - Establishing doctoral assistantships to support doctoral students in areas of interest to the DoD and DoN;
 - Identifying and attracting the most talented students;
 - Clarifying academic and non-academic career paths, especially for doctoral students;
 - Defining entry points into careers and identify skills needed for those jobs; and
 - Providing internships and work-study programs for graduate students.
5. Develop a new strategic plan:
 - Identify and propose solutions to cultural impediments that prevent the DoD and DoN from responding quickly to new threats or employing emerging technology.
 - Manage uncertainty by identifying, nurturing and challenging NPS' most creative people. Studies suggest that creative people tend to invite disruptive change, are comfortable with ambiguity, and are better overall innovators.
 - Capitalize on the increasing need for innovation across capabilities, technologies, operational concepts, personnel policies and organizational structures.
 - Regularly discuss the NPS value proposition with personnel at appropriate leadership levels — including their likely successors — to develop “champions” within the DoD and DoN.

Education and Research

BACKGROUND

Education and research constitute the heart of the NPS mission, but NPS has a particular challenge because it needs to be focused on what is next in scientific and scholarly inquiry and also in the present to maintain its relevance and responsiveness to national security priorities. This is the classical tension between education and training.

The task of this section is twofold: (1) to evaluate current responsiveness to the Department of Defense, Department of the Navy and other federal agencies aligned with the national security agenda, and (2) to be forward-looking and aspirational.

NPS, like every higher education institution, is a collection of various graduate schools and research centers often with competing interests. Thus, like many organizations, the key is to continually make NPS work cohesively as one unit, so that the “whole is truly bigger than the sum of its constituent parts”.

The basic NPS mission must continue to focus on what is critical for the national agenda and not duplicative with civilian universities. It is distinctive in that it is the only federal graduate institution with the breadth and depth of programs ranging from science, technology, and engineering to business and public policy to international relations. A general assessment of NPS, recently completed by the regional accrediting agency (Western Association of Schools and Colleges) gave NPS high marks for the rigor of its academic programs and its focused mission on national defense and security priorities. In fact, each of the individual professional accrediting agencies also gives NPS consistently high marks for its academic quality and service to the nation (Accrediting Board of Engineering and Technology, Association of American Colleges and Schools of Business, and National Association of Schools of Public Policy and Administration).

OBSERVATIONS

Education Former Secretary of Defense Gates recently defined education as a top priority to sustain U.S. global leadership and competitive position in the 21st century. The 2008 Department of Defense Instruction 1322.10 asserts the importance of education to developing leadership, critical thinking, and decision-making skills. The same instruction encourages a lifelong continuum of education for every career officer and talks about the importance of developing and maintaining a cadre of highly qualified officers in fields that fulfill present needs and anticipated requirements.

It is noteworthy that NPS' graduate educational mission and focus on outcomes assessment have received high praise from the regional accrediting body, the Western Association of Schools and Colleges. NPS has a plan in place to conduct an academic program review every five years and a curriculum review every two years, making the whole program of review, assessment, and continuous improvement both comprehensive and thorough.

A careful examination of the graduating student surveys reveals an extremely high level of satisfaction with the various degree programs. However, many faculty and students also call for enhancing intellectual life on campus and having greater access to enrichment activities between quarters to broaden their horizons. There is some underlying tension about the volume of graduation requirements not providing more opportunities for innovative and reflective learning.

Every program at NPS is governed by review by a curriculum sponsor and this review includes Education Skill Requirements (ESRs) that define expected learning outcomes. A curriculum review every two years ensures a regular assessment of academic quality and relevance. This is a distinctive aspect of NPS educational programs, and something that should be preserved in the future.

METHOD

In addition to consulting the documentation included in the bibliography, additional materials were reviewed: alumni and graduating student survey reports, and strategic planning documents. Interviews were conducted with senior administrators, faculty members and leadership to obtain a comprehensive view of the underlying and often interrelated set of issues.

Lt. Omari Buckley, right, a student in the Mechanical Engineering curriculum, demonstrates the capabilities of NPS' Biofuels Testing Facility to Secretary of the Navy Ray Mabus, left, during a visit to campus, Aug. 29, 2011.



Increasingly, new kinds of graduate education providers are showing up on the higher education landscape. Purely distance learning schools, for-profit institutions, virtual institutions — all are increasing in number and national reach. Questions about the quality and rigor of those programs are concerns voiced by some of the external stakeholders interviewed by the Committee in Washington, D.C. earlier in 2011. It is a concern shared by NPS, because if only “check-the-box” kind of thinking is employed in reviewing officer promotion boards, the result will be a dilution of the impact of a graduate degree. This kind of approach also has implications for prospective student choices since the path of least resistance — a program that can be accomplished through reading material and taking quizzes but that does not require geographic relocation — may be seen as preferable to a challenging curriculum that takes 18-24 months away from an ambitious career path.

The proliferation of federal graduate institutions is also a concern. With capacity at NPS, the question must be asked: what action is required to ensure that NPS is the institution of choice for higher education and research for the best and brightest officers and government civilians? Further, NPS is the logical institution to be engaged with graduate education program review for other institutions and with the development of the Navy graduate education strategy.

LEVERAGING NPS' ACADEMIC PROGRAMS

NPS' Education Brand NPS' education programs have a distinct brand, providing a foundation of strength for the future. NPS' strategic challenge will be to sustain that brand into new programmatic areas that provide unique benefit to the Navy and the defense/security community.

NPS can leverage its existing academic programs to greater benefit to the Navy, the DoD and the defense/security community:

- **Consolidation of Navy Graduate Education** Naval officers currently are funded for and receive graduate education through a number of alternative programs. Major programs include those at NPS, at civilian institutions (CIVINS) in fully-funded programs, at civilian institutions supported by tuition-assistance programs (e.g., Graduate Education Vouchers), at civilian institutions support by veterans' programs (e.g., GI Bill). The Navy may leverage its investment in NPS to better use NPS' existing capacity by permitting a shift of other Navy/Naval graduate education programs to NPS, to resident education or distance learning programs, where NPS' defense relevant programs already provide current capability and capacity. The premise of this approach is that NPS' incremental cost to assimilate existing common programs and curricula is less than current alternatives. Extension of NPS education programs to naval enlisted personnel is consistent with this consolidation. Pursuing this consolidation approach would require Navy rethinking its graduate education requirements and the best means of satisfying them.
- **Civilian Defense/Security Workforce Development** As a national security research university, NPS is uniquely well-positioned to benefit the Navy and defense/security community by leveraging its program capability and capacity to contribute to the development of the future DoD and national security workforce. NPS has long provided within-career education to government civilians. The future potential and opportunity is for NPS to play an expanded role in preparing civilians for entry into the defense/security workforce. NPS' current programs in this direction include a set of “scholarship-for-service” programs, providing specific education programs to prepare civilians for positions in the Science, Technology, Engineering, Mathematics (STEM) career fields; Intelligence, Surveillance, Reconnaissance fields; Information Security career fields; and a Research Assistant program, applicable to a range of defense/security career fields. The technical and security orientation of NPS' curricula and NPS' experience with workforce development programs provide the foundation for NPS' involvement in education to high-demand, high-need career fields that overlap with NPS' existing capabilities. Emerging opportunities include, for example, NPS education for wounded warriors and veterans, for non-active reservists, for development of faculty for other defense education institutions.

NPS' EDUCATION BRAND MAY BE CHARACTERIZED AS FOLLOWS:

Relevant NPS provides programs and curricula tailored to the specific education fields of the defense/security community.

Unique Consistent with its mission, NPS provides faculty expertise, curricula and courses not available at other universities.

Transformative NPS provides academic programs specifically designed to fit within the career patterns of most military officers, and advance the professional development of officer students. In recent years, URL officers are finding it difficult to take the time to obtain a graduate education and still meet all their career goals. As a result, NPS is exploring options to provide programs that are more directed to URL needs.

Responsive and Flexible With respect to curriculum content and delivery mode, NPS offers programs designed and provided on demand.

Excellent NPS faculty comes from top research universities. NPS programs are heavily reviewed and assessed, with full accreditation.

Research-Connected All NPS academic programs include a capstone research/analysis component devoted to defense/security-relevant research problems.

Cost-Effective When compared with alternative ways of satisfying comparable Navy-specified educational requirements, NPS is cost-effective.

- **Navy Graduate Education Management** In addition to providing graduate education programs, NPS already serves the Navy/DoN by program management and review coordination of Navy officer graduate education at civilian institutions. NPS manages the Civilian Institutions Program (CIVINS) coordinating the review of Navy officer civilian graduate programs for the assignment of subspecialty designations. NPS has the expertise to expand/extend its service to Navy through broader involvement in coordination of Navy graduate education strategy, and assistance in the review and modeling of Navy graduate education requirements and programs to satisfy them.
- **Distance Learning Education** NPS is the Navy's, and probably DoD's, leading institution for distance learning (DL) education, certainly at the graduate university level. NPS has been involved with DL for nearly 20 years, serves over 1300 DL students with over 20 programs, using multiple modes and models of DL delivery. NPS' DL programs are fully incorporated in NPS' academic departments, are rigorously reviewed and assessed, and fully accredited. NPS' opportunity is to leverage its existing DL capability and expertise in two ways: first, where appropriate and feasible, to extend program delivery to expanded segments of Navy officers' career and second, to utilize its expertise by becoming a center of excellence for DL education technology, pedagogy and delivery for the Navy and DoD higher education institutions. Although cost differentials between resident and nonresident programs are relatively small, the major benefit is in expanding educational offerings to the warfare communities where career development requirements are less flexible and do not permit extended periods of time away from operational responsibilities.
- **Research Education Model** NPS' education programs are strongly connected to its research programs. The research element of NPS education programs is explicitly designed to be a setting for development of student independent inquiry and critical thinking abilities. All NPS education programs have a capstone component, typically a thesis that provides formal connection to research. NPS' opportunity is to become a leader in innovation in the development of a research-based education model. The premise of this model is that NPS explicitly and more directly expands the incorporation of research-based learning in its education programs. Elements of this approach may include: research-oriented directed study courses to replace traditional classroom courses; student practicum courses to provide management/operational/scientific project experiences; systematic inclusion of students in sponsored research activities and package sponsorship of NPS programs, where sponsors support and block fund programs that include delivery of both research and student education.

- **Research** Complementing the focus on graduate teaching either at a Masters' level or the more recent emphasis on Doctoral programs has been a highly successful focus on basic and applied research over the years. Research at NPS serves two tightly coupled purposes. Fundamentally, research supports the educational mission of NPS, providing the opportunities for learning — both the technical state-of-the-art, and more broadly instills the skills of research and critical thinking. Secondly, due to the unique world-class expertise of its faculty in multiple areas, NPS is responsible for developing new knowledge that can be transitioned to the operational theatre in a timely way.

While NPS is moving into the echelon of top-tier research universities, it is important to understand how

the NPS research culture is driven by different dynamics than those of civilian universities. Research at major civilian research universities is predominantly driven by principal investigators, defined and shaped by the intellectual interests of the faculty. It is open-ended and basic in nature, primarily without regard for strategic national needs (although some civilian research universities are beginning to move into national security-related research as other research fund sources diminish). Research at NPS, while also largely driven by principal investigators, is strongly guided by Navy, or more broadly defense or national security, relevance through:

- the students who are sent here and what they are sent to learn;
- what DoD/DoN or other sponsors are currently willing to fund;



Operations Research Ph.D. student, Cmdr. Jay Foraker's research explored an algorithm for optimal search patterns for detecting incoming threats to ships and carriers in narrow waterways.

- recruitment of faculty in disciplinary competencies identified to satisfy the needs of the above; and
- absence of “political controversy” over military research.

While there is a certain evolutionary dynamic to the system, it is reactive rather than proactive. As a result, NPS is following rather than setting the agenda unlike the agenda being set by breakthroughs and discoveries made by civilian universities and national labs.

Three things appear to be lacking in the NPS research enterprise. The first is an adequate 6.1/6.2 (basic/applied) component to the research portfolio; currently it is in the range of 15–20%, whereas a healthy balance would be closer to 50%, based on comparisons with other universities and the national laboratories. The second is a research strategic plan, owned by the Vice President/Dean of Research, and continually updated. Good research strategic planning should have a continuum outlook with intense focus on anticipating mission needs in the 5–10 year time frame, but a significant focus on the 20–30 year time frame as well. *NPS needs to also anticipate and inform Navy and DoD long-range mission needs, rather than mainly receiving and reacting to them.* The third is an institutional R&D program to solicit and review internal proposals aligned with that strategy, and adequate funding (“seed corn”) to run an effective internal R&D program to prepare for the future.

The current research landscape at NPS can be presented in three sections. The first will be a summary of some of the *existing* “crown jewels” of NPS, i.e. signature programs that define the best and most relevant capabilities of the university, for which DoD and DoN look to NPS as among the primary stewards. Next is presented some *near-term* capabilities and areas of expertise that must be developed for NPS to carry out its mission effectively. The third is a short list of *long-range* capabilities and areas of expertise to prepare for the challenges of national and global security in the 21st century.



EXISTING NPS “CROWN JEWELS”

It is emphasized that this list contains only a selection of the core competencies of NPS, deliberately skewed towards recent or emerging areas, and an expectation of strong growth in the near term. Omitted are programs which have historically enjoyed a national or international reputation, e.g. Meteorology, Undersea Warfare, Oceanography, Operations Research, National Security Affairs, Space Systems, and Business and Public Policy, all of which are fully expected to remain prominent and relevant.

Cyber Broadly inclusive of all aspects of collection, transmission, storage and manipulation of information for both offensive and defensive operational capability, cyber is recognized as one of the most critical domains for 21st century national security. While the many component disciplines of cyber have long been NPS’ areas of strength, the aggregation of them into a coherent and far-reaching program is new. As indicated by the CNO in a meeting (16 May 2011) with the President of NPS, a cybersecurity Center of Excellence will be established at NPS.

Surveillance, Reconnaissance and Directed Energy While formally distinct from a mission perspective, these three areas enjoy strong synergies in advanced optical control and beam dynamics, recognized recently by the establishment of a Center of Excellence at NPS by the Office of Naval Research (ONR), the National Reconnaissance Office and Air Force Research Lab. The Directed Energy aspect should evolve into a major beam physics program with the construction of a superconducting recirculating free electron laser laboratory.

Modeling and Simulation High-fidelity modeling and simulations (M&S) is increasingly valued as a cornerstone capability by DoD and other agencies, critical for both operational understanding and operator training. The breadth of application of M&S is virtually limitless, where considerations of time, funding or security make life training exercises impossible. Modeling and simulation offers safer and less costly alternatives to real-time experiments. M&S also offers opportunities to expand application of M&S technology. The NPS M&S program, for example, is now moving into the area of medical simulation and training for robotic surgery, interest in which is undergoing explosive growth worldwide.

Maj. Gen. Ellen Pawlikowski, then Commander of the Air Force Research Laboratory, placed the final signature on the Memorandum of Agreement in May 2011, completing the process to officially establish an Adaptive Optics Center of Excellence for National Security at the Naval Postgraduate School.

Acquisition Research Program With increasing budget constraints and the likelihood of future cuts, the DoD needs to approach its business practices with the same critical analytic skills applied to operations. The acquisition research program at NPS has steadily increased its position as a leader in this arena by providing a forum for dialogue and study.

NEAR-TERM OPPORTUNITIES

Presented below are topics where NPS’ contributions to near-term Navy or DoD mission needs would be greatly enhanced, through focused efforts to leverage, extend and coordinate existing areas of strength. If successful, these too could join the list of the institution’s signature programs, and with permanent secretarial-level visibility and resourcing.

Autonomous and Robotic Warfare The new paradigm for vastly extending the reach of war fighting by autonomy and robotics is evolving so rapidly that the future is already here. The use of autonomous and robotic systems in the operational theaters in the past decade (i.e. Iraq and Afghanistan) has grown exponentially with year; literally tens of thousands of systems for surveillance, strike, demining, etc. are now in operation — and these are primitive by standards of what autonomous and robotic systems will be a decade from now. This is another area where NPS has long possessed all the component disciplines, but which are just now being brought together in CRUSER (Consortium for Robotics and Unmanned Systems in Education and Research), a SECNAV initiative. As the “thought house” for autonomous and robotic systems, NPS will contribute to understanding how this new paradigm will ripple through the entire fabric of the operational Navy, including policy and acquisition, ethical and legal, along with all its technological aspects.

Energy Energy is a large and complex topic: energy science and technology will be the major driver for the national and global economic and security posture of this century. It is an ironic truism that our current overdependence on fossil fuels both fans the flame of war, and hamstring our ability to prosecute them. Furthermore their contribution to climate change will further exacerbate the situation by driving more people into poverty and unrest, and will also dramatically change future operational scenarios (e.g. increase in severe storm systems, disappearance of the north polar ice cap, and change in littoral environments). Thus energy has become a key priority for the Navy (and DoD more broadly). SECNAV and the CNO have laid out an ambitious and breath-taking program of goals for both fleet and shore installations. NPS has contributed ‘around the edges’ of the energy problem, but again has many of the requisite areas of expertise to play a much bigger role. NPS is poised to put together a coherent educational and research program in energy, and in fact have just begun to do so, with the encouragement

of Deputy Assistant Secretary of the Navy (Energy) and Assistant Secretary of Defense (Operational Energy). The energy initiative will naturally result in the development of a distinct climate change thrust within the METOC community.

Energetic Materials and Materials Properties at Extreme Conditions The cluster hire of five young materials scientists into Mechanical and Aerospace Engineering and Physics in 2010 was an unqualified success; these faculty members are already well coupled into important fleet problems and making a difference. The time is ripe for a further expansion of the Materials Science Center to encompass both energetic materials, as well as the study of materials properties at extreme temperatures, pressures, and strain rate. First, the study of ordnance is undergoing a major renaissance in the DoD, including new developments in thermobar-

ic weapons, low collateral damage bombs, and “green” explosives. Second, with the recent commissioning of the Gas Gun Laboratory, NPS has taken its first steps towards what could be a premier capability in shock physics, complementing the capabilities of its DoE weapons lab partners, i.e. Lawrence Livermore and Los Alamos National Labs. NPS is well-positioned to fill an important niche for the study of high tech armor. These are topical areas with high DoD and DoN relevance, and NPS has much to contribute.

“We’re in the ‘game changer’ that we’ve been saying was coming, a new experience of war in which robots and unmanned systems operated at a distance of thousands of miles are being deployed at an exponential rate and changing the face of warfare. Unmanned vehicles aren’t future visions; they’re an integral reality on today’s battlefields.”

Dr. Peter W. Singer
Foreign Policy Senior Fellow
Director, 21st Century Defense Initiative
Brookings Institution

CONSIDERATIONS

As in most institutions of higher learning, resource allocation and competition for scarce dollars, faculty, facilities, technology and administrative resources will only intensify and not lessen over the next decade. This puts even more onus on the criteria of academic quality, transparency, accountability, legitimacy, and credibility. But it also requires the Department of the Navy to have explicit roles and responsibilities for the Naval Postgraduate School.

Graduate education programs will look different within the next decade. Academic fields and disciplines are constantly changing. Student markets are changing. A continued focus has to be maintained on the relevance of degrees for the future that is complex, uncertain and changing. Given the importance of research, both basic and applied to the larger NPS mission, the growth of doctoral programs is a natural evolution for the School.

Turning the general graduate education domain to a more long-range, mission-oriented research perspective, three areas will most certainly be central to the interests of the DoD and other agencies sharing in the national security mandate in the coming few decades. Not only will it be argued that these science and technology areas will transition to operational relevance much faster than expected, but the case will be made that their effective exploitation will require education of our Navy and total force students.

Genomic Biology and Life Sciences This is a trend which is already in full swing, but so far led by the other services. NPS should develop a core competency in this area. Among the drivers for genomics, metabolomics, etc. at the very leading edge of the field are:

- The need for cheap, versatile field assays for chemical or biological Weapons of Mass Destruction (WMD). Operational personnel need to be deeply involved in the understanding and development of these capabilities, as the “soldier of the future” is envisioned to have a vast read-out capability built in to their combat gear, both sensors of the external environment as well as for the physiological state of the soldier. The intersection of biology and nanotechnology in such systems is well-advanced, e.g. at the Natick Soldier Research Center.
- The use of gene expression markers as the most prompt and high-fidelity indicators of exposure and reaction to radiation or pathogens (even previously unknown, i.e. designed pathogens) in theater. While chemical/biological threats may be unique to ground combat, radiation exposure will be just as likely in naval as in ground scenarios.
- In regards to the above, the soldier/sailor of the future can be remotely assessed and given autonomous point-of-care treatment from their combat garments.
- Short term genetic inoculation (“hardening”) of personnel against chemical, biological and radiological threats.
- Department of Homeland Security and other agencies are leading the way in field-portable DNA assays that can uniquely identify a person of interest by the genetic information in a single skin cell, either airborne or left on a door handle.
- Ultimately, tailoring individual-specific viral weapons that could be transmitted from half-way around the world, uniquely targeting one person of interest.

Advanced Neuroscience and Artificial Intelligence These are two distinct fields, but related within the context of two of the technical thrusts mentioned previously. To go to the next step, modeling and simulations in virtual environments will need an entirely new level of sophistication to assess the training experience of the operator. Functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG) have already been introduced in training representing the first primitive steps in this direction. In regards to autonomous and robotic systems, the rapidly evolving field of brain-machine interface (BMI) will someday enable a large number of robotic assets to be controlled by a single operator, without need for any tactile control panel. Ultimately, autonomous swarms will ex-

“Cyber is the ‘fourth domain’, making it a focus alongside air, sea and land. Cyber is an especially asymmetric technology. The low cost of computing devices means that our adversaries do not have to build expensive weapons, like stealth fighters and aircraft carriers, to pose a significant threat to our military capabilities. Cyber is also offense dominant. The Internet was designed to be open and interoperable. Security and identification management were lower priorities in system design. Structurally, our ability to defend networks always lags behind intruders. Defenders must defend everything; adversaries only need a single failure to exploit.”

The Honorable William J. Lynn, III
Deputy Secretary of Defense

ecute highly complex missions with minimal or no human intervention but this will require an even greater level of sophistication in machine intelligence, emulating as much as possible the complexity of the human brain.

Quantum Computing and Communication Most every industrialized nation is pouring large (and often undisclosed) amount of resources into R&D on the problem of taming quantum systems to compute. The paradigm by which traditional binary computers — with ‘bits’ representing 0 and 1 being replaced with ‘qubits’, i.e. a continuum of complex numbers — is potentially so disruptive that no one can afford to lose the race. If fully developed, quantum computers of the future could make today’s supercomputers as obsolete as the slide rule. One of the first consequences would be that traditionally secure cryptography could be easily compromised. Complex multiphysical simulations of vast dimensionality would become tractable. The national security implications of such a capability would be immense. Likewise, quantum-entangled photon states have been shown to enable secure communication, over many kilometers of fiber, and now even between satellites and ground; indeed the first commercially available (but not terribly useful yet) units hit the market a few years back. NPS is already involved in this; in fact some of our

faculty members have already begun to teach courses on theoretical quantum computing with an emphasis on algorithms. There are many opportunities to get involved in the physics and technology of quantum computing, particularly in partnerships with NPS and laboratory partners. As with artificial intelligence, NPS must be involved due to the application-specific nature of architecture and coding.

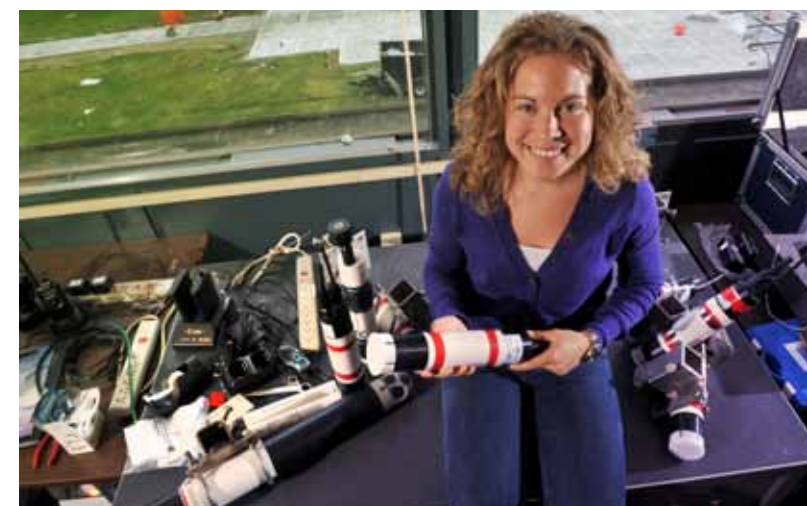
SUMMARY

There will be increasing blurring of the lines of what can be done by civilian universities, and other military schools within DoD, and in tight economic conditions, it would be easy to come to hasty conclusions. As in many instances, it would be easy to focus and fixate on data points — how many graduates, how many research

dollars expended, how much grant monies realized, placement of graduates, size of total budget over the years, etc. All of these are important markers and point to the ‘outputs and outlays’ as they relate to NPS; but perhaps more critical to a “futures” perspective is the ‘outcomes’ lens. That lens provides a view of what NPS ought to be — not next year, but a decade from now — as it continues to train and educate a whole cohort of students on an increasingly complex set of national security challenges. This perspective will also ensure that NPS’ mission continues to remain rigorous, timely, non-duplicative, and of critical importance for the country.

RECOMMENDATIONS

1. Make the following visible and aggressive institutional priorities: classified research and education capabilities, energy, government acquisition, cyber, modeling and simulation, regional studies, directed energy, and unmanned systems. Investments will have to include expansion of classified facilities
2. Commit greater emphasis in the next decade on developing new “student markets” — international, students’ spouses, enlisted personnel, distance, and modular courses. At the same time, develop more strategic, partnerships with other selective educational and research institutions.
3. Leverage NPS’ unique educational capability and capacity to provide increased return on investment to the Navy, through wider servicing of Navy education needs.
4. Rebalance the NPS research portfolio, to increase 6.1/6.2 research upwards to 50% over the next several years, from the current value of 15–20%. The most effective long-term measure to attain this goal is by making it a selection criterion in the hiring of junior tenure-track faculty.
5. Modify promotion board precepts to value high-quality graduate education in the selection process.
6. Designate NPS and NWC as important contributors to the Navy’s Graduate Education Strategy with objectives that place them at the core of providing graduate education for the Navy and other Services officers (and civilians).



Naval Postgraduate School Oceanography doctoral student Jenna Brown was selected by the Office of Naval Research to receive the National Defense Science and Engineering Graduate Fellowship. Brown’s doctoral research is on mapping the three-dimensional structure of rip currents and the exchange of materials in and out of surf zones.

Faculty

BACKGROUND

NPS President Oliver frequently states: “What makes us unique is our students, what makes us relevant is the defense focus of our education and the applied nature of our research, but what makes us great is the world-class quality of our faculty.” The faculty and staff members that comprise the Naval Postgraduate School exhibit the principles of academic quality, recruited from the best research universities in the U.S. They embrace the mission of NPS — to increase the combat effectiveness of the Navy and Marine Corps and to support the Department of the Navy through continuing programs of naval and maritime research (SECNAV 1524.2B and SEVNAVINST 5450.210C). In addition, they experiment, invent, and innovate to ensure NPS students are intellectually challenged and operationally competent. They educate our nation’s future leaders and inspire them to transform the world.

OBSERVATIONS

Maintaining a Strong Faculty Base Faculty positions are strongly tied to student enrollments. In some academic areas, enrollments are strong and growing, while in other areas, enrollments are decreasing. Some academic areas bring in significant amounts of reimbursable research funding and may be able to grow without increasing student enrollments. The breadth of disciplines currently supported at NPS is important to maintain for future academic vitality and quality. As a result, different metrics may be necessary for different disciplines.

The funding models needed to support faculty have traditionally been enrollment based, but research also provides an important source of funding — especially during periodic enrollment declines in certain disciplinary areas. The issue is one of balance. An over-reliance on enrollments to support mission-funded faculty positions is of concern because enrollments fluctuate periodically. Relying too heavily on research funding may be seen as defining teaching as a lesser priority. These tensions are inherent in all research universities, and their calibration is an ongoing focus of attention. NPS is no different from its peers in this regard.

Because in-residence enrollment rates are diminishing in certain academic programs, while distance learning rates are increasing, it is prudent to explore options for getting DL students to attend the NPS as in-residence students for a short period of time to allow them the benefit of face-to-face interaction with faculty and their student colleagues. For example, hybrid education models (½ Resident and ½ DL) could achieve this goal. It is much more palatable to organizations (e.g., federal, state and local governments) to allow their workforce to attend NPS for one to two quarters than for a full year. This type of hybrid education model already exists within some programs (e.g., the Center for Homeland Security teaches students based on a model of students in residence for one week, followed by eight weeks of distance learning, and followed with another one week in residence) and perhaps could be expanded.

FACULTY COMPOSITION

Military Faculty Military faculty and Professional Military Faculty (PMP) are able to make important connections among military and academic topics and institutions. Connections between curriculum subjects and military missions are naturally forged in the classroom when military faculty members are used as instructors. Connections between student research and military capabilities are strengthened when military faculty members serve as thesis advisors. They have been particularly strong proponents of interdisciplinary work at NPS, for both students and faculty, within their Schools, Centers, and Institutes. It is most beneficial for PMPs to have the terminal degree, Ph.D., since the Ph.D. is required to establishing an appropriate academic portfolio. Currently, NPS has few military faculty members and PMPs and would like more.

Race/Ethnicity and Gender Based on national data reporting, NPS is at the low-end of the spectrum when compared

METHOD

The Committee conducted numerous interviews with faculty members and reviewed NPS reports and documents, as well as national studies regarding graduate education. Also reviewed were data, both NPS and comparative, regarding faculty demographics and compensation.

Dr. Timothy Chung, Director of Research and Education for the Consortium for Robotics and Unmanned Systems Education and Research (CRUSER), beside the RMP 400 Robot. Chartered by Under Secretary of the Navy Robert Work, CRUSER launched in March of 2011. CRUSER is a community of interest that offers a collaborative environment for researchers, industry, students, and defense personnel interested in all aspects of employing unmanned systems in an operational environment now and in the future.



to the peer institutions (17 institutions including NPS) regarding faculty diversity in terms of both women and minorities. Certainly, it is important to continue this issue as an institutional priority and to ensure NPS continues to recruit women and minorities. Another faculty diversity issue that should be considered is the mentoring of women and minorities into positions of leadership across the university. Examples of such positions include department chairs and deans.

Age The NPS has had a long history of focused hiring bursts followed by long periods of hiring inactivity. The result is a skewed age distribution in most departments. A quick scan across department faculty rosters reveals that most departments are top heavy with almost all faculty members being at the tenured professor level with little or no assistant professors. Out of 250 tenure-track faculty members, 100 are full professors, 90 are associate professors, and about 60 are assistant professors. This is a major challenge because new hires bring new ideas and energy to teaching, research and service, vital to maintaining a competitive position in national higher education.

Salary Salaries for assistant and associate professors at NPS appear competitive with peer institutions, and that is something that needs to be maintained since Monterey is an expensive area in which to live and recruitment must remain competitive for the best talent available. Salaries for full professors are less competitive and when looking at University of California campuses and the three major private research universities in the state, full professor salaries at NPS fare even worse.

It should be noted that this understates the extent of the issue since most universities have large undergraduate enrollments with significant humanities, arts, and social sciences programs. These programs typically have lower salary scales than the professional schools, science, and engineering areas.

Universities frequently make senior hires to anchor a new area or accelerate improvement of an existing area with an established scientist or scholar with a large research program that younger professors and graduate students can engage in quickly. This requires a hiring package that is financially competitive. With NPS faculty salaries limited to the Congressional salary cap, it is nearly impossible to make senior hires. This underscores the importance for NPS Foundation involvement and the flexibility to augment faculty salaries with private funding.

CONSIDERATIONS

Multidisciplinary and Collaboration The future of academia is in multidisciplinary efforts through collaborative work. As a result, the time-honored traditions of independent work and depth of single disciplinary approaches are becoming less relevant. Increasingly, institutions that are gaining in academic stature and reputation are responsive to emerging fields that challenge traditional organizational boundaries. NPS has been exceptionally strong in its agility and ability to mobilize response to thorny, multidisciplinary problems. However, it is important to consider how it might improve its incentives to cross-disciplinary work and collaboration.

One area to consider is the organizational structure of the schools and institutes. It has been suggested that NPS needs fewer schools and institutes and more support for project-based work. It has also been suggested that support for academic departments should be emphasized and support for institutes should be de-emphasized. This is an area that would benefit from further discussion and consideration of effective models used by other research universities.

With regard to multidisciplinary research, there are already many examples of large, multidisciplinary projects. This funding model already exists at NPS where big projects are being led by a few Principal Investigators (PIs) with the work being done by many members of the faculty (e.g. Consortium for Robotics and Unmanned Systems Education and Research). One way of institutionalizing this sort of collaborative work is to manage some of the larger research programs through either centers or institutes. In a similar vein to the agile NPS curricula, having research centers with members organized by specific skill sets will allow a smaller group of faculty to conduct the necessary research required by funding agencies.



Distinguished Professor of Physics Bill Colson explains the unique features of the university's free electron laser lab. Colson and his team are researching the possibility of using high-energy laser systems for shipboard defense.

Strategic Hiring Future faculty hiring needs to be strategic. One way of ensuring this is to maintain a list of priority (or growth) areas (e.g., Scientific Computing and Secured Communications in Applied Mathematics). This would be one way of ensuring that future cluster-hires will help NPS grow targeted research areas and to leverage these to expand the instructional components.

Academic Quality With regard to academic programs, the challenge is to maintain academic quality by raising the percentage of courses taught by Ph.Ds. and by tenured and tenure-track faculty members. This is a challenge at most research universities nationally, and is something shared by NPS. Particularly in the context of budget reductions, it will become increasingly important to keep the institutional priority on academic quality. In some cases, the use of practitioners for teaching is appropriate and important. However, the percentage of courses taught by Ph.Ds. should ideally follow accreditation standards of 70% or higher.

Quality of Work Life Faculty and staff members consistently voice concerns about the difficulties of business processes at NPS. Examples include the amount of time it takes to order equipment or supplies, hire staff, contract for services, and get multiple signatures on countless forms. These difficulties take time away from the classroom, student mentoring, and research projects. Business procedures should be improved or better staffed to ease the administrative burden on faculty.

Professional Development Faculty provide leadership in the academic departments through the departmental structure. Faculty with an interest in moving to higher levels of leadership should be provided opportunities for development and mentoring. This would provide NPS with a greater pool of capable, talented leaders for administrative areas.

Intellectual Life of the Campus The intellectual energy of a university extends beyond the classroom and laboratory walls into invited lectures, brownbag discussions, seminars, conferences, and workshops. Such events are held at NPS, but nearly all supported through scarce department funds. The difficulties in paying invited speakers, providing for modest refreshments, finding available on-campus auditoria, and other administrative logistics make hosting these events arduous. In fact, many faculty members note that they consider the administrative tasks required to put on these events as disincentives. This is a significant issue because it is an important element in fostering collaboration and communication among NPS faculty and students and with university partners. It is important for NPS to consider conference facilities and support for its future development.

RECOMMENDATIONS

1. Maintain a vital mix of assistant, associate and full professors.
2. Take a more active role in managing the faculty age distribution through more consistent hiring efforts.
3. Ensure that Ph.Ds. teach 70% or more of all courses, based on thresholds set by accreditation agencies.
4. Diversify the faculty ranks in the areas of age, Professional Military Professors, minorities and women.
5. Pursue statutory authority to enhance faculty compensation with NPS Foundation funds. In addition, the NPS Foundation should be asked to support academic conferences, invited lectures, seminars, and workshops.
6. Pursue efforts to improve multidisciplinary education and research, including development of conference facilities and support for conferences.
7. Initiate a business procedures improvement program to reduce faculty time on administrative matters.
8. Review the NPS organizational structure to determine that it is the best design for the future to ensure it is efficient with minimal and unnecessary overhead expenses. It is recommended that a group of internal and external members (similar to the Committee on the Future) be established and charged with doing this look at internal organizational structure since significant changes in the organization have occurred since the last reorganization.

“The masters' and doctoral programs at NPS give officers an opportunity not only to advance their knowledge in specific areas, but more importantly the programs give them an opportunity to hone their higher order thinking. For the Information Warfare Community, the electrical engineering program is one of several curricula at NPS that is foundational to the technical aspect of our mission. I have been able to directly apply that knowledge gained at NPS to every subsequent job.”

Rear Adm. Jan Tighe
Deputy Director of Operations
U.S. Cyber Command, National Security Agency

Students

BACKGROUND

A distinctive strength of the Naval Postgraduate School is its student body. The students represent all of the U.S. uniformed services, a few defense contractors, civilian employees of federal, state and local governments, as well as officers and civilians from 50 foreign countries. The majority of resident students are U.S. military officers, many of whom have seen front-line, operational duty before attending NPS. As a result, these students are more mature, more professionally oriented and more attuned to defense needs, setting them apart from the graduate student typically enrolled in a civilian institution. Selection for graduate education at NPS should always be based upon outstanding professional performance, promotion potential, and a strong academic background.

Because NPS emphasizes study and research programs that are relevant to the interests of the DoD, DoN, and other federal agencies, NPS students receive their graduate degrees as a result of successful completion of programs designed primarily to prepare them for success in technical, analytical or policy assignments later in their careers.

Degrees are awarded at NPS on the basis of the same high academic standards that prevail at other accredited institutions. NPS students are also expected to uphold the highest standard of honesty and integrity, and must follow the academic honor code at all times.

OBSERVATIONS

NPS Capacity The resident capacity of NPS is approximately 2,200 students, limited principally by physical plant capacity. A range of 1,500–2,000 students is optimal for maintaining sufficient breadth and depth of academic programs. Current resident enrollments total about 1,600. Distance learning enrollments total about 1,300 with a capacity of approximately 4,000 over the next five years, limited by faculty size and information technology infrastructure. Operating towards the higher end of the NPS capacity, and working to grow distance learning programs demonstrates educational value to NPS sponsors, increases knowledge of NPS programs among potential students, creates a larger base for long term NPS ‘champions’ and amortizes fixed costs over a larger student body, thereby reducing per student cost (an often used though misleading metric).

Composition of the Student Body The special nature of the resident population is grounded in its diversity. Students from all of the uniformed services attend with civilians, and international officers and civilians — making for a rich mix of backgrounds, experiences, and objectives. The result is a profound and indelible education that has far-reaching impact.

The presence of international students is one of NPS’ strengths. The extent of international engagement made possible at NPS is extraordinary. Over 50 different nations are represented at NPS, and the relationships that are developed here persist long after graduation.

The personal and family relationships forged at NPS last a lifetime — crossing borders, religions, racial and ethnic lines, and geographical distances. When students study together, break bread together, explore the area together, and talk about their aspirations and challenges together, strong bonds between and among individuals develop. The graduates of NPS, both U.S. and international, become leaders in their militaries and governments. When crises inevitably occur or international cooperation is needed for humanitarian assistance or disaster recovery, former colleagues and friends are called to clear the obstacles. One such example actually references

METHOD

A number of areas were identified for review including resident student capacity, distance learning capacity, the mix of international, civilian, and uniformed services, costs per student and the P-code system.

The approach included:

- Input from NPS Student Council
- Review of student enrollment data, by categories of students, gender, ethnicity, etc.
- NPS resident capacity data
- NPS alumni surveys
- Study of NPS student data and growth patterns
- Officer demographic and educational data from the Defense Manpower Data Center

Students exit King Auditorium following one of the university’s periodic Secretary of the Navy Guest Lectures (SGLs). Offered several times each year, the SGL series provides NPS students and faculty with the opportunity to hear from senior leadership across the national security enterprise, ensuring their research and studies are enriched with the perspectives of today’s top defense decision-makers.



an international conflict averted when two NPS graduates sat together at the 11th hour before conflict broke out. As soon as they recognized each other, the tenor of the discussion changed and a diplomatic solution was reached. This is engagement in action.

As a result, the international composition of the NPS student body is not only important to the enrichment of educational and co-curricular experience, but also a key factor in U.S. military-to-military relations and perhaps to the dynamics of international relations. The depths of personal relations forged are similar to exchange programs at the U.S. Naval Academy or the Naval Command College program at the U.S. Naval War College — NPS' sister flagship institutions. Arguably, these personal relationships are key contributors to the Navy's maritime strategy, *Cooperative Strategy for 21st Century Seapower 2007*, on par, or even superior to port visits, exercises and other military-to-military engagement meetings. (Ref. 30).

P-codes Uniformly, it is understood that the P-code system works effectively for the restricted line officer community and is largely ineffective for the unrestricted line officer community. Unrestricted line officers often are not detailed to P-coded billets based on their graduate degree, making the link between curriculum and successful Navy career less direct and obvious. However, as then VCNO Jon Greenert conveyed to the Committee, "The way we talk about payback tours needs to be reframed — every tour should be considered a payback tour." The Navy benefits greatly from every tour of an officer with an NPS graduate education. The Navy needs to capture that benefit more effectively for the unrestricted line community and NPS needs to articulate that benefit to Navy leaders, especially in the key warfighting communities and personnel policy and assignment commands.

The 2010 Rand study, *Evaluating Navy's Funded Graduate Education Program: A Return-on Investment Framework* asserted,

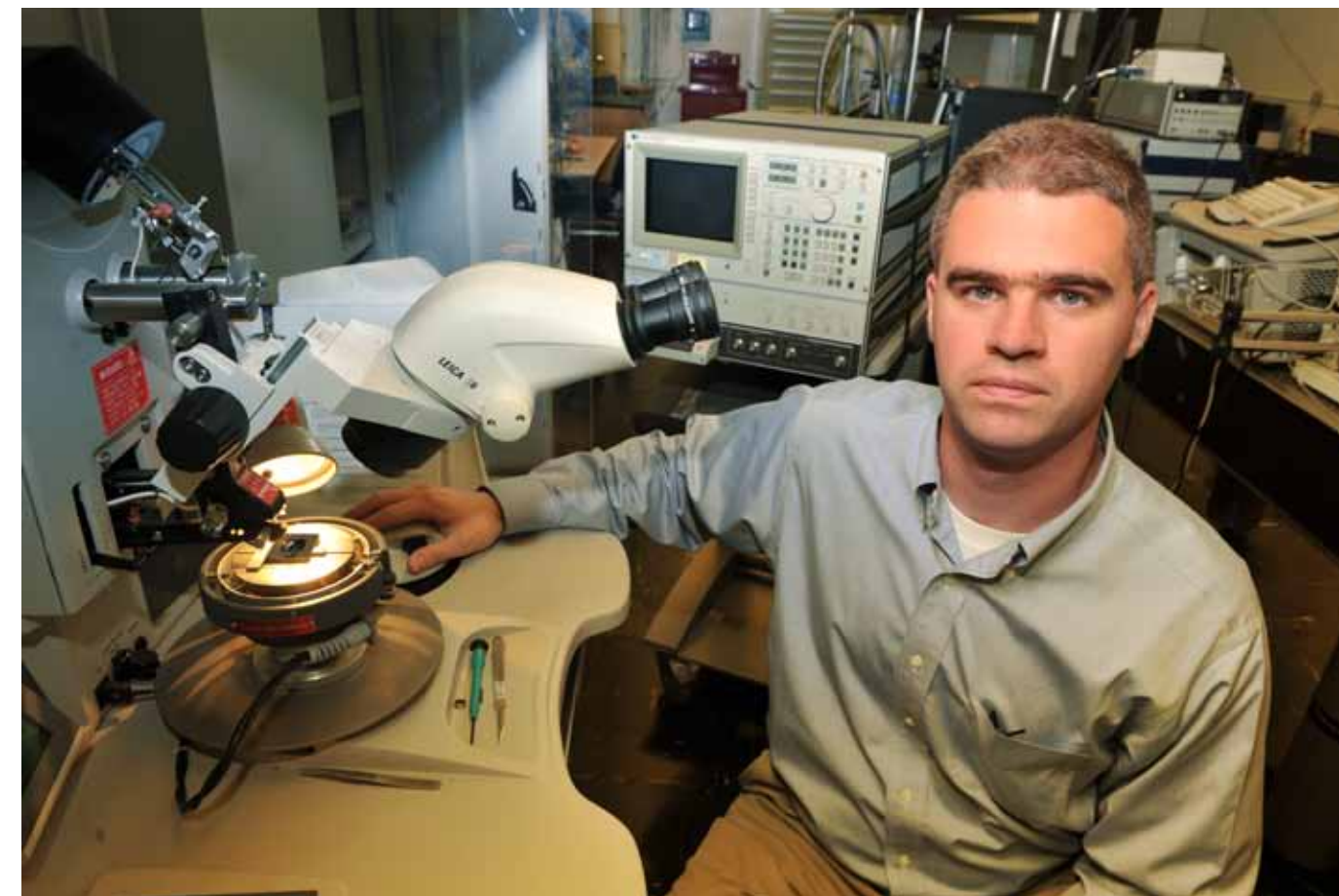
"To bring Navy educational practices more in line with DoD policy to shift graduate education toward development of future capabilities, the Navy needs to introduce a top-down approach to replace the bottom-up one it now employs. This shift would include reviewing existing graduate education instructions to verify that the language and intent square with current DoD policy. Navy policymakers should consider the intent of DoD policy (DoD Instruction 1322.10), revised in April 2008, that "knowledge is good, and more is preferable." Once this policy language is clear, Navy leaders need to communicate their graduate education policy to graduate education program managers, community managers, and officers." (Ref. 43).

Academic Quality Committee members and a number of leaders interviewed by the Committee expressed concern about the proliferation of graduate programs nationally and the ease with which degrees are awarded. Credit for work experience, master's programs without thesis or major project requirements, or without meaningful communication with faculty members are all potential challenges to academic quality. All degrees are not equal — diploma mills for military officers permit checking the boxes on degree requirements but diminish the future strength of the officer corps. To a person, everyone referenced NPS as a high quality institution with disciplined academic requirements, and all urged NPS to stay the course of academic rigor.

Costs Often costs are mentioned as a key (and easy to calculate) metric for graduate education or for a specific institution. At present, with resident enrollment capacity, the obvious response to any questions of cost is to expand the enrollment base to capacity to change the denominator of the calculation. Since the current military engagement is distributed around the globe and national economic drivers are challenging the federal budget

"This is a great opportunity now to grow the next generation — the kinds of folks that are going to be critical to keeping our missions operational. Things we didn't consider previously, we now have to consider routinely. We need the cyber warriors to be able to understand what the problems are. We are about 35,000 people short at the federal level with cybersecurity skills. Many of those skills are being developed right here at the Naval Postgraduate School. There are invaluable programs here training and educating the next generation of cyber warriors. And we can't get them to the field fast enough."

Dr. Ron Ross
Sr. Computer Scientist and Information Security Researcher,
National Institute of Standards and Technology
Lead, Federal Information Security Management
Act Implementation Project



Lt. Cmdr. Mike Touse, a recent doctoral graduate, demonstrates the wirebonder device he used to wire microchips for his Ph.D. research. The Naval Postgraduate School has made a concerted effort to increase the number of doctoral students on campus, both active duty and civilian, realizing a dramatic growth in this sector over the past decade.

to reduce its deficit, an obvious option is to consider expanding the flexibility of NPS enrollments to include student spouses using the GI bill, veterans returning to civilian life who would value an NPS degree, and other civilians — to the extent NPS has excess capacity for selected programs.

Value Given the centrality of NPS' mission to serving national security priorities, it is relevant to consider long-term value and the contributions of NPS-educated alumni to DoD and DoN rather than cost alone, despite the difficulty of capturing these "returns on investment." The value of having an institution that provides international engagement opportunities while at the same time providing leading edge curricula and relevant research projects for the future leaders of our military and government is a compelling argument that needs to be refined and more broadly disseminated.

CONSIDERATIONS

Alumni Perspective on NPS Value In keeping with the current strategic goal of educating the total force, and considering future national security needs within agencies such as the DoD, Department of Energy, State Department, and Department of Homeland Security, NPS is poised to support the expected need for science and technology experts, defense managers, master's and Ph.D. graduates, personnel for national laboratories, and our allies' need for highly trained and sophisticated personnel.

In a recent survey of Navy-only NPS graduates, nearly all respondents noted their NPS education as relevant and useful to their career. When asked to relay which areas were critical to the *success of their naval career*, a large majority of the respondents valued analytical, critical thinking and problem solving skills as most important. The results further reflect the *value of an NPS education in enhancing the career essential skills* of its alumni, particularly in the aforementioned areas.



Surveys from NPS graduating students have shown that overall, a large majority of the respondents agreed that NPS supports teaching and research to enhance the effectiveness of all forces, and is successful in doing so. Several student comments reflected a deep appreciation for NPS as a unique institution, with a high caliber and diverse faculty. The general high regard for NPS was also reflected in a persistent finding over time that nearly all alumni would recommend NPS to other military officers or defense civilians.

According to nearly 90 percent of NPS graduates, the defense-related orientation at NPS makes their education more relevant than if they were at a civilian institution. In every survey, the most highly rated aspect of the NPS experience was the high quality of the faculty and their dedication to student success, their availability and their involvement in students' active and participative learning. For example, only the professors teach, no teaching assistants are allowed. This is not true of the majority of U.S. research universities.

Graduation Rates NPS students persist to graduation at high rates. They are less likely to defer courses, delay graduation, or drop out. Nearly 90 percent graduate — a stunning result when compared with civilian universities — and nearly all graduate in the appointed timeframe. This is despite the fact that many students are frankly poorly prepared for many of the NPS offerings — a fact that NPS aggressively rectifies with impressive success.

Retention in the Navy NPS graduates are more likely to remain in the Navy than graduates of other graduate programs or graduates of only undergraduate programs. Promotion rates are comparable with graduates of other institutions, and since NPS turns “poets into engineers,” this is a remarkable finding. As an example, of the recent entering cohort of Electrical and Computer Engineering students, none had ECE undergraduate degrees, yet history indicates they will all graduate after meeting all the educational requirements.

Promoting the NPS Experience Prohibited from advertising, and subject to limitations on the kinds of materials that can be produced to market the institution, increasing NPS visibility is challenging. Other universities recruit aggressively from the pools of students they identify as most appropriate for their institutions, and even offer research assistantships and scholarships as incentives. Similar flexibility for NPS should be sought.

NPS Undersea Warfare student Lt. Brandon Schmidt, right, and Meteorology/Oceanography student Lt. George Suh spent ten days in March at this camp in the Arctic, using sensors and sonar to study the impact of ice keels on thinning ice layers. The trip, sponsored by the Office of Naval Research, was part of the Navy's Submarine Force Ice Exercise 2011.

Leveraging NPS with Partnerships with Other Universities While NPS has agreements with other universities for targeted programs, they are generally limited to like programs for military officers only. The Air Force Institute of Technology (AFIT) participates in the Dayton Area Graduate Studies Institute, which is a consortium of AFIT, University of Dayton, and Wright State University that permits sharing of faculty, curricula and students and provides the ability for the institutions to collect and keep tuition. This helps tremendously in keeping classrooms “level loaded” with students. NPS should establish a Monterey Bay Graduate Student Institute to permit similar cooperative arrangements with University of California Santa Cruz, California State University Monterey Bay, and Hopkins Marine Station (Stanford University), Monterey Bay Aquarium Research Institute and Monterey Institute of International Studies.

“Effective leadership all boils down to three essential skill sets: technical competence in your job; adaptability because things change; and the ability to communicate with people that work for you, around you and above you. These seem to me to be the most important, and ones that you really learn in the military.”

Mr. Marshall Carter
Chairman, Board of Directors
NYSE Group/New York Stock Exchange
NPS Alumnus

Ph.D. Students Ph.D. students provide opportunities to improve academic quality through their participation in and contributions to research programs. They are also a recruitment and retention resource for attracting world-class faculty members, and provide greater visibility by raising the academic profile of the institution. For example,

Carnegie categories of universities are, in part, determined by the number of Ph.Ds. awarded in a range of disciplines (e.g. 30 or more degrees in ten or more disciplines). NPS has increased its Ph.D. enrollments substantially over the last four years, but it should continue that trajectory in the future.

RECOMMENDATIONS

1. Establish a regional graduate student institute, as capacity permits for selected programs using the Dayton Area Graduate Studies Institute as a model to leverage resources and enroll civilians.
2. Expand international enrollments and maintain the number of countries represented at no fewer than 45.
3. Educate Combatant Commanders, DoD and DoN policy leaders on contributions NPS can make to theater security cooperation plans, building partnership capacity and the Navy's maritime strategy.
4. Expand selected civilian student enrollments, including student spouses and enlisted personnel to relevant academic programs to more fully utilize NPS' existing capacity.
5. Increase distance learning programs strategically to meet growing DoN needs for graduate education. This can meet Navy and Marine officer graduate education needs where a resident program is impractical and considerably improve DoN civilian human capital development, especially in the extensive DoN technical communities.
6. Increase Ph.D. enrollments.
7. Gain flexibility on marketing, recruitment, and promotional programs essential to the institution's visibility and competitive status.

Information and Communications Technology

BACKGROUND

A Tradition of Computing Leadership The Naval Postgraduate School has a long history of leadership in the computing arena. It was one of the first universities to use computing in the classroom, and it was one of the first institutions to incorporate networking into its core educational experience. In 2004, the Naval Postgraduate School celebrated its 50th anniversary of computing with a panel of world-renowned academicians and industry leaders. It was an opportunity to reflect on a past that was marked with significant milestones of technology innovation and adoption.

Under the leadership of Warren R. Church, the Naval Postgraduate School installed a NCR102A “Automatic Digital Computer” in the Math Department in 1953. It was the first computer on the NPS campus, and one of the first in the world to be used in support of education. The NCR102A in the Math Department Computing Facility provided “high speed computations in support of scientific research”, and was used by math professors and students in support of the curricula. The Dudley Knox Library began offering computerized information searches to faculty and students in 1961.

Modern mainframe computing arrived at NPS in 1967 with the installation of the IBM 360/67, featuring twelve remote typewriter stations, Job Control Language, punch cards and open-reel tapes. This was one of the first general-purpose mainframe computers ever assembled.

In 1969, NPS became a pioneer in network use, with the arrival of the ARPANET to campus. The Department of Computer Science was instrumental in bringing network services to campus. This was the start of e-mail and file-sharing, of research collaboration via what came to be known as the Internet. In 1976, the Dudley Knox Library offered the first fully online catalog at NPS.

In 2011, information and communication technologies are more important than ever before. They comprise a cyberinfrastructure that is an integral part of every academic area and support every administrative office. The CNO recently designated NPS as the centerpiece of cyber education and research for the Department of the Navy. The Director of the National Security Agency and head of U.S. Cyber Command asserted his commitment to the Naval Postgraduate School as his “go-to place” for all things cyber.

Cyberinfrastructure Defined The *Report of the National Science Foundation Blue-Ribbon Advisory Panel of Cyberinfrastructure* stated “like the physical infrastructure of roads, bridges, power grids, telephone lines and water systems that support modern society, “cyberinfrastructure” refers to the distributed computer, information and communication technologies combined with the personnel and integrating components that provide a long-term platform to empower the modern scientific endeavor.” (Ref. 124).

Information and communications technology have become indispensable for 21st century life. All major social institutions (political, economic, education, military, and social) rely on technology services for communication, education, and commerce. In higher education, this is perhaps even more acutely true, and in a graduate university such as the Naval Postgraduate School, cyberinfrastructure is a *sine qua non* to its very mission. Not only is information technology an academic area itself, it represents an infrastructure upon which the entire academic enterprise relies, and one that is integrally coupled with critical user services and support in the day-to-day life of the university.

Every academic program and discipline depends on cyberinfrastructure — for access to content, applications, visualization of scientific problems, collaboration tools, classroom technologies, data repositories, back-up systems,

METHOD

In order to consider the future of cyberinfrastructure, the Committee reviewed a number of documents, reports, and plans referenced in the bibliography. This review included Department of Defense, Department of the Navy, higher education, and industry materials. It also included a review of NPS' own planning materials, both institutional and those relating to Information Technology and Communication Services. A number of individuals were interviewed, including faculty members, administrators, librarians, staff, and students. The NPS IT Task Force, advisory to the Vice President for Information Resources and CIO, was asked to comment on the chapter. As is mentioned elsewhere in the report, military and government leaders were also interviewed, and virtually every leader mentioned the criticality of cyberinfrastructure to the future.

Staff in NPS' High Performance Computing facility manage the university's Hamming supercomputer. The ability to support complex data simulations requires sophisticated assets in technology, something NPS has a long history of since its receipt of one of the first computers in the world in 1953.



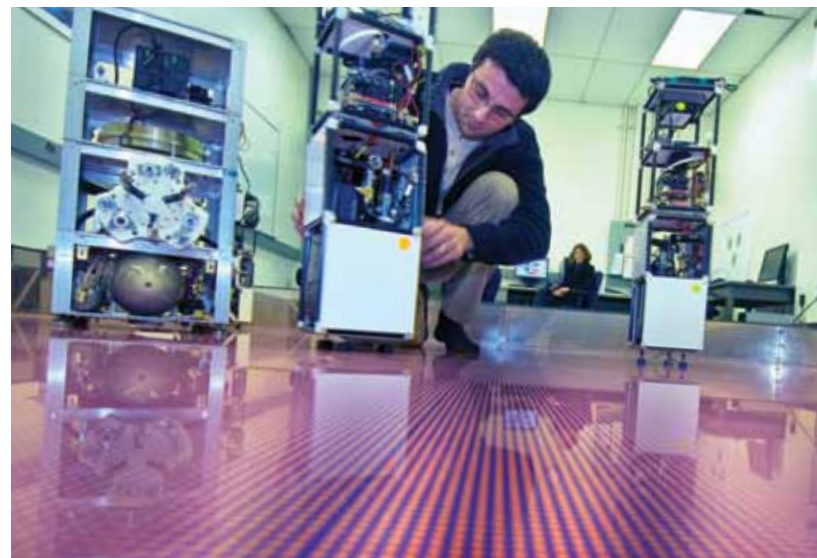
high performance computing, research methods and instrumentation. This also means high-speed, reliable access to advanced networks nationally and globally and it means mobile access, anytime and anywhere.

Internet2 (the high-speed advanced national network linking research universities and national laboratories with each other and other global networks) leadership asserts, “The research and education community increasingly relies on a comprehensive suite of advance information technologies, including networking, computation, visualization and collaboration tools — to accomplish its work. The term ‘cyberinfrastructure’ encompasses all of these, as well as the extensive ecology of skills and other resources needed to develop, deploy, use and support them” (www.internet2.edu/ci).

OBSERVATIONS: RISKS AND CHANGING ASSUMPTIONS

Risks Ahead NPS faces a number of mission execution risks in the future that are directly related to cyberinfrastructure. For example, cybersecurity incidents pose an increasing threat to network viability. Demands for capacity are growing at a time of shrinking budgets. Technology talent is integral to cyberinfrastructure support and the increasing inflexibility in federal hiring policies makes it difficult to recruit and retain the most talented individuals. Uneven funding streams cause poor technical and financially inefficient technology acquisition decisions. Licensing and maintenance costs consistently exceed the consumer price index. Unfunded mandates and regulatory compliance requirements continue to erode technology spending power.

Changing Assumptions Current assumptions must be challenged in order to imagine future scenarios. For example, planning for support of resident programs needs to be expanded to include nonresident programs since the latter is expected to continue its more rapid growth in the coming years. Traditional degree programs need continued support, although continuing education and professional development short courses, workshops and seminars must also be supported. Technology decisions have life spans — estimating the right life expectancy is tricky and yet imperative. Mobility changes everything — including educational space requirements. Budget reductions often imply standardization but research universities require support for experimentation and rapid development of new tools and knowledge. Finding ways to provide multiple platforms and systems to support graduate education and research in a resource-constrained is the challenge. Partnerships take time, energy, and resources and are often the first victims of budget cuts. Partnerships can also be resource multipliers if forged strategically. Securing data and networks often assumes a level of rigidity inconsistent with academic mission.



Researchers in the university's Spacecraft Research and Design Center use sensitive equipment to simulate the environment of working in the final frontier. It is one of several areas where advanced computing architectures are needed to support advanced research.

CONSIDERATIONS: FRAMING THE FUTURE

The Action Strategy To expand what is possible, NPS cyberinfrastructure plans and policies should be guided by principles that reflect the academic mission and the priorities of the faculty and students.

PRINCIPLES TO GUIDE CYBERINFRASTRUCTURE PLANNING

Flexibility The most important aspect of cyberinfrastructure in graduate education is flexibility. Networks must be adaptive, fast, and robust. Faculty members and students need to be linked with colleagues at other institutions in the U.S. and in other countries. Educational resources must be accessed 24 hours per day, 7 days per week from all parts of the world and all society sectors. Projects may require dedicated light waves using high-speed global networks. Open-source and open community products must be available, as well as a multitude of proprietary options — depending on the academic requirements. A common platform is needed for all computing on campus — including education, research and administrative support. Faculty and students need to innovate and experiment without endangering production networks. A secure environment is needed as well although cybersecurity must be agile and adaptive.

Mobility In the popular YouTube video on *Socialnomics*, recent statistics challenge even the most aggressive previous estimates on the importance of mobile technologies. Currently, 80 percent of Twitter updates are on mobile devices. A recent survey indicated that 25 percent of the U.S. population has downloaded a short video on their phones. Mobility has become a requirement of communications technologies. (Ref. 130).

Convergence In the past few decades, voice and data were primary in communications technologies. Today, video holds the central role in where the action is. Over 100 million videos appear on YouTube today, making video an important component of 21st century communications. The convergence of voice, video, and data technologies is a cornerstone of cyberinfrastructure planning for the present and future. Facilitating faculty-student, student-student, and faculty-to-faculty connections with state-of-the-art networking is expected. This increased interconnectivity will also require ever-increasing amounts of storage space for video, photo, email and other data.

Speed of Change This year, the population of Generation Y exceeds the population of Baby Boomers, and 96 percent of GenY members have joined a social network. Diffusion of this new approach to networking was fast. It took only nine months for Facebook to have 100 million users. It took the same amount of time to have over a billion iPod downloads.

National Defense University Professor Linton Wells describes the imperative of maneuvering “faster, and more effectively, than our opponents through the interacting environments of the global commons.” (Ref. 146). He also notes that the “tyranny of computing cycles means that important actions will have to be pre-approved — rules of cyber engagement — and that at least some of the decision-making will have to be decentralized.” Teaching how to negotiate these rules, experimenting with levels of decentralized decision-making, and modeling outcomes are precisely the agenda of cyber education and research. The cyberinfrastructure required to support these areas must be up to the challenge in terms of responsiveness, reliability, security, and adaptiveness.

Cybersecurity According to PandaLabs, in the first ten months of the year, the number of threats created and distributed account for one third of all viruses that exist. This means that 34% of all malware ever created has appeared in the last ten months. The company's database, which automatically detects, analyzes and classifies 99.4% of the threats received, now has 134 million separate files, 60 million of which are malware (viruses, worms, Trojans and other threats). In the year up to October, some 20 million new strains of malware have been created (including new threats and variants of existing families), the same amount as in the whole of 2009. The average number of new threats created every day has risen from 55,000 to 63,000. [Date: 24 November 2010; Source: www.net-security.org/malware_news.php?id=1545]

“Cybersecurity is so critically important today to every one of us, whether in the warfighter side, the intelligence community, the civil part of government or the private sector. Information technology is at the heart of everything we do. Computer systems are fueling our ability to achieve mission success. And in order for us to be successful and carry out those missions, the technology that we deploy today must be dependable. And in order for that technology to be dependable, we have to make sure that it is properly secure.”

Dr. Ron Ross
Sr. Computer Scientist and Information Security Researcher,
National Institute of Standards and Technology
Lead, Federal Information Security Management
Act Implementation Project

The amount of attention that is required to adequately defend the integrity of networks, systems and data is increasing at a substantial rate. The level of technical sophistication that is required is increasing as well. This implies resource reallocation, a commitment to professional development, and partnership with academic areas developing intrusion protection tools and data loss prevention mechanisms.

In addition, classified computing is a distinctive capability within NPS that is not available at most other universities. Classified courses and research programs are growing and institutional attention must be directed to ensuring that appropriate capacity and service support are provided.

Talent Graduate institutions of the 21st century must be supported with highly developed communications and computing infrastructure and services. This means highly-skilled technical support for high-performance comput-

ing, visualization, streaming video, digital media services, cybersecurity, wireless landscapes, cloud services, and areas that have not yet been fully developed. Innovative, talented technical staff and information professionals must be competitively recruited and retained. Professional development programs must be aggressive to maintain talent currency, and effective management must include offering access to challenging problems. Technical staff should be engaged with colleagues in the Department of Defense, Navy, professional associations and federal agencies, as well as with colleagues at other higher education institutions.

Leveraging Resources Effectively As requirements for cyberinfrastructure and services increase and costs of software and maintenance agreements outpace consumer price indices, employing cost saving and cost containment strategies will be essential in every organization. Information technology and communication services can play a substantial role in those efforts.

The recent *25 Point Implementation Plan to Reform Federal Information Technology Management* (Ref. 60) by the U.S. Chief Information Officer, Vivek Kundra, underscores this point. The following examples show ways in which technology can contribute to institutional cost reductions and containment strategies:

- Moving to open-source, community source products wherever possible, thus eliminating the need for expensive, inflexible, proprietary software and systems;
- Consolidating cyberinfrastructure and services in the institution under the central IT organization, whenever feasible and appropriate;
- Continuing to encourage sharing of best practices by providing a collaboration platform;
- Aligning acquisition with the technology cycle — in other words, for those areas (e.g. classroom technology), fund life cycle replacement at the beginning of the fiscal year with line item support, rather than waiting until the end of the year for opportunistic funds that do not result in the most efficient or effective acquisitions;
- Partnering across departments and administrative domains to make the best investments possible (e.g. partnerships with academic (or administrative) departments often yield cooperative purchases that extend the resource base in ways that benefit a larger user base); and
- Collaborating with other organizations (e.g. the Monterey Peninsula DoDNet) to share cyberinfrastructure and expertise. Partnering with industry to pilot new technologies to ensure faculty and students have access to the most current technologies in the classroom and laboratory.

Information and Communication Technologies as Strategic Enablers

Indiana University President Michael McRobbie posits that at the most basic level, investment in IT infrastructure is part of the cost of doing business at a research university. At the very least, an institution must provide basic IT resources and connectivity to faculty, staff and students. But this is no longer enough to ensure that an institution is even minimally competitive. Why? Because research in nearly all academic areas requires advanced IT infrastructure to a greater or lesser degree, and because an institution's ability to attract and retain research faculty — and increasingly, instructional faculty — now depends, in large part, on its ability to provide and support the infrastructure. Students, too, expect their IT infrastructure to be contemporary and flexible, ready to change dramatically from one generation of students to the next — a period, on average of only about five years. (Ref. 64). Tied to that infrastructure is the need for faculty and students to understand how to accurately access information in a useful and timely fashion.

SUMMARY

Cyberinfrastructure is both strategic to an institution's future and a crucial competitive driver. On the educational front, it helps to keep curricula current and research relevant and promotes lifelong learning. It helps to attract and retain leading faculty members. It connects NPS faculty and students through high-speed networks with sponsors, stakeholders, scholars and educational resources, both here in the U.S. and throughout the world. On the admin-

“Industry and IT professionals can learn from military strategy. The network is the backbone for warfighters; it is a battlefield, so it must be built and designed to be defensible. NPS students can learn to use their warrior skills and their warrior mindset when they are in positions of authority to look at cybersystems and bring a military perspective to how we defend networks.”

Ms. Mary Ann Davidson
Chief Security Officer
Oracle Corporation



An NPS student participates in CDX2010, an annual competition between Department of Defense educational institutions designed to challenge students in both offensive and defensive network security.

istrative front, it can be used to contain costs and improve business activities. The classified computing arena is an important differentiator for NPS, and should be developed as a premier element of NPS capabilities.

Cyberinfrastructure is an important differentiator among institutions, and it requires flexibility, mobility, quick response to changing technologies and requirements, technical talent, cybersecurity, convergence of voice, video, and data technologies, and smart leveraging of resources. The above must be used as principles to guide cyberinfrastructure planning and implementation. In short, the institution must consider cyberinfrastructure a strategic enabler of its mission in its strategic and operational plans.

Cyberinfrastructure is an integral part of the production system that contributes significantly to the value of NPS. The Naval Postgraduate School has a tradition of leading in computing and should continue that prominent leadership role into its next century. NPS is committed to producing graduates who are sophisticated in the Cyber arena, and research this is leading-edge and responsive to national security priorities.

RECOMMENDATIONS

1. Include cyberinfrastructure as a visible strategic enabler of NPS mission through its inclusion in all strategic and operational plans.
2. Maintain NPS leadership in technological currency through experimentation and a close partnership between Information Technology and Communications Services and the academic departments.
3. Incorporate cyber education and research prominently in NPS plans and priorities.
4. Highlight cybersecurity as an element of every curriculum at NPS.
5. Maintain the .edu environment at NPS, and enhance its flexibility with expanded partnerships with other universities, laboratories, and industry.

Facilities

BACKGROUND

All institutions of higher learning require facilities that enable academic teaching, research and development, and other support activities in order to successfully accomplish the educational mission. The Naval Postgraduate School is certainly no exception.

From its inception in 1909 at the Naval Academy in Annapolis, Maryland, through its relocation in 1951 to the former Hotel Del Monte in Monterey, California, NPS has been housed in a combination of unique facilities. Some of the facilities have been adapted from their original use to support the NPS mission, while others have been built with the academic mission in mind.

Construction of the academic quadrangle was begun shortly after the move to Monterey in 1951. Over the years since, other facilities were added to NPS to support its expanding student body and curriculum. Most recently, these included the construction of Glasgow Hall, construction of a new Mechanical Engineering building, and significant renovations to the library and to Herrmann Hall. After more than a century of service, NPS now enjoys a unique combination of historic and modern structures that house its academic and research capabilities.

In late 2003, the Navy created the Navy Installations Command and began to consolidate management responsibility for the Navy's shore infrastructure into geographic regions. As a part of the consolidation, NPS was realigned under Navy Region Southwest, headquartered in San Diego. One of the implications of this regional realignment was that the facilities planning and management functions were now performed by the Navy Region, not directly by NPS. NPS does have a strong relationship with Naval Support Activity (NSA) Monterey which serves as the Navy Region's local command for infrastructure support.

NPS has also withstood challenges to its existence during rounds of Base Realignment and Closure (BRAC) over the past two decades. During the BRAC review, the Navy questioned the need for retaining its own postgraduate institution, as opposed to using civilian institutions for postgraduate education and closing NPS and its supporting installations. Fortunately, the unique nature of NPS and its value to not only the Navy but also to the other military services and government agencies was recognized during the BRAC deliberations and NPS remains in full operation today.

OBSERVATIONS

The Navy's land and facilities are a part of the Navy's inventory of platforms, systems and infrastructure that enable it to accomplish its mission. As with ships, aircraft and weapons systems, the Navy's shore infrastructure must receive an appropriate level of commitment, concern and support. The Navy's Shore Facilities Planning System (SFPS) is designed to plan, acquire, operate and maintain the shore infrastructure in a way that helps achieve mission readiness.

The SFPS analyzes facilities needed to perform assigned missions — the adequacy (both quantity and quality), use and utilization of existing facilities against a set of derived facility requirements. The SFPS is designed to develop and implement site-specific plans to acquire, maintain, optimally utilize and dispose of shore assets. SFPS planning consists of five steps: (1) Facilities Requirements; (2) Asset Evaluation; (3) Analysis, Concepts and Proposals; (4) Implementation; and (5) Quality Assurance.

This chapter primarily will focus on the generation of facilities requirements for NPS, as that appears to be one of the primary issues with regard to adequacy of the shore infrastructure to support the NPS mission.

During the requirements generation phase of the SFPS, Basic Facility Requirements (BFRs) are developed for each category of facilities (e.g., Shore Capability Areas such as Airfield Operations, Training and Utilities, and Shore

METHOD

The Committee reviewed numerous reports and analyses having to do with NPS' facilities' history, its current status, and future plans.

Herrmann Hall serves as the main administration building for the university, and is a stunning and iconic landmark on campus. Academia requires more than history and beauty however, and NPS has dedicated considerable effort to provide the type of facilities that education and research need to flourish.



Task Descriptions such as Family Housing, Academic Instruction, Aircraft Maintenance). The BFRs are driven by factors such as base loading (i.e., what is the supported population and the mission requirements of that population). BFRs are generally determined in one of three ways:

1. Derived from Naval Facilities Engineering Command (NAVFAC) accepted and established planning criteria where space is well-defined;
2. Derived from engineering analyses or technical studies where space is partially or wholly undefined; or
3. Derived from a combination of #1 and #2 above. (Ref. 17).

The mission of NPS is unique when compared to typical naval installations. The only other naval activities that are similar in nature to NPS are the United States Naval Academy and the Naval War College. These three institutions are often referred to as the Navy's "Flagship Institutions." Despite their unique missions, the Flagship (premier) Institutions are, for the most part, controlled by the SFPS criteria which, related to the broad area of education, tends to focus more on training. Thus, SFPS criteria do not lend themselves to adequately identifying facilities requirements for the unique academic education mission that these Flagship Institutions share. Future military construction projects at NPS are unlikely given the overall budget situation for the Department of Defense and the Navy. Research, however, continues to grow, and faculty stories of turning away sponsors offering research funding because of lack of space are numerous.

CONSIDERATIONS

Current State and Benchmarking (USNA/NWC and Civilian Academic Facilities Processes) Using the SFPS, NPS generated its BFR in 2003/05 and again in 2009. The current requirements identified in the BFR are included in the bibliography of this report. In addition to these BFRs, NPS engaged Active Decision Support to perform an inventory of existing space. A summary of the information from this inventory is also included in the bibliography of this report. (Ref. 109).

While the information in these attachments outlines the current state of facility assets and requirements at NPS, they do so in the context of the existing SFPS criteria. As mentioned previously, these criteria are oriented more toward training facility requirements than toward the unique nature of advanced educational requirements.

These documents acknowledge the unique nature of the missions of the Navy's Flagship Institutions and of the resources required to effectively execute those missions. Unfortunately, with the current resource constraints on the Navy in general, it may be difficult for the Navy to provide the levels of resource support that all may agree are necessary and desired.

Despite the stated support by Navy leadership for their Flagship Institutions, these constraints reflect a significant difference between the facility support under which NPS operates and similar support for civilian institutions of higher learning. This hampers NPS' ability to truly obtain the kind of facility infrastructure that would be needed to support its mission. It also imposes on NPS the need for greater diligence and rigor in optimizing the use and utilization of the facilities it does have.

Nonetheless, there is a significant amount of facilities information available on civilian colleges and universities, both public and private. This information can be used to benchmark and obtain best-practice information that might be incorporated into NPS' facilities planning and management functions.

The Association of Physical Plant Administrators (APPA) was founded in 1914 by representatives of 14 educational institutions. APPA is a source not only of this type of information but also of the Facilities Management Evaluation Program (FMEP) that might be considered to help assess and enhance NPS' facility management processes. This may be especially useful under regionalization, where NPS does not have direct control over its facilities but must rely on Navy Region Southwest.

Guiding Principles for NPS Facilities During the Committee on the Future assessment of facilities for NPS, the following characteristics and guiding principles have emerged for consideration:

THE UNIQUE MISSION OF NPS HAS RECEIVED SOME ACKNOWLEDGEMENT FROM NAVY LEADERSHIP IN THE FOLLOWING PERTINENT DOCUMENTS:

- CNO Memorandum 1524 Ser N00/100105 of 31 Oct 08: NAVY-WIDE EDUCATION GOVERNANCE
- CNO Letter 5860 Ser N00/100113 of 9 Nov 08 to Congressman Farr
- CNO Letter of 9 Nov 08 to VADM (ret) Dan Oliver, NPS President
- CNO Letter of 9 Nov 08 to RADM Wisecup, President, Naval War College
- Flagship Institution Agreement for United States Naval Academy, executed 21 Jul 05

- This is a period of rapid change on multiple dimensions, where national demographic trends, economic conditions, instructional technology changes and the asymmetric nature of threats to national security contribute to a high level of uncertainty within which NPS must operate.
- To be successful in this uncertain environment, NPS must be able to respond with agility to rapidly changing demands.
- Facility planning and management must continue to be driven by NPS mission requirements and best practices (from both Navy and civilian/educational industry standards). Because of the dynamic nature of these requirements, the resource constraints inherent in current federal budgets and the limitations of NPS' current land footprint, any facility planning and management regime must provide maximum flexibility for NPS to configure/reconfigure and utilize its physical plant assets.



Technology and design are integral components to the educational process, and all new facilities must embrace what is currently known about the environments that support learning.

- In addition to the current criteria included in the SFPS for training/education facilities, technical analyses and benchmarking with similar institutions (both public and private) should be used in the ultimate determination of facility requirements. These analyses should incorporate factors that may be applicable to NPS but not necessarily to civilian institutions (e.g., classified space, Anti-Terrorism Force Protection). These should also utilize a common set of metrics for drivers of facility requirements (e.g., student enrollment, types of degree programs, technology evolution, instructional mission requirements, and conference capabilities).
- NPS should have the flexibility to lease buildings off-campus, especially for "surge" requirements, that might require facilities outside the boundaries of NPS.
- A detailed benchmarking analysis with the Naval Academy (USNA), the Naval War College (NWC) and civilian institutions (e.g., University of California, Georgia Tech, Iowa State's Facilities Design Manual) would be useful in enhancing understanding of the adequacy of NPS facilities. In addition to data like gross square feet, expand benchmarking data under consideration to include drivers like student enrollment and research volume. Develop ratios of key data elements to enhance comparability. Utilize these benchmarking analyses to complement (and perhaps supplant) standard SFPS facility planning criteria in updating the NPS BFR. The BFR analysis should include the impact of any focus changes emerging from the Committee on the Future and any substantive updates to the NPS Strategic Plan.
- The APPA FMEP evaluation would be a useful third-party analysis to assess the adequacy of the current NPS facility planning and management.

SUMMARY

NPS must have flexibility to manage and plan its facilities to support its academic mission. Especially in times of budget reductions, flexibility is more important than ever. Decisions about facilities maintenance, renovation, upgrade and new construction all have to be considered within the context of the academic mission and available resources. Extending flexibility in funding models is addressed in a different section of this report, but should be considered as a complement to the following recommendations.

RECOMMENDATIONS

1. Perform a full update to the NPS Master Plan to reflect the BFR and benchmarking analyses. The Master Plan must address both repair and modernization of existing facilities as well as potential construction of new facilities. The Master Plan should be part of a long range development plan that lays out long-range capacity/capabilities based on anticipated quantitative and qualitative infrastructure improvements needed to meet NPS mission.
2. Explore transferring responsibility for basic facility planning and management to the Flagship Institutions, with specialized support and assistance from the appropriate Navy Region Facility Engineering Centers.

Funding

BACKGROUND

The goal of this chapter is to discuss funding issues concerning the Naval Postgraduate School. Many recent discussions have occurred about funding, but most often driven by the precipitous budget reductions that have been projected to impact NPS over the next five years — as well as the Navy and Department of Defense budgets. This chapter will provide some discussion of those budget challenges, but attempt to concentrate on funding challenges and how NPS and the Navy can provide for growth and development of NPS' mission *in spite of* the budget reductions being faced.

OBSERVATIONS

Over the past few years, NPS has been coping with budget reductions related to everything from funding new uniforms for the forces to reductions focused on making labor dollars more efficient by forcing the hire of government employees in place of contractors. Looking into FY12 and the next five years, NPS again faces cuts designed to make it more efficient. Only very recently has NPS fended off attempts to cut its budget \$6, \$8, and growing to \$10 million a year, based on an assumption that it could raise tuition to its non-Navy education sponsors to cover the reductions. NPS has frequently had to answer the question of why the Navy mission-funded budget divided by the number of Navy officers educated at NPS in a year does not provide the right answer of what it costs per student. Additionally, it has had to answer the associated question of “How much can I save if I send fewer students to NPS?”

No one at NPS shies away from efficiency goals. It is one of the four major goals in the NPS strategic plan, *Vision for a New Century*, and is assessed regularly. However, efficiency is not the same as budget reductions and the two must be decoupled in analysis and discussion. Administrative operations can become more efficient at NPS but they require some flexibility by the Department of the Navy to be able to streamline. For example, some regulations that were designed for ship-building operations simply are not appropriate for a research university.

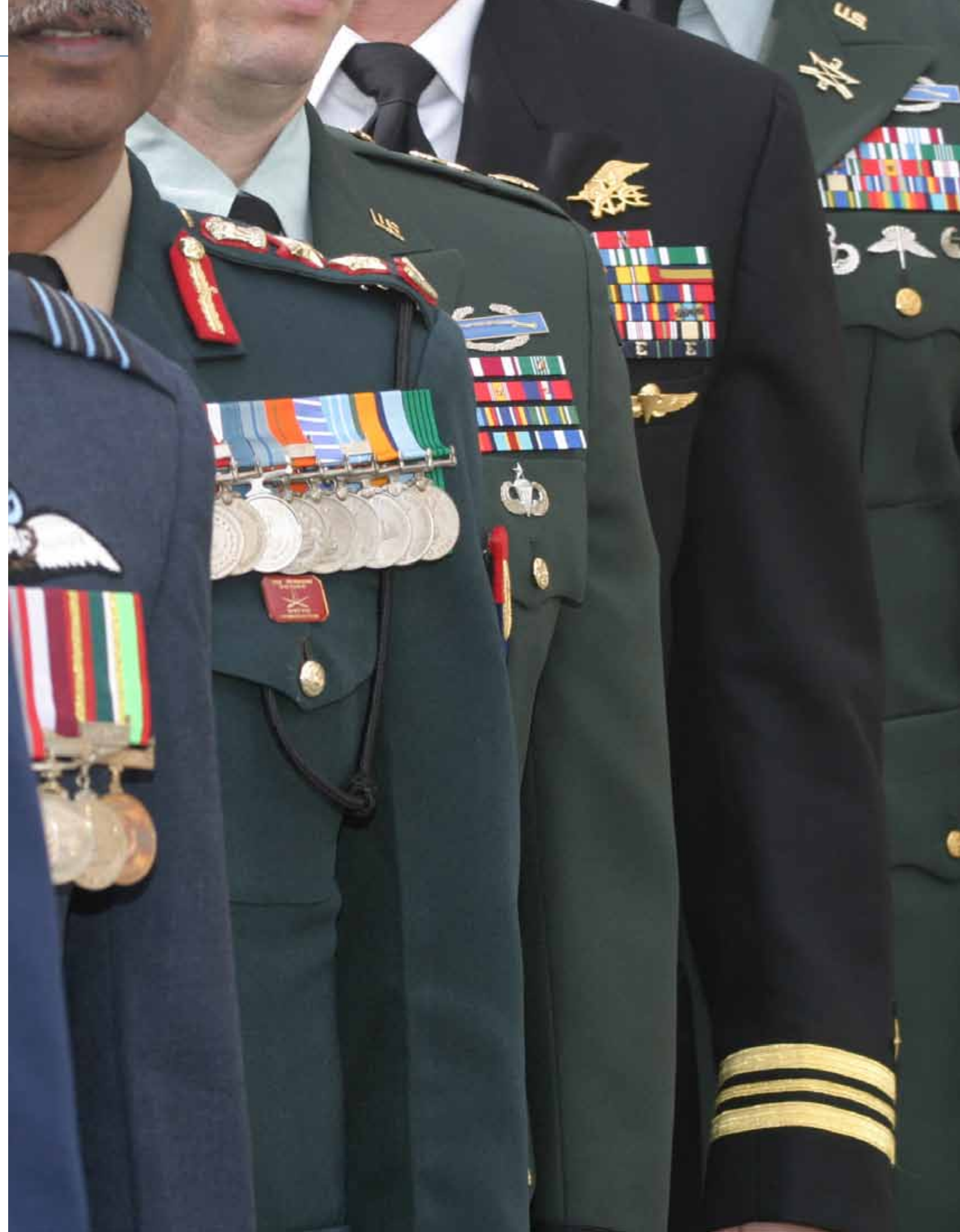
Internal changes will be required as well as new ways of doing business. All will mean a change in organizational culture to adopt change. NPS has already suggested some efficiencies in educational program delivery and will move to implement those next year.

For example, NPS leads the Navy and the Department of Defense in providing quality graduate education through a flexible mix of distance learning programs. However, distance education is not a substitute for resident education. Quality graduate education must be founded on a solid investment in resident education and research. While resident graduation rates are nearly 90 percent, non-resident graduation rates are substantially lower, and that needs to be considered in any discussion of program efficiency. The hybrid delivery method (a mixture of distance learning with periodic short resident periods) shows promise, because students do not incur the Permanent Change of Station (PCS) costs. Travel to NPS once or twice a quarter would be incurred, but the hybrid delivery model would also not include Individual Account (IA) costs. Additionally, students are not taken away from their regular positions while still attending NPS. However, a hybrid program may be effective for some programs but not all. For example, a hybrid approach may not be appropriate for science, technology, and engineering programs.

NPS also must further explore ways to take better advantage of growing revenues that are not solely dependent on Navy mission dollars. NPS has the capacity and capability of adding additional students without the burden of much additional cost, particularly in the Science, Technology, Engineering, and Mathematics (STEM) curricula. The Navy does not want to divest itself of the STEM programs, despite falling quotas and attendance rates, with class sizes averaging ten students. It is expensive to put a professor in a classroom, particularly one with laboratory requirements, and only have seven students in the class. However, if the capability of providing that education is

METHOD

A number of documents were reviewed, internal and external, as well as models from other universities and research organizations. This chapter was also informed by the May 2011 conversation with Chief of Naval Operations Gary Roughead and several key Navy staff leaders, which pointed the direction for the future growth and development of NPS.



lost to the Navy, it is much more expensive to get it back, and civilian institutions just cannot replicate the STEM experience that an NPS student gains from receiving an education about and working on problems to resolve warfighter issues. The applied nature of NPS' educational experience is what makes it unique and prepares the officer to put his/her NPS education to work in support of the military.

NPS can, with its available capacity, educate more students, not only naval officers but also students from other services, international students and civilians. These non-Navy students can also bring valuable experience and insight from industry and in solving problems faced by other countries. These students can be tuition-paying students, and that tuition can substitute for declining Naval dollars. Additionally, there are no PCS or IA costs for the Navy to incur — classes can be optimized without the Navy having to invest additional students or dollars.

CONSIDERATIONS

In order to gain these efficiencies and experience revenue growth, NPS will need to look at different ways of operating. Some of these considerations are as follows:

Density of Curricula

NPS students sometimes earn two to three times the number of credits that they would earn if they attended a civilian institution because NPS curricula include components for refresher, preparatory, and Educational Skill Requirements (ESR) beyond degree requirements. This does occur most often in the technical curricula, and particularly when a student needs refresher and/or preparatory course work. The ESRs that naval sponsors require of graduates must be examined in conjunction with the program managers and curricula providers at NPS. Lowering the number of required courses reduces the need for classroom instructors (a cost saving), but may require additional professorial attention and time in research (a less efficient way of delivering ESRs).

Enrollment of Tuition-Paying Students NPS is currently restricted to enrolling only 125 contractor civilians in its programs, and only when there are unfilled seats in the classroom. The unused capacity is an opportunity lost to NPS and to the Navy. Charging and retaining tuition for civilians can help offset decreasing mission funds. For example, veterans using the GI Bill, spouses of military members, international students who can also provide valuable manpower acting as research assistants. Additionally, the variety of students sharing the classroom and laboratories with Naval and other military officers will enhance the educational experience of all. The optimal level of resident students is 1,500–2,000; less than 1,500 and the resident student population is too small to achieve any efficiencies, and more than 2,000 students creates a capacity issue. The current resident student population is 1,560. Important growth in civilian attendance can occur, but it should not be allowed to overwhelm the military officers or cause additional program costs for instruction.

NPS Foundation and Private Fundraising The uniqueness of NPS in providing military officers with graduate education based on the needs of the warfighter provides a powerful hook for attracting private donations. The NPS Foundation has the capability to generate significant dollars for NPS to create a margin of excellence that Navy funding alone cannot provide. The NPS Foundation anticipates a strong endorsement from Navy leadership for NPS to fully realize its potential for assisting it in enhancing and promoting the NPS mission.



Students diligently take notes during one of Senior Lecturer Bard Mansaser's Applied Mathematics courses. With refresher courses and sponsor-mandated Educational Skill Requirements, on top of the required degree courses, NPS students can earn up to 2–3 times more credits than they would at a traditional civilian university over the same period of study.

Business, Operational, and Financial Restrictions NPS is restricted in its ability to partner with other higher education institutions, with industry, and with its own Foundation. It has inflexible rules related to carry forward of funds across fiscal year ends, inefficient hiring practices that limit good management and the ability to shape the workforce to meet changing needs, a time keeping system that was never designed to be used in an academic or sponsor-funded environment, and contracting that is performed by a regional office that is ill-equipped to handle the unique needs of a research institution. Additionally, relative to its overall proportion of the entire Navy budget, NPS receives a high degree of specific oversight by the office of the CNO. NPS needs to be able to set its own course and take greater control of these essential elements of production.

“The Naval Postgraduate School is the anchor for our advanced education in the Navy, and in many ways, the military. The exchange of ideas, the exposure to a broader perspective, to technology and research is absolutely vital for our young officers, both ours as well as the international officers who are here.”

Adm. Michael Mullen
Chairman, Joint Chiefs of Staff

Research Quality graduate education cannot occur without a dynamic research effort directly linked to the classroom student. NPS follows the government regulations regarding management of sponsors' funds, allocating overhead funds collected back to where the costs

were incurred and ensuring that all funds are expended within the appropriation timeframes of the federal sponsor. However, the methodology that NPS is required to use in collecting and utilizing that overhead is inconsistent with the way ONR itself oversees civilian institutions' overhead. Additionally, the inability to carry forward across year ends the overhead funds collected on sponsored research does not allow NPS to amortize key capital equipment or facilities costs, putting NPS researchers in a constant state of wondering where they will find the money to replace or repair the tools used in their research. Additionally, NPS does not collect any overhead funds associated with the Navy-provided facilities for research. This means that the Navy is effectively subsidizing all non-Naval research at NPS. The advantage of being a federal institution, especially with the easy transfer of funds to NPS by federal sponsors, makes NPS very attractive and low cost to those sponsors, but NPS' ability to carry out those research programs is hampered by the restrictions that accompany its status as a federal institution.

RECOMMENDATIONS

The following recommendations are based on discussions and follow up courses of action resulting from the 16 May, 2011 discussion with the CNO.

1. Decrease the density of the curriculum for some programs.
2. Establish a development function for NPS that would support fund-raising as seen in public state universities.
3. Seek waivers to inflexible business, financial, and operational rules or request legislative changes (e.g. enrollment of tuition-paying students).
4. Create an alternative organizational model, such as a research institute organized similarly to Georgia Tech Research Institute or some other approach that would still allow NPS to remain a naval institution.

Partnerships

BACKGROUND

In the rapidly evolving global landscape, selectively fostering agreements with a broad range of partners allows the Naval Postgraduate School to remain adaptable and cost-effective in the execution of its mission, in generating innovative concepts, and in conducting research and experimentation in support of national security.

As both a fully accredited graduate research university and a Department of Defense and Department of the Navy institution, NPS maintains a spectrum of educational, research, operational, infrastructure and outreach partnerships with the DoD and DoN; United States Marine Corps, Air Force, Army and Coast Guard; other foreign military services; other government agencies; civilian higher education; industry; and international groups and agencies. These partnerships improve learning and innovation by encouraging dialogue and thinking among a range of stakeholders, and effect changes in multiple areas such as policy, doctrine, organization, training, material, leadership and education, personnel and facilities. In this time of constrained resources, the School's partnerships also serve as resource multipliers, enabling NPS to focus on core capabilities and avoid program redundancy with other institutions. Partnerships also increase NPS' visibility which is critical for recruiting and retaining world-class faculty; attaining a competitive advantage in grants and awards, and enticing top performing officers and civilians to enroll as students. Finally, the collective efforts of NPS and its partners across experimentation, analysis, study and discovery can better inform policy making and resource allocation decisions by DoN and DoD leaders.

OBSERVATIONS

NPS has actively pursued educational, research, infrastructure, outreach, industry, and peer partnerships that generally align with the NPS mission, leverage resources effectively, create collaborative networks and vibrant talent pools, have distinguishing characteristics and measurable outcomes, and increase the School's visibility as a national security research university.

Driven by an increasingly entrepreneurial faculty, the number of partnerships has grown over time, though without any "top-down" strategic direction and without fully established means of assessing and re-evaluating the "return on investment" of time, money, and management attention required by each specific partnership. Furthermore, while each partnership has required the active engagement of the NPS faculty and leadership, an "active" approach to cultivating strategic partnerships to advance the essential goals of the institution has not always been used.

A *tour d'horizon* of the NPS partnership landscape follows, indicating its breadth and value to the institution.

Cooperative Agreements Among Institutions As the three institutions that collectively provide the core officer education within the DoD, the USNA, NWC, and NPS have created successful partnerships. For twelve years, through its College of Distance Education, the NWC has embedded into NPS a group of satellite faculty who offer a series of four courses that fulfill the requirements for a NWC Command and Staff diploma, which includes JPME phase 1 accreditation. NPS provides facilities, administrative and academic support — schedulers, advisors, clerical, educational technologies, curriculum officers and staff from the NPS Dean of Students' Office — while NWC provides all faculty and materials for courses they offer at NPS. When invited, faculty from NWC also lecture at NPS, are readers for NPS master's theses, and work with other NPS programs. In turn, NPS faculty provide expertise and lectures for NWC courses and collaborate with NWC personnel on issues important to the DoN and DoD.

METHOD

The working group's approach was to collect and evaluate data on the School's scope of current partnerships, articulate the importance and value of partnerships, identify gaps in the spectrum of the school's current partnerships, and develop recommendations and key principles for developing and maintaining future partnerships.

The group also evaluated current and future international partners, and the School's partnership with the National Defense University, Naval War College, United States Naval Academy, peer institutions, and the community. An assessment of NPS' current partnerships was conducted and compared with DoD/DoN trends, and specifically tasked areas such as NWC and community partnerships were reviewed in the attempt to further develop recommendations for both key principles and future partnership areas.

NPS has tremendous experience in partnering with allied nation militaries spanning several years. International students have been on campus since 1954, and to date, representatives from more than 100 nations have received an education at the Naval Postgraduate School.



A seminal partnership with the Air Force Institute of Technology was signed by the Secretaries of the Air Force and Navy, respectively, to assist in collaborative work between the two institutions. As with any partnership agreement, it is a living document, informed and shaped by current events, and would benefit from a review of benefits to date and opportunities in the future.

NPS has also partnered with the Air Force Institute of Technology to develop a jointly-developed and jointly-distributed learning master's program in Cost Estimating and Analysis. Designed for the cost estimating professional, this program for civilians, contractors and military personnel is designed to help the student learn how to meet government expectations, and develop accurate and realistic cost estimates.

Broad and non-specific strategic partnerships with peer institutions include NPS collaborators in the National Security Institute (NSI) — Lawrence Livermore National Laboratory and the University of California Santa Barbara — established during this new era of research and development which requires the complete engagement of talent from academia, national laboratories and the private sector. Under NSI, a superior class of joint research programs is being created from the combination of intellectual and technological capabilities of all three institutions.

Partnerships with the Naval Surface Warfare Center, the Space and Naval Warfare Systems Command, Department of Homeland Security, Office of the Director of National Intelligence, and Commander of the United States Pacific Fleet can be categorized as enduring, long-standing and open relationships.

The National Science Foundation has established NPS as a national center and resource for aircraft assets and flight services for the national meteorological program. Among the School's most significant assets are two Twin Otter aircraft and an A-10 aircraft for severe storm research, which allow the School to participate scientifically as a peer of the best meteorological institutions in the world.

Memorandums of Agreement Memorandums of Agreement which establish Chairs at NPS have been developed with research sponsors to provide:

- a conduit for students enrollment and sponsor funding;
- links for students to their organization and opportunities for students to use their experience on their next tour or job;
- a clearly communicated plan for resolving the sponsor's issue;
- conveys the full rights and responsibilities, limits and privileges of a tenured professor by which he/she can teach and do research; and
- situational awareness of the sponsor to the broader capabilities of NPS which they may wish to exploit.

Another innovative partnership is the Navy Higher Education Information Technology Consortium (NHEITC), in which the Chief Information Officers from NWC, USNA and NPS congregate annually to share communication technology challenges and opportunities, offer tested solutions, and participate in defining the future direction of DoD/DoN initiatives that affect all three institutions.

In addition to participation in NHEITC, the NPS Vice President and Chief Information Officer is also a member of the Cisco Higher Education Executive Exchange, a ten-member group of higher education CIOs representing research universities.

Partnerships can also include multiple organizations that form partnership networks. One such example involves NPS' engagement with digital data preservation

research and network-enabled High-Performance Computing visualizations. This initiative includes CineGrid (an organization with entertainment and technology industry members as well as higher education), the Electronic

“The battlefield of today is changing rapidly. Our enemies are changing rapidly in terms of how they come at us. To confront them and to deal with a global world, we have to implement the latest technologies, and bring the military together and operate together to meet our mission. You don't learn how to do that on the battlefield, in a tank, or on a ship; you learn how to do that at the Naval Postgraduate School.”

The Honorable Leon Panetta
Secretary of Defense



Admiral Mike Mullen, Chairman of the Joint Chiefs of Staff (CJCS), spoke to NPS students, staff and faculty in Aug. 2010. He encouraged establishing relationships with other militaries around the world and working together on common issues. Part of that understanding can come from the international community represented on the NPS campus, Mullen noted, where opportunities for students to broaden their experiences and understandings are all around.

Visualization Lab at University of Illinois, Calit2 (an advanced technology center) at UC San Diego, and the Science and Technology Council of the Academy of Motion Pictures Arts and Sciences. The CineGrid Exchange Project is designed to help the DoN and other government agencies move a step closer to protecting, managing, distributing and preserving their huge quantities of video data.

The Dudley Knox Library also engages in partnership networks with several groups in order to enhance capacity, maintain awareness of current issues and challenges and work synergistically to provide solutions. These partnerships include such groups as the Consortium of Navy Higher Education Libraries which links NPS with the NWC and USNA and the Monterey Bay Area Library Cooperative which connects the library to the local community.

Cooperative Research and Development Agreements A Cooperative Research and Development Agreement (CRADA) is a written agreement between a private company and a government agency which provides a framework for both to work collaboratively on a project. NPS currently has 20 CRADAs with a variety of industry partners.

International Engagement The value of NPS is ultimately measured by the success of its students: with over 4,900 international student officer graduates since 1954, and 216 current students from 42 countries enrolled in over 35 curricula, NPS is firmly committed to its international programs. An integral link in establishing the long term military-to-military relationships between U.S. and international officers, NPS not only provides a valuable exchange of military perspectives within its unique academic environment, but also many international graduates achieve flag and general officer rank and assume positions of prominence in their military, government, and industry.

The School of International Graduate Studies provides an excellent link between NPS resident degree programs and non-degree programs taught by the Defense Resources Management Institute, Center for Civil-Military Relations,



and the International Defense Acquisition Resource Management Program, which have collectively sponsored over 100 Mobile Education Teams that have taught short courses to over 3,500 students in more than 50 countries. In addition, over 500 international officers from 100 countries have participated in resident short courses tailored to a country's requirements.

For success in executing its mission worldwide, NPS has established international educational alliances that explore cooperative graduate education and research in defense technology, systems engineering and analysis, globalization, security, public policy, and other areas of mutual interest and/or benefit.

In 2009, NPS hosted the first Global Security Challenges Roundtable in Geneva, Switzerland for representatives from eleven universities, ten research institutes, four international organizations and four humanitarian non-governmental organizations and four private sector corporations who participated in an intensive two day interdisciplinary dialogue on globalization and emerging security challenges. In attendance was Professor Jean-Dominique Vassali, Rector of the University of Geneva and Talal Abu-Ghazaleh of the German-Jordanian University College of Business, with whom NPS has launched several collaborative international initiatives.

Drawing upon the synergies of NPS and the National University of Singapore, in 2001, an 18-month Master in Defense Technology Systems dual-degree program was established under a cooperative agreement. Approximately 30 students from various nations enroll annually in the program, after which graduates will be proficient in the underlying scientific principles of key technologies and capabilities of maneuver war, precision, strike, comprehensive awareness and communications and protection/survivability; conversant in applying systems engineering methodologies in large scale and complex systems; capable of conducting technical studies and operational testing and evaluation efforts to expand systems' operating envelopes and skilled in analyzing the impact of future technologies on military operational concepts.

International partnerships leverage the benefits of NPS international enrollments in powerful ways. These are strategic to NPS' future and its value to the Navy.

Attendees of a cybersecurity workshop at Yarmouk University in Jordan listen to the opening address by NPS Executive Vice President and Provost Leonard Ferrari. The workshop is just the beginning of what NPS and Jordanian leadership hope is an expanding partnership between the two universities.

Informal Partnerships Finally, informal partnerships exist between and among organizations where no written agreement is required. Informal cooperative discussions take place that often result in joint research proposals or visiting faculty appointments or formal agreements describing more specific deliverables.

CONSIDERATIONS

Partnerships are inherently an investment of time and talent, and hence should be actively and selectively pursued and maintained where, ideally, they result in high payoff for each partner. NPS should solicit feedback from partners or prospective partners on impediments or challenges of partnering with NPS. Identify, prioritize and develop mitigations for these impediments to help NPS become a preferred partner of choice.

NPS should also identify its distinguishing characteristics as a partner, e.g. high return on investment for the next marginal dollar invested. In addition, the mechanisms in place to keep partnerships current and relevant should be reviewed. Sunset clauses and/or periodic evaluative reviews should be implemented. The review process should include the balance across partnership categories and type.

EXHIBIT I. NPS PARTNERSHIPS

	Navy/USMC	Other Military	Other Govt.	Civilian Higher Ed	Industry	Int'l	Total
Educational	19	9	5	9		7	49
Research	20	14	11	11	20	8	84
Infrastructure	2		2				4
Total	41	23	18	20	20	15	137

Exhibit 1 provides a macro view of the spectrum of current NPS partnerships. When viewed through the lens of DoN and DoD trends (see Chapter 1), there are areas that may warrant additional emphasis. For example, one could envision a need for developing stronger and more diverse international partnerships, both to leverage world-class research talent outside the U.S. and also to further enrich the NPS education experience for U.S. students' knowledge of their global partners.

Additionally, the subject area of the partnerships, e.g. Cyber, Unmanned Systems, etc. should be examined for ensuring NPS is engaged with quality partners in areas of future importance to national security. In establishing partnerships, NPS constituents should determine if the relationship will be a resource multiplier and if the partners' expertise and professional networks:

- Provide greater efficiencies;
- Increase visibility for improving NPS' competitive position;
- Increase impact opportunities; and
- Provides actionable insights for DoN or DoD policymakers or operational insights for Naval and Joint warfighters.

RECOMMENDATIONS

It is imperative that NPS partnerships align, accelerate and enhance execution of the School's mission. To achieve that end, NPS must:

1. Streamline the method of formalizing partnerships.
2. Take an active approach to developing and maintaining partnerships.
3. Maintain relevance to national security, the DoN and United States Marine Corps, Air Force, Army and Coast Guard as a key metric for partnerships.
4. Develop operational partnerships to demonstrate relevance to key constituents.
5. Communicate results of the school's partnerships to civilian and military leaders.

Organization

BACKGROUND

The Naval Postgraduate School is a graduate research university whose mission is focused on priorities related to national security. As a Department of the Navy institution, NPS is subject to regulatory compliance across a broad spectrum of areas. As a fully accredited institution, NPS is also subject to higher education standards of capacity and quality. Additional professional accreditations for engineering, business and public policy/administration provide further and more specific programmatic criteria.

OBSERVATIONS

NPS Leadership Because of the unique mission of the NPS, it is a strategic advantage to have a university President with ties to the Department of Defense in general and the Department of the Navy specifically. The current situation, of having a President with a five-year position, is a major improvement over the previous short-term tenure of an active duty superintendent. Longevity is important for universities because it takes time to plan and execute academic and administrative programs.

Within the context of this topic, it is worth discussing the rest of the leadership structure. For example, the current structure of Vice Presidents and Deans appears to be a logical distribution of workload and responsibilities but perhaps a more precise definition of these job functions and the length of their tenure requires further discussion. Currently, the NPS has four vice presidents: the Provost (Executive VP), the VP of Finance and Administration, the Vice President for Information Resources and Chief Information Officer, and the Vice President of Research; while the Vice Provost for Academic Affairs is not a VP, this position is more aligned with the VP structure. The University Librarian heads the Dudley Knox Library. The NPS has six deans: Dean of the Graduate School of Engineering and Applied Science (GSEAS), Dean of the Graduate School of Operational and Information Sciences (GSOIS), Dean of the Graduate School of Business and Public Policy (GSBPP), Dean of the School of International and Graduate Studies (SIGS), Dean of Students (the only military dean), and the Dean of Research (who is also the VP of Research). With the exception of the Dean of Students, the deans are primarily civilian and (more importantly) academics. This appears to offer a healthy balance of administrators (those who understand how to manage an academic institution) and academics (those who understand what the faculty does on a day-to-day basis) within the university leadership. The Dean of Research, however, appears to be out of place within this precise definition of administrators and academics since the position overlaps both realms.

The next level of faculty administrators (below the school deans) are the department chairs. The department chairs represent the first line of communication between the faculty and the administration. To maintain fresh perspectives it is advantageous to rotate faculty members through the position of department chair. This has the added advantage that faculty members with the ability for university leadership positions can be identified more easily. A more regular rotation in the Deans' offices is healthy for the institution because a fresh perspective is maintained while ensuring that the Dean's office has a closer tie to the faculty (the conjecture is that a Dean who neither teaches nor does research will quickly lose touch with what it means to be a faculty member).

Commitment to External Review and Accountability External review is the cornerstone of American higher education, and NPS has externalized review at all levels: from the department to the institutional. Every five to seven years, departments undergo an academic program review which involves a departmental self-study, an external review team of disciplinary leaders from around the country who conduct an intensive campus visit, and deliver a final report with recommendations for improvement in both the educational and research programs. Curricular reviews are conducted every two years with curriculum sponsors in the DoN and DoD who evaluate the currency

METHOD

The Committee reviewed a number of NPS documents, reports, and analyses having to do with institutional mission, structure and organization, including self-study reports submitted to the Western Association of Schools and Colleges from 2006–2009 as well as external consultant reports such as the Organizational Structure Analysis by LMI in April 2008. Numerous individuals on campus provided input as well. (Refs. 62, 85, 88, 95, 97, 98).

NPS President Dan Oliver engages Chief of Naval Operations Adm. Gary Roughead in conversation during a recent campus visit in early 2011. The university has made great strides to stabilize its organization leadership over the past several years.





and relevancy of programs for serving Navy and Defense priorities. As a result, accountability and commitment to continuous improvement are embedded in the essential work of NPS.

The recent reaccreditation of NPS for a full ten years by the Western Association of Schools and Colleges (WASC), the regional accrediting authority for higher education institutions, was an extraordinary endorsement of this commitment. This decision by the Senior College Commission of WASC was noteworthy and important. While full term reaccreditation may be more common in other regions, this is not the case in the WASC region.

NPS is also subject to review by the Navy Inspector General. The most recent review yielded useful recommendations and strong endorsement of NPS' strategic planning.

Balancing Accountability with Mission Execution Because NPS is both a DoN and higher education institution, providing information about the institution is essential for NPS; however, many of the regulatory and reporting requirements are not applicable and do not contribute to mission improvement. In fact, the time that is required to respond often takes away from attention to the core mission of the institution.

In this report, seven of the nine working groups recommended that NPS consider a different organizational model that will permit a more accommodating structure to its distinctive role as both a Navy and higher education institution in service to the nation's security priorities.

An example of some regulatory or structural issues that actually serve as impediments to NPS' progress include:

1. Financial Issues

- **Contracting** Research universities purchase a wide variety of products and services, ranging in volume and technical complexity. This is not widely understood with regional contracting centers and recurring efforts to reduce the number of contracts required by NPS illustrates this issue.
- **Indirect Cost Recovery** This is unevenly understood within the DoN and is another crucial issue relating to NPS core funding capacity.

Students attend a lecture in one of several academic buildings on campus. While the university continues an exhaustive effort to define best organizational processes, the institution must also keep a firm hand on its core mission, to educate officers of the Navy, the U.S. uniformed services, and the militaries of our allies across the world.

- **Roll-Over Funds** Being able to roll funds into subsequent years is a capability that is standard operating procedure at other universities. It allows for better management of resources.
- **Multiple Budget Planning Requests** Requests for information are often redundant, deadlines are unrealistic and follow-through information is not provided.
- **Unfunded Mandates** While some are unavoidable, many should be assessed with a mindful eye to NPS mission.
- **Timing of Financial Support** A stable budget procedure that includes multi-year planning is important for building academic quality.
- **Travel System** While Defense Travel System performs reasonably well for travel within the U.S., international travel is challenging. Since many of NPS faculty members travel throughout the world, this is a significant obstacle to business efficiencies.
- **Institutional Control** Resource allocation based on institutional priorities is currently not possible because many of the resources are governed by Navy organizations outside the purview of the NPS leadership: facilities, human resources, security, public works, and auxiliary services (MWR, Golf Course, etc.)
- **Ability to Create Endowed Chairs for Select Faculty Members** This would allow the institution to attract senior nationally renowned scholars to NPS.

2. Staff

- **Increased Support for Staff Professional Development** Staff development has an inconsistent history at NPS. Recently, NPS has committed to more support for this area. In 2007, the Staff Development Advisory Committee (SDAC) was formed to provide a framework for career and professional development opportunities. One of the first activities was a staff survey regarding development needs, followed by focus groups and interviews. As a result of the data collection effort, recommendations to the President included: (1) a need for stronger orientation programs (needed for both faculty and staff), (2) more training opportunities, (3) better communication about advancement opportunities and (4) funding for training. Training for certain levels of administrative support positions should be standardized and regularly available. Too often, staff members are thrown into positions where they have to learn complex procedures, use awkward and unfriendly software, and have little or no training to accomplish the tasks. This sends a message of inefficient and insensitive management. Unnecessary, repetitious or irrelevant training should be eliminated.

“What really matters today is your vision, plans, doctrine and how to put it all together. To maintain the advantage, we need to have a systems focus and take time to experiment to get to the right decision.”

Dr. Peter W. Singer
Foreign Policy Senior Fellow
Director, 21st Century Defense Initiative
Brookings Institution

- **Hiring** Although National Security Personnel System has been terminated, it provided hiring flexibility useful for a research university where hiring the most talented individuals for sophisticated, technical areas is urgent. Similarly, the flexibility provided by the Navy internship program to bring in more junior staff in targeted technical areas was also cancelled. NPS also needs the ability to conduct better external searches for administrators and managers at all levels.
 - **Pay Flexibility** To meet service level agreements, it would be more useful to offer “stand-by” pay rather than adding staff members. For example, where coverage is required for the data center, it is more efficient to provide stand-by pay for existing staff members than adding new staff. In addition, while salaries are competitive at the assistant and associate professor levels, the pay ceiling for senior faculty members makes recruitment at this level nearly impossible.
- #### 3. Institutional Visibility
- It is important for NPS to communicate with constituents, stakeholders, industry, other universities, and prospective students and faculty. To accomplish this requires support for communications vehicles (publications, web operations, media placements, conference support, and promotional initiatives).
 - **Fund-Raising** All civilian universities, either public or private, have the ability to raise corporate and private funds for the institution. Permitting NPS to support fund-raising would allow the institution to develop an annual fund for support, collect alumni organization dues, and launch a major fund-raising campaign to build an endowment.

4. Facilities

- **Quality of Work Surroundings** The amount of available space for NPS is insufficient. Some faculty and staff do not have adequate spaces for the type of work performed. Quality of air conditioning/heating in some buildings is substandard. In comparison to facilities the Committee observed at the Naval War College and the Air Force Institute of Technology, NPS facilities are below average.
- **Condition of Laboratories** Because they require special research instrumentation, maintenance coverage, and environmental consideration (e.g. clean room or special HVAC requirements), science and engineering laboratories should be funded on a life-cycle management model.
- **Upgrades** The ability to build new facilities or undertake major renovations is a capability afforded every other university.

CONSIDERATIONS

A number of different organizational models should be considered for NPS. A few of these are described below:

University Affiliated Research Center (UARC) UARCs are owned by a university, subject to the regulations of that institution. The ability to accept MIPRs would have to be explicit. Often, these are considered Department of Defense research centers dedicated to engineering, science and technology areas defined as strategic to the DoD. UARCs receive sole source funding under the authority of 10 U.S.C. Section 2304(c) (3)(B) and may compete for other external funds.

Research Park Research parks associated with universities often provide an effective mix of higher education, research, government and private industry strengths dedicated to a common set of goals and objectives. Resources are leveraged in effective ways, and cooperative work can be actively facilitated. Exploring a research park model in conjunction with the Naval Postgraduate School might be a model to consider.

Research University Partnership Partnerships with civilian universities can yield similar benefits of shared access to research instrumentation, faculty members, graduate students, and larger research proposal development. A recent article in the *Chronicle of Higher Education* reported that with decreasing institutional budgets, “big science” is getting new visibility. This suggests larger proposals that are multi-disciplinary and even multi-institutional. In order to participate in such proposals, NPS must be able to have similar standing with those institutions with regard to its internal operations and ability to share and commit resources.

Federally Funded Research and Development Center (FFRDC or GOCO) This is an organizational structure that is similar to a UARC but does not require affiliation with a civilian university. Examples of FFRDCs are the Department of Energy (DoE) Laboratories, Center for Naval Analyses (CNA), and the National Center for Atmospheric Research (NCAR). The typical format of an FFRDC is that they are sponsored by a specific government agency. For example CNA is sponsored by the DoD, the DoE Labs by DoE, and NCAR by NSF.

Special Charter Status Special charter status has been used effectively by other universities nationally and may be appropriate within the DoN. A number of institutions are state universities with special charters with their respective states. Rutgers, The State University of New Jersey, has a charter that established it as a public university in 1956. The charter exempted the university from certain state regulations and policies with the understanding that Rutgers required such flexibility to mature and improve its standing as a national research university. The flexibility provided Rutgers paid off. In the 1980s, Rutgers was admitted to the prestigious American Association of Universities (AAU), the top 60 research universities in North America. The University of California system has a similar charter for the same purpose. Of the eight UC campuses eligible for AAU consideration, seven are AAU institutions.

“NPS is part of our heritage and provides the Navy with the opportunity to influence what the Navy gets out of a graduate education. This is distinctive, important and strategic for our future.”

Adm. Jonathan W. Greenert
Vice Chief of Naval Operations

Special charter status does not suggest lack of accountability or regulatory compliance. It simply means an acknowledgment of the special nature of research universities and the need for some flexibility in operations. Each of



President Dan Oliver, left, met with Executive Vice President and Provost Leonard Ferrari, right, and the Classified Computing Committee in November 2010. Recognizing the need to ensure classified computing capabilities were given due attention, campus leaders convened to examine the university's current infrastructure, and provide recommendations on how best to move forward.

the universities mentioned above are accountable to their sponsors and are required to provide information about their stewardship of resources and their academic quality.

Similar charter status for NPS would underscore the distinctive requirements of a research university and could be crafted with the distinctive framework of the DoN in mind. Further, the charter could be time-bound for some period (e.g. ten years), at which point the arrangement could be reviewed for impact and effectiveness.

The charter would provide greater administrative and operational flexibility for NPS and permit it to focus more sharply on its core mission of education and research in support of priorities related to national security. At the same time, the charter would provide appropriate reporting and performance measures to ensure accountability to the DoN.

RECOMMENDATIONS

1. Explore an organizational model that better addresses NPS' requirements as a research university. While more research is required to adequately assess costs and benefits, development of a charter between NPS and the Department of the Navy would ultimately provide the Navy with increased support more effectively and efficiently.
2. Recognize the importance of future growth in the classified areas as part of organizational and facilities plans.
3. Provide increased support for staff professional development.

Conclusion

The future is defined by instability in the geostrategic landscape, growing complexity, increasing sophistication of technology, significant resource constraints, and environmental challenges. All of these contribute to extreme levels of uncertainty in multiple dimensions. The implications for defense and national security are the same as for higher education institutions: large bureaucratic institutions should become more flexible and responsive to emerging requirements.

Institutions will be engaging people who are intellectually curious, tolerate ambiguity; embrace abstraction and lifelong learning, and are creative. Those needed skills and understandings will influence curricula development and change the way in which the military, government and industry selects its leaders.

The Naval Postgraduate School has demonstrated great skill and energy in the development of impressive outputs. Graduates are talented, capable and effective. They are educated in both theory and practice, and able to apply knowledge in a wide-ranging variety of operational scenarios. Graduates view their education as dynamic and continuing beyond the diploma earned at NPS. They continually seek out new knowledge and reach back to NPS for assistance in their quest. The challenge is in the area of inputs. Resources are constrained by both dollars and regulatory strictures. Having flexibility in being able to seek a more diverse resource base and getting relief from statutes and regulations that do not add value to mission is the most important priority for NPS in defining its future success.

For the Naval Postgraduate School, the recommendations in the previous chapters are specific to the topics of those report sections and important for the institution to implement. Many are internally focused and are immediately actionable. Instead of listing those again, the following recommendations distill the most important themes of the Committee's deliberations and imperatives for action that include an external reach with actions that require DoN engagement:

1. Implement a special charter status for NPS with the Department of the Navy that provides flexibility in hiring faculty and staff, funding and fund-raising, facilities, student markets, advertising/recruitment, and partnerships.
2. Capitalize on the need for innovation across capabilities, operational concepts, personnel policies and organizational structures.
3. Continue NPS' responsiveness to national security priorities and accelerate development of hybrid resident/distant programs to improve responsiveness to DoD/DoN and federal agency requirements. Investments in this area should consider the establishment of conference facilities.
4. Make the following visible and aggressive institutional priorities: classified research and education capabilities, energy, government acquisition, cyber, modeling and simulation, regional studies, and unmanned systems. Investments will have to include expansion of classified facilities.
5. Expand the NPS research portfolio and rebalance to increase 6.1/6.2 research.

“The papers may be lost, the projects may be forgotten, but what will remain are those revelations that you had, the lessons you learned and the visions that you will have developed by being in this extraordinarily rich environment. They will shape your perceptions, and more importantly, they should shape your actions as warfighters and as leaders.”

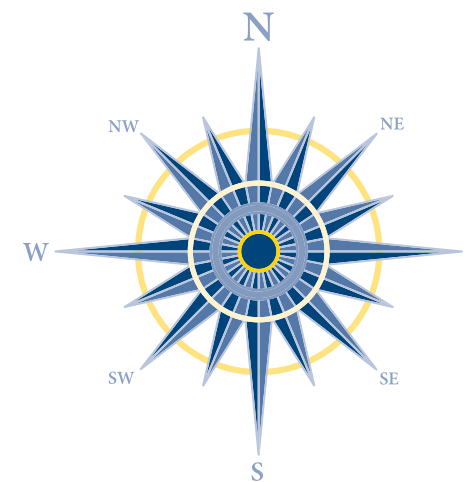
*Adm. Gary Roughead
Chief of Naval Operations*

6. Maintain technological flexibility with a robust cyberinfrastructure and services.
7. Consolidate base operations with local community and other local Department of Defense assets.
8. Work with SECNAV to modify promotion board precepts to value quality graduate education in the selection process. Request the CNO designate NPS and NWC as the major contributors to the Navy's Graduate Education Strategy with objectives that place them at the core of providing graduate education for the Navy and other Services (and civilians).
9. Promote the NPS value proposition with DoD, DoN and federal agency leaders through programs, events, publications, and media.

Like the Department of Defense and the Department of the Navy it serves, NPS faces a future defined by complexity and uncertainty. Its mission and the tools it uses to educate students and conduct research are likely to change more rapidly than ever before, and its sponsors will be relentless in their search for operating efficiencies. These macro trends have implications for nearly every aspect of NPS operations. The next Strategic Plan will have to account for specific adjustments related to the above. More difficult perhaps will be the need to assess carefully some fundamental but difficult changes in organization and leadership selection, so that NPS has the agility and flexibility to meet 21st century challenges.

The crucial element for the future is flexibility — not continued requests for additional resources or building on existing programs using the same historical patterns for program growth. The successful institutions of the future will be adaptable to changing conditions or newly discovered information. Speed of responsiveness will be another defining factor. But they require the flexibility to recruit and retain the best faculty and staff talent, expand and reduce physical capacity as needed, raise funds, reallocate resources, publicly communicate their intentions and accomplishments, expand student markets, increase international enrollments and engage in partnerships with other institutions and industry.

The above recommendations represent actions that will provide NPS with the flexibility to innovate and excel in targeted areas of curriculum and scientific inquiry, and to raise NPS' national and global profile as a world-class institution of education, research and service to national security priorities.



When the CNO visited NPS as the graduation speaker in March 2011, he and President Oliver had occasion to discuss the work of the Committee on the Future. The CNO was intrigued by the findings to date and asked to meet with President Oliver on May 16, 2011 for a half-day session where many of the above recommendations were discussed and subsequent related actions were directed. It is gratifying for the Committee to see the value of NPS being leveraged by the CNO in open discussions and consideration of innovative approaches to NPS' future contributions. This is precisely the kind of adaptability and responsiveness to emerging requirements that will define a successful future — for NPS and the Department of the Navy.

Appendix 1: CHARTER LETTER

NAVAL POSTGRADUATE SCHOOL COMMITTEE ON THE FUTURE CHARTER APRIL 2010

As the Naval Postgraduate School implements its strategic plan, *Vision for a New Century*, and works to extend that vision, the Committee on the Future is asked to look beyond the boundaries of the present and into the possibilities of the future. The world continues to change at a significant pace and higher education institutions must challenge themselves to stay current with the frontiers of knowledge creation and scientific inquiry.

The Committee on the Future is asked to consider some of the important changes on the higher education landscape and provide advice about how the Naval Postgraduate School can fully realize its potential itself as a central resource to the nation — a center of academic quality, in research and graduate education, and a source of relevant, leading edge information on national security priorities.

A university is more than a collection of curricula and projects, faculty and students — it is an intellectual energy that fuels inquiry and provokes the status quo. How an institution ensures its edge is by asking thought leaders to comment on how the future will be shaped. Specifically, NPS needs to hear what academic areas are crucial to national security, what technologies must be developed, what multidisciplinary synergies must be cultivated, and what focused areas of research must be supported. At the same time, NPS needs to hear about alternate resourcing strategies, possible improvements to use of existing resources, and methods for priority-setting.

The Committee is asked to take a full year to develop its report and to consider the voice of the campus community as well as opinions of leaders in the Department of Navy, Defense, other federal agencies, higher education institutions, and those of our global partners.

Chair of the Committee

Rear Adm. Jerry Ellis, USN (ret)
Professor and Chair, Undersea Warfare

Membership

Dr. Christine Haska
*NPS Vice President for Information Resources,
Vice Chair*

Mr. Michael Bayer
*President/CEO, Dumbarton Strategies,
NPS Board of Advisors*

Mr. Mark Breckenridge
*Deputy Director, Defense Manpower
Data Center*

Capt. James Durham USN (ret)
Chief Operating Officer, Strategic Analysis, Inc.

Mr. James M. McGarrath
*PE, Rear Adm., CEC, USN (ret), Director,
Information Technology and Telecommunications
Laboratory, Georgia Tech Research Institute*

Dr. Frank Giraldo
NPS Professor, NPS Faculty Council

Mr. Mark Gorenflo
*SES, Principal Deputy and Senior Director
for Future Capabilities for the Deputy Under
Secretary of the Navy for Plans, Policy,
Oversight and Integration*

Capt. Karl M. Hasslinger, USN (ret)
*Director, Washington Operations,
General Dynamics, Electric Boat*

Dr. Doug Moses
NPS Vice Provost for Academic Affairs

Ms. Colleen Nickles
*NPS Vice President, Administration
and Finance*

Dr. Sunder Ramaswamy
*President, Monterey Institute
of International Studies*

Dr. Karl van Bibber
NPS Vice President for Research

Maj. Randy Staab
Chair, President's Student Council, 2010

Appendix 2: MEMBERS' BIOGRAPHIES

The membership composition of the Committee on the Future, Naval Postgraduate School has been selected ensuring a balanced, independent perspective representing the following factions:

Academia
Military (Navy, Air Force, Marine Corps, Army)
Business
Research
National Security

REAR ADM. W. G. "JERRY" ELLIS, U.S. NAVY (RET.)

*Undersea Warfare Chair and the Director of the Undersea Warfare
Research Center, Naval Postgraduate School*

Rear Admiral W. G. "Jerry" Ellis, U.S. Navy (Ret.), became the Undersea Warfare Chair and the Director of the Undersea Warfare Research Center at the Naval Postgraduate School in Monterey, California, in March 2009. Prior to this, he served as the Special Assistant for Undersea Strategy in the Office of the Secretary of the Navy. As such, he was the senior advisor to the Secretary of the Navy for policy relating to the Department of the Navy's Undersea Warfare Strategy.

After 36 years of active duty, Rear Admiral Ellis retired and entered the Senior Executive Service in June 2000, continuing on as the Director of the Deep Submergence Program and Director, Defense Liaison Division. In that position he served as the CNO's principal advisor on Submarine Rescue, Deep Submergence Vehicles, and Deep Diving Operations.

Rear Admiral Ellis attended Georgia Tech for one year before attending the U.S. Naval Academy, graduating with distinction in 1964. A career nuclear submariner, Rear Admiral Ellis served aboard the submarines *USS Catfish* (SS 339), *USS Snook* (SSN 592), *USS Billfish* (SSN 676), and *USS Andrew Jackson* (SSBN 619). He commanded *USS Ulysses S. Grant* (SSBN 631) conducting missile patrols out of Holy Loch, Scotland. In addition, he was the first Commanding Officer of *USS City of Corpus Christi* (SSN 705). He also commanded Submarine Squadron Six, which included a submarine tender and ten attack submarines. While assigned as the Chief of Staff for Commander Submarine Force U.S. Atlantic Fleet, he was selected for Flag Rank. As a Flag Officer, he served as Commander Submarine Group Ten, which consisted of all strategic submarines in the Atlantic Fleet. His final sea assignment was command of the U.S. Pacific Fleet Submarine Force.

Ashore, Rear Admiral Ellis served as the Director of the Enlisted Nuclear Power School in Mare Island, California. Later, as a Captain, he was the Head Detailer for all enlisted submariners and nuclear trained personnel in the Bureau of Naval Personnel. Following this, he was the Senior Member of the Atlantic Fleet's Nuclear Propulsion Examining

Board charged with inspecting and ensuring the safety of all nuclear powered ships and submarines in the Atlantic. His first tour as a Flag Officer was as the Deputy Assistant Secretary for Military Application in the Department of Energy. This was accomplished during a period of great change to the Nation's Nuclear Weapons Program. In addition, Rear Admiral Ellis has also served as the Oceanographer of the Navy and as Director, Navy Special Programs.

Rear Admiral Ellis' personal decorations include the Defense Distinguished Service Medal, the Navy Distinguished Service Medal (two awards), the Legion of Merit (five awards), the Meritorious Service Medal (three awards), the Navy and Marine Corps Commendation Medal, the Navy and Marine Corps Achievement Medal, and various service and campaign awards. As a Senior Executive, he was awarded the Meritorious Senior Executive Presidential Rank Award for 2004 and 2009. In June, 2007, Rear Admiral Ellis was presented the National Intelligence Distinguished Service Medal, the Nation's highest award for Intelligence. Recently, the Secretary of the Navy presented him with the Distinguished Civilian Service Award, the highest Department of the Navy award for civilian service.

During his career, Rear Admiral Ellis earned a Masters Degree from Sloan School of Management at MIT as a Chief of Naval Operations Scholar. He has also attended the Naval War College and many other executive-level courses. He serves on the Advisory Council of the Naval Submarine League and is a former National Director for the Navy League of the United States. In addition, he is a former Chairman of the Board of Trustees for the Georgia Tech Research Corporation and the Georgia Tech Applied Research Corporation. He is currently serving as a member of the External Advisory Council for the Georgia Tech Research Institute and a member of the External Advisory Board for the Applied Physics Laboratory of the University of Washington.

MICHAEL BAYER

*President/CEO, Dumbarton Strategies, and Board of Advisors,
Naval Postgraduate School*

Michael Bayer is the President and CEO of Dumbarton Strategies which provides strategic planning and merger and acquisition counsel for enterprises engaged in the energy and national security sectors. Mr. Bayer also serves as Director of Dyncorp International, Siga Technologies Inc, and Willbros Group Inc. In addition, he is the Chairman of the Defense Business Board, a member of the Sandia National Laboratory's National Security Advisory Panel, the Defense Science Board, the Oak Ridge National Laboratory's National Security Strategic Advisory Group, and the CNO's Executive Panel. Early in his career, he was Counsel to a senior Member of the U.S. House of Representatives, Deputy Assistant Secretary at the U.S. Department of Energy, Malcolm

Baldrige's Associate Deputy Secretary of Commerce, Counselor to the U.S. Synthetic Fuels Corp, Counselor to President Bush's Commission on Aviation Security and Terrorism, and the Federal Inspector for the Alaska Natural Gas Transportation System.

MARK BRECKENRIDGE

SES, Deputy Director, Defense Manpower Data Center

Mr. Breckenridge is the Deputy Director of the Defense Manpower Center (DMDC) and is responsible for oversight of the largest and most comprehensive identity protection family of systems in the Department of Defense (DoD), management of a dozen major operational DoD programs, oversight of DoD eligibility and benefits management systems, supervision of a multi-disciplinary staff, and administration of the Seaside, California office. DMDC responds to the information and analysis requirements of the Office of the Secretary of Defense (OSD), the Military Departments, the Congress and others involved in developing and evaluating manpower and personnel policy. Prior to his current assignment, Mr. Breckenridge served as the Deputy Director of the Identity Authentication Office (IAO) at DMDC. He was responsible for program management of secure enterprise identity management and access solutions including the Defense Biometric Identification System (DBIDS). DBIDS is the largest operational physical access and authentication system in the Department of Defense and is used to protect military bases around the world. Mr. Breckenridge holds a Master's degree in Software Engineering from National University, and is a 1980 graduate of the United States Naval Academy. He is also a graduate of the Federal Executive Institute.

CAPT. JAMES DURHAM USN (RET)

Vice President and Director, Undersea Systems and Technology Systems Planning and Analysis, Inc.

James Durham leads the Naval Systems, Technology and Analysis Division, which conducts assessments, program and acquisition planning, systems engineering and effectiveness analyses across a spectrum of naval and national security issues. The Division is comprised of three groups: the Intelligence, Surveillance, Reconnaissance Systems Group, the Underwater Technology Assessment Group, and the Joint Tactical Analysis Group.

Mr. Durham has more than 36 years experience in the management, development and implementation of undersea systems, including 26 years as a Navy Officer in submarine command and intelligence operations. His experience includes programmatic assessments, and assessment of technical, operational, and financial aspects of various programs, emerging technology concepts and systems. He has been with Systems Planning and Analysis, Inc. since 1996.

Mr. Durham holds a degree in Mathematics from the U.S. Naval Academy, and a degree in Ocean Engineering from MIT and Woods Hole Oceanographic Institution.

NOTE: In 2011, Mr. Durham became the Chief Operating Officer of Strategic Analysis, Inc.

DR. FRANK GIRALDO

Professor and Associate Chair for Research, Department of Applied Mathematics, Graduate School of Engineering and Applied Sciences, Naval Postgraduate School

Dr. Frank Giraldo is a Professor and Associate Chair for Research in the Department of Applied Mathematics and Graduate School of Engineering and Applied Sciences at the Naval Postgraduate School. In addition to teaching and lecturing at the Naval Postgraduate School, Dr. Giraldo has headed up many important research projects, received numerous grants and several prestigious awards and honors for his work. The focus of his work has been in the development of accurate and efficient computer models for predicting the behavior of the atmosphere and ocean. Among his achievements, is the construction a new atmospheric model called NSEAM, currently shown to be the most accurate atmospheric model in existence.

He is also the Chairman Elect for the Naval Postgraduate School's Faculty Council.

Dr. Frank Giraldo received BS in Mechanical Aerospace Engineering from Princeton University and his PhD in Mechanical and Aerospace Engineering from the University of Virginia.

MARK GORENFLO

SES, Principal Deputy and Senior Director for Future Capabilities for the Deputy Under Secretary of the Navy for Plans, Policy, Oversight and Integration

Mr. Gorenflo was first appointed to the Senior Executive Service as the Deputy Assistant Secretary for Policy for the Department of Veterans Affairs in April 2008. From Sept. 2007–April 2008, he served as Acting Principal Director for Forces Transformation & Resources in OSD. From August 2005–August 2007, Mr. Gorenflo served as the Director of Communications for the 7th Vice Chairman of the Joint Chief of Staff, Adm. E.P. Giambastiani, USN. His first appointment in the Civil Service was as the Director of the Commanders Advisory Group for the Supreme Allied Commander Transformation/Commander U.S. Joint Forces Command in Norfolk, VA from October 2004–August 2005.

From 1983 to 2004, Mr. Gorenflo served as a submariner in the United States navy, retiring as a Commander. During his Navy career, he served aboard *USS Norfolk* (SSN714), *USS Montpelier* (SSN 765) as new construction Engineer, and *USS Georgia* (SSBN 729) (Blue) as Executive Officer and commanded *USS Parche* (SSN683).

Mr. Gorenflo graduated with distinction from the United States Naval Academy in 1983, where he served as Brigade Commander and received a bachelor's of science as a Trident Scholar. He went on to receive a master's of arts degree in politics and philosophy as a Rhodes Scholar from the University of Oxford in 1985.

CAPT. KARL M. HASSLINGER, USN (RET)

Director, Washington Operations General Dynamics, Electric Boat

Karl M. Hasslinger is a retired Navy Captain and former nuclear attack submarine commander with a background in defense strategy. He served as a Fellow on the Chief of Naval Operations Strategic Studies Group, as the Strategic Planning Assistant to the Director of Submarine Warfare on the Chief of Naval Operations staff and as a Military Assistant in the Office of Secretary of Defense — Net Assessment. He is currently the Director of Washington Operations for General Dynamics Electric Boat, where he is responsible for the company's strategic analysis, government relations, business development and missile defense activities.

DR. CHRISTINE M. HASKA

Vice President of Information Resources and CIO, Naval Postgraduate School

Dr. Haska joined The Naval Postgraduate School as CIO (Chief Information Officer) in 2002, and soon after established the Office of Institutional Research. In 2007, she also took on responsibility for Institutional Advancement. The Information Resources portfolio includes a number of areas: Information Technology and Communication Services, Institutional Research and Planning, Educational Technology, Information Assurance, and Institutional Advancement. She serves on the Higher Education and Research Competitive Cluster for the region, and is engaged in a number of collaborative initiatives with other higher education and Department of Defense institutions. Dr. Haska earned her baccalaureate and master's degrees from San Jose State University and her Ph.D. from the University of Arizona.

At NPS, she led the effort to develop a five-year strategic plan for Information Technology, she established a program of ongoing Institutional Research to support accreditation and strategic planning, and worked with colleagues at the Naval Academy and Naval War College to develop the Navy Higher Education IT Consortium. Dr. Haska is one of the six CIOs overseeing the Monterey Peninsula DoDNet, a regional infrastructure linking six local Department of Defense organizations. Dr. Haska has been active in publishing articles and presenting papers at professional association conferences.

For ten years previously, she served as Vice President for Planning at Rutgers, The State University of New Jersey, overseeing Information Technology, University Communications, Institutional Research and Strategic Planning. Prior to that, she worked at Tulane University for eight years, her last position there being Deputy Provost.

REAR ADM. JAMES M. MCGARRAH, PE, CEC, USN (RET)

Director, Information Technology and Telecommunications Laboratory, Georgia Tech Research Institute

Following successful Navy and telecommunications industry careers, Jim McGarrah joined the Georgia Tech Research Institute (GTRI) in November, 2008, as the Director of the Information Technology and Telecommunications Laboratory (ITTL). In this capacity, he leads over 200 research faculty, staff and students in delivering applied research solutions for sponsors in federal, state and local government and in the commercial sector.

Jim graduated "With Distinction" from the U.S. Naval Academy with a Bachelor of Science degree in Mechanical Engineering and received his Navy commission in 1973. He served in both the active and reserve components of the U.S. Navy for 33 years. His key assignments included Electronic Warfare Officer and Damage Control Assistant in *USS Belknap* (CG-26), staff engineer assignments with U.S. Central Command and U.S. European Command, and various line and staff assignments in the Naval Construction Force. During his command of Naval Mobile Construction Battalion TWENTY-FOUR (NMCB-24), he led recovery operations in the Southeastern U.S. following Hurricane Hugo, and supported operations of the FIRST Marine Expeditionary Force in Saudi Arabia and Kuwait during Operation Desert Storm. His "Seabee" battalion was twice selected as "Best of Type" under his command. He also commanded the THIRD Naval Construction Regiment and served as Deputy Commander of the FIRST Naval Construction Division. During his final uniformed position as Deputy Chief of Civil Engineers and Director of the Contingency Engineering Group, he assumed additional duties leading a special assignment for the Secretary of the Navy. Following retirement from the Navy in 2006 as a Rear Admiral (O-8), he served an additional two years as a senior civilian Special Assistant working for the Deputy Secretary of Defense. His military awards include the Defense Distinguished Service Medal, Legion of Merit, Bronze Star Medal, Meritorious Service Medal (2), Navy/Marine Corps Commendation Medal (3), Navy/Marine Corps Achievement Medal and various campaign and service medals.

In addition to his military career, Jim spent 24 years in the telecommunications industry working for Southern Bell, BellSouth and Cingular Wireless. He served primarily in operational and planning assignments with the network department. He also led organizations that were involved in the evaluation and deployment of new technologies such as fiber optics and wireless communications. He represented BellSouth's wireless segments for four years in various North American telecommunications standards organizations. He retired from Cingular Wireless in 2003 as Executive Director of National Network Planning and Operations.

Jim holds a Master's of Arts degree in Human Resource Management from Pepperdine University, a Master's of Science degree in Mechanical Engineering from Georgia Institute of Technology, and is a registered Professional Engineer in the state of Georgia. He is an active member and Chairman of the Board of Trustees of his church, a member of several civic and professional organizations, and is Past President and member of the Board of the Seabee Memorial Scholarship Association.

DR. DOUG MOSES

Vice Provost of Academic Affairs, Naval Postgraduate School

Dr. O. Douglas Moses is currently the Vice Provost of Academic Affairs. A graduate of Cornell University, San Diego State University and University of California Los Angeles, where he received his B.A., M.B.A. and Ph.D., respectively.

Dr. Moses has served at NPS as an Associate Professor in the Graduate School of Business and Public Policy and Associate Provost for Academic Affairs, an Associate Dean and Associate Chair of Instruction,

and as an Academic Associate for Financial Management. Dr. Moses has also been a visiting lecturer at Stanford University, University of California Berkeley, Santa Cruz and Los Angeles, at California State University Hayward, San Jose State University and at Golden Gate University.

A veteran of the United States Navy, Dr. Moses' teaching and research interests include financial and managerial accounting, reporting and statement analysis as well as business education. A recipient of the Allen Griffin Award and the John Jay Schieffelin Award for Excellence in Teaching, and the Arthur Anderson Distinguished Teaching Award at University of California Los Angeles. Dr. Moses is also a member of the American Accounting Association.

Publications by Dr. Moses include *Error Patterns from Alternative Cost Progress Models*, published in the *Journal of Parametrics; Organizational Slack and Risk Taking Behavior*, published in the *Journal of Organizational Change Management; Cash Flow Signals and Analysts' Earnings Forecast Revisions*, published in the *Journal of Business Finance and Accounting*.

MS. COLLEEN NICKLES

*Vice President of Finance and Administration,
Naval Postgraduate School*

Ms. Colleen Nickles, Vice President, is the chief administrative officer for Finance and Administration at the Naval Postgraduate School. Her responsibilities include providing vision and leadership for a number of academic support services to the campus, and representing NPS with external parties on financial and administrative issues. She has organizational responsibility for the Comptroller's Office, Command Evaluation, Resource Planning and Management, and financial systems support. She is the executive sponsor for the implementation of the Quali Financial System at NPS. Vice President Nickles is a member of the NPS senior leadership team, serving on the Provost's Council and the President's Executive Council. She currently serves on the NPS Western Association of Schools and Colleges (WASC) Steering Committee and the Educational Effectiveness Task Force, and participates with WASC as an evaluator for other institutions.

Ms. Nickles has a Master's Degree in Higher Education Administration from the University of California, Berkeley, and an undergraduate degree in Business Education from the University of Illinois, Champaign-Urbana. She has spent the past 25 years of her career in serving higher education institutions. Before assuming the title of Vice President, Ms. Nickles was a Special Advisor to the President at NPS for financial and administrative matters. Previous to her service at NPS, she was Assistant Vice Chancellor for Financial Services in the Chancellor's Office of the California State University, with responsibility for Accounting, Sponsored Programs, Contracts and Procurement, Risk Management, External Finance, Cash Management, Banking, and Investments for the 23 campus system. Ms. Nickles spent 17 years with the University of California in budget, finance, cash management, and administrative roles in the Treasurer's Office, the Office of the President, and the San Francisco campus. During her seven years with the California State University, she also served as Associate Vice President and Auxiliary Director for the Monterey Bay campus of the California State University.

DR. SUNDER RAMASWAMY

President, Monterey Institute of International Studies

Sunder Ramaswamy Sunder Ramaswamy became the 13th president of the Monterey Institute of International Studies in January 2009.

Ramaswamy is widely recognized for his scholarly and professional work in international and development economics, particularly in India and Africa. He has written and edited books, authored articles for a variety of scholarly journals focused on development and international economics, delivered presentations at international conferences on four continents, and been quoted in local, national, and international media.

His academic and administrative background is well suited to helping MIIS respond to the challenges ahead and to the emerging needs of 21st-century students. Prior to his transition to Monterey, Ramaswamy served as Middlebury College's Frederick C. Dirks Professor of International Economics (a position he continues to hold), the dean for faculty development and research, and the project director of the Middlebury-Monterey Integration Task Force. He has also served as the director of the Madras School of Economics in Chennai, India, one of India's premier institutes for graduate education and economics research.

He received his Ph.D. in economics from Purdue University in 1991, in addition to an M.S. from Purdue, an M.A. in economics from the Delhi School of Economics, and a B.A. in economics from St. Stephen's College, University of Delhi, India.

Ramaswamy is currently working on projects fostering economic reforms in India. He has also been involved with USAID and INTSORMIL projects on agricultural development in Sub-Saharan Africa. His teaching and other academic work has been supported by grants from the Davis Foundation, Ford Foundation, and Kellogg Foundation. He has also been a consultant to UNCTAD, UNIDO, the United Nations University, and the World Bank.

MAJ. RANDY STAAB

United States Marine Corps, Chair, President's Student Council, 2010

Major Randy Staab is currently assigned to the Naval Postgraduate School's Graduate School of Engineering and Applied Sciences and is enrolled in the Department of Electrical and Computer Engineering. Upon graduation in December 2011, he will receive a M.S. in Electrical Engineering with a certificate in Network Engineering and report to Marine Corps Tactical Systems Support Activity, Camp Pendleton, California. He is also enrolled in the Graduate School of Business and Public Policy where he will receive a M.S. in Program Management.

Major Staab is a Naval Aviator with over twenty-one years of service beginning in 1990. After serving three years as an enlisted Marine, he attended the U.S. Naval Academy and graduated with a B.S. in Engineering in 1997. After his qualification as a Marine helicopter pilot in 2000, he served from 2001–2009 in Operation Enduring Freedom and Operation Iraqi Freedom as a pilot, forward air controller embedded within an infantry battalion, and staff officer. Prior to his current assignment, he was the Deputy Chief of Strategic Plans for the Multi-

National Security Transition Command-Iraq and the NATO Training Mission-Iraq.

He has attended a variety of military schools including the U.S. Naval Academy, Marine Officer Basic Course, Naval Flight Training School, Tactical Air Control Party Course, Aviation Safety Officer School, MATSS Basic Instructor Course, Marine Corps University Amphibious Warfare School, and the Marine Corps University Command and Staff College, and the Naval Postgraduate School.

His personal awards include the Bronze Star Medal, Air Medal (Strike/Flight), Navy and Marine Corps Commendation Medal with Combat Distinguishing Device, Joint Service Achievement Medal, Navy and Marine Corps Achievement Medal, and the Combat Action Ribbon.

DR. KARL VAN BIBBER

Vice President & Dean of Research, Naval Postgraduate School

Karl van Bibber received B.S. (Physics, Mathematics) and Ph.D. (Physics) degrees from the Massachusetts Institute for Technology, where he subsequently served as Instructor of physics. After a Lectureship at the University of California Berkeley, and Postdoctoral fellowship at Lawrence Berkeley National Laboratory, he joined the faculty of Stanford University, serving as Assistant Professor of Physics from 1980–1985.

He joined LLNL in 1985, where he founded and built up the High Energy Physics & Accelerator Technology Group, bringing the Laboratory into collaboration with DoE Office of Science laboratories in the design, construction and scientific exploitation of accelerators for high energy physics. He was the LLNL Project Leader for the SLAC/LBNL/LLNL B Factory accelerator and detector, which announced the discovery of CP-violation in the b-quark system in July 2000, and Program Leader for R&D on the future International Linear Collider. He is Co-Spokesperson for the Axion Dark Matter eXperiment (ADMX) sited at Livermore, the most sensitive search for axionic dark matter in the world.

In 2001, he became Chief Scientist for the Physics & Space Technologies Directorate. In 2002 was appointed Deputy Director of the Laboratory Science & Technology Office (LSTO) at LLNL, providing day-to-day management of the Laboratory's \$95M Laboratory Directed Research and Development (LDRD) Program. In 2007 he was appointed Chief Scientist for the newly-constituted Physical Sciences Directorate.

He joined the Naval Postgraduate School in January 2009, serving as Vice-President and Dean of Research. He also holds an appointment to Professor of Physics within the Graduate School of Engineering and Applied Sciences.

He has authored or co-authored more than 100 papers in nuclear and particle physics, accelerator technology, and particle astrophysics. He was the recipient of an Alfred P. Sloan Research Fellowship (1982), the Director's Distinguished Performance Award for the B Factory (1997), and the LLNL Science and Technology Award (2002, with the B Factory team) for outstanding scientific and technical contributions to the discovery of CP-violation in the B-Meson System. In 2000 he shared the DoE Deputy Secretary's Award for the B Factory. In 2001 was elected

Fellow of the American Physical Society, and in 2006 he was elected Fellow of the American Association for the Advancement of Science, for his research in dark matter. Five physics postdoctoral fellowships were endowed in his name at Stanford University in 2005 by an anonymous industrialist and Stanford alumnus. He currently serves as the Vice-Chair of the California Section of the American Physical Society.

LT. MATTHEW T. YOKELEY

*United States Navy, Chair, President's Student Council, 2011,
Naval Postgraduate School*

A native of Marshall, Missouri, Lieutenant Matthew T. Yokeley graduated from the University of Missouri-Columbia in 2006 with a Bachelor of Science degree in Agricultural Journalism.

Afloat, Lieutenant Yokeley completed his division officer tours aboard the destroyer *USS James E. Williams* (DDG 95) as the Strike Warfare Officer and as the Navigator. During his sea tours he made three deployments. His first two deployments were to the Fifth Fleet AOR in support of Operations Iraqi Freedom and Enduring Freedom. His third deployment was also to the Fifth Fleet AOR in support of Commander Joint Task Force Horn of Africa counter-piracy operations.

Ashore, Lieutenant Yokeley is currently a student at the Naval Postgraduate School earning a Master of Science degree in Operations Analysis and a Masters of Human Systems Integration. He is also completing the Naval War College Non-resident Program for Joint Professional Military Education Phase I.

Lieutenant Yokeley's personal awards include the Navy and Marine Corps Achievement Medal as well as multiple unit and service awards. He is married with three children.

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