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THESIS

THE U.S. NAVY SUBMARINE HYDRODYNAMICS/HYDROACOUSTIC COMMUNITY: A CASE STUDY IN STRATEGIC PLANNING FOR A DECENTRALIZED, MULTI-ORGANIZATIONAL, MILITARY COMMUNITY

by

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The United States Navy Submarine Hydrodynamic/Hydroacoustic community is a decentralized, multi-organizational, geographically distributed enterprise. Strategic planning and management, whether formal or ad hoc, is necessary for effective functioning of any organization. However, formal strategic planning is particularly difficult in multi-organizational, geographically diverse enterprises. Enterprise-wide performance measurement and a shared understanding of enterprise performance is necessary to devise compelling and effective strategies.

During the Cold War, the U.S. Navy submarine force had a clear mission and compelling goals, with resulting clarity on performance metrics. The Submarine Hydrodynamic/Hydroacoustic workforce was focused on helping the submarine force achieve these goals. In the post-Cold War era, the submarine force mission in the integrated battle space is less defined. The percentage of the military budget that can be spent on discretionary spending is decreasing. The Submarine Hydrodynamics/Hydroacoustic community has been directly impacted by the recent lack of focus and budget reductions.

The purpose of this thesis is to research the past processes used to perform strategic planning for the Submarine Hydrodynamic/Hydroacoustic community, identify current strategic issues for the community, and document strategic lessons learned that can be identified through the evaluation of product successes and failures.

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ABSTRACT

The United States Navy Submarine Hydrodynamic/Hydroacoustic community is a decentralized, multi-organizational, geographically distributed enterprise. Strategic planning and management, whether formal or ad hoc, is necessary for effective functioning of any organization. However, formal strategic planning is particularly difficult in multi-organizational, geographically diverse enterprises. Enterprise-wide performance measurement and a shared understanding of enterprise performance are necessary to devise compelling and effective strategies.

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The purpose of this thesis is to research the past processes used to perform strategic planning for the Submarine Hydrodynamic/Hydroacoustic community, identify current strategic issues for the community, and document the strategic lessons learned that can be identified through the evaluation of product successes and failures.

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EXECUTIVE SUMMARY

The purpose of this thesis is to research the processes used to perform strategic planning for the Submarine Hydrodynamic/Hydroacoustic community prior to 2002, identify current strategic issues for the community, and document strategic lessons learned identified through the evaluation of product successes and failures. The research and development capability that resides in the Submarine Hydrodynamic/Hydroacoustic community has been a key reason for the superiority of U.S. submarines. However, with the end of the Cold War, investment in U.S. warships is declining, as is the investment in research and development associated with those warships.[1] With these reduced budgets, the technical community that has maintained the superiority of U.S. submarines is becoming fragmented as positions are eliminated and key facilities are closed due to lack of funds.[2] This fragmentation of the community caused concern among managers responsible for submarine hydrodynamic and hydroacoustic research. Based on this concern, the author was asked to identify the key strategic issues facing the Submarine Hydrodynamic/Hydroacoustic community.

This research found that the key questions facing the Submarine Hydrodynamic/Hydroacoustic community are:

- How can the Submarine Hydrodynamic/Hydroacoustic community reduce the time and cost currently required to perform the research and development necessary to field products?
- How can the Submarine Hydrodynamic/Hydroacoustic community maintain and nurture technical expertise of the hydrodynamic and hydroacoustic workforce?
- How can the Submarine Hydrodynamic/Hydroacoustic community attain the synergistic goals of reducing programmatic volatility and achieving stable funding?

[1] "National Security Assessment of the U.S. Shipbuilding and Repair Industry," U. S. Department of Commerce, May 2001, p. 68.

[2] ibid. p. xii.

The issues were identified in this research using a combination of facilitated planning meetings, interviews, and surveys. The ethnographic interviews were conducted with 27 senior managers across Navy, academia, and industry who are involved in Hydrodynamic and Hydroacoustic research supporting the U.S. Submarine force. In addition to soliciting information on key issues facing the community, these interviews solicited information on products produced by the Submarine Hydrodynamic/Hydroacoustic community and on lessons learned with respect to the success or failure of those products.

A survey tool was generated from the results of the interviews. There were 43 managers involved in Hydrodynamic and Hydroacoustic research who completed the survey successfully. Analysis of the survey results identified the questions listed above as the key issues facing the Submarine Hydrodynamic/Hydroacoustic community. The survey also yielded additional information on the lessons learned and products produced by the Submarine Hydrodynamic/Hydroacoustic community.

In the period of time since the identification of the three key issues listed above, funding for the Submarine Hydrodynamic/Hydroacoustic community has dropped precipitously, in excess of 50 percent in many technology areas.[3] Even when funding streams from multiple sponsors are considered, the funding levels are not sufficient to maintain the breadth and depth of competency recommended as a minimum core by the Submarine Hydrodynamics Technical Authority.[4] The funding that is available is not aligned with the critical technical categories required to support design and development for a new design. Four or more years will be required to re-constitute certain capabilities.[5]

The laboratories will continue to perform design work as funded by sponsors. Unfunded personnel will be reassigned to other technical areas. Propulsor design and

[3] Crockett, Charles R., "Updated Propulsor Minimum Core Capability," July 2003.

[4] ibid. p. 5.

[5] ibid. p. 8.

development expertise will erode, and the Hydrodynamics technical authority anticipates it will take four or more years to re-constitute the advanced propulsor design capability.[6]

In light of these developments and the research reported in this thesis, the author recommends that the community concentrate on developing strategies to:

- Reduce avoidable program volatility, and
- Maintain and nurture technical expertise within the hydrodynamic and hydroacoustic workforce.

This thesis focuses on the processes used in strategic planning, the identification of key strategic issues, and strategic lessons learned through the evaluation of product successes and failures.

[6] Crockett, Charles R., "Updated Propulsor Minimum Core Capability," July 2003, p. 14.

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I. INTRODUCTION

> "Cheshire Puss," she began… "Would you tell me, please, which way I ought to go from here?"
>
> "That depends a good deal on where you want to get to," said the Cat.
>
> "I don't much care where --" said Alice.
>
> "Then it doesn't matter which way you go," said the Cat.
>
> \- Lewis Carroll in
> *Alice in Wonderland*

A. BACKGROUND

Strategic planning is vital to the effective functioning of any organization. All organizations have identifiable strategies that shape and guide what that organization is, what it does, and why it does it. Strategic planning is the "disciplined effort to produce fundamental decisions and actions that shape and guide"[7] an organization.

Strategic planning as a formal discipline has developed over the past century mainly as it applies to commercial enterprises--manageable organizational entities with clear management hierarchies and relatively simple goals (e.g., maximize profit, increase market share). It is only in the past decade that the literature has formally recognized the unique challenges faced by non-profit and public organizations.[8]

Strategic planning in the military has typically been based on the techniques developed for commercial companies. These techniques are adequate for some military entities. However, military systems are so complex that the people involved with producing individual military products are often drawn from a complex community united neither by organization, motivation, nor common leadership. Winston and Albright describe the "seat of the pants" approach past managers and executives used to solve problems, "that is, they used their business experience, their intuition, and some

[7] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers, 2005, p. x.

[8] Simon, Cary -- interview, March, 2002.

thoughtful guesswork to obtain solutions."[9] If this seat of the pants approach to management is becoming inadequate for the complex problems facing commercial companies, it seems reasonable to extrapolate that complex problems facing a complex non-profit collaboration of individuals would be even less well served by mere "seat of the pants" management techniques.

Within the U.S. Navy, the alignment of organizations rarely coincides with the development process through which a product must travel from concept to fielded military system. This difference between organizational alignment, federal fiscal requirements, and the logical product evolution process makes it difficult to plan strategically for technology areas and product lines. An example of inefficiency is the practice of "stovepiping,"[10] or the optimizing of processes within a particular technical discipline (i.e., sub-optimization) with little cross-discipline collaboration.[11] Another example of inefficiency is the so-called "Valley of Death."[12] This is the phenomenon where a technology or product, demonstrated to be feasible by Science and Technology (S&T) research, is put on hold for several years. This is the time it takes for a product-specific Research and Development (R&D) funding line to be inserted into the federal budget. This research and development is usually necessary to mature technologies for fleet application.

Some Navy products can be bought commercial-off-the-shelf (COTS), taking full advantage of science and technology investigations and research and development paid

[9] Winston, Wayne L. and S. Christian Albright, "Practical Management Science," second edition, Duxbury Thompson Learning, 2001, p.1.

[10] A stovepipe is a thin-walled cylindrical metal tube that conducts hot gases away from a stove to a chimney flue. "Stovepiping" is a term describing the phenomenon of organizational entities working in isolation from other entities involved in the product development process, as though separated by physical barriers.

[11] In organizational terms, this is known as a U-form (unitary form) organization. A U-form organization is decomposed into "specialized units" where similar tasks are grouped together. This can be contrasted with a M-form (multi-divisional form) organization, which consists of "self-contained units" where complementary tasks are grouped together. An integrated product team is an example of an M-form organization.

[12] The term "Valley of Death" was first used in the King James Bible (Psalm 23) to characterize ultimate earthly difficulty. In naval research, the term "Valley of Death" has been used to describe the funding gap that frequently exists between demonstration that a technology is feasible (based on sience and technology explorations) and obtaining funding to perform research and development to further mature the technology for insertion into fleet products.

for in the commercial sector. Other Navy products are at least nominally similar to commercial products (e.g., Navy fighter jets benefit from the commercial aircraft industry, even though requiring military-specific research). But there is not a commercial submarine industry. Further, the U.S. commercial shipbuilding industry is not strong. A recent survey of the U.S. shipbuilding and repair industry[13] indicates that the shipbuilding industry is heavily dependent on U.S. Navy investment. U.S. Navy ship purchases have slowed with the end of the Cold War. Given the low production rate of Navy ships, productivity in the U.S. shipbuilding industry is far lower than for shipbuilding industries in other nations or for other industries in the United States.

For example, within the shipbuilding industry, the study of the dynamics of high velocity fluid flowing over ship hulls is a field with relatively little application outside the Navy. The study of fluid flows over submarines is even more particular to the Navy. Submarine hydrodynamics refers to the dynamics of submarine/water interactions. Submarine hydroacoustics is the noise created by water flows over submarines. Figure 1 illustrates some of the hydrodynamic and hydroacoustic phenomena of interest to the U.S. Navy submarine community. The capabilities of researchers in the areas of hydrodynamics and hydroacoustics have played a key role in the superiority of U.S. warships, particularly U.S. submarines.[14] However, shrinking research and development budgets are causing these capabilities to become fragmented as positions are eliminated and key facilities are closed due to lack of funds[15] The situation has become sufficiently alarming that restoration of submarine-related research and development funds is included prominently on the Chief of Naval Operations' list of Unfunded Programs.[16] This thesis discusses development of strategic issues for the community of individuals engaged in hydrodynamic and hydroacoustic research and development for submarines, hereafter called the Submarine Hydrodynamic/Hydroacoustic community.

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[13] "National Security Assessment of the U.S. Shipbuilding and Repair Industry," U. S. Department of Commerce, May 2001.

[14] ibid. p. 68.

[15] ibid. p. xii.

[16] Clark, Vern, letter to the Honorable Ike Skelton of 27 February 2003, Enclosure (1), "Navy FY04 Unfunded Programs List," p. 3.

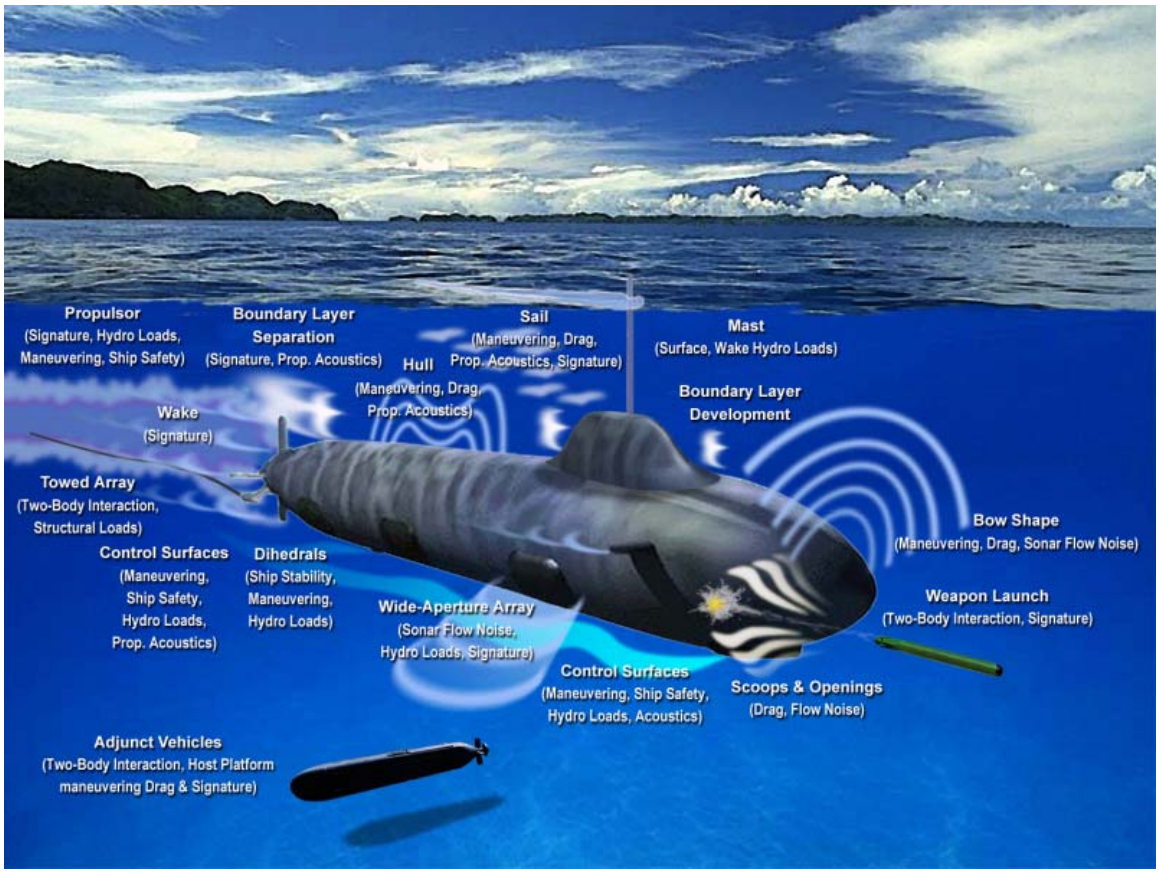

Figure 1. Hydrodynamic and Hydroacoustic Phenomena of Interest in the Development of Submarines (From: Jim Lane, 2001)

B. PURPOSE

The purpose of this thesis is to research the past processes used to perform strategic planning for the Submarine Hydrodynamic/Hydroacoustic community, identify current strategic issues for the community, and document the strategic lessons learned that can be identified through the evaluation of product successes and failures.

The research and development capability that resides in the Submarine Hydrodynamic/Hydroacoustic community has been a key reason for the superiority of U.S. submarines. However, with the end of the Cold War, investment in U.S. warships is

declining, as is the investment in research and development associated with those warships.[17] This research identifies the key strategic issues facing the Submarine Hydrodynamic/ Hydroacoustic community, to guide strategic management of this multi-organizational, geographically diverse organization as it becomes necessary to eliminate positions and close key facilities due to lack of funding.

C. PREVIOUS PLANS DEVELOPED BY THE SUBMARINE HYDRODYNAMIC/HYDROACOUSTIC COMMUNITY

Annual planning had been performed within the Hydrodynamic and Hydroacoustic Submarine Community since 1996 by an entity known as the Hydro Sub Group. Three individuals headed the planning process: the Hydrodynamics/ Hydroacoustics Manager in the Submarine Research and Development Office, the Hydrodynamics technical authority, and the director of the Hydrodynamics/ Hydroacoustics Technology Center. This planning process led to a detailed description of the execution plans for the upcoming year, but took months to formalize due to the length of the resulting documents. Additionally, the compilation of the execution plans was invariably classified. Between the length and classification of the plans, the annual plans were rarely referenced after completion. However, the process of coming to an annual consensus was seen as valuable, even though the document describing the plan was rarely used.[18]

D. RESEARCH QUESTIONS

The following questions are asked in this research:

[17] "National Security Assessment of the U.S. Shipbuilding and Repair Industry," U. S. Department of Commerce, May 2001," p. 68.

[18] Dahmer, Douglas -- interview of April 2002.

- What are the overarching strategic guidelines within which the Submarine Hydrodynamic/Hydroacoustic Community operates?
- How has the Submarine Hydrodynamic/Hydroacoustic Community developed and promulgated strategic plans?
- Does the community feel the current strategic planning processes are adequate?
- Is there a need for a revised strategic planning effort?
- What are the key issues facing the Submarine Hydrodynamic/ Hydroacoustic Community?
- What is the consensus on the most valued lessons learned?
- What is the consensus on the success or failure of products developed by the Submarine Hydrodynamic/Hydroacoustic Community?

E. BENEFITS OF STUDY

This study identifies the key strategic issues facing the community in 2002, which may be used to guide priorities for future strategic management of the community. Secondarily, a ranking of lessons learned can assist management understanding of the practices that are widely accepted or are particularly valuable, and which management practices may require more effort before being adopted. Finally, community consensus on past efforts should assist managers avoid the mistakes that have contributed to past failures and provide guidance as to which past successes, used as models for future endeavors, will inspire more global acceptance.

F. SCOPE AND METHODOLOGY

The scope of this thesis includes: 1) identification of the overarching strategic guidelines governing the Submarine Hydrodynamic/Hydroacoustic Community and past planning efforts, 2) assessment of the need for improving the process, 3) identification of key issues facing the community, and 4) creation of a consensus with respect to lessons

learned and success of items produced by the community to form a shared context for future strategic planning efforts. The actual creation of a strategic plan to address these issues is outside the scope of this thesis.

A literature review was performed to identify appropriate strategic planning methods and the strategic posture of the organizations of particular concern to the Submarine Hydrodynamic/Hydroacoustic Community. These were the Department of Defense, the Department of Navy, the shipbuilding industry, and the submarine community. A review was also conducted of past planning efforts within the Submarine Hydrodynamic/Hydroacoustic Community.

Data to achieve the objectives of this research were obtained via 1) meetings with the group of managers within the community traditionally charged with developing the annual executions plans, 2) ethnographic interviews of 27 senior managers of submarine Hydrodynamic/ Hydroacoustic research, and 3) a community survey completed by 43 of a population of 71 managers.[19] These data were used to identify strategic issues and develop a shared vision of lessons learned and the success or failure of past products, tools, and facilities developed by the community.

Data regarding products, tools, and facilities were extracted from the ethnographic interviews by tabulating the number of times each item was mentioned by interviewees as having been particular successes or failures. Concise lists of issues and lessons learned were developed from the interviews by grouping similar statements and developing a representative or archetypal statement that characterized each grouping of statements. Finally, data from the survey of managers in the Submarine Hydrodynamic/ Hydroacoustic Community were used to identify the key issues. Opinions regarding lessons learned and products developed by the community were subjected to the chi-squared test to identify the majority opinion.

[19] These managers were targeted because of their active responsibility for financial or technical oversight of current Hydrodynamic/Hydroacoustic research in support of the submarine community.

G. ORGANIZATION OF STUDY

This study consists of five chapters. Chapter I provides a brief introduction to strategic planning and the unique nature of the Submarine Hydrodynamic/Hydroacoustic community. Chapter II reviews the literature regarding strategic planning, particularly strategic planning in non-profit organizations, as well as the overarching strategic guidance for the Submarine Hydrodynamic/Hydroacoustic Community. Chapter III describes the research methods, particularly the conduct of planning meetings, ethnographic interviews and surveys, as well as data analysis processes. Chapter IV contains analysis of the results of the planning meetings, the ethnographic interviews, and the survey. Finally, Chapter V summarizes the conclusions and recommendations.

II. LITERATURE REVIEW

A. INTRODUCTION

The field of strategic planning and management has been thoroughly documented since its modern development in the past half century. The object of this review was to focus on key concepts that influence strategic planning for public and non-profit entities. This chapter also contains a review of the literature establishing the strategic guidelines within which the Submarine Hydrodynamic/Hydroacoustic community operates.

B. STRATEGIC PLANNING AND MANAGEMENT

Strategic planning and management is defined as the process of specifying an organization's objectives, developing policies and plans to achieve these objectives, and allocating resources to implement the plans. It is the highest level of managerial activity, usually performed by the company's Chief Executive Officer (CEO) and executive team.

In broad terms it asks three questions:

- Where are we now?
- Where do we want to go?
- How do we get there?[20]

Strategic planning and management aims to exploit the opportunities of tomorrow rather than merely deal with day-to-day operations.

Strategic planning and strategic management emerged as a separate topic of study during the second industrial revolution, with the mass production and mass markets made

[20] "Strategic management," Wikipedia, the free encyclopedia, revised 19 August 2003 [online] at http://www.wikipedia.org/wiki/Strategic management, accessed 29 August 2003.

possible by the advent of steam, gas, and oil-powered machines.[21] In the 1900s, Max Weber began to study the operation of modern, large-scale enterprises in the political, administrative, and economic realm. Weber[22] perceived that these large enterprises were coordinated by means of bureaucracies organized according to impersonal rules based on rational principles. Only through this organizational device (i.e., bureaucracy) was large-scale planning for the modern state and modern economy possible. However, Weber noted that bureaucracy, despite certain advantages, was unwieldy and even stultifying in dealing with individual cases.

In 1911, Frederick Winslow Taylor published *Principles of Scientific Management*, which examined ways to make workers more productive and efficient by separating specific management functions.[23] Over the next several decades, many writers published works dealing with the scientific management and detailed analysis of organizational functions.

Technological advances created an environment for intense competition after World War II, leading Peter Drucker to develop the theory of "Management by Objectives."[24] In 1965, Igor Ansoff developed an approach for strategic improvement called "gap analysis," where strategic planners identified the gap between where they are currently and where they would like to be, and then develop what Ansoff called "gap reducing actions."[25] In the 1960s, companies began to perform situational analysis to formally analyze the strengths, weaknesses, opportunities, and threats in the business environment--the SWOT analysis first put forward by Edmund Learned.[26]

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[21] Bryce, David J., "Introduction to Strategic Management," BYU Marriott School of Business, 3 September 2002, [online] marriottschool.byu.edu/teacher/BM499/Bryce/Intro%20to%20Strat%20Mgt%20(Sep3).ppt, p. 5, accessed 29 August 2003.

[22] Coser, Lewis A., "Masters of sociological thought : ideas in historical and social context," 2nd edition, New York, Harcourt Brace Jovanovich, 1977, pp 230-233.

[23] Taylor, Frederick Winslow, 1856-1915. "The principles of scientific management," Mineola, N.Y. : Dover Publications, 1997.

[24] Drucker, Peter Ferdinand, "The practice of management," New York, Harper, 1954.

[25] Ansoff, H. Igor. "Corporate strategy; an analytic approach to business policy for growth and expansion," New York, McGraw-Hill, 1965.

[26] Learned, Edmund Philip, et al., "Business policy: text and cases," Homewood, Ill., R. D. Irwin, 1969.

In the 1970s much of strategic management dealt with size, growth, and portfolio theory. The Profit Impact of Market Share (PIMS) study was a long-term study started in the 1960s. Still ongoing under the auspices of the Strategic Planning Institute, the PIMS study now contains decades of information on the relationship between profitability and strategy. The initial conclusion of the PIMS study was unambiguous: The greater a company's market share, the greater will be their rate of profit. The high market share provided economies of scale and learning curve advantages. The combined effect was clearly increased profits.[27]

The success of strategic management efforts in "for-profit" companies could be easily judged based on the financial bottom line. The urge to maximize the return on any investment has led to positioning companies with respect to their target industries. In the 1980-1990s, companies began to view their business as a series of "value chain" components, identifying sources of cost, value, and differentiation.[28] During the previous few decades, the field of operations management had embarked on strategic process initiatives such as *Just in Time (JIT) manufacturing* (minimizing unnecessary warehousing), *Time-based competition* (identifying the total time required to deliver a product), and quality-based initiatives such as *6-sigma* to reduce losses associated with rework and loss of business associated with perceptions of poor quality.[29, 30] These initiatives are among those seen as maximizing value to customers by reducing unnecessary expense and processes. Inasmuch as these initiatives eliminate organizational "fat," this maximization of value to the customer is known as *Lean*.[31]

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[27] "Strategic Management," Wikipedia, the free encyclopedia, [online] http://en.wikipedia.org/wiki/Strategic_management#Historical_development_of_strategic_management, accessed 19 August 2004.

[28] Bryce, David J., "Introduction to Strategic Management," BYU Marriott School of Business of 3 September 2002, [online] marriottschool.byu.edu/teacher/BM499/Bryce/Intro%20to%20Strat%20Mgt%20(Sep3).ppt, p. 7, accessed 29 August 2003.

[29] Nahmias, Steven, "Production and Operations Analysis," New York, NY, McGraw-Hill, 2001, pp. 48-49.

[30] Montgomery, Douglas C., "Introduction to Statistical Quality Control," New York, NY, John Wiley & Sons, Inc., 2001, pp. 23-25.

[31] "What is Lean?" [online] http://www.leanadvisors.com/Lean/demo/lean_concept/lean_concept_lean.cfm, accessed 2 September 2004.

Within the public and non-profit sector there has been a tendency to adopt strategies and processes based on market economics, with the presumption that market-style management practices are inherently good for any organization. However, these practices are focused on wealth creation and profit maximization, and are not necessarily appropriate for public sector organizations required to operate at zero profit and provide services for free.[32, 33] The unique challenges of public and non-profit organizations are increasingly the subject of research and literature on strategic management. A recent search of Amazon.com for books dealing with strategic management of public and non-profit organizations yielded over 30,000 titles, featuring works by John M. Bryson, Michael Allison, and Jude Kaye.[34,35] The Bryson text is used to teach strategic planning at the Naval Postgraduate School, and has served as a guide for many of the activities reported in this research.

In all organizations there is a tension between two approaches to strategic management. The first approach is called the *Design school* or *Rational planning model*, where logical, linear, and rational strategies are developed to achieve the central goal based on an assumption that the environment is predictable and the organization is simple. The second approach is called the *Evolutionary school* or *Political decision-making model*, where issues are identified and policies and programs (i.e., political treaties) are continually developed and reshaped to deal with the key issues. Proponents of the evolutionary school (e.g., Pettigrew, 1985 and Mintzberg, 1990) argue that strategic designs rarely result from planned moves. Empirical research has shown that real managerial decision-making is not, in fact, logical and rational. However, even Mintzberg makes the point that both approaches (design and evolutionary) have a

[32] "The history of strategic planning and management: Strategic development and public organizations," 14 October, 2002 [online] http://www.martinwebster.info/content/sisp/the_history_of_strategic_planning_and_management.html, accessed 29 August 2003.

[33] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1995, p 5.

[34] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1995.

[35] Allison, Michael and Jude Kaye, "Strategic Planning for Nonprofit Organizations: A Practical Guide and Workbook," New York, NY, John Wiley & Sons, 1997.

contribution to make and are not mutually exclusive.[36] Bryson states this in the following terms:

> Having drawn a sharp distinction between the rational planning model and political decision making, I must now emphasize that the two models are not inherently antithetical. They simply need to be relied upon appropriately… for example, sequencing them properly.
>
> While the planning and decision-making that goes into the formulation of a strategic plan may look fairly sloppy to an outsider, once a consensus is reached on what to do, the resulting strategic plan can be rewritten in a form that is in fact quite rational by ordinary definitions of the term. Furthermore, the rational planning model may be used to sort out and address any minor (and perhaps major) inconsistencies embedded in the political outcome."[37]

The processes for developing a consensus are potentially messy. Bryson followed up his 1995 text with a workbook that facilitates the processes for developing consensus and developing strategic plans.[38] The Bryson approach to strategic management and consensus building is the approach taught by the Naval Postgraduate School due to its unique ability to deal with the realities of strategic management and planning in military (and therefore political, public, and non-profit) organizations. Bryson lays out a ten-step strategic planning and management process.[39] These steps are:

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[36] "Two approaches to strategic management," 24 October, 2002 [online] http://www.martinwebster.info/content/sisp/two_approaches_to_strategic_management.html, accessed 29 August 2003.

[37] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1995, p. 12.

[38] Bryson, John M., and Farnum K. Alston, "Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1996.

[39] ibid. pp. 7-12.

- Initiate and agree upon a strategic planning process
- Identify organizational mandates
- Clarify organizational mission and values
- Assess the organization's external and internal environments to identify strengths, weaknesses, opportunities and threats
- Identify the strategic issues facing the organization
- Formulate strategies to manage these issues
- Review and adopt the strategic plan or plans
- Establish an effective organizational vision
- Develop an effective implementation process
- Reassess strategies and the strategic planning process

Figure 2 shows the Bryson strategy change cycle. It illustrates the relationship between the 10 steps mentioned above. Additionally, it identifies where the strategy change cycle can begin, steps where goal formulation may occur, and steps where vision formulation may occur. Although Bryson lays the process out as linear and sequential, he acknowledges that in practice the process is often iterative, and that the process does not always begin at step number one.[40]

[40] Bryson, John M., and Farnum K. Alston, "Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1996, pp. 12-13.

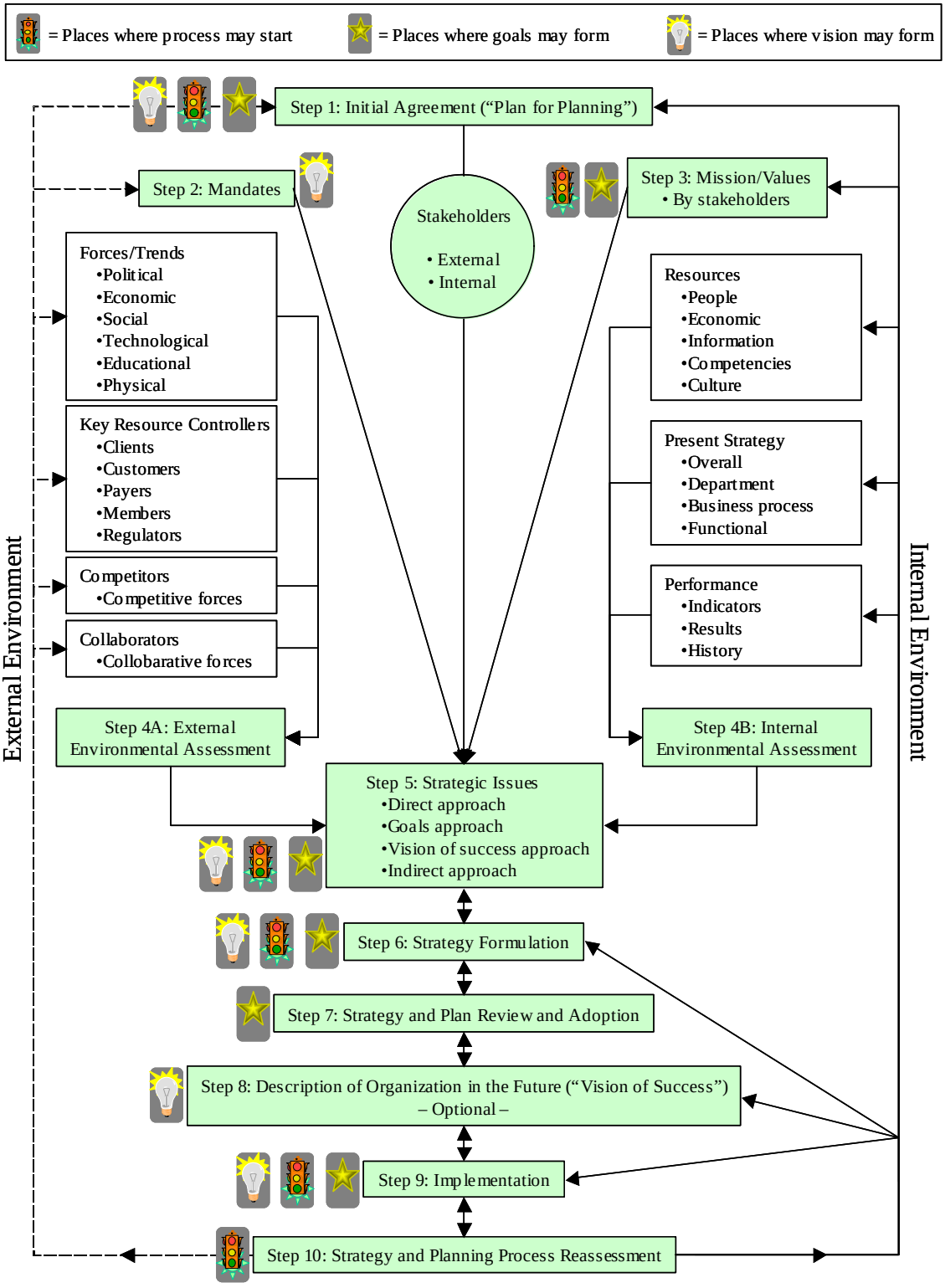

Figure 2. The Bryson Strategy Change Cycle (After: Bryson, 1996)

C. OVERARCHING STRATEGIC GUIDANCE FOR THE U. S. SUBMARINE FORCE

A key component of strategic planning for any organizational entity is to identify the environment in which the organizational entity operates. This section reviews the overarching guidance within which the Submarine Hydrodynamic/Hydroacoustic community must operate. These are:

- U.S. military transformation from "threat-based" to capabilities-based posture laid out in the 2001 Quadrennial Defense Review.
- Acquisition Reform and the Defense Department Planning, Programming, Budgeting and Execution Process (PPBE).
- Sea Power 21, the Navy's response in 2002 to the military transformation being led by Secretary of Defense Donald Rumsfeld.
- "Submarines... The Road Ahead," the vision for the submarine force created in 1997 by the Future Studies Working Group, operating under the direction of the Naval Operations staff (OPNAV).
- SUBTECH, the mechanism created to identify the investments the submarine force needs to make to achieve the strategic concepts identified in "Submarines... The Road Ahead." After the announcement of Sea Power 21, SUBTECH has become the mechanism used to align submarine-related investments with the goals of Sea Power 21.[41]

1. Department of Defense Transformation

In 2000, the state of military readiness was a key part of George W. Bush's presidential campaign. In an October 2000 article in National Defense Magazine, George W. Bush is quoted as follows:

> U.S. defense spending has declined by nearly 40 percent [under the current administration] and is now at its lowest levels as a percentage of the Gross National Product than at any time since 1940. This has led to what the [current] undersecretary of defense termed a "budgetary death spiral," -- pouring more and more money into older and older equipment,

[41] Goldstein, Daniel, "SUBTECH Process," presentation of 31 March 2004, pp. 2, 4.

> draining funds away from modernization, and helping to cause lower morale and problems with retention and recruiting.[42]

On December 28, 2000, President-elect George W. Bush selected Donald Rumsfeld to be Secretary of Defense. Secretary Rumsfeld was faced with turning around the military death spiral, but fiscal realities demanded that he do so without significant increases in defense spending. The 2001 Quadrennial Defense Review of September 2001 details Secretary Rumsfeld's strategy, shifting from the old "threat-based" approach to a new capabilities-based approach:

> Adopting this capabilities-based approach to planning requires that the nation maintain its military advantages in key areas while it develops new areas of military advantage and denies asymmetric advantages to adversaries. It entails adapting existing military capabilities to new circumstances, while experimenting with the development of new military capabilities. In short, ***it requires the transformation of U.S. forces, capabilities, and institutions*** [emphasis by author] to extend America's asymmetric advantages well into the future.[43]

The transformation of the military is aimed at achieving the four Defense Policy Goals:[44]

- Assuring allies and friends
- Dissuading future military competition
- Deterring threats and coercion against U.S. interests
- If deterrence fails, decisively defeating any adversary

These goals are achieved by the following strategic tenets:[45]

- Managing Risks

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[42] "2000 Presidential Election: George W. Bush's Views on Defense," NDIA staff, October 2000 [online] http://www.nationaldefensemagazine.org/article.cfm?Id=286, accessed 2 September 2003.

[43] "2001 Quadrennial Defense Review," 30 September 2001 [online] www.capitol.northgrum.com/files/qdr2001.pdf, p. iv, accessed 2 September 2004.

[44] ibid. p. 11.

[45] ibid. p. 13-16.

- A Capabilities-Based Approach
- Defending the United States and Projecting U.S. Military Power
- Strengthening Alliances and Partnerships
- Maintaining Favorable Regional Balances
- Developing a Broad Portfolio of Military Capabilities
- Transforming Defense

In discussing this transformation, Secretary Rumsfeld explained:

> Transformation is at the heart of this new strategic approach. The Department's leadership recognizes that continuing "business as usual" within the Department is not a viable option given the new strategic era and the internal and external challenges facing the U.S. military. Without change, the current defense program will only become more expensive to maintain over time, and it will forfeit many of the opportunities available to the United States today. Without transformation, the U.S. military will not be prepared to meet emerging challenges. At the same time, it would be imprudent to transform the entire force all at once. A balance must be struck between the need to meet current threats while transforming the force over time. Therefore, the Department is committed to undertaking a sustained process of transformation – based on clear goals -- and strengthening the spirit of innovation in its people, while remaining prepared to deal with extant threats.[46]

Six critical operational goals provide the focus for DoD's transformation efforts:[47]

- Protecting critical bases of operations (U.S. homeland, forces abroad, allies, and friends) and defeating Chemical, Biological, Radiological, Nuclear or High-Yield Explosive (CBRNE) weapons and their means of delivery
- Assuring information systems in the face of attack and conducting effective information operations

[46] "2001 Quadrennial Defense Review," 30 September 2001 [online] www.capitol.northgrum.com/files/qdr2001.pdf, p. 24, accessed 2 September 2004.

[47] ibid. p. 30-31.

- Projecting and sustaining U.S. forces in distant anti-access or area-denial environments and defeating anti-access and area-denial threats
- Denying enemies sanctuary by providing persistent surveillance, tracking, and rapid engagement with high-volume precision strike, through a combination of complementary air and ground capabilities, against critical mobile and fixed targets at various ranges and in all weather and terrains
- Enhancing the capability and survivability of space systems and supporting infrastructure
- Leveraging information technology and innovative concepts to develop an interoperable, joint C4ISR architecture and capability that includes a tailorable joint operational picture

Finally, DoD's approach to transformation rests on four pillars:[48]

- Strengthening joint operations through standing joint task force headquarters, improved joint command and control, joint training, and an expanded joint forces presence policy
- Experimenting with new approaches to warfare, operational concepts and capabilities, and organizational constructs such as standing joint forces through wargaming, simulations and field exercises focused on emerging challenges and opportunities
- Exploiting U.S. intelligence advantages through multiple intelligence collection assets, global surveillance and reconnaissance, and enhanced exploitation and dissemination
- Developing transformational capabilities through increased and wide-ranging science and technology, selective increases in procurement, and innovations in Department of Defense processes

The 2001 Quadrennial Defense Review concludes by calling for development of joint and Service transformation roadmaps. Force structure, budget, and infrastructure impacts were expected to become clearer as the

[48] "2001 Quadrennial Defense Review," 30 September 2001 [online] www.capitol.northgrum.com/files/qdr2001.pdf, p. 32-47, accessed 2 September 2004.

Services completed their FY03 budgets and Program Objective Memoranda (POM 04).[49]

2. Acquisition Reform and the Defense Department Planning, Programming, Budgeting and Execution Process (PPBE)

On October 30, 2002, Deputy Secretary of Defense Paul Wolfowitz cancelled the Department of Defense acquisition directives and instructions "effective immediately" in order to "create an acquisition policy environment that fosters efficiency, flexibility, creativity and innovation."[50] The previous requirements generation process was seen as flawed because it was focused on individual services (e.g., Army, Navy, Air Force) rather than on Joint operations. Duplication of effort existed between services, and systems that could have been made common across the services were not necessarily integrated. The previous acquisition policies were seen as overly prescriptive, and as stifling efficiency, creativity, innovation and evolutionary acquisition. Finally, the Planning, Programming and Budgeting System (PPBS) imposed fiscal discipline, but did not integrate strategy into a coherent defense program, nor did it drive identification of needs for military capabilities.[51]

a. Joint Capabilities Integration and Development System (JCIDS)

The Joint Capabilities Integration and Development System (JCIDS) was changed to enhance the ability to identify and describe military capability gaps across the services. Five Functional Capabilities Boards were charted in the areas of Command and

[49] ibid. p. 78.

[50] Wolfowitz, Paul, Memorandum Ser U16167-02 "Defense Acquisition" of 30 October 2002.

[51] "DoD Business Transformation: Meeting the Security Challenges of the 21st Century," Defense Acquisition University [online] www.dtic.mil/ndia/2004test/mon/transformation.ppt, accessed 2 September 2004.

Control, Battlespace Awareness, Force Application, Focused Logistics, and Protection. The responsibilities of these boards were as follows:[52]

- Ensure new capabilities are conceived and developed in joint warfighting context
- Ensure Joint Capabilities Integration and Development System (JCIDS) proposals are consistent with integrated joint force
- Validate Joint Impact proposals
- Organize, analyze, and prioritize capabilities proposals
- Oversee development and update of Functional Concept(s)
- Ensure integrated architectures (as available) reflect functional area

The documents used to reach a decision were identified as:[53]

- The Initial Capabilities Document (ICD). This replaces the Mission Need Statement (MNS) and identifies the capability gap or other deficiency, describes evaluation of approaches, supports Analysis of Alternatives (AoA). Once an initial capabilities document is approved, it is not updated.
- The Capability Development Document (CDD). This replaces the Operational Requirements Document (ORD) and identifies operational performance attributes of a proposed system. The capability development document is based on initial technology development and is updated or rewritten as needed for additional increments of the system, assuming an evolutionary program.
- The Capability Production Document (CPD). This document also replaces the Operational Requirements Document (ORD) and identifies production attributes for a single increment of a program. Where the capability development document is based on initial technology development, the capability production document is prepared during system development and demonstration, when the system is more mature. Like the capability development document, the capability production document is rewritten for each increment in an evolutionary program.

[52] CJCSM 3170.01A, "Operation of the Joint Capabilities Integration and Development System" Enclosure A, 12 March 2004 [online] http://www.dtic.mil/cjcs_directives/cdata/unlimit/m317001.pdf, accessed 19 August 2004.

[53] ibid. Enclosures (D), (E), and (F).

The Joint Capabilities Integration and Development System (JCIDS) documents are assessed against overarching thresholds, goals and standards in the five functional capability areas. Figure 3 shows the Joint Capabilities Integration and Development System (JCIDS) analysis process.[54]

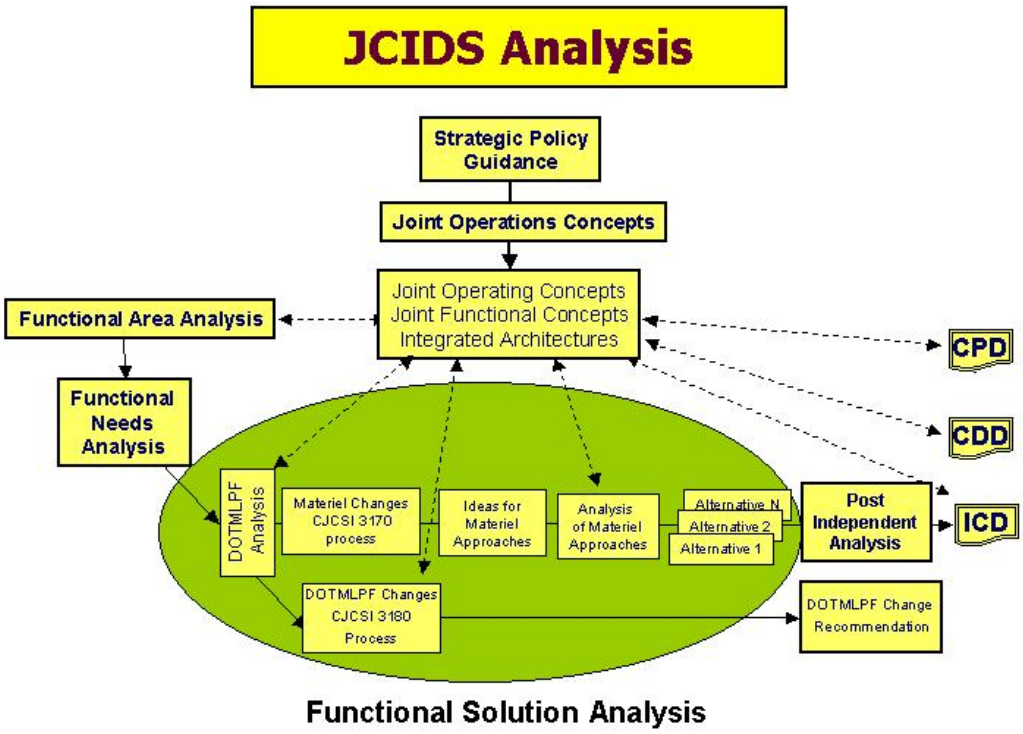

Figure 3. The Joint Capabilities Integration and Development System (JCIDS) Analysis Process[55] (From: Defense Acquisition University, 2003)

[54] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21st century" of 9 September 2003, [online] http://dod5000.dau.mil/DOCS/V5DoDBusinessTransformationBrief.ppt, accessed 2 September 2004.

[55] ibid. p. 8.

b. The Defense Acquisition System

The result of the Deputy Secretary of Defense Paul Wolfowitz' cancellation of the previous Defense Acquisition policies was a streamlined policy intended to empower the program managers of major acquisition programs by reducing regulation and focusing on required outcomes and the minimum statutory requirements. Figure 4 shows the interaction of the new Joint Capabilities Integration and Development System (JCIDS) with the acquisition of a system from the decision to acquire a capability/system to the insertion of that capability into the fleet (initial operational capability or IOC).

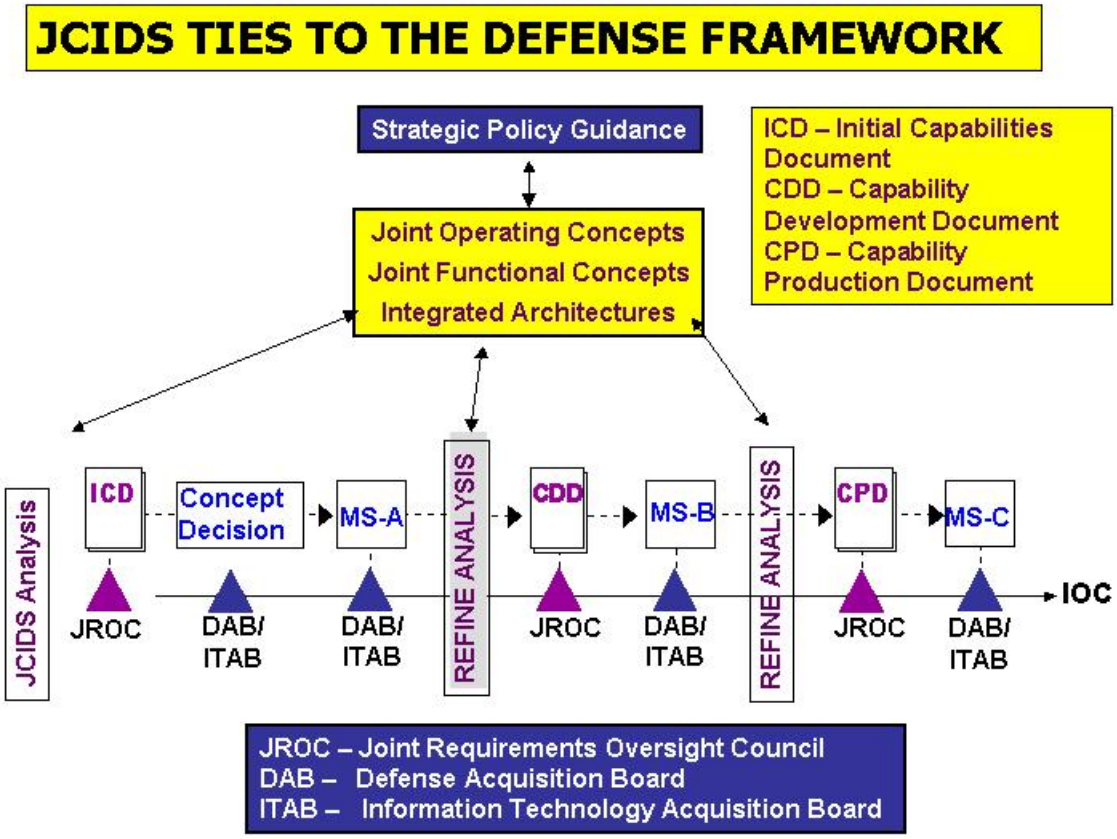

Figure 4. Interaction of Joint Capabilities Integration and Development System (JCIDS) with Defense Acquisition[56] (From: Defense Acquisition University, 2003)

The revised acquisition policy leans heavily towards evolutionary acquisition strategies. The two evolutionary acquisition processes are:

- Develop a set of known increments to get from initial operational capability to full operational capability (incremental development)
- Develop requirements for future increments based on technology maturation and user feedback from initial increments (spiral development)

Figures 5 and 6 show the 2003 Defense Acquisition Management Framework, and how that framework lends itself to evolutionary acquisition.

[56] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21st century" of 9 September 2003, [online] http://dod5000.dau.mil/DOCS/V5DoDBusinessTransformationBrief.ppt, p. 15, accessed 2 September 2004.

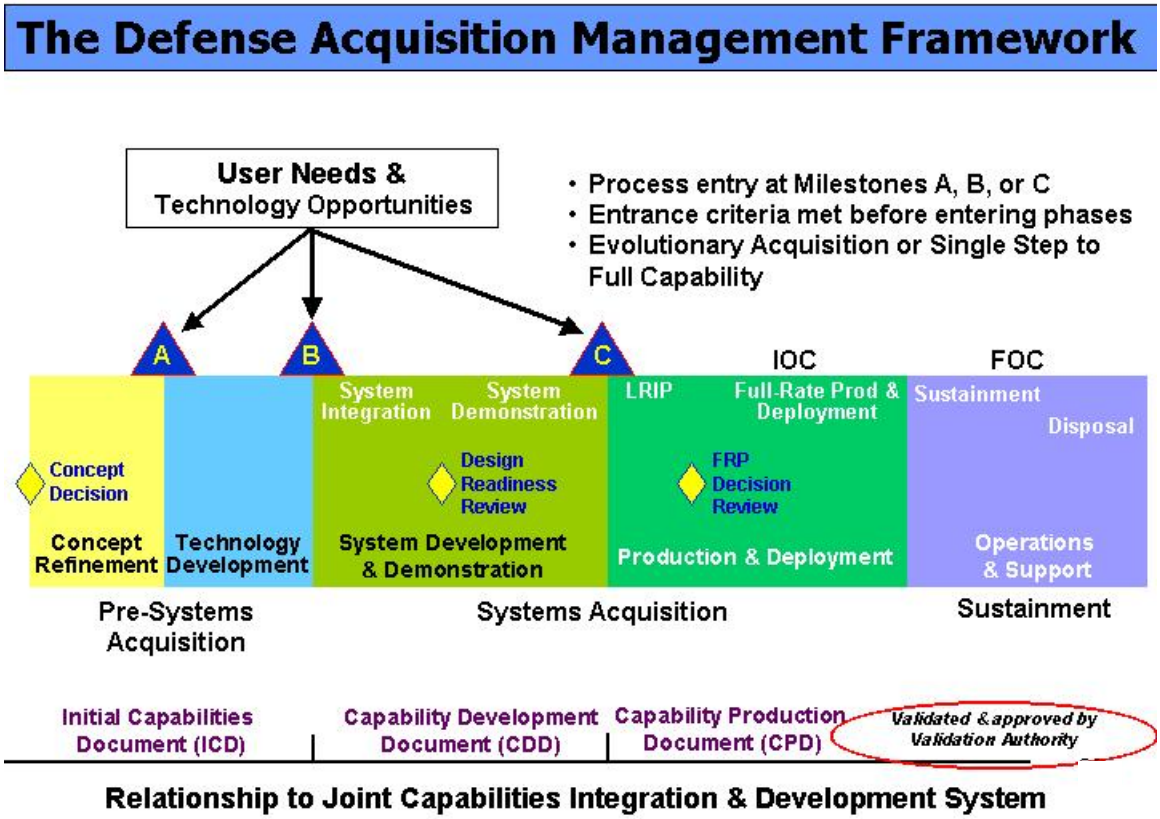

Figure 5. Defense Acquisition Management Framework[57] (From: Defense Acquisition University, 2003)

[57] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21st century" of 9 September 2003, [online] http://dod5000.dau.mil/DOCS/V5DoDBusinessTransformationBrief.ppt, p. 32, accessed 2 September 2004.

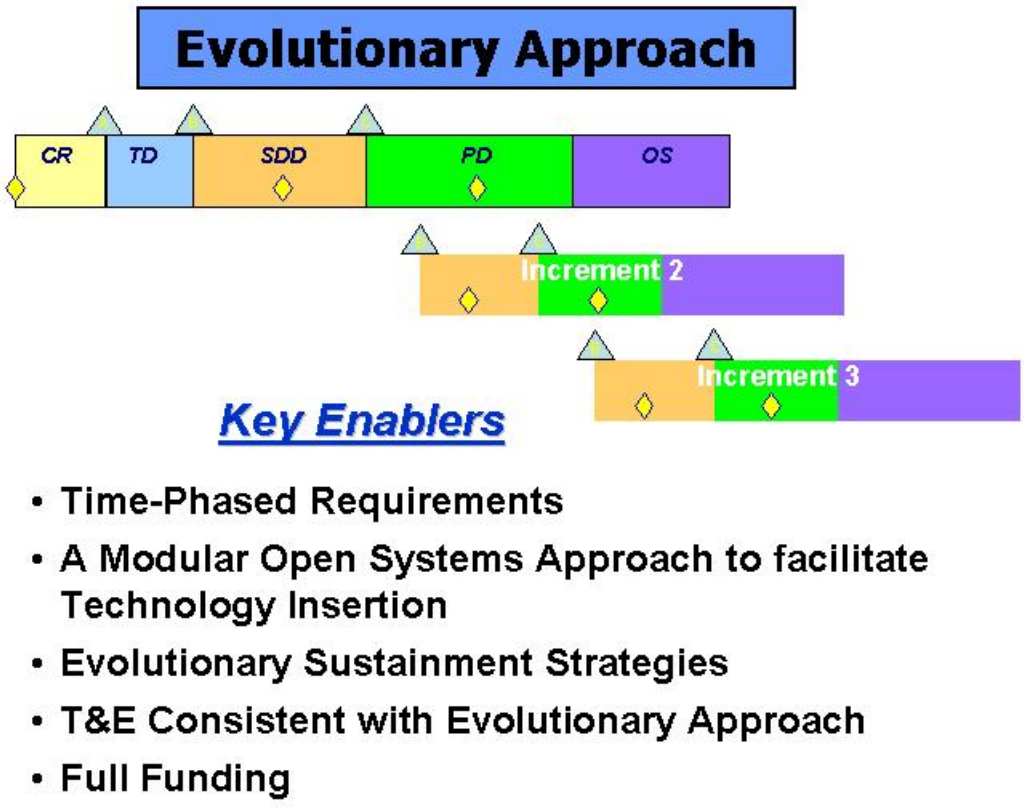

Figure 6. Evolutionary Acquisition Strategy in the Context of the 2003 Defense Acquisition Management Framework[58] (From: Defense Acquisition University, 2003)

The evolutionary acquisition strategy has a number of benefits. It gets capability out to the fleet without waiting for a perfect solution. It allows future development to benefit from fleet experience. Finally, it allows for a more gradual and sustained research and development investment.

[58] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21st century" of 9 September 2003, [online] http://dod5000.dau.mil/DOCS/V5DoDBusinessTransformationBrief.ppt, p. 25, accessed 2 September 2004.

c. Planning, Programming, Budgeting, and Execution Process

The old Planning, Programming, and Budgeting System (PPBS) was rigid, unresponsive and ill-suited for a dynamic and uncertain security environment.[59,60] An example of the results of this rigidity is the "Valley of Death" funding gap that frequently existed between demonstration that a technology was feasible (based on science and technology explorations) and obtaining funding to perform research and development to further mature the technology for insertion into fleet products.

Under the PPBS, major changes to defense budgets for future years were submitted every two years. These proposed budgets (Program Objective Memorandum or POM) took over a year to develop and budget before being submitted as the President's Budget in the February before the expected Congressional authorization and appropriation. In alternate years, smaller course corrections could be considered via the Program Revision (PR) process, similar to the POM process. While the PPBS imposed fiscal discipline, it did not drive identification of needs for military capability or integrate strategy into a coherent defense program.[61]

Under the new Planning, Programming, Budgeting, and Execution Process (PPBE) there will be no Program Objective Memorandum (POM) or Budget Estimate Submission (BES) submissions to the Office of the Secretary of Defense in odd years. Instead, the Department of Defense will live within the current budgets. Any program or budget changes will be compensated by offsets in other programs. Proposals to change programs (Program Change Proposals or PCPs) will be resolved through Program Decision Memorandums (PDMs) and proposals to change budgets (Budget Change

[59] Spangler, Caral, Office of the Under Secretary of Defense (Comptroller) Role in the Budget Cycle, 14 May 2003, [online] at bmc.ida.org/2003/presentations/T7-PPBSChanges-CaralSpangler.ppt, p4, accessed 2 September 2004.

[60] "FY 2004 Defense Planning Guidance," April 2003, [online] www.oft.osd.mil/library/library_files/document_129_Transformation_Planning_Guidance_April_2003_1.pdf, p. 7, accessed 2 September 2004.

[61] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21ST century" of 9 September 2003, [online] at http://dod5000.dau.mil/DOCS/DoD Business Transformation Brief Ver 7.ppt, p. 4, accessed 2 September 2004.

Proposals (BCPs) will be resolved through Program Budget Decisions (PBDs). Program Change Proposals must exceed $250 million across the six years from budget appropriation (the future years development plan or FYDP). The old PPBS process took almost 2 years from issuance of Defense Planning Guidance to locking down a budget as the President's Budget for the upcoming Congressional authorization and appropriation cycle. In the revised PPBE process, program change proposals (PCPs) are due less than 5 months before the lock on the President's Budget. Budget change proposals (BCPs) are due less than three months before the lock on the President's Budget. The purpose of these changes was to align the PPBE interface with the Joint Capabilities Integration and Development System (JCIDS) and Defense Acquisition Process,[62] and create an acquisition policy environment that fosters efficiency, flexibility, creativity, and innovation.[63]

Figure 7 shows how the revised Defense Planning process corresponds to the four-year Presidential term.

[62] Defense Acquisition University, "DoD Business Transformation: Meeting the Security Challenges of the 21ST century" of 9 September 2003, [online] at http://dod5000.dau.mil/DOCS/DoD Business Transformation Brief Ver 7.ppt, p. 49, accessed 2 September 2004.

[63] ibid. p. 16.

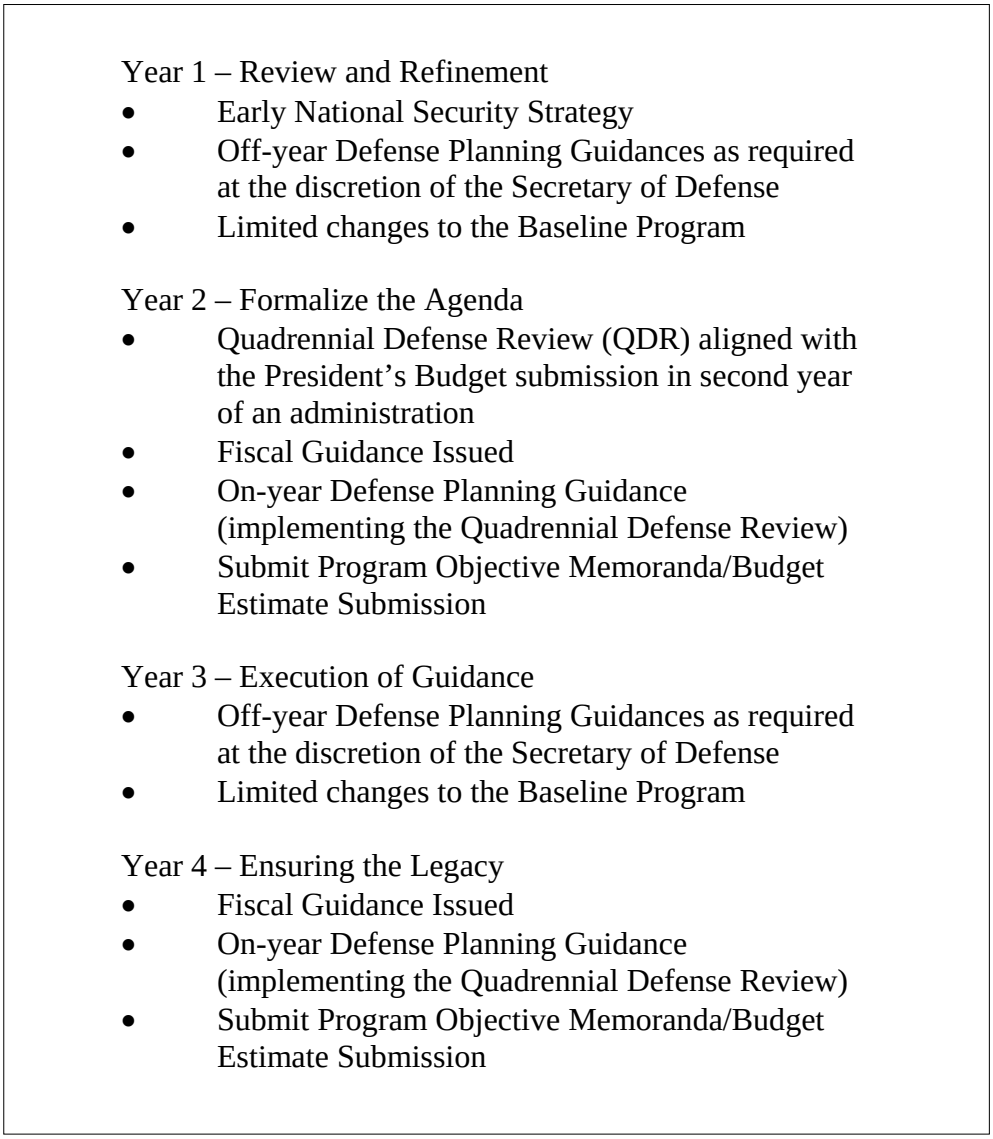

Figure 7. Defense Planning Process Corresponding to the Four-year Presidential Term[64] (From: Defense Acquisition University)

[64] "DoD Acquisition Transformation" [online] dod5000.dau.mil/DOCS/ DoD%20Business%20 Transformation%20Brief%20Ver%207.ppt, p. 42, accessed 2 September 2004.

3. Sea Power 21

The Chief of Naval Operations (CNO), Admiral Vern Clark, unveiled the new vision for the future of the Navy on 12 June 2002.[65] Sea Power 21 was the Navy response to Secretary of Defense Donald Rumsfeld's call for military transformation. Sea Power 21 defines a Navy with three fundamental concepts: Sea Strike, Sea Shield, and Sea Basing, enabled by FORCEnet. Together, these concepts will enhance America's ability to project offensive power, defensive assurance, and operational independence around the globe. A supporting triad of initiatives will develop those core operational concepts: Sea Warrior, Sea Trial, and Sea Enterprise. These components of Sea Power 21 were defined by Secretary of the Navy Gordon England in the document "Naval Power 21" in October, 2002:[66]

- **Sea Strike** is a broadened concept for naval power projection that leverages enhanced C4ISR, precision, stealth, and endurance to increase operational tempo, reach, and effectiveness.[67]
- **Sea Shield** develops naval capabilities related to homeland defense, sea control, assured access, and projecting defense overland. By doing so, it reassures allies, strengthens deterrence, and protects the joint force.[68]
- **Sea Basing** projects the sovereignty of the United States globally while providing Joint Force Commanders with vital command and control, fire support, and logistics from the sea, thereby minimizing vulnerable assets ashore.[69]
- **Sea Warrior** is the process of developing 21st century Sailors. It identifies the knowledge, skills, and abilities needed for mission accomplishment; applies a career-long training and education continuum;

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[65] Ausiello, David, "CNO Introduces "Sea Power 21,"" Navy News Stand, Story Number: NNS020614-02, Release Date: 6/14/2002 10:11:00 AM, [online] http://www.news.navy.mil/search/display.asp?story_id=2081, accessed 20 August 2004.

[66] England, Gordon, ADM Vern Clark, James L. Jones, "Naval Power 21… A Naval Vision," October 2002, [online] www.chinfo.navy.mil/navpalib/people/secnav/england/navpow21.pdf, accessed 19 August 2004.

[67] ibid. p. 6.

[68] ibid. p. 6.

[69] ibid. p. 6.

and employs a responsive, interactive career management system to ensure the right skills are in the right place at the right time.[70]

- **Sea Trial** is a continual process of concept and technology development through focused wargames, experiments, and exercises. It strengthens the Navy's culture of innovation and accelerates the delivery of enhanced capabilities to the Fleet.[71]
- **Sea Enterprise** captures efficiencies by employing lessons from the business revolution to assess organizational alignment, target areas for improvement, and prioritize investments.[72]

The three pillars of Sea Strike, Sea Shield, and Sea Basing would be enabled by FORCEnet, which refers to Navy efforts to make the idea of network-centric warfare a reality in the fleet.[73]

4. Submarines… The Road Ahead

In 1998, Director, Submarine Warfare Division (OPNAV N87) chartered the Submarine Future Studies Group (FSG). This group was established to develop submarine future concepts and goals focusing on innovative and revolutionary capabilities for the far term. In July 2000, the Submarine Future Studies Group produced a vision and roadmap for the submarine force, titled "Submarines... the Road Ahead."[74] This initial report laid out the Submarine Joint Strategic Concepts for the 21st Century. These were:

- ***Gain and sustain access*** for the battleforce, within militarily contested and politically denied littoral areas and vital sea lanes of communication.

[70] England, Gordon, ADM Vern Clark, James L. Jones, "Naval Power 21… A Naval Vision," October 2002, [online] www.chinfo.navy.mil/navpalib/people/secnav/england/navpow21.pdf, p. 6, accessed 19 August 2004.

[71] ibid. p. 6.

[72] ibid. p. 6.

[73] ibid. p. 5.

[74] Submarine Future Studies Group, "Submarines... the Road Ahead," July 2000.

- ***Develop and share knowledge*** of the battlespace, with the battlegroup, regional and unified CINCS, intelligence communities, the National Command Authority, and other customers.
- ***Project power*** with surprise and from close-in, within the adversaries' defensive umbrella, as an essential complement to other power projection forces, minimizing risk to other forces.
- ***Deter and counter weapons of mass destruction***, including monitoring, targeting and when clear evidence of hostile intent exists, destroying capability for manufacture, storage, transportation, and launch.

These strategic concepts provided a capabilities-based vision for future submarines and associated long-term research and development and science and technology efforts. In 2003, the Submarine Future Studies Group aligned the Submarine Force strategic concepts document "Submarines... the Road Ahead" to the tenets and operational goals of Sea Power 21.[75]

5. SUBTECH

The Virginia-class submarine's major design and technology efforts led to the genesis of the submarine technology management process (SUBTECH) in 1997. The SUBTECH process guides strategic management of submarine technology evolution from the science and technology phase, through research and development, and into the acquisition phase. This process documents recommended science and technology and research and development investment strategies that integrate, align, and prioritize technology investments and take into consideration the needs of existing acquisition programs. The SUBTECH process and plans identify paths to expeditiously move technology into the acquisition and production environments and ensure alignment with the chief of naval operations' Sea Power 21 vision.

[75] Clark, Vern, "United States Navy: Chief of Naval Operations - Top Five Priorities: Status Report on CNO Guidance for 2002," published in 2003 [online] http://www.chinfo.navy.mil/navpalib/cno/cno-top5-report2003.html, accessed 2 September 2004.

The success of SUBTECH has led the Navy to stand up technology management processes for the aircraft carriers (CARTECH) and surface ships (SURFTECH). The SUBTECH, CARTECH, and SURFTECH technology management processes work together to identify synergies, areas for cooperative development, and opportunities for collaboration.[76]

The SUBTECH organization includes participation from the submarine type commanders (TYCOMS),[77] the research and development community (Naval Operations Submarine Warfare staff (OPNAV N77), Naval Sea Systems Command (NAVSEA), Space and Naval Warfare Systems Command (SPAWAR), Naval Undersea Warfare Center (NUWC), and Naval Surface Warfare Center (NSWC)), the science and technology community (Office of Naval Research (ONR) and Defense Advanced Research Projects Agency (DARPA)), the submarine shipbuilding industry (General Dynamics Electric Boat Corporation (GDEB) and Northrup Grumman Newport News Shipbuilding (NGNN)), and other interested parties. Representatives from these organizations come together annually for a two-day integrated working group (IWG) meeting, with smaller integrated process teams (IPTs) meeting more frequently throughout the year.

The SUBTECH process identifies the capability gaps that must be addressed to achieve the capability needs articulated in the Submarine 2020 vision and the CNO's Sea Power 21 vision.[78] The SUBTECH staff operates under the direction of the Director, Undersea Technology Directorate (SEA 073R), and puts forth an annual set of integrated research and development recommendations to OPNAV N77 and science and technology recommendations to ONR and DARPA. In addition, the SUBTECH staff produces an annual report to Congress on Submarines and Submarine Technology.

[76] Sykes, Kevin, "'CarTech' Looks to Future for Carrier Program," The Flagship, 28 August 2003 [online] http://www.flagshipnews.com/archives_2003/aug282003_6.shtml, accessed 2 September 2004.

[77] All ships are organized into categories by type. Submarines come under the Commander Submarine Force in the Atlantic and Pacific Fleets (COMSUBLANT and COMSUBPAC).

[78] Goldstein, Daniel, "SUBTECH Process," presentation of 31 March 2004, pp. 2, 4.

The SUBTECH staff is charged with actively engaging the submarine community at important gatherings, such as the Joint Undersea Warfare Technology Conferences,[79,80] the Naval-Industry Research and Development Partnership Conference,[81] and the Submarine Technology Symposium.[82] Finally, the SUBTECH staff maintains the SUBTECH Center, which provides a visual depiction of the Sea Power 21 and Submarine 2020 Visions and highlights key near-term and long-term technologies identified to achieve it. The SUBTECH Center is located at the Washington Navy Yard and is used to communicate the submarine vision and key technologies to congressional personnel, defense leaders, and industry partners.[83]

D. NATIONAL SECURITY ASSESSMENT OF THE U.S. SHIPBUILDING AND REPAIR INDUSTRY

In May 2001, the U.S. Department of Commerce issued a report[84] assessing the U.S. shipbuilding and repair industry at the request and partial sponsorship of the Carderock Division of the Naval Surface Warfare Center. The report found that the U.S. shipbuilding and repair industry is a strategic asset analogous to the aerospace, computer, and electronic industries. The domestic capability to produce and repair warships, support vessels, and commercial vessels is not only a strategic asset but also fundamental

[79] The Spring Joint Undersea Warfare Technology Conference is held in March at the Naval Postgraduate School in Monterey, California, see the NPS Undersea Warfare Archive of Past Calendar Events [online] http://www.nps.navy.mil/usw/calendarArchive.html, accessed 2 September 2004.

[80] The Fall Joint Undersea Warfare Technology Conference, also kown as the Clambake, is held in September at the Naval Submarine Base New London in Groton, Connecticut, see the most recent conference website [online] at http://www.ndia.org/Template.cfm?Section=4240&Template=/ContentManagement/ContentDisplay.cfm&ContentID=4252, accessed 2 September 2004.

[81] The ONR Naval-Industry Research and Development Partnership Conference is held in August in Washington, DC, see the most recent conference website [online] http://www.onr.navy.mil/about/conferences/rd_partner/, accessed 2 September 2004.

[82] The Navy Submarine League's Submarine Technology Symposium is held in May at the Johns Hopkins University Applied Physics Laboratory near Washington, DC, see the conference website [online] http://www.jhuapl.edu/sts/, accessed 2 September 2004.

[83] Johnson, Stephen -- meetings from January 2004 through July 2004.

[84] "National Security Assessment of the U.S. Shipbuilding and Repair Industry of May 2001: Executive Summary," U.S. Department of Commerce, May 2001.

to national security.[85] However, less than 0.5 percent of manufacturing in the United States is in shipbuilding and repair compared to 6 percent in automobile assembly and 1.8 percent in aircraft assembly.[86] Over 70 percent of all U.S. shipbuilding revenues are from U.S. Navy procurement[87] and most technological advancements for ships in the U.S. are developed in government research facilities rather than within the shipbuilding industry.[88]

With respect to productivity and competitiveness, the assessment found that current U.S. Department of Defense procurement policies do not adequately reward innovation in military ship construction practices (which indirectly encourages shipbuilders to maximize labor hours).[89] Department of Labor statistics show that productivity in the U.S. shipbuilding industry has not improved significantly since the mid-1980s, with productivity gains of only 12 percent.[90] This compares to productivity gains of up to 84 percent during the same period of time in the aircraft manufacturing industry.[91] Productivity of international shipbuilders is much higher than that of U.S. shipbuilders, with major Korean yards reportedly making productivity gains of 15 percent annually in the last decade.[92] U.S. shipbuilding has been profoundly affected by the slowdown in defense production levels at the end of the Cold War. Productivity has been further eroded by procurement practices such as change orders and uncertainty in annual appropriations.[93]

The excellence of research and development associated with U.S. shipbuilding is a key reason that U.S. warships (including submarines) are acknowledged to be the best

[85] "National Security Assessment of the U.S. Shipbuilding and Repair Industry of May 2001: Executive Summary," U.S. Department of Commerce, May 2001, p. xvi.

[86] ibid. p. 102.

[87] ibid. p. 7.

[88] ibid. p. xii.

[89] ibid. p. 59.

[90] ibid. p. 47.

[91] ibid. p. 47.

[92] ibid. p. 60.

[93] ibid. p. 59.

in the world.[94] For the U.S. industrial base as a whole, the research and development environment is more robust than ever.[95] However, the shipbuilding industry has not participated in this new environment of rapid growth in research and development.[96] Only 21 of the 118 entities responding to the Department of Commerce study reported any research and development activity.[97] The ratio of research and development spending to revenues was 1.23 percent for the U.S. shipbuilding industry from 1996 to 2000.[98] In contrast, the aerospace industry's total was more than 12 percent of total revenues during this time period.[99] The declining research and development budgets associated with the U.S. shipbuilding industry necessitate the closing of key facilities and loss of some positions (described by the Department of Commerce report as fragmentation of the research and development capability) that have historically contributed to the excellence of U.S. warships.[100] In the most recent year for which data were provided on sources of funding, the U.S. government was the source of over 45 percent of the research and development funds in the area of U.S. shipbuilding and repair.[101]

The Department of Commerce report makes several recommendations, of which the following three are of particular interest to the Submarine Hydrodynamic/ Hydroacoustic community:

- The nation needs a unified strategy for developing and maintaining an infrastructure to produce world-class ships at more competitive prices.[102]
- The U.S. Navy should consider reforming current procurement practices to reward major defense shipyards for increasing productivity and/or

[94] "National Security Assessment of the U.S. Shipbuilding and Repair Industry of May 2001: Executive Summary," U.S. Department of Commerce, May 2001, p. 65.

[95] ibid. p. 66.

[96] ibid. p. 66.

[97] ibid. p. 67.

[98] ibid. p. 68.

[99] ibid. p. 68.

[100] ibid. p. 65.

[101] ibid. p. 69.

[102] ibid. p. xvii.

reducing costs. Currently, long-term stability and predictability in DoD ship procurement budgets are essential to allowing cost reductions. This initiative could potentially provide substantial savings for the Department of Defense and U.S. taxpayers.[103]

- The U.S. Navy, the Maritime Administration, the shipbuilding industry, and institutions of higher learning should work together to develop a long-term research and development plan that supports the national maritime vision. This plan should address advanced ship concepts, platform efficiencies, improvements to manufacturing productivity, academic curricula to train the future workforce, and incentives to develop and maintain a world-class industry and associated research and development infrastructure.[104]

E. CHAPTER SUMMARY

Strategic planning specifically geared towards non-profit and public organizations is a relatively new phenomenon. Much of the thinking for the past century has focused on maximizing value to customers in a for-profit environment. However, these for-profit strategies may not be fully applicable to public-sector organizations required to operate at zero profit. The submarine community is facing a rapidly evolving environment, due to the end of the Cold War, the Rumsfeld military transformation initiative, and the rollout of the Chief of Naval Operation's Sea Power 21 vision. The Submarine Technology Management Process is aligned with these high-level initiatives to expedite the transition of submarine technology to the fleet with as little waste as possible. However, the Commerce Department has expressed concern that the reduction in research and development budgets associated with the end of the Cold War is eroding productivity, and that current procurement policies do not adequately reward innovation in military ship construction. The Department of Commerce recommends maintaining the infrastructure to produce naval ships, reforming procurement practices to increase long-term stability and predictability in ship procurement, and developing and maintaining industry and research and development infrastructure.

[103] "National Security Assessment of the U.S. Shipbuilding and Repair Industry of May 2001: Executive Summary," U.S. Department of Commerce, May 2001, p. xvii-xviii.

[104] ibid. p. xviii.

Past planning efforts for the Submarine Hydrodynamic/Hydroacoustic community had focused on annual execution, rather than a multi-year strategic vision. Developing the annual execution plans facilitated communication between members of the Submarine Hydrodynamic/ Hydroacoustic community and key stakeholders. However, the resulting plans were lengthy and classified, which made them difficult to use in an effective manner. This planning process did not provide the long-term strategic guidance necessary to manage the Navy submarine Hydrodynamic/ Hydroacoustic resources during the current era of declining budgets. This caused fragmentation of the research and development capability that supports the pre-eminence of U.S. Submarines.

III. RESEARCH METHODOLOGY

A. INTRODUCTION

This chapter describes the method used to identify the key issues for the Submarine Hydrodynamic/Hydroacoustic community. Based on the review of strategic planning literature, the author identified a need to conduct an analysis of the strengths and weaknesses of the Submarine Hydrodynamic/Hydroacoustic community, and the opportunities and threats facing the community (a SWOT analysis). The traditional planning body for the Submarine Hydrodynamic/Hydroacoustic community was comprised of a handful of senior managers with responsibility for the Submarine Hydrodynamic/Hydroacoustic Research and Development and technical oversight of Submarine Hydrodynamics and Hydroacoustics, collectively called the Hydro Sub Group. The author chose to use a workbook developed by John Bryson and Farnum K. Alston[105] to facilitate this SWOT analysis and other strategic planning efforts with the Hydro Sub Group.

During the initial planning meetings, the Hydro Sub Group identified the Submarine Hydrodynamic/Hydroacoustic Community's strengths, weaknesses, opportunities, and threats in the areas of Mission and Vision, Fiscal and Human Resource Management, Communications, and Leadership, Management and Organization. The Hydro Sub Group also identified the barriers working against successful strategic planning, as well as the expected costs and benefits of a strategic planning exercise. After considering the results of these meetings, the Hydro Sub Group agreed that a strategic planning effort should be conducted. The results of this SWOT analysis are contained in Appendix A.

After completing the initial planning meetings, however, members of the Hydro Sub Group realized they did not have the time and personnel resources required to do the strategic planning process laid out by Bryson. Additionally, the members of the Hydro

[105] Bryson, John M. and Farnum K. Alston, "Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1996.

Sub Group, though senior managers, were not in a position to effectively lobby for an overall strategy across the entire Submarine Hydrodynamic/Hydroacoustic community. The author developed a plan to solicit input regarding strategic issues from a broad cross-section of managers in the Submarine Hydrodynamic/ Hydroacoustic community, including admirals and senior executives whose time was at a premium. This process involved interviews and a survey tool developed from the answers given during the interviews. The survey tool is contained in Appendix B.

B. PLANNING MEETINGS

Investigation of the processes used by the Submarine Hydrodynamic/ Hydroacoustic Community to develop and promulgate strategic plans identified that a small group of senior managers, called the Hydro Sub Group, had developed the "Hydro Plan" for several previous budget cycles.[106] An initial set of planning meetings was held with the Hydro Sub Group to determine if there was a need for a revised strategic planning effort. Presuming that there would be such a need, the meetings were also intended to develop an approach for the revised strategic planning effort.

A review of the strategic planning literature for non-profit organizations resulted in selection of the methodology laid out by Bryson and Alston in 1996[107] to perform a SWOT analysis and assess the need for a strategic planning effort. These initial meetings resulted in the decision to begin identifying issues for the community. The author assisted the Hydro Sub Group in performing the following activities prescribed by Bryson to assess the need for a strategic plan:

- Identification of Strengths, Weaknesses, Opportunities, and Threats (SWOT analysis) in the following areas:
  - Mission and Vision
  - Fiscal and Human Resource Management

[106] Dahmer, Douglas -- interview of April 2002.

[107] Bryson, John M. and Farnum K. Alston, "Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass, Inc., 1996.

    - Communications
    - Leadership, Management and Organization
- Identification of barriers to strategic planning, as well as ways in which the barriers could be addressed
- Identification of the costs the strategic planning effort could be expected to incur, as well as ways to manage those costs
- Identification of the expected benefits of strategic planning, as well as ways in which these benefits could be enhanced
- Assessment of the community readiness to proceed with a strategic planning effort

The worksheets developed during these planning meetings are attached as Appendix A.

The Bryson text contains a checklist of readiness criteria that indicate when an organization is ready to embark on a strategic planning effort. Figure 8 lists these criteria.

- The strategic planning process has strong sponsors
- The strategic planning process has strong champions
- Resources are available to conduct strategic planning
- The strategic planning process is within our mandate
- The identified benefits of strategic planning outweigh the identified costs
- The strategic planning process will have real value for the organization
- The strategic planning process will be linked with operational plans and budgets

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Based on the above answers a decision can be made to:

- Proceed (if all the criteria above are met)
- Figure out how to meet criteria that are not yet met (e.g., develop a champion, obtain resources)
- Forget about strategic planning for now

Figure 8. Readiness Criteria for Proceeding with Strategic Planning[108] (After: Bryson, 1996)

The Hydro Sub Group identified that lack of consensus was a key obstacle to developing an effective strategic plan for the Submarine Hydrodynamic/Hydroacoustic community. An additional barrier was the inability to gather a quorum of major stakeholders to work out a consensus. The challenge was to obtain input from key stakeholders and identify consensus among those stakeholders without requiring them to gather. The author proposed that she would go to individual stakeholders to solicit information on key issues, rather than attempt to arrange a series of meetings. Consensus on the opinions expressed during interviews would be identified by means of a survey developed from the interview results. The Hydro Sub Group identified a list of 55 stakeholders in key management positions responsible for submarine hydrodynamic and hydroacoustic research. These managers had fiscal and/or technical responsibility for

[108] Adapted from Bryson et al., "Creating and Implementing Your Strategic Plan: A Workbook for Public and Non-Profit Organizations," 1996, Jossey-Bass, Inc., p. 26.

research and included military officers, government civilians, managers in academia, and industry leaders. Figure 9 shows the affiliations of the managers identified by the Hydro Sub Group.

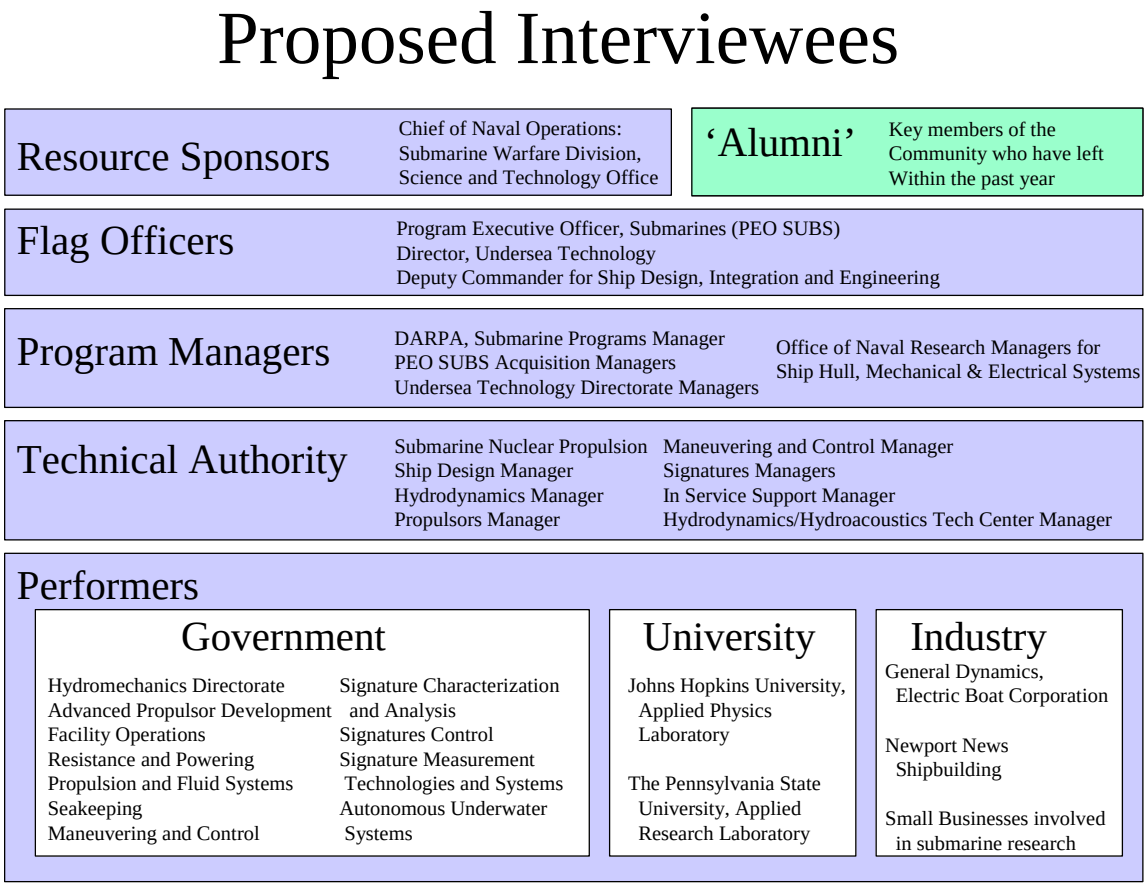


Figure 9. Managers with Fiscal or Technical Responsibility for Submarine Hydrodynamic and Hydroacoustic Research

C. THE ETHNOGRAPHIC INTERVIEW

The author was concerned that a simple request for key issues from interviewees would not result in the explicit answers necessary to develop the thorough understanding of the group (which would be required to develop a list of key strategic issues). One technique for obtaining an understanding of a group is to conduct interviews--specifically, ethnographic interviews. Ethnography is the study of a group of people,

particularly, "concern with the meaning of actions and events to the people we seek to understand."[109] In most cultures, the majority of these meanings are taken for granted and only communicated indirectly. Yet these complex systems of meaning form the rationale for people's behavior, their understanding of themselves and others, and their sense of the world in which they live.[110]

The ethnographic interview is one strategy for getting people to explicitly talk about what they know and about the meanings they assign to actions and events. However, it is important to avoid asking questions that could too easily precondition the answer.[111]

When conducting ethnographic research, there are a variety of ethical principles that must be followed. These are:[112]

- **Consider the interviewee first.** When there is a conflict of interest, the needs of the interviewee must come before the needs of the author.
- **Safeguard interviewees' rights, interests, and sensitivities.** All interviewees must have the protection of saying things "off the record" which never find their way into the author's field notes.
- **Communicate research objectives**. The author should explicitly tell each interviewee the aim of the research and ways in which the study could be useful to other interviewees.
- **Protect the privacy of interviewees**. Interviewees have the right to remain anonymous.
- **Don't exploit interviewees**. Interviewees should not suffer harm from the research, and should benefit from the experience. This does not need to be a monetary benefit. This benefit could be as simple as the satisfaction gained from helping the author learn about the interviewee's unique worldview.
- **Make reports available to interviewees**. No reports should be provided to individuals commissioning the study (sponsors) that are not also available to the general public and, where practicable, to the population studied.

[109] Spradley, James P., "The Ethnographic Interview," 1979, Holt Rinehart and Winston, p. 5.

[110] Spradley, James P., "The Ethnographic Interview," 1979, Holt Rinehart and Winston, p. 5.

[111] ibid. p. 26.

[112] ibid. pp. 34-39.

1. Identifying Potential Interviewees

A list of potential interviewees was drawn up with the help of the mid-level managers who had been tasked to develop the Hydrodynamic/Hydroacoustic Plan. Qualities of good interviewees are identified below[113]:

- **Thorough enculturization**. The potential interviewees were all individuals who had spent many years working as either sponsors, managers, advisors, or performers of Submarine Hydrodynamic/Hydroacoustic research.
- **Current involvement**. The potential interviewees were individuals who were currently involved with the community.
- **Adequate time**. A thorough ethnographic study of an unfamiliar culture would involve multiple interviews that amounted to several hours combined. The purpose of this series of interviews was limited and did not require hours of commitment per interviewee. However, interviewees were asked to set aside roughly an hour for the interview.

2. Interview Questions

The author developed a set of questions for the interviews. The intent was to prompt the interviewees to think about the most outstanding successes and failures they had experienced, as well as the factors that had contributed to each success and failure. Towards the end of the interview, the interviewees were asked to identify the issues they felt faced the community, and provide suggestions for strategies to address those issues. The interview questions were as follows:

- Identify three hydro successes.
  - Why did they succeed?
  - What is your metric for success?
- Identify three hydro failures.

[113] Adapted from Spradley, pp. 45-54.

- Why did they fail?
- What is your metric for failure?

- What do you feel are the three most important issues facing the Hydro community?
- What strategies do you suggest to address these issues?

The discussion of successes and failures served several purposes. First, the discussion prompted the interviewee to describe those products that had been successes and failures. Second, the discussion prompted the interviewee to provide lessons learned about the success or failure of each product. Third, the discussion solicited the reasons why a product was categorized as either a success or failure (the performance metric). Fourth and finally, the discussion prompted the interviewee to think deeply about the factors that contributed to success and failure and contrast those conditions with the current conditions. This mental preparation was key to soliciting ideas on the important issues facing the Hydrodynamic/ Hydroacoustic community. This identification of strategic issues is the heart of the strategic planning process.[114]

3. Interview Methodology

An ethnographic interview is in many ways similar to a friendly conversation. In fact, interviews that stray too far from friendly conversation run the risk of turning into interrogations, with an understandable loss of rapport and lack of further cooperation on the part of the interviewee[115]. But unlike a simple friendly conversation, the ethnographic interview includes three elements that are explicitly intended to explain the research process and solicit information. These elements are:[116]

[114] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1995, p. 128.

[115] Spradley, James P., "The Ethnographic Interview," 1979, Holt Rinehart and Winston, p. 58.

[116] ibid. p. 59-66.

- **Explicit purpose**. The author reminds the interviewee that there is a purpose to the conversation or interview, and what that purpose is. For this research, the purpose of the interview was to develop a list of strategic issues to guide future strategic planning for the Submarine Hydrodynamic/Hydroacoustic Community, as well as lessons learned and concensus on the success or failure of products developed by the community.
- **Ethnographic explanations**. The author explains aspects of the interview process. This includes explanations of how the conversation is being documented, what the project is about, and explanations about the ethnographic questions. For this research, conversations were documented by the author using written notes. The project was focused on developing strategic issues and community consensus, as well as serving as the subject for a Master's Degree Thesis in Product Development at the Naval Postgraduate School.
- **Ethnographic questions**. Ethnographic questions solicit information on the objects and events of particular interest to the interviewee. The three main types of questions are:
    - **Descriptive questions**. Descriptive questions prompt the interviewee to explicitly describe an object or event to ensure the author understands the viewpoint of the interviewee, for example "What is the ABC UUV?"
    - **Structural questions**. Structural questions identify the components of an activity or object. Examples of structural questions are "Why did the ABC UUV succeed?" and "Can you think of any other factors that contributed to the success of the ABC UUV?"
    - **Contrast questions**. Contrast questions illuminate how the interviewee distinguishes or categorizes the events and objects. Examples of contrast questions are "What is the difference between the ABC UUV and the XYZ UAV?" or question pairs such as "What is your definition of failure? What is your definition of success?"

Aside from including ethnographic elements, an ethnographic interview will differ from a simple conversation in the following ways: [117]

[117] Spradley, James P., "The Ethnographic Interview," 1979, Holt Rinehart and Winston, p. 67-68.

- **The conversation is asymmetrical**. The author asks most of the questions, and the interviewee does most of the talking.
- **Repeating is a good thing**. The author repeats what she understood the interviewee to have said, and restates questions as needed to solicit additional information.
- **The author repeatedly expresses interest and ignorance**. These expressions of ignorance and interest encourage the interviewee to continue their explanations. Otherwise the interviewee might stop explaining because he/she thinks that he/she is either boring the author or telling the author something she already knows.
- **The author encourages the interviewee to expand on cryptic statements.** In friendly conversations, information is exchanged in an abbreviated fashion because the speakers assume the other can infer their meaning. The researcher tries to minimize the need for inference by asking the interviewees to be more complete in their explanations.

Figure 10 summarizes the elements of an ethnographic interview.

1. Greetings
2. Giving ethnographic explanations
    a. Explaining the project
    b. Explaining questions
    c. Explaining recording/documentation methods
    d. Encouraging use of language the interviewee is comfortable with
    e. Explaining the interview process
3. Asking ethnographic questions
    a. Descriptive questions
    b. Structural questions
    c. Contrast questions
4. Encouraging asymmetric conversation or turn taking
5. Expressing interest
6. Expressing ignorance
7. Repeating
8. Restating the interviewee's terms
9. Incorporating the interviewee's terms
10. Creating hypothetical situations to explore meaning of interviewee's statements
11. Asking friendly questions
12. Taking leave

Figure 10. Elements of an Ethnographic Interview[118] (After: Spradley, 1979)

For this series of interviews, the main questions, as well as a description of the project and the interview process, were provided in advance of the actual interview. While providing questions in advance of an interview is not common ethnographic procedure, the author felt the possibility of receiving over-analyzed answers was outweighed by the potential increase in productivity of each interview, enabled by pre-interview reflection.

[118] Spradley, James P., "The Ethnographic Interview," 1979, Holt Rinehart and Winston, p. 67.

The author documented the interviews using written notes. Written notes allowed the interviewees to talk more freely and discuss things off the record. The notes also served to safeguard the interviewees' rights, interests, and sensitivities. In addition, many of the interviews were held in locations where audio recording was prohibited for security reasons. While it would have been possible to have a scribe attend the interviews, the absence of a separate scribe served multiple purposes. First, the fact that the author was writing down notes allowed a natural opportunity to ensure that the written words accurately reflected the interviewee's statements. Secondly, the absence of a secondary scribe simplified logistics and reduced the risk to the interviewees' rights, interests, and sensitivities. In the cases where prospective interviewees had already written out their responses, an ethnographic interview was still conducted to ensure the author understood the nuances of the responses.

4. Analysis of Ethnographic Interviews

The results of the ethnographic interviews were analyzed to develop questions for the survey tool. Particular attention was given to three sets of answers:

- Products and tools identified as either successes or failures
- The factors that contributed to either success or failure, and
- The key issues identified by the interviewees.

The interviews also resulted in strategies to address the key issues mentioned by interviewees. These strategies were based on the individual interviewee's understanding of other key issues and his or her values. It was felt that neither the secondary issues nor the community values could be known for certain before the results of the initial survey were analyzed. Therefore, the survey did not solicit information on strategies to address key issues.

Data regarding products, tools, and facilities were extracted from the ethnographic interviews by tabulating the number of times each item was mentioned by interviewees as

having been a particular success or failure. Lists of specific issues and lessons learned were developed from the interviews by grouping similar statements and developing a representative or archetypal statement that characterized each grouping of statements. The information on products, lessons learned, and issues is contained in the next chapter.

D. SURVEY DEVELOPMENT

A survey tool was generated to acquire the following categories of information for key managers of hydrodynamic and hydroacoustic research:

- Demographic questions
- Questions on experiences with strategic planning in the community
- Questions on opinions about how future efforts could be more effective
- Questions on key issues
- Questions on assessments of:
  - Lessons Learned
  - Products
  - Tools
- Questions on survey follow-up

The first three categories above were developed to characterize the respondent population and to identify consensus on opinions that had been expressed in conjunction with the planning meetings and interviews. The next two categories, regarding issues and assessments, were explicitly derived from the series of ethnographic interviews. The last category was included to pave the way for following-up with survey respondents as necessary. Appendix B contains the word version of the survey distributed to managers in the Submarine Hydrodynamic/Hydroacoustic Community. The survey was sent to the managers identified as key stakeholders by the Hydro Sub Group as well as several managers who were identified as key stakeholders during the interview phase of the research. The survey questions are discussed below.

1. Demographics

The demographic questions in the survey were as follows:

- **Age of Respondent**. To maintain anonymity, broad categories were used (20-29, 30-39, 40-49, 50-54, 55+). The older ages were adjusted to identify how many of the survey respondents are eligible for retirement now and how many will become eligible for retirement in the next five years.
- **Rank**. This question was designed to identify the management level at which the respondents were operating. Because of differences in terminology between organizations, these ranks could eventually only be differentiated between 1) middle managers (for example, managers at the GS-13 level), 2) senior managers (for example, managers at the GS-14 and GS-15 level), and 3) admirals and senior executives.
- **Years of Experience**. This question was designed to identify how long the respondents had worked within the Submarine Hydrodynamic/Hydroacoustic community. In addition, this question asked for total number of years of experience with the Submarine Hydrodynamic/Hydroacoustic community, years of technical experience, and years of management experience within the community. If all these questions were answered, it was possible to determine whether respondents became managers of Hydrodynamic and Hydroacoustic work by coming up through the technical ranks, or by being pulled in to manage Submarine Hydrodynamic/Hydroacoustic work by virtue of being a successful manager in other technical areas.
- **Research and Development Categories**. This question was designed to identify the categories of research and development with which the respondents had been involved over the course of their careers. The intent was to identify if the survey respondents represented a good cross-section of research and development experience, from basic research on the one hand, to engineering and manufacturing development on the other.

2. Experience with Strategic Planning in the Submarine Hydrodynamic/Hydroacoustic Community

The following questions were asked to identify the respondents' familiarity with overarching guidance and past planning efforts of importance to the Submarine Hydrodynamic/Hydroacoustic community. The respondents were asked whether they agreed or disagreed with the following statements:

- I am actively involved in the Hydrodynamic and Hydroacoustics Community
- I am familiar with the Submarine Force's four Strategic Concepts
- I am familiar with the 3 pillars of CNO's Sea Power 21 vision
- I participated in developing a strategic plan for the community during the past five years
- I am familiar with the strategic plan(s) developed during the past five years
- I have found the strategic plan(s) useful in guiding my efforts
- The Hydrodynamic and Hydroacoustic community effectively develops strategies to address key issues
- I believe significant improvements could be made to the current strategic process

3. Time, Classification, and Distribution of Future Strategic Planning Efforts

The respondents were asked whether they agreed or disagreed with the following statements:

- Finalize plan in time to impact POM papers (April/May of odd years)
- Keep unclassified to allow wide distribution
- Keep classified to allow more detailed description
- Limit distribution to allow management flexibility
- Post plan and accompanying brief in central location for easy access

4. Key Strategic Issues

A list of key issues was developed based on answers given during the ethnographic interviews. The survey respondents were requested to select the three issues they felt were most important. In case the respondent felt that one of his/her most important issues was not captured by the available choices, there was a space to write-in an issue. The list of candidate issues was as follows:

- How can we maintain/nurture technical expertise of the Hydrodynamic/ Hydroacoustic workforce?
- How can we maintain/nurture high quality, knowledgeable leadership in the community?
- How can we reduce the R&D time and cost currently required to field products?
- How can we successfully transition technologies from S&T to R&D/Acquisition?
- How can we spark innovation and excitement within the community?
- How can we reduce program volatility?
- How can we achieve stable funding?
- How do we ensure that basic research continues to support improved tools and future innovations?
- How do we market Hydrodynamics/Hydroacoustics to make Navy relevance clear?
- How do we ensure funds available are most effectively utilized for the fleet?
- How can the Hydrodynamics/Hydroacoustics infrastructure become more flexible?
- Other not listed above _____

5. Lessons Learned

A list of lessons learned was developed based on discussion during the ethnographic interviews in response to why certain products had succeeded or failed. For the survey, the list of lessons learned was condensed to the following:

- Clear guidance from upper management
- Frequent reviews with high level management
- Knowledgeable personnel
- Validated tools
- Community support
- Early, stable definition of goals
- Strong programmatic support (funding, priority and schedule)

- High-level focus/attention
- Coordination between S&T, R&D and acquisition sponsors
- Persistence
- Sponsor tolerance of risk
- Integrated multi-disciplinary teams
- Technical oversight from appropriate SEA 05 personnel
- Team continuity
- Good communication between team members
- Decision authority/flexibility delegated to lowest appropriate level
- Perceived impartiality of program managers
- Realistic expectations

6. Product and Tool Assessment

The survey included lists of the products and tools identified as particular successes or failures by at least two individuals during the course of the ethnographic interviews. The purpose of asking opinions about individual products was to identify the consensus on these products. For example, some products have strong proponents and strong detractors. The survey allows us to assess which products are seen as successful by a statistically significant majority of the respondents. This consensus vision of the past is important to develop a vision of future success.[119] For products, respondents were asked to identify how they would assess the product using the following categories:

- Programmatic and technical success
- Technical success
- No opinion
- Programmatic failure
- Programmatic and technical failure

[119] Bryson, John M., "Strategic Planning for Public and Nonprofit Organizations," San Francisco, CA, Jossey-Bass Publishers 1995, p. 163.

The asymmetry of the possible responses was based on the information gleaned during the interviews, where programmatic failings were sometimes characterized as overwhelming technical success, or technical success was identified even in light of programmatic difficulties. In a few cases, technical failure of a research and development project was characterized as a net success during the interview process. Mixed success was predominantly seen as succeeding based on technical merit, where mixed failure was predominantly seen as failing because of programmatic weakness. However, because of feedback in response to the survey, the author suggests that future surveys ask which of the following descriptions best characterizes the product:

- Programmatic and technical success
- *Programmatic or* technical success
- No opinion
- Programmatic *or technical* failure
- Programmatic and technical failure

For tools, respondents were asked to identify how they would assess the tool using the following categories:

- Extremely useful
- Useful
- No opinion
- Useful but with major shortcomings
- Not useful

7. Survey Follow-up and Feedback

Finally, the survey included questions on whether the respondents wanted information on the outcome of the survey, and if they would be willing to participate in future surveys. A field was provided for contact information if the answer to either question was “yes.”

E. DEPLOYMENT TECHNIQUES.

The survey was deployed using a web-based survey service known as Zoomerang. An initial e-mail was sent to 71 members of the Submarine Hydrodynamic/Hydroacoustic Community. These members included governmental, academic, and commercial organizations with management responsibilities for either financial or technical management of submarine Hydrodynamic/Hydroacoustic efforts. The target population was provided with information for completing the survey using the web-based tool. In addition, the survey was created as an electronic form and attached to the e-mail for those who might wish to print out the survey and complete it on paper. A fax number to a secure location was provided for submitting the paper form. The survey form attached to the e-mail could also be filled out electronically and returned via e-mail. Finally, paper copies of the survey were distributed by hand to key individuals.

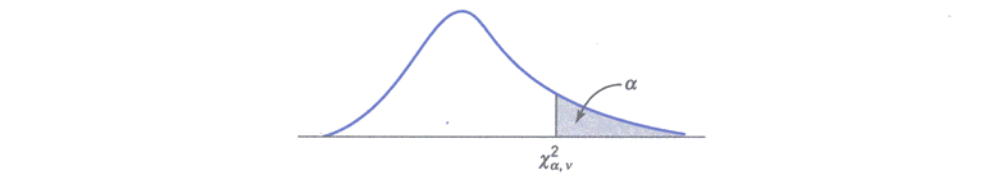
F. EVALUATING STATISTICAL SIGNIFICANCE OF RESULTS

To obtain a simple majority, just over half the people must agree with the statement. But to determine if a majority opinion is statistically significant, a more sophisticated measure is required. An important sampling distribution defined in terms of the normal distribution is the chi-squared or χ^2 distribution. For this survey, all the answers were treated as having one degree of freedom. In other words, the answers were "yes/no" or "agree/disagree." This allows us to answer the analysis question: "Is the majority opinion statistically significant?" For the one-degree of freedom case, chi-squared is calculated using the following equation:

$$\chi^2 = (|\text{majority} - \text{minority}| - 1)^2 / (\text{majority} + \text{minority})$$

Equation 1. Calculation of χ^2 for a Single-Degree-of-Freedom ($\nu = 1$)

Figure 11 on the next page shows the values of χ^2 that are required to assert that a conclusion is true with a probability of $1-\alpha$ for a single degree of freedom ($\nu = 1$).



	α								
ν	0.995	0.990	0.975	0.950	0.500	0.050	0.025	0.010	0.005
1	0.00 +	0.00 +	0.00 +	0.00 +	0.45	3.84	5.02	6.63	7.88

Figure 11. Percentage Points for the χ^2 Distribution[120] for a Single-Degree-of-Freedom System ($\nu = 1$) (After: Pearson and Hartley, 1966)

For the majority position of the respondents to have a 95 percent probability of reflecting the true majority of the global population, the value of χ^2 must be equal to or greater than 3.84 ($\chi^2 \geq 3.84$). For the majority position of the respondents to have a 99 percent or 99.5 percent probability of reflecting the true majority of the global population, the value of χ^2 must be equal to or greater than 6.63 and 7.88, respectively. For the purposes of this thesis, a conclusion is considered statistically significant if the probability that it is true is 95 percent or greater. Figure 12 and Table 1 show the size a set needs to be to be a simple majority and a statistically significant majority ($1-\alpha \geq 95$ percent) for the range of populations applicable to this survey (up to 50). The sample size must be at least 6 in order for even a unanimous opinion to have a 95 percent probability of reflecting the majority opinion of the entire population. Similarly, the sample size must be 9 for a unanimous opinion to have a 99 percent probability of reflecting the majority opinion. The sample size must be 10 for a unanimous opinion to have a 99.5 percent probability of reflecting the majority opinion.

[120] Adapted from *Biometrika Tables for Statisticians*, Vol. 1, 3rd ed., by E. S. Pearson and H. Q. Hartley, Cambridge University Press, Cambridge, 1966.

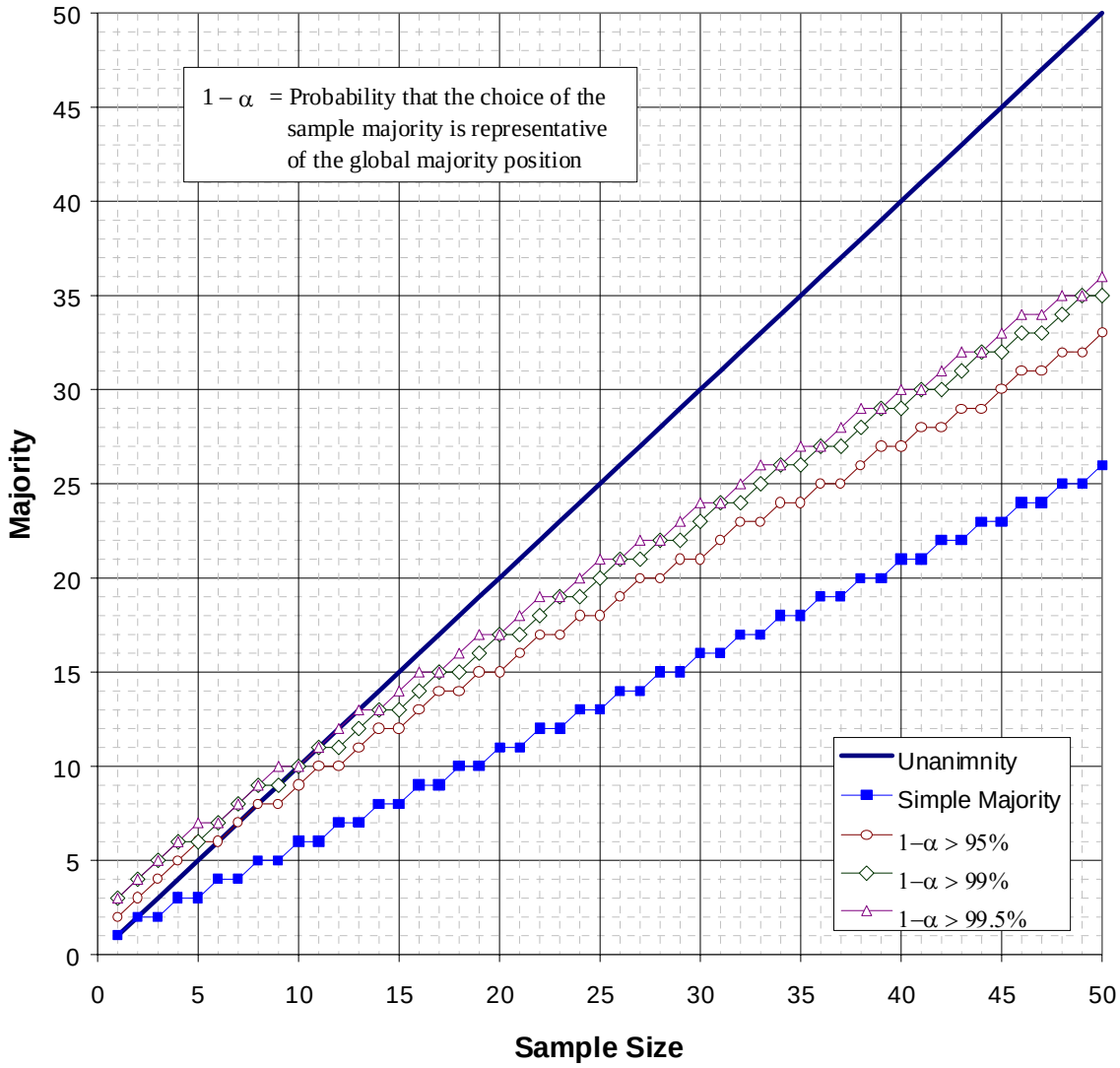


Figure 12. Plot of Majority Required to Achieve Statistical Thresholds

Sample Size	Simple Majority	Majority such that $1-\alpha \geq 95\%$	Majority such that $1-\alpha \geq 99\%$	Majority such that $1-\alpha \geq 99.5\%$
6	4	6	7	7
7	4	7	8	8
8	5	8	9	9
9	5	8	9	10
10	6	9	10	10
11	6	10	11	11
12	7	10	11	12
13	7	11	12	13
14	8	12	13	13
15	8	12	13	14
16	9	13	14	15
17	9	14	15	15
18	10	14	15	16
19	10	15	16	17
20	11	15	17	17
21	11	16	17	18
22	12	17	18	19
23	12	17	19	19
24	13	18	19	20
25	13	18	20	21
26	14	19	21	21
27	14	20	21	22
28	15	20	22	22
29	15	21	22	23
30	16	21	23	24
31	16	22	24	24
32	17	23	24	25
33	17	23	25	26
34	18	24	26	26
35	18	24	26	27
36	19	25	27	27
37	19	25	27	28
38	20	26	28	29
39	20	27	29	29
40	21	27	29	30
41	21	28	30	30
42	22	28	30	31
43	22	29	31	32

Table 1. Majorities Needed to Achieve Statistical Thresholds for $\nu = 1$

G. CHAPTER SUMMARY

This chapter described the methods used to identify the processes used in strategic planning for the Submarine Hydrodynamic/Hydroacoustic community, the identification of strategic issues, and the lessons learned that affect strategic management and evaluation of past product successes and failures. Meetings with the Hydro Sub Group led to a determination that there was a need for a revised strategic planning effort. The group identified major barriers to successful strategic planning within the community, including lack of personnel resources and extreme difficulty in gathering empowered managers from across the multi-organizational, geographically diverse subject community. These resource constraints suggested that a non-traditional approach should be used to obtain input from a broad cross-section of managers in the Submarine Hydrodynamic/ Hydroacoustic community, including admirals and senior executives whose time was at a premium. This process involved interviews and a survey tool developed from the answers given during the interviews. The author assessed the statistical significance of the majority position using the chi-squared criterion assuming a single-degree of freedom and a normal distribution of the population.

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IV. RESULTS

A. INTRODUCTION

This chapter contains the results of the interviews and survey tool described in the previous chapter. Meetings with the Hydro Sub Group resulted in a SWOT analysis and a decision to identify the overarching strategic issues facing the Submarine Hydrodynamic/Hydroacoustic community. The worksheets developed during these planning meetings are attached as Appendix A. However, identifying community consensus on even the key strategic issues would be difficult for the multi-organizational, decentralized Submarine Hydrodynamic/Hydroacoustic community using traditional tools.

A series of ethnographic interviews was held with 27 managers in the Submarine Hydrodynamic/Hydroacoustic community. These interviews identified a wide range of possible issues that could be used to form the basis of a strategic posture, but no means of determining a consensus. The interviews also yielded a great amount of information on the factors that interviewees felt were important in the success or failure of products and tools produced by the Submarine Hydrodynamic/Hydroacoustic community. Finally, the interviews provided information on strategies that could address the potential issues facing the Submarine Hydrodynamic/Hydroacoustic community.

A survey tool was developed based on results of the ethnographic interviews. The survey was sent to 71 managers in the Submarine Hydrodynamic/Hydroacoustics Community. There were 43 surveys that were completed and returned to the author. Analysis of the answers to this survey provides a clear consensus on the key issues facing the Submarine Hydrodynamic/Hydroacoustic community.

B. INTERVIEW RESULTS

The purpose of the interviews was to identify candidate strategic issues for the Submarine Hydrodynamic/Hydroacoustic community. Interviews were conducted over the course of two months with 27 of the 55 individuals identified as key stakeholders by the Hydro Sub Group.

1. Outstanding Products and Tools

The interviews had solicited information about the "Submarine Hydro successes and failures." The successes and failures identified were relatively easy to list. However, the same product was sometimes identified by different titles or program names. During the interviews themselves, the identification of successes and failures served to facilitate introspection. In the process of the interviews, an interviewee would occasionally characterize a product previously identified as a success to actually be a failure. In fact, one individual identified three products as successes, then proceeded to identify the same three products as failures. Given this observed lack of consensus on products produced by the Submarine Hydrodynamic/Hydroacoustic community, it was decided to use the survey to identify the majority consensus on the performance of key products.

The records of each interview were examined to extract a list of those tools and products that had impressed the interviewees as either outstanding successes or failures. Almost 60 distinct items were identified as outstanding successes or failures by the interviewees. Table 2 on the next page lists those items that were mentioned at least twice, with an indication of how many times the items were mentioned as successes and/or failures. Table 2 also indicates the category to which each item belonged: propeller, tool, or other. Finally, the last column shows whether the interviewees who mentioned the product saw it as a success (green) or a failure (red). The cell is colored yellow if the interviewees were not unanimous and there was not a statistically significant majority.

Product/Tool Name	Times mentioned as a success	Times mentioned as a failure	Total times Mentioned	Category	G-Y-R
Seawolf WAA	0	7	7	Other	R
Albacore	5	0	5	Other	G
Seawolf trials	4	0	4	Other	G
Advanced Sail/ATSOL	4	0	4	Other	G
Automatic Control	2	0	2	Other	G
NOO AUV (Seahorse)	2	0	2	Other	G
AN/WSQ-9	2	0	2	Other	G
Maneuvering Objectives	2	0	2	Other	G
Neutral Angle	0	2	2	Other	R
Seawolf prop	11	1	12	Propeller	G
VIRGINIA	4	4	8	Propeller	Y
Los Angeles props	5	3	8	Propeller	Y
ASDS prop	0	7	7	Propeller	R
Suprejet	4	0	4	Propeller	G
Advanced Hybrid	2	1	3	Propeller	Y
Suprelite	0	3	3	Propeller	R
ASPS	1	2	3	Propeller	Y
PSAM	0	2	2	Propeller	R
CFD	1	3	4	Tool	Y
H/HTC	2	1	3	Tool	Y
Simulation capability (Multi-Vortex)	3	0	3	Tool	G
Computational tools	3	0	3	Tool	G
LSV 1 (Kokanee)	1	1	2	Tool	Y
LSV 2 (Cutthroat)	0	2	2	Tool	R

Table 2. Hydrodynamic and Hydroacoustic Products and Tools Identified as Outstanding Successes or Failures by Multiple Individuals During Interviews

2. Lessons Learned

All interviewees were asked to explain the factors they felt had contributed to the success or failure of each product or tool. Factors that had led to success were considered as lessons learned for this survey. Factors that led to failure were converted by the author and expressed as lessons learned that could lead to a "success." For example, an interviewee might have identified that a product failed because "the requirements kept changing over the course of the program." This would be changed to read "requirements stay stable over the course of the program" and added to the list of lessons learned.

The resulting raw list of lessons learned was extensive. The author desired to develop a list that was both manageable and detailed. This list would then be included in a survey tool to identify the community consensus of the importance of these lessons learned in producing successful products. The individual lessons learned were written down, then grouped together until there were roughly 20 groups of statements, each group being similar in intent. Next, a representative or archetypal expression for the group was developed. The large number of groups was selected because the author desired to retain lessons learned that reflected the particular language and culture of the Submarine Hydrodynamic/Hydroacoustic Community. The author felt a more concise list of lessons learned would become indistinguishable from those found in any reputable management text. Figure 13 contains the final list of lessons learned developed from the interview responses. Those lessons learned that are peculiar to the language and culture of the Submarine Hydrodynamic/Hydroacoustic community are listed in the lower half of the figure. The meaning of each statement of a lesson learned is expanded below.

- **Clear Guidance from Upper Management**
- **Frequent Reviews with High-level Management**
- **Integrated Multi-disciplinary Teams**
- **Decision Authority/Flexibility Delegated to Lowest Appropriate Level**
- **Strong Programmatic Support (Funds, Priority, and Schedule)**
- **Good Communication between Team Members**
- **Early, Stable Definition of Goals**
- **Persistence**
- **High-level Focus/Attention**
- **Knowledgeable Personnel**
- **Realistic Expectations**
- **Team Continuity**

- **Perceived Impartiality of Program Managers**
- **Coordination between S&T, R&D and Acquisition Sponsors**
- **Technical Oversight from Appropriate SEA 05 Personnel**
- **Sponsor Tolerance of Risk**
- **Community Support**
- **Validated Tools**

Figure 13. List of Representative Lessons Learned Developed from Ethnographic Interviews

Clear Guidance from Upper Management. Many of the interviewees talked about the importance of getting clear guidance from upper management, and how that clear, unambiguous guidance had contributed to success in a given endeavor. Lack of clear, consistent guidance was also mentioned as a factor in some failures.

Frequent Reviews with High-level Management. Some programs mentioned as successes had been particularly high profile, such that monthly reviews of the progress

were held with an admiral who was involved. These frequent reviews were mentioned as contributing to the success of those programs.

Knowledgeable Personnel. A key factor mentioned for many of the successes was involvement of knowledgeable, experienced personnel. Reference to the availability of experienced, knowledgeable people was often accompanied by the concern that availability of these people would be compromised with the loss of talent through retirement or lack of funding. Lack of knowledgeable personnel was also mentioned with respect to some failures. Usually, this was because the responsible managers (typically from outside the traditional Submarine Hydrodynamic/Hydroacoustic community) did not ensure that proper hydrodynamic analyses were performed. In one case, it was alleged that the prime contractor had hired recent college graduates to perform the hydrodynamic analysis, without supervision by experienced hydrodynamicists or hydroacousticians.

Validated Tools. The success of many products was attributed to the use of simulation and modeling tools that had been proven to provide valid results. In the area of computational fluid dynamics and hydroacoustics, valid tools are simulation codes that produce valid trends and results. An example of a validated simulation tool is computational fluid dynamics (CFD) to compute flow fields based on Reynolds-Averaged Navier-Stokes (RANS) calculations using two-equation turbulence models. For example, the Unsteady Computation of Field Equations (UNCLE), developed at the University of Mississippi, accurately simulates details of non-uniform submarine flow-fields when run with the q-ω turbulence models. In the area of testing and experimentation, valid tools are testing methodologies that produce true predictions of full-scale results. An example of a validated experimental tool is the Large Scale Vehicle or Kokanee, a one-quarter scale, autonomous model of the Seawolf submarine used to measure performance of propulsors and appendages. In one failure mentioned, the phenomenon that caused the failure was outside the state-of-the-art knowledge-base of the submarine community, and there were no valid tools.

Community Support. Several of the recent successes benefited from community investments such as the Hydrodynamic/Hydroacoustic Technology Center (H/HTC), that

houses servers and classified connections linking the shipyards, university affiliated research centers (UARCs), and government organizations. The H/HTC serves as the repository for computational tools and data as well as providing services to facilitate communication across the community.

Early, Stable Definition of Goals. The early and stable definition of goals was seen as a factor contributing to success, and the lack of early goals, particularly goals that shifted over time, was mentioned as a factor contributing to failures. This is similar to "Clear guidance from upper management," but differs because the guidance is not only clear, but is provided early in the development process and remains stable over the course of the product development process.

Strong Programmatic Support (Funds, Priority, and Schedule). Adequate funds, high priority to increase the probability of getting the right people, and appropriate schedules (neither too compressed nor too stretched out) were mentioned as key contributors to successes.

High-level Focus/Attention. High-level attention was mentioned as a factor for many of the successes. While this high-level attention did not always ensure adequate funding and appropriate schedules, it seemed to go along with high priority for the developmental efforts.

Coordination between Science and Technology, Research and Development, and Acquisition Sponsors. In one case, mentioned by several people, coordination between the science and technology, research and development, and acquisition sponsors resulted in a product reaching the fleet in a relatively short period of time. This coordination can also reduce the possibility of technologies languishing in the "Valley of Death" between completion of science and technology investigations and initiation of research and development if the coordination is strong enough that research and development sponsors initiate out-year funding wedges for promising science and technology products.

Persistence. This factor was mentioned with respect to several products that were non-traditional. Because the products were non-traditional, there had been significant opposition. The fact that these products had either reached the fleet or were still

scheduled to be inserted into the fleet was attributed to the persistence of advocates for those products.

Sponsor Tolerance of Risk. A factor in the success of several products had been the willingness of the sponsor to be patient and accept some risk in order to allow the use of advanced techniques and approaches. Similarly, the failure of recent complex systems to progress past the early stages of research and development was attributed in part to the unwillingness of sponsors to consider components or construction techniques that were not yet fully developed.

Integrated, Multi-disciplinary Teams. Product development teams that involve members from a wide range of disciplines has been identified as having successfully developed complex systems such as the Boeing 777 and the VIRGINIA Class submarine. These integrated product teams (IPTs) and integrated process and product development (IPPD) were mentioned by some people to have contributed to the success of some of the more recent products. However, other interviewees felt that integrated teams wasted money and were disproportionately likely to be associated with complex products that failed to mature beyond early research and development investigations.

Technical Oversight from Appropriate SEA 05 Personnel. This lesson learned is similar to "Knowledgeable people." This lesson learned was mentioned with respect to failed efforts, where there was a lack of appropriate oversight for hydro products developed by individuals who are not part of the community. Several interviewees indicated that if the proper technical authorities for hydrodynamics, hydroacoustics and structures had been consulted during the product development process, the need for appropriate analysis or for experienced personnel would have been identified prior to failure of these products in the fleet environment. These technical authorities are located in the NAVSEA Ship Design, Integration and Engineering organization, NAVSEA 05.

Team Continuity. Maintaining the same group of people over time in development of a product reduces time spent bringing people up to speed, and is associated with efficiencies. Several products that had succeeded were characterized by having had a fairly stable team working together over the technology maturation process.

Good Communication between Team Members. Good communication was one of the many factors mentioned in success of products. Lack of good communication was also mentioned as a problem contributing to the failure of other products.

Decision Authority/Flexibility Delegated to Lowest Appropriate Level. Delegation and empowerment of the performers was seen as a contributor to success of complex Hydrodynamic/Hydroacoustic products. Several failures were attributed in part to decision-makers who made program management decisions and commitments without an understanding of the subtleties that were apparent to lower-level managers and performers.

Perceived Impartiality of Program Managers. The shipyards, university-affiliated research centers (UARCs), and Navy working capital-funded organizations are in competition for funds. Several individuals complained that Navy funds were wasted because program managers sent money to organizations based on political considerations rather than technical merit.

Realistic Expectations. This factor is similar to "Sponsor tolerance of risk" but is general to all team members and stakeholders. This refers to the importance of neither overselling benefits of a potential product nor promising more work that can physically be accomplished with the funds and schedule provided for the task.

3. Strategic Issues

Interviewees were asked to list the three key issues they saw facing the Submarine Hydrodynamic/Hydroacoustic Community. While the raw list of issues identified by the interviewees was not as extensive as the list of lessons learned, there was still a need to come up with a finite set of representative or archetypal issues that reflected the individual concerns voiced by the interviewees. Again, it was desirable to retain issues that reflected the particular language and culture of the Submarine Hydrodynamic/Hydroacoustic community. Figure 14, shown on the next page, contains

the list of representative or archetypal issues the author derived from the ethnographic interviews.

- How can we maintain/nurture technical expertise of the Hydrodynamic and Hydroacoustic workforce?
- How can we maintain/nurture high-quality, knowledgeable leadership in the community?
- How can we reduce the R&D time and cost currently required to field products?
- How can we successfully transition technologies from S&T to R&D/Acquisition?
- How can we spark innovation and excitement within the community?
- How can we reduce program volatility?
- How can we achieve stable funding?
- How do we ensure that basic research continues to support improved tools and future innovations?
- How do we market Hydrodynamics/Hydroacoustics to make Navy relevance clear?

Figure 14. List of Representative Issues Developed from Ethnographic Interviews

The meaning of each strategic issue is expanded below.

How can we maintain/nurture technical expertise of the Hydrodynamic and Hydroacoustic workforce? Many individuals interviewed felt that the technical expertise of the Submarine Hydrodynamic/Hydroacoustic community was at risk due to imminent retirement of experienced scientists and engineers, and poor future prospects for future funding due to completion of the research and development phase for several important submarine systems. These individuals felt that the technical expertise of members of the community had been very important in the ability of the submarine force to achieve performance goals and avoid submarine-related disasters.

How can we maintain/nurture high-quality, knowledgeable leadership in the community? Interviewees mentioned concern that, despite excellent technical personnel, it was critical to develop leaders who would make knowledgeable choices with respect to program execution and funding. These individuals felt it was important for individuals leading submarine research to be knowledgeable about the unique issues involved with the Submarine Hydrodynamic/Hydroacoustic community. For example, management practices developed in "for-profit" settings, if applied to submarine hydrodynamics and hydroacoustics research, could result in inefficiencies, given the unique challenges of the community.

How can we reduce the R&D time and cost currently required to field products? Interviewees were clearly aware of the need to perform research and development products for less cost and in shorter time than previously.

How can we successfully transition technologies from S&T to R&D/Acquisition? Many interviewees had expressed concern that the technologies being developed were not finding their way into the fleet. Even for the successful technology transitions, the time between initial technology investigations and insertion into the operational fleet was measured in decades. In an environment of waste-reduction, it is fatal to not show visible and timely connections between research and fleet products.

How can we spark innovation and excitement within the community? Interviewees were concerned that the community was stagnating, risking loss of talented personnel and increasing the difficulty of attracting new talent. There was also concern that conservative thinking was perpetuating high-cost, long-lead-time practices.

How can we reduce program volatility? Program volatility, where program changes occurred suddenly and seemingly arbitrarily, was seen to create a multi-fold problem. First, it was demoralizing to the performers, even when the volatility resulted in funding increases with the resultant workload increases. Second, it was seen as inefficient, with previous efforts no longer well matched to the new set of program guidelines. Finally, interviewees provided anecdotes about how program managers known to be associated with volatile projects had difficulty regaining the trust and services of valued performers.

How can we achieve stable funding? Interviewees viewed lack of stable funding as preventing cost efficiencies that would be possible were funding stable and predictable. The uncertainty associated with unstable funding was seen as a factor inhibiting retention of key talent and recruitment of qualified scientists and engineers. Stable research and development funding had been shown to yield performance and cost benefits in the Ballistic Missile Submarine Security Program, cited by some interviewees as a desirable pattern.

How do we ensure that basic research continues to support improved tools and future innovations? Several interviewees expressed concern that basic research in hydrodynamics and hydroacoustics was being curtailed by funding reductions and by diversion of funds to focus on discrete Future Naval Capabilities. The strategy of concentrating on Future Naval Capabilities identified by the Navy's capability gap analysis is intended to ensure key technologies expeditiously move into the acquisition and production environments. However, the strategy eliminated funding for potentially important technologies interviewees felt were critical to the hydrodynamic and hydroacoustic tools and innovations required to enable the Future Naval Capabilities.

How do we market Hydrodynamics/Hydroacoustics to make Navy relevance clear? The submarine force enjoyed a clear mandate during the Cold War, with the stealth and speed enabled by hydrodynamic and hydroacoustic research playing a prominent role. The role of submarines in the Global War on Terrorism (GWOT) is less clear, and the submarine force is primarily concerned with achieving connectivity and improving payload capability. Interviewees felt that future connectivity and payload advances would require significant hydrodynamic and hydroacoustic research to maintain current performance with respect to speed and stealth. The funding levels and distributions laid out in the Navy Future Years Development Plan indicated that the continued importance of hydrodynamic and hydroacoustic research was not appreciated by congress, the Joint Forces community, or even by key individuals within the submarine acquisition community.

How do we ensure funds available are most effectively utilized for the fleet? Several interviewees explicitly expressed their obligation to taxpayers to maximize the

value of the research and development investment to the fleet. These individuals expressed concern about wasteful practices. It was not clear from the interview process that there exists a consensus about which practices are wasteful.

How can the Hydrodynamics/Hydroacoustics infrastructure become more flexible? The Hydrodynamics/Hydroacoustics infrastructure was seen as being strongly divided along organizational and technology area lines. The turf battles over these divisions had been memorable, and were expected to intensify with reduced funding. The interviewees indicated a desire to move to a structure that would be better able to respond quickly to major shifts in future research requirements. After the completion of this research, the Navy Warfare Centers were realigned to focus on Product Areas.[121] While this realignment is intended to increase flexibility and reduce inter-organizational conflict between warfare center divisions, it is not clear that this addresses conflicts between warfare center, university and industry performers in the Submarine Hydrodynamic/Hydroacoustics community.

4. Suggested Strategies

While suggested strategies identified during the interview process have been documented, the strategies tended to be specific to a set of presumed key issues and lessons learned. The author felt that neither the secondary issues nor the community values could be known for certain before the results of the initial survey were analyzed. Discussion of suggested strategies is beyond the scope of this thesis.

[121] "NAVSEA Warfare Centers Alignment," NSWC, 2 September 2003 [online] http://www.nswcdc.navy.mil/docs/Alignment.doc, accessed 2 September 2004.

C. SURVEY RESULTS

1. Demographics

The data for rank versus age are contained in Figure 15. Older managers hold the higher-ranking positions, as expected. Over half the survey respondents (23 of 43) are 50 years old or older. Over one third of the respondents (16 of the 43) will be eligible for retirement in the next five years. All of the admirals and senior executives surveyed fall into this category.

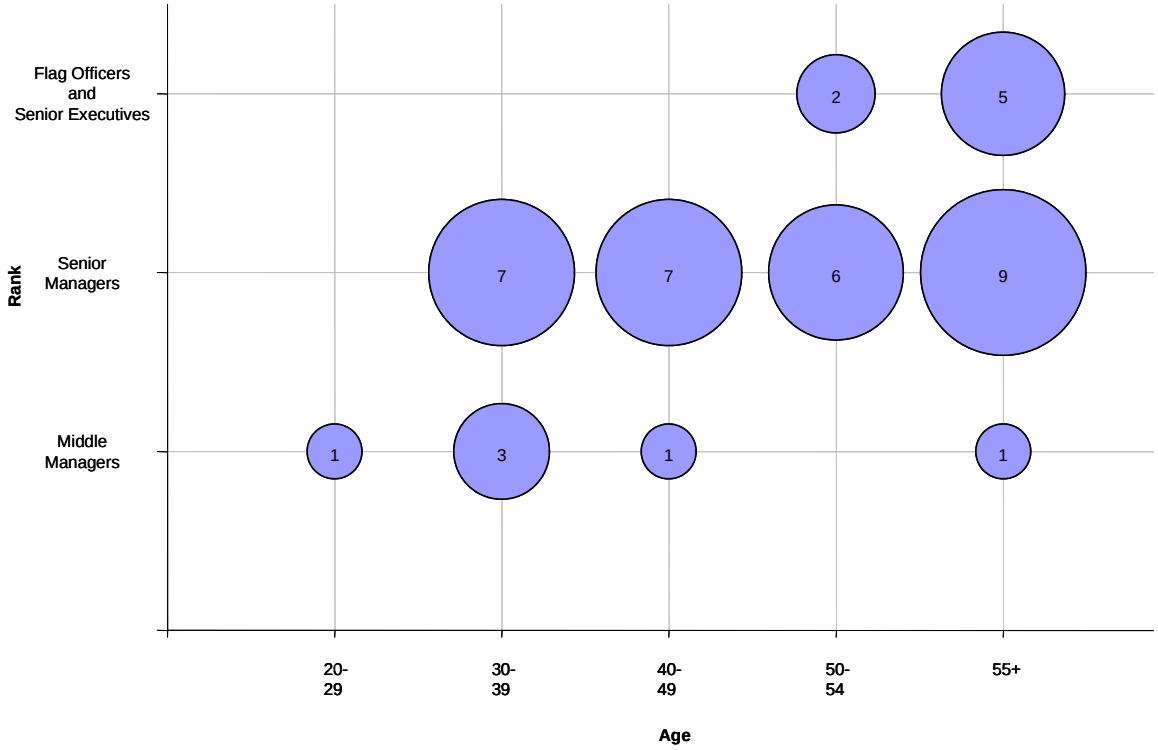

Figure 15. Rank versus Age

The ranks of survey respondents versus the Navy categories for research, development, testing and evaluation (RDTEN) are shown in Figure 16. The purpose of this question was to identify the breadth of research and development experience of the

survey population. Those individuals who were only familiar with basic research could be expected to have a different set of experiences and issues compared to those individuals experienced with acquisition of full-scale hardware. The author's expectation was that fewer individuals would report working on advanced technology demonstrations (ATDs, RDTEN category 6.3). In fact, the survey respondents represent a very even cross section with respect to experience with the different RDT&E categories. This surprised the author, given the much-bemoaned "valley of death."

Several explanations suggest themselves. First, senior managers and executives would be more likely to be involved in any given high-profile program. Advanced Technology Demonstrations (RDTEN category 6.3) have traditionally been high-profile programs.

Second, the respondent could have had experience with a particular RDT&E category at any point in their career, so an even cross section with respect to this question is not necessarily indicative that as many people are currently involved in 6.3 research as are currently involved in Applied Research (RDTEN category 6.2) or Technology Demonstration and Validation (RDTEN category 6.4).

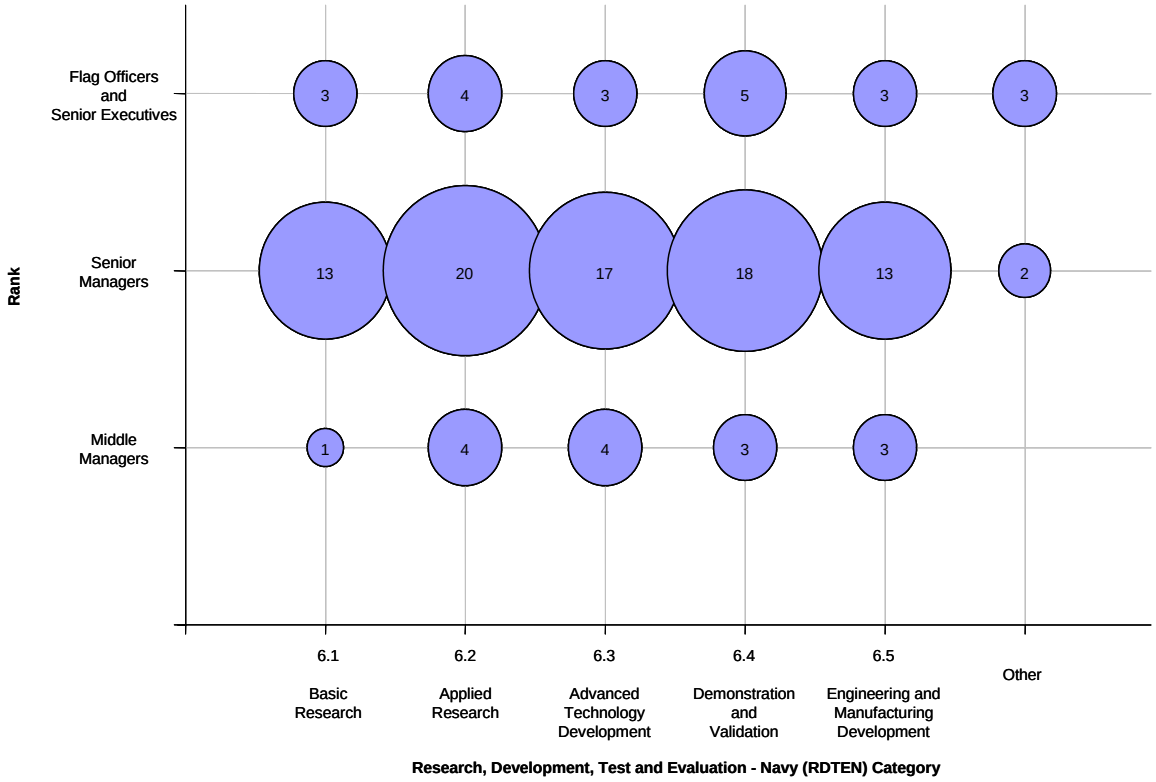

Figure 16. Experience with RDT&E Categories versus Rank

Figure 17 on the next page shows a plot of the years senior managers had spent doing technical work versus the number of years they had spent managing efforts in the Submarine Hydrodynamic and Hydroacoustics community. The purpose of this question was to identify if the individuals responding to the survey had become managers from within the ranks of the Submarine Hydrodynamic/Hydroacoustic community, or had evolved into management of the Submarine Hydrodynamic/Hydroacoustic community from outside the ranks of the community. Even though all the managers participating in this effort had responsibility for hydrodynamic and hydroacoustic efforts, these data indicate that the majority of them see themselves as insiders, developed from within the Hydrodynamic and Hydroacoustic community and performing technical Hydrodynamic and Hydroacoustic work before they became managers of hydrodynamic and Hydroacoustic work (shaded section of graph). Other managers migrated to management of Hydrodynamic and Hydroacoustic work from outside of the Submarine Hydrodynamic/ Hydroacoustic community.

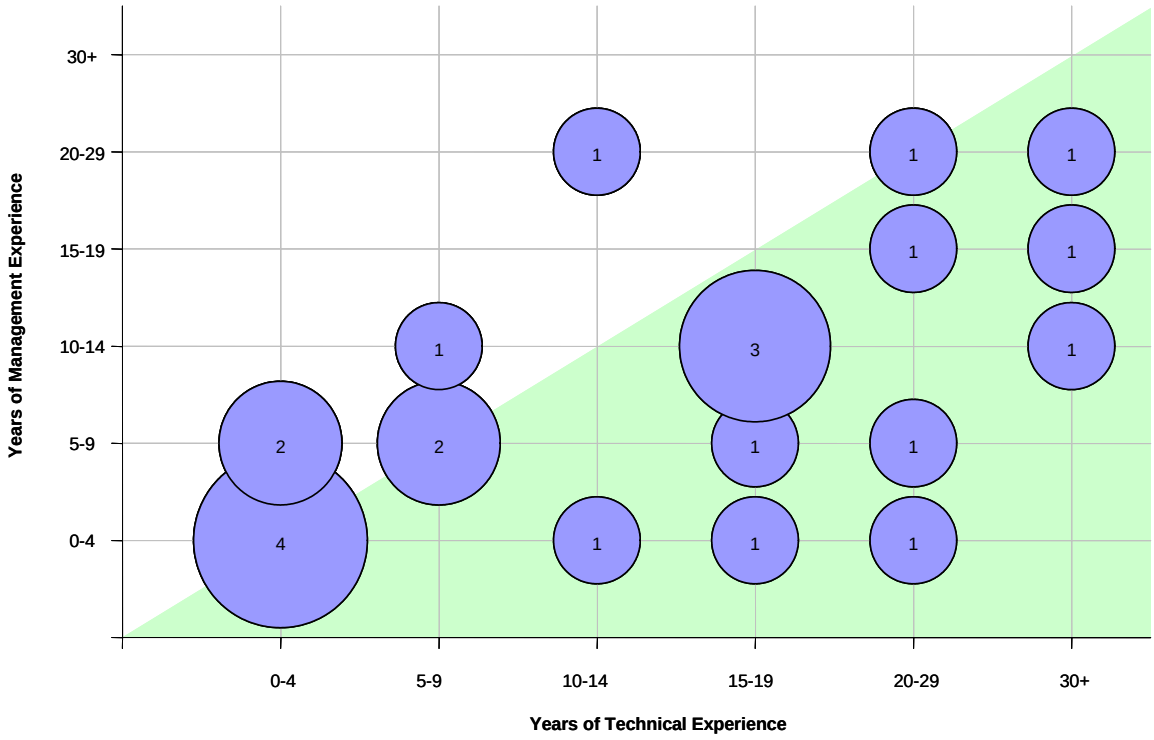

Figure 17. Senior Managers: Technical versus Management Experience with the Hydrodynamic and Hydroacoustic Community

Insufficient data were reported to draw a conclusion about middle managers or Flag Officers and senior executives. However the data that do exist indicate that current middle managers are being developed through the technical ranks of the Submarine Hydrodynamic/Hydroacoustic Community rather than imported from other technical disciplines (Figure 18). On the other hand, admirals and senior executives who answered these questions seem to have predominantly evolved into management of submarine hydrodynamics/hydroacoustics from outside the Submarine Hydrodynamic/ Hydroacoustic Community (Figure 19 on the next page).

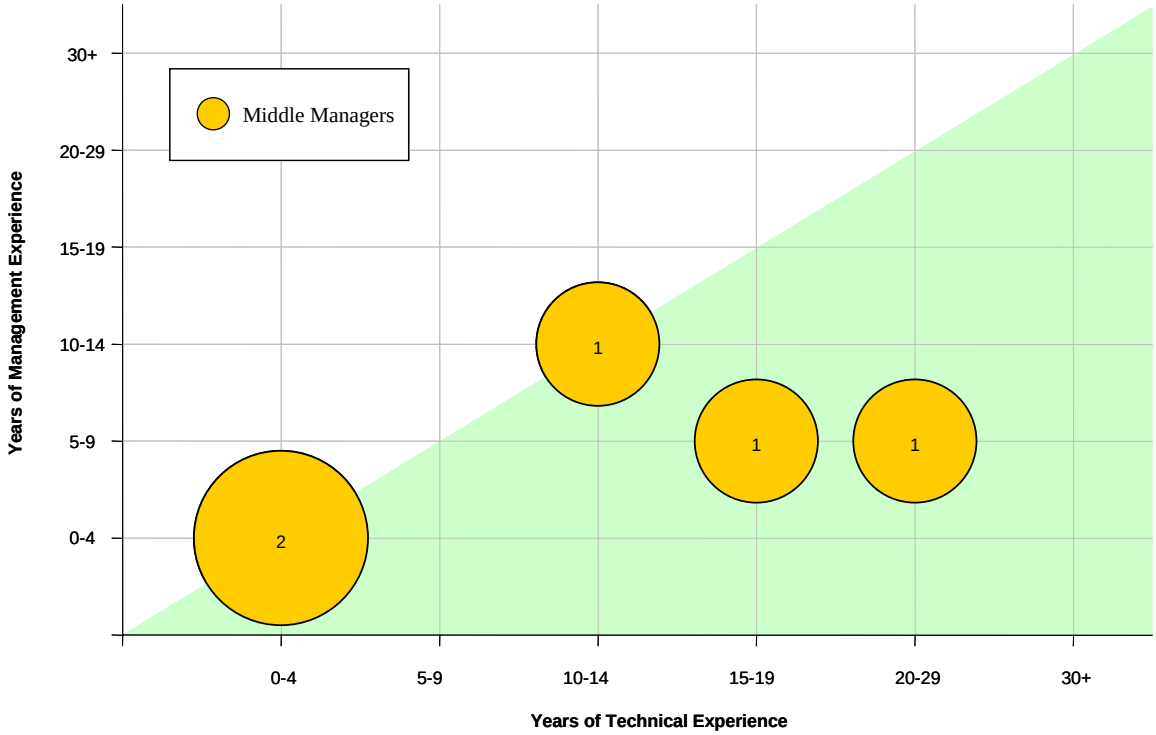

Figure 18. Senior Executives: Technical versus Management Experience with the Hydrodynamic and Hydroacoustic Community

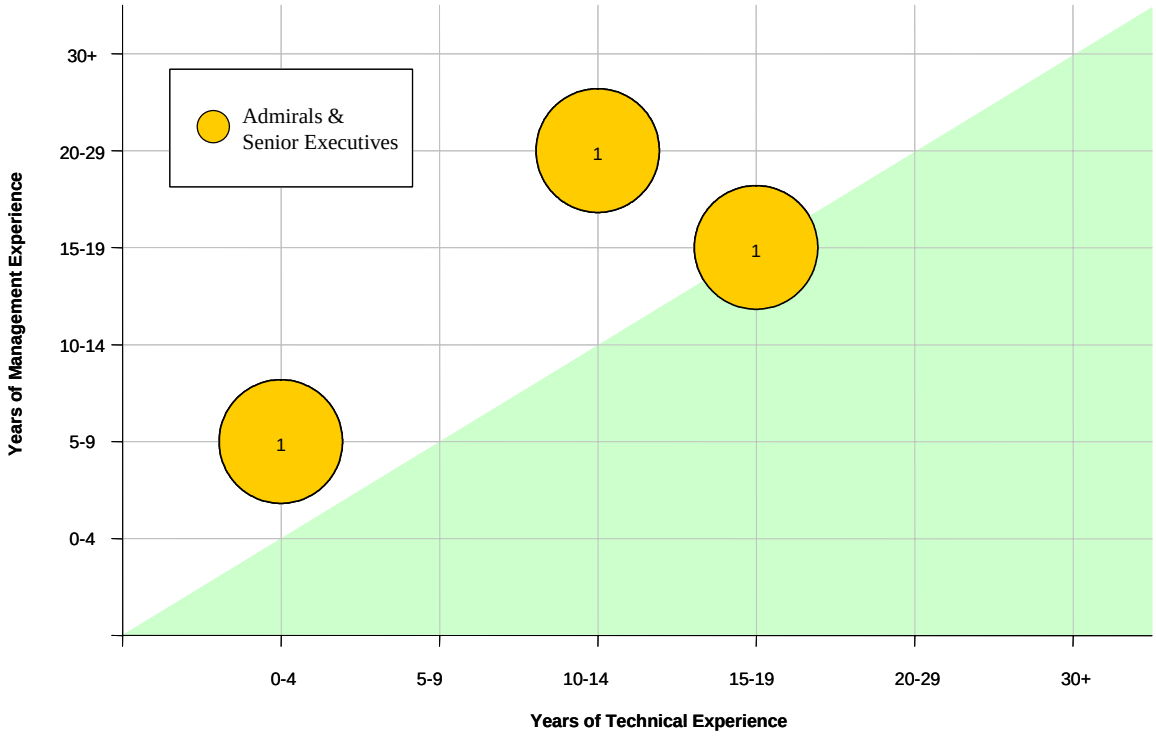

Figure 19. Flag Officers: Technical versus Management Experience with the Hydrodynamic and Hydroacoustic Community

The survey was designed to maintain the anonymity of the respondents. For this reason no information was sought that might reveal the identity of an individual respondent. However, the author was able to develop statistics on the broad affiliations of survey respondents. As can be seen in Figure 20 on the next page, roughly one sixth of the managers responding to the survey were affiliated with the shipbuilding industry, roughly one sixth were affiliated with a university affiliated research center (UARC) or federally funded research and development center (FFRDC), and one sixth were military officers. Approximately half of the survey respondents were government civilians, with a quarter of the respondents working at Navy laboratories operating under the Navy working capital fund. The other half of the respondents was comprised of sponsors and technical personnel in appropriation-funded positions at various government agencies.

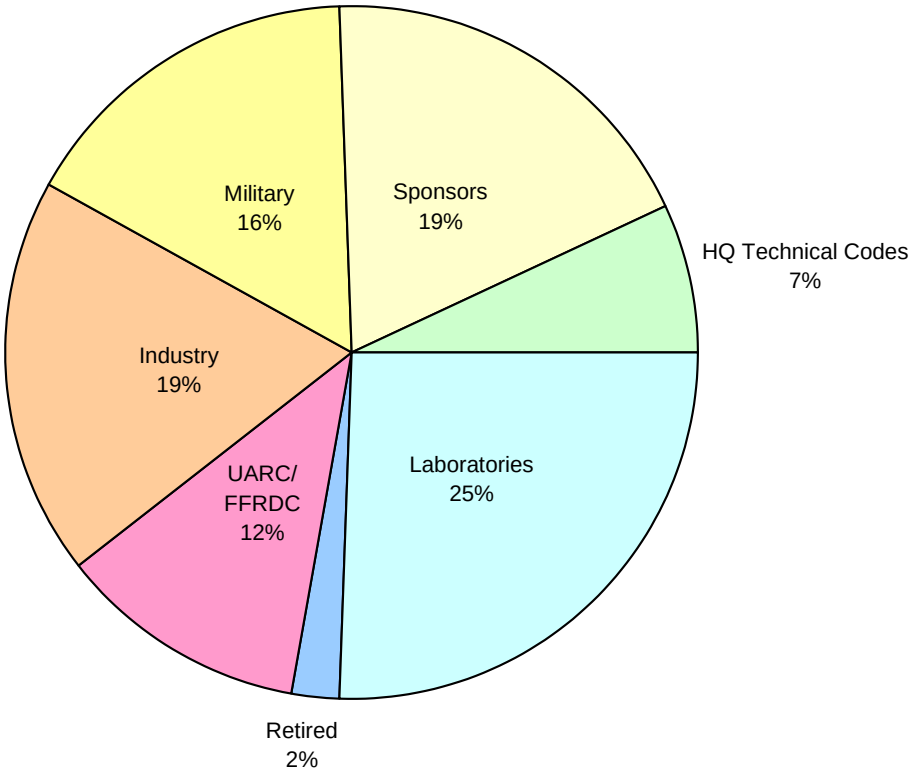

Figure 20. Affiliations of Survey Respondents

2. Assessment of Lessons Learned

Table 3 on the next page contains a simple tabulation of the distribution of responses for each lesson learned and the number of respondents who felt the "lesson learned" was a critical factor to success, important, nice to have, unimportant, or actually counter-productive. If a respondent marked more than one box or if no box was marked for a given item, no data were collected. Therefore the number of valid responses is sometimes lower than the total number of respondents.

Lesson Learned	Total	Critical To Success	Impor-tant	Nice to Have	Un-impor-tant	Counter-Produc-tive
Clear guidance from upper management	42	25	14	2	0	1
Frequent reviews with high-level management	41	4	22	13	0	2
Knowledgeable personnel	43	38	5	0	0	0
Validated Tools	43	16	20	6	1	0
Community Support	42	11	18	12	1	0
Early, stable definition of goals	41	16	15	10	0	0
Strong programmatic support (funding, priority and schedule)	42	18	21	3	0	0
High level focus/attention	41	8	20	11	0	2
Coordination between S&T, R&D and Acquisition sponsors	42	10	25	6	0	1
Persistence	42	18	17	6	0	1
Sponsor tolerance of risk	41	10	21	9	1	0
Integrated multi-disciplinary teams	43	10	17	10	4	2
Technical oversight from appropriate SEA 05 personnel	42	5	12	13	10	2
Team continuity	41	5	25	11	0	0
Good communication between team members	43	22	20	1	0	0
Decision authority/flexibility delegated to lowest appropriate level	41	2	24	11	4	0
Perceived impartiality of program managers	42	7	15	15	5	0
Realistic expectations	42	10	21	11	0	0

Table 3. Tabulation of Assessment of Lessons Learned

Table 4 on the next page reorders the lessons learned by the following headings:

★★★★	A statistically significant majority agrees this factor is critical to success.
★★★½	A simple majority agrees this factor is critical to success, and a statistically significant majority agrees this factor is at least important.
★★★	A statistically significant majority agrees this factor is at least important.
★★½	A simple majority agrees this factor is at least important, and a statistically significant majority agrees this factor is at least nice to have.
★★	A statistically significant majority agrees this factor is at least nice to have.

Under each heading the factors are ranked according to the size of the majority. Those numbers contributing to a simple majority are bolded, while numbers contributing to the statistically significant majority have a white background.

Lesson Learned	Critical To Success	Impor-tant	Nice to Have	Un-impor-tant	Counter-Produc-tive
★★★★ Factors identified as "critical" to the success of programs by a statistical majority of respondents					
Knowledgeable personnel	**38**	5	0	0	0
★★★½ Factors identified as "critical" to success by a majority or respondents, but only as at least "important" by a statistically significant majority					
Clear guidance from upper management	**25**	14	2	0	1
Good communication between team members	**22**	20	1	0	0
★★★ Factors identified as being at least "important" to the success of programs by a statistically significant majority of respondents					
Strong programmatic support (funding, priority and schedule)	**18**	**21**	3	0	0
Validated Tools	**16**	**20**	6	1	0
Persistence	**18**	**17**	6	0	1
Coordination between S&T, R&D and Acquisition sponsors	**10**	**25**	6	0	1
Early, stable definition of goals	**16**	**15**	10	0	0
Sponsor tolerance of risk	**10**	**21**	9	1	0
Realistic expectations	**10**	**21**	11	0	0
Team continuity	**5**	**25**	11	0	0
Community Support	**11**	**18**	12	1	0
High-level focus/attention	**8**	**20**	11	0	2
★★½ Factors identified as at least "important" to the success of programs by a majority of respondents, but only as at least "nice to have" by a statistically significant majority					
Integrated multi-disciplinary teams	**10**	**17**	10	4	2
Perceived impartiality of program managers	**7**	**15**	15	5	0
Decision authority/flexibility dele-gated to lowest appropriate level	**2**	**24**	11	4	0
Frequent reviews with high level management	**4**	**22**	13	0	2
★★ Factors identified as being at least "nice to have" by a statistically significant majority of respondents					
Technical oversight from appropriate SEA 05 personnel	**5**	**12**	**13**	10	2

Lessons learned are ranked according to the size of the majority. Numbers contributing to a simple majority are bolded. Numbers contributing to the statistically significant majority have a white background.

Table 4. Prioritized List of Lessons Learned

Two factors stand out in this ranking. First, the number one factor, judged critical to success by a significant majority of respondents, is "Knowledgeable Personnel."

However, the second factor that stands out is "Technical Oversight from Appropriate SEA 05 personnel." This is the only factor not ranked at least important by even a simple majority of respondents. The Naval Sea Systems Command Ship Design, Integration and Engineering organization (NAVSEA 05) is primarily responsible to make sure the Navy "does the right thing."

There are at least three possible explanations why oversight from the group of individuals legally charged with being the "knowledgeable people" is not seen as being more important. First, NAVSEA 05 is under continuing pressure to become smaller, with the remaining individuals accepting ever-increasing workloads. There simply aren't enough NAVSEA 05 personnel to cover every project where their input would be valuable. A second possibility is that any oversight entity is likely to be resented, no matter how great the demonstrated need for the oversight. Third, there is the possibility that the safety net provided by NAVSEA 05 oversight is only appreciated when a disaster occurs (which NAVSEA 05 oversight could have prevented). Interviewees who mentioned technical oversight had mentioned that lack of technical oversight from the appropriate NAVSEA 05 codes had been a contributor to the failure of a product. Oversight was never explicitly mentioned as a factor in the success of any of the products.

3. Assessment of Outstanding Products and Tools

As mentioned in the previous chapter, a consensus regarding the success of past efforts is important for forming a shared vision for the future. The data collected regarding products during the interview phase of this research were insufficient to form a conclusion regarding consensus with the exception of a couple of products. The survey data allowed the author to identify the community consensus for most of the products mentioned during the interviews as important successes or failures.

a. Assessment of General Hydrodynamic and Hydroacoustic Products

Table 5 presents the assessment of each of the general Hydrodynamic and Hydroacoustic products listed in the survey. It is possible to make a statistically significant conclusion about each product, i.e., there are at least 6 people expressing an opinion in each case. The product is marked green if a statistically significant majority of respondents marked it as a success. It is marked red if a statistically significant majority of respondents marked it as a failure, and yellow if the results were not conclusive. A statistically significant majority finds these products to have been successful with two exceptions.

PRODUCT	Total Opinions	Success	Failure	Majority	**G, Y, R**	1-α
ALBACORE	26	26	0	Success	G	>99.9%
ATSOL/Advanced Sail	27	24	3	Success	G	>99.9%
NOO AUV (SEAHORSE)	8	8	0	Success	G	98.7%
AN/WSQ-9	17	14	3	Success	G	98.5%
SEAWOLF WAA Fairings	24	7	17	Failure	Y	93.4%
SEAWOLF Trials	29	27	2	Success	G	>99.9%
Automatic Control	22	20	2	Success	G	>99.9%
Maneuvering Objectives	27	21	6	Success	G	99.3%
SEAWOLF Neutral Angle	13	5	8	Failure	Y	42.1%
VIRGINIA Neutral Angle	12	10	2	Success	G	95.7%

Table 5. Assessment of General Hydrodynamic Products

The first exception is the "SEAWOLF WAA Fairings." This product was the hydrodynamic fairing over the sonar hull array for Seawolf. A portion of the fairing on the Wide Aperture Array (WAA) came off during initial sea trials of SEAWOLF in 1996[122]. Despite this well-publicized problem, the number of people voicing an opinion who identify the WAA fairings as a failure is not statistically significant. This may be due to the subsequent high profile effort that successfully corrected the flawed WAA fairing attachment design.

The second exception is the SEAWOLF neutral angle. First, relatively few people indicated an opinion on this product. The "neutral angle" of a submarine is the pitch angle of the boat when the dive planes are at the "zero" position. When the neutral angle is not zero, the helmsman must hold an angle on the dive planes to maintain level flight. During the initial SEAWOLF sea trials, the neutral angle was not zero. The community failed to predict this phenomenon based on the existing processes prior to the SEAWOLF trial. For SEAWOLF, the problem was fixed by putting an offset on the dive planes, so that a zero angle for the helmsman actually resulted in a local angle of attack on the dive planes and a zero angle of attack on the submarine as a system. This fix involved minimal cost and did not incur any known side effects. The subsequent effort to ensure the VIRGINIA neutral angle was zero is seen as a success by a statistically significant majority of respondents voicing an opinion.

b. Assessment of Submarine Propellers

Table 6 on the next page presents the assessment of submarine propeller products listed in the survey. The propeller results are grouped in three main areas:

- Fleet Propellers. These are production propellers that have been used by the U.S. submarine fleet.

[122] Director, Operational Test and Evaluation FY98 Annual Report: SEAWOLF SSN 21 CLASS ATTACK SUBMARINE AND AN/BSY-2 COMBAT SYSTEM [online] http://www.globalsecurity.org/military/library/budget/fy1998/dot-e/navy/98ssn21.html, accessed 7 August 2003.

- Research Propellers. These are submarine propellers or propulsion system designs, some of which have been tested at large scale or even full-scale, but which never reached production.
- Other. The single propeller in this category was the initial propeller for the Advanced Swimmer Delivery System (ASDS), a small manned submersible used by Special Operations Forces (SOF).

	PROPELLERS	Total Opinions	Success	Failure	Majority	Y, G, R	1-α
Fleet Props	LOS ANGELES (I3B – original)	16	11	5	Success	Y	78.9%
	LOS ANGELES (I3M)	19	19	0	Success	G	>99.9%
	LOS ANGELES (I3 tip mod)	19	19	0	Success	G	>99.9%
	LOS ANGELES (Hybrid)	24	21	3	Success	G	>99.9%
	SEAWOLF	32	29	3	Success	G	>99.9%
	VIRGINIA	25	20	5	Success	G	99.5%
Research Props	Advanced Hybrid	15	12	3	Success	G	96.1%
	SUPREJET	24	17	7	Success	Y	93.4%
	SUPRELITE	24	4	20	Failure	R	99.8%
	Advanced Submarine Propulsor System (ASPS)	26	8	18	Failure	Y	92.2%
	Propulsor Stern Appendage Module (PSAM)	23	4	19	Failure	R	99.7%
	Propeller for Advanced Swimmer Delivery System (ASDS)	20	1	19	Failure	R	>99.9%

Table 6. Assessment of Propellers

A statistically significant majority saw all the fleet propellers as a success with one exception. The initial Los Angeles Class design, the I3B, was only seen as a success by a simple majority of those respondents expressing an opinion. Relatively few people (16) had an opinion about the I3B. Additionally, there was a need for several subsequent design improvements.

The Advanced Hybrid and the SUPREJET were the only two research propellers seen as successful by even a simple majority. Both of these designs had been successfully demonstrated at large scale, although neither was produced in quantity for installation on fleet submarines. It is possible that the lower assessment of the SUPREJET was due to the precipitous removal of the propeller from a full-scale submarine. In fact, the SUPREJET had been at sea for several years longer than originally intended when the SUPREJET was installed as a "temporary alternation" to the submarine.[123]

The rest of the research propellers were seen as failures by a majority of survey respondents. However, failure in a research propeller is not a life-threatening event. During the course of the interviews, several people mentioned that when "failure" leads to early termination of a poor idea, it could actually be seen as a success. Furthermore, the process improvements associated with a particular research propeller could be seen as successful, even if the actual propeller itself was never deployed in the fleet. This process improvement was the reason that one interviewee cited the ASPS propeller development as a success (see table 2), and is probably the reason why this particular propeller was not seen as a failure by a statistically significant majority.

The Advanced Swimmer Delivery System (ASDS) is a mini-sub used in special operations. The initial propeller for the ASDS did not perform well and was fresh in the minds of community members at the time of the survey. This was a particular product where the lack of NAVSEA 05 oversight was seen as a contributing factor to the failure of the propeller to operate properly.

[123] "COMMERCE BUSINESS DAILY ISSUE OF AUGUST 24,1995 PSA#1417," 24 August 1995, [online] http://www.fbodaily.com/cbd/archive/1995/08(August)/24-Aug-1995/Jsol017.htm, accessed 7 August 2003.

c. Assessment of Tools and Facilities Used in Hydrodynamic and Hydroacoustic Research for Submarines

The tools identified as particular successes or failures fall into two categories: computational tools and facilities. Table 7 presents the assessment of computational tools and facilities listed in the survey. Two of the facilities are large experimental test vehicles. The KOKANEE is a 10-foot diameter model of the submarine USS SEAWOLF. KOKANEE has been in use since 1988 and played a significant role in the success of the SEAWOLF propulsor development program. The CUTTHROAT is a 10-foot diameter model of the submarine USS VIRGINIA. CUTTHROAT has not yet been delivered for use as a Navy test vehicle. The last facility is the Hydrodynamic/Hydroacoustic Technology Center (H/HTC), housing servers and classified connections linking the shipyards, university affiliated research centers and government organizations. The H/HTC serves as the repository for computational tools and data as well as providing services to facilitate communication across the community.

TOOLS		Total Opinions	Success	Failure	Majority	G, Y, R	1-α
Computational	UNCLE	35	25	10	Success	G	98.2%
	Multi-Vortex	26	23	3	Success	G	>99.9%
	Maneuvering Data Analysis Tool (MDAT)	26	13	3	Success	G	97.6%
	Propulsor Data Analysis Tool (PDAT)	15	10	5	Success	Y	69.8%
	Integrated Acoustic Model (IAM)	18	11	7	Success	Y	52.1%
Facility	Hyrodynamic/Hydroacoustic Technology Center (H/HTC)	39	**29**	10	Success	G	99.6%
	Large Scale Vehicle (KOKANEE)	36	27	9	Success	G	99.5%
	Large Scale Vehicle (CUTTHROAT)	26	13	13	Draw	Y	N/A

Bolded numbers indicate a statistically significant majority of all survey participants (i.e., the majority is at least 29)

Table 7. Assessment of Tools

"Validated Tools" were seen as an important factor contributing to success, and all tools identified during the interviews are seen as successful by a simple majority of survey respondents expressing opinions. The two computational tools not yet seen as successful by a statistically significant majority are relatively new tools, as indicated by the low numbers of people expressing opinions about those tools. The facility not yet seen as successful is the 10' diameter model of the VIRGINIA Class submarine (CUTTHROAT or LSV 2). At the time of the survey the Navy had not accepted delivery on the Cutthroat. One respondent sent this explanatory note as to why he had marked "No Opinion" on the survey: "I marked 'No Opinion' because I believe the LSV 2 will be of great use, but it has not yet been accepted and so hasn't delivered on that promise."

D. STRATEGIC PLANNING EFFORTS

Table 8 shows the results of questions asking about respondents' involvement with past strategic planning efforts and awareness of overarching strategic guidance. When the majority opinion represents a statistically significant majority of all survey participants (the majority is at least 29) the majority number is bolded. As long as the majority opinion reflects a statistically significant majority of those responding to that particular question, the question is marked green for "Agree" and red for "Disagree." If the majority is not statistically significant, the question is marked yellow. A statistically significant majority of those voicing an opinion say they are involved in the Submarine Hydrodynamic/ Hydroacoustic community, and they are aware of the two principle overarching strategic guidelines (The three pillars of Sea Power 21 and the four strategic concepts from "Submarines… the Road Ahead"). A statistically significant majority of those voicing opinions agree that they have participated in developing a strategic plan for the community in the past five years and that they are familiar with that plan.

QUESTION	Total Opinions	Agree	Disagree	Majority	G, Y, R	1-α
I am actively involved in the Hydrodynamic and Hydroacoustics Community.	40	**34**	6	Agree	G	100.0%
I am familiar with the Submarine Force's 4 Strategic Concepts	33	24	9	Agree	G	98.5%
I am familiar with the 3 pillars of CNO's Sea Power 21 vision	38	27	11	Agree	G	98.5%
I participated in developing a strategic plan for the community during the past 5 years	42	**29**	13	Agree	G	97.9%
I am familiar with the strategic plan(s) developed during the past 5 years	38	**33**	5	Agree	G	100.0%
I have found the strategic plan(s) useful in guiding my efforts	29	16	13	Agree	Y	29.0%
The Hydrodynamic and Hydroacoustic community effectively develops strategies to address key issues	32	18	14	Agree	Y	40.4%
I believe significant improvements could be made to the current strategic process	34	**34**	0	Agree	G	100%

Bolded numbers indicate a statistically significant majority of all survey participants (i.e., the majority is at least 29)

Table 8. Experience with and Assessment of Current Strategies and Plans

Less than 75% of survey respondents marked an opinion regarding the usefulness and effectiveness of existing plans and strategies. Therefore the majority of respondents expressing an opinion who marked that the strategic plans had been useful in guiding their efforts does not comprise even a simple majority of survey respondents. Similarly inconclusive results are found with respect to the question on whether the community effectively develops strategies. This question had been included to allow for the possibility that ad hoc methods were satisfying the need for strategic guidance in place of a formal strategic planning exercise. Even though a significant majority of the managers responding to the survey had participated in developing past plans, only a minority of the managers indicate they have used the plan since, or feel that the community effectively develops strategies outside of the formal planning process. The survey did not provide a way for respondents to explain this result. However, the initial planning meetings with the Hydro Sub Group and the data obtained during the interviews lead the author to conclude that the classification and sheer size of the previous plans contributed to this result.

Everyone who expressed an opinion felt that significant improvements could be made to the current strategic planning process. This comprises a statistically significant majority of all survey respondents, even though not everyone marked their opinion. Table 9 on the next page contains the results with respect to the timing, classification and distribution of future plans.

QUESTION	Total Opinions	Agree	Disagree	Majority	G, Y, R	1-α
Finalize plan in time to impact POM papers (April/May of odd years)	33	**31**	2	Agree	G	100.0%
Keep unclassified to allow wide distribution	31	13	18	Disagree	Y	52.8%
Keep classified to allow more detailed description	31	23	8	Agree	G	98.8%
Limit distribution to allow management flexibility	27	4	23	Disagree	R	99.9%
Post plan and accompanying brief in central location for easy access	33	**29**	4	Agree	G	100.0%

Bolded numbers indicate a statistically significant majority of all survey participants (i.e., the majority is at least 29)

Table 9. Attributes that would Enhance the Effectiveness of a Strategic Plan for the Hydrodynamic and Hydroacoustic Community

The following conclusions regarding the schedule of strategic planning and the distribution of those plans can be drawn from these data:

- Strategic planning should be completed in time to impact the development of POM papers in order to provide maximum benefit to the community.
- The plan should include adequate detail, even if it then becomes classified, with the resultant difficulties in dissemination
- The plan should be available in a central location for easy access. This is possible using the classified web space maintained for the community at the Hydrodynamic/Hydroacoustic Technology Center.

E. ISSUES FACING THE COMMUNITY

The survey respondents were asked to select the three most important issues facing the Submarine Hydrodynamic/Hydroacoustic community from the following list:

- How can we maintain/nurture technical expertise of the Hydrodynamic and Hydroacoustic workforce?
- How can we maintain/nurture high quality, knowledgeable leadership in the community?
- How can we reduce the R&D time and cost currently required to field products?
- How can we successfully transition technologies from S&T to R&D/Acquisition?
- How can we spark innovation and excitement within the community?
- How can we reduce program volatility?
- How can we achieve stable funding?
- How do we ensure that basic research continues to support improved tools and future innovations?
- Other not listed above _____

Figure 21 on the next page shows the response of the survey respondents to this question. The issues in Figure 21 are presented in the same order they appeared on the survey, which was loosely reflective of the number of times the issue was raised during the series of interviews.

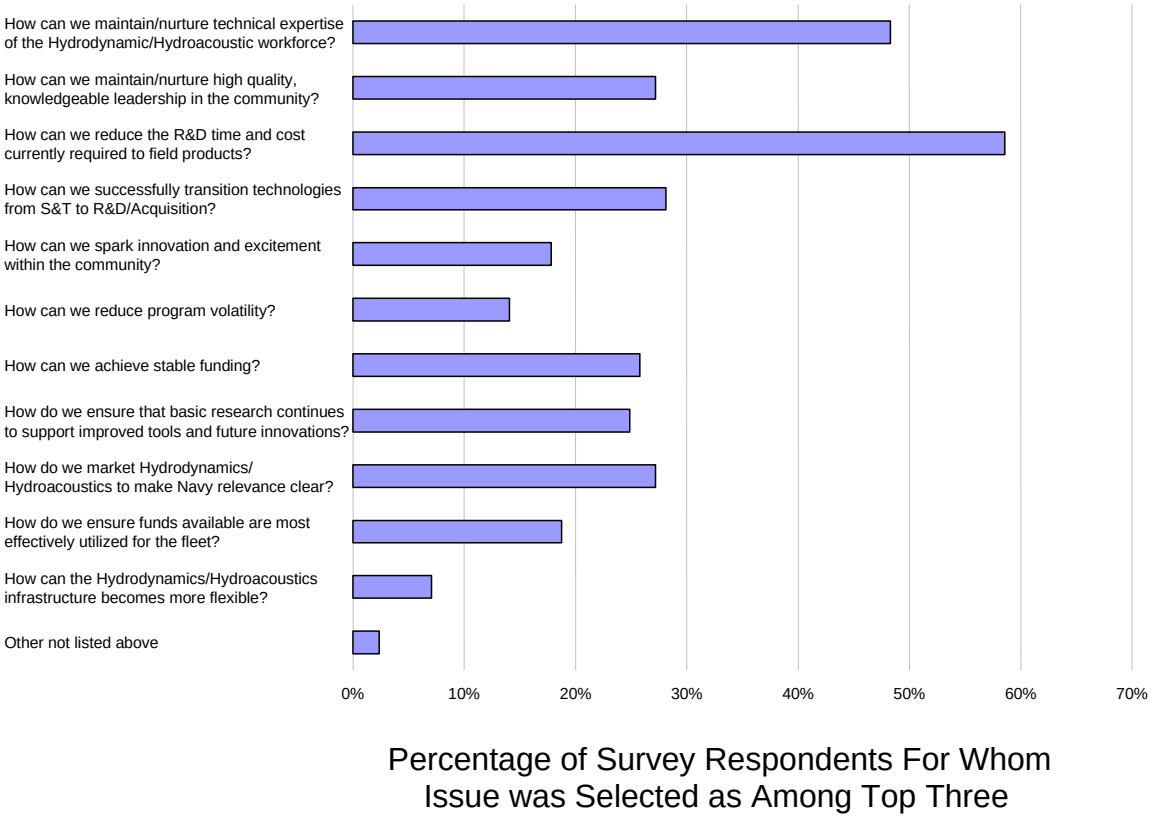

Figure 21. Response of Community to Important Issues

Two issues were selected as key issues more frequently by a factor of two. These are:

- How can we reduce the R&D time and cost currently required to field products?
- How can we maintain/nurture technical expertise of the Hydrodynamic and Hydroacoustic workforce?

Figure 22 on the next page shows the issues prioritized by the percentage of all respondents that selected each issue. Additionally, Figure 22 shows the percentage of Flag Officers and Senior Executives that selected each issue.

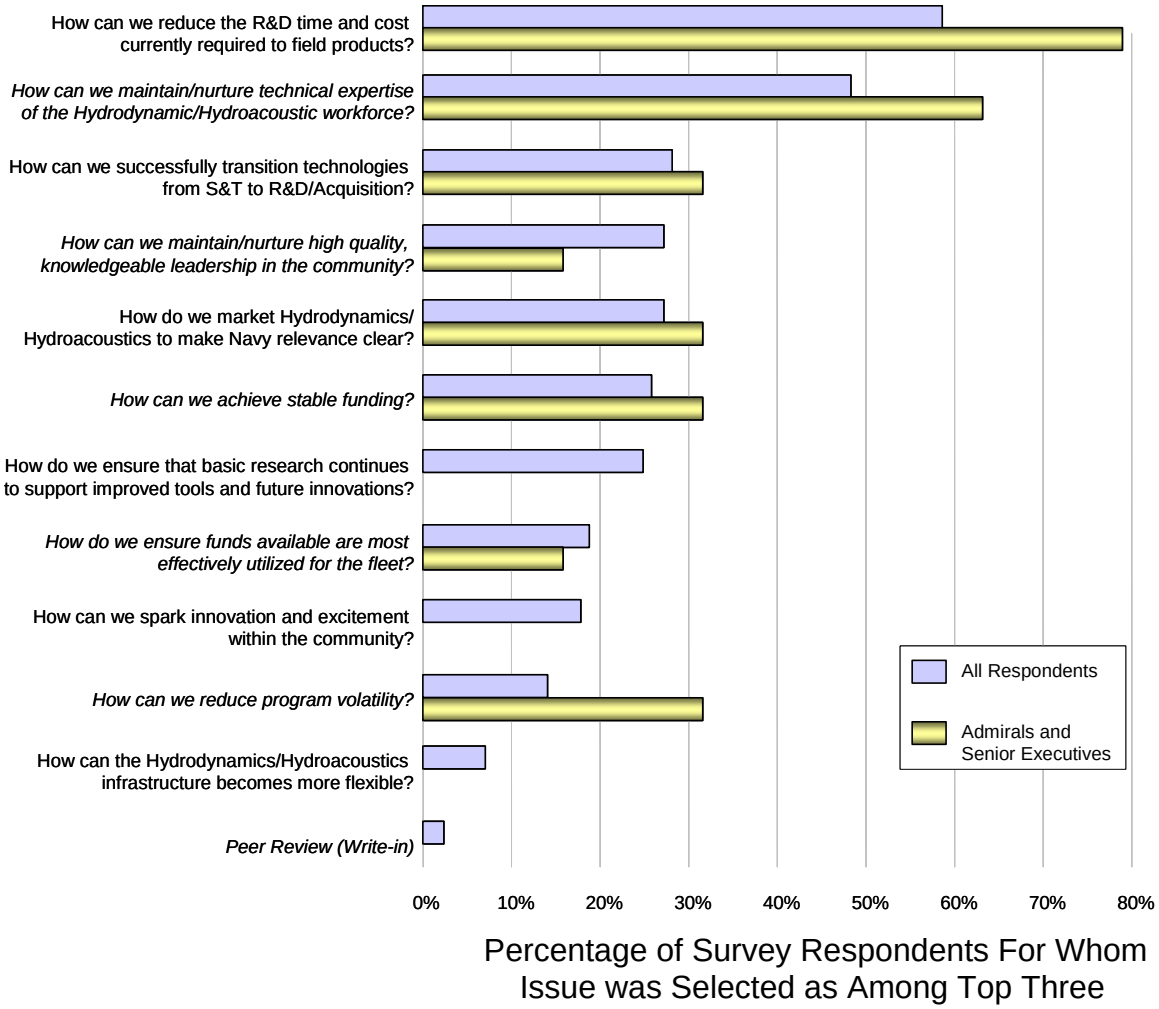

Figure 22. Ranking of Issues and Responses of Senior Executives and Flag Officers

Finally, issues are grouped in the following focus areas:

- Issues focused on the development of products and associated processes
- Issues focused on taking care of the people associated with the community
- Issues focused on the management of funds in the community
- Issues that do not clearly fit into any of the above categories or which are secondary to other key issues

The issues relating to management of funds included "How can we reduce program volatility" and "How can we achieve stable funding." Based on the responses to

these issues, the author thinks that these two separate questions are actually statements of the same issue. The different wording of the issue would arise from the perception shift between the localized viewpoint of lower-level managers compared to the more global viewpoint of senior executives and admirals. Therefore the responses to these two issues are combined in Figure 23 below.

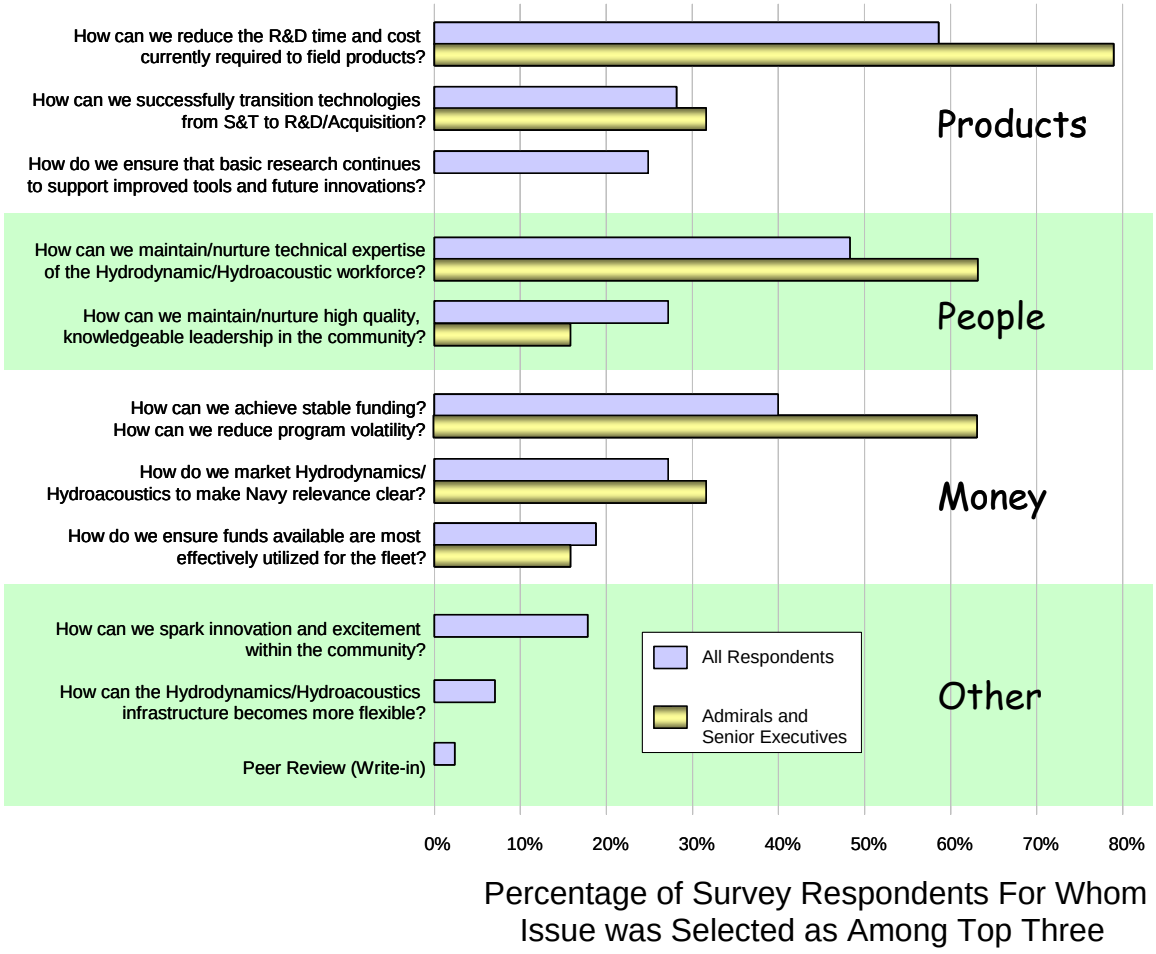

Figure 23. Key Issues Sorted by Focus Areas and Percentage of Respondents Identifying the Issue as a Key Issue

The Admirals and Senior Executives were focused on the concerns dealing directly with people, products and money. Other differences between senior management and the overall group of survey respondents are not statistically significant considering the small size of the senior management group (seven individuals).

Based on the survey results, the key issues for the Submarine Hydrodynamic/Hydroacoustic community are:

- How can the Submarine Hydrodynamic/Hydroacoustic community reduce the time and cost currently required to perform the research and development necessary to field products?
- How can the Submarine Hydrodynamic/Hydroacoustic community maintain and nurture technical expertise of the hydrodynamic and hydroacoustic workforce?
- How can the Submarine Hydrodynamic/Hydroacoustic community attain the synergistic goals of reducing programmatic volatility and achieving stable funding?

F. CHANNELS USED TO RESPOND TO SURVEY

The author expected most survey respondents would use the web-based survey to respond, as requested in the original e-mail. The web-based survey was deployed using a web-based service called Zoomerang. A word version of the survey had also been attached to the e-mail. This was based on the author's expectation that several individuals in the target population would be unlikely to complete the survey if the web link were the only option. The word version of the survey was created as a form that respondents could view and fill out electronically.

Over half the survey respondents chose to fill out the form electronically and reply by e-mail. Figure 24 is a graphic representation of the methods respondents used to reply to the survey.

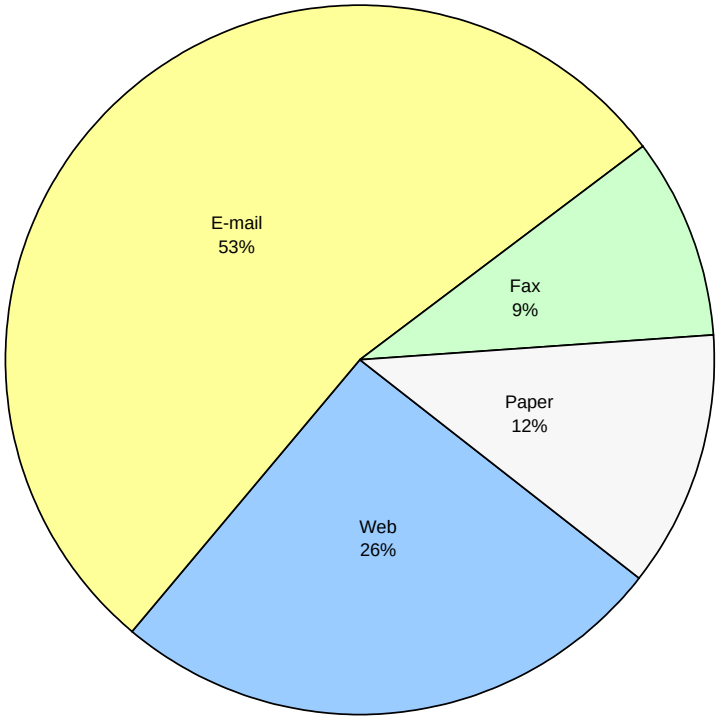

Figure 24. Methods Respondents Used to Reply to Survey

G. CHAPTER SUMMARY

This chapter presented the results of the planning meetings, interviews and survey tool used to identify key issues for the Submarine Hydrodynamic/Hydroacoustic community. The planning meetings resulted in a determination that a new look at the strategic posture of the Submarine Hydrodynamic/Hydroacoustic community was needed.

A series of ethnographic interviews was held with 27 managers in the Submarine Hydrodynamic/Hydroacoustic community. These interviews identified a wide range of possible issues that could be used to form the basis of a strategic posture, but no means of

determining a consensus. The interviews also yielded a great amount of information on the factors that interviewees felt were important in the success or failure of products and tools produced by the Submarine Hydrodynamic/Hydroacoustic community. Finally, the interviews provided information on strategies that could address the potential issues facing the Submarine Hydrodynamic/Hydroacoustic community.

A survey tool was developed based on results of the ethnographic interviews. The survey was sent to 71 managers of Submarine Hydrodynamic and Hydroacoustics, and 43 surveys were completed and returned to the author. Analysis of the answers to this survey provides a clear consensus that the key issues facing the Submarine Hydrodynamic/Hydroacoustic community are as follows:

- How can we reduce the R&D time and cost currently required to field products?
- How can we maintain/nurture technical expertise of the Hydrodynamic and Hydroacoustic workforce?
- How can we achieve stable funding and reduce program volatility?

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V. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this thesis is to research the processes used to perform strategic planning for the Submarine Hydrodynamic/Hydroacoustic community prior to 2002, identify current strategic issues for the community, and document strategic lessons learned that can be identified through the evaluation of product successes and failures.

The research and development capability that resides in the Submarine Hydrodynamic/Hydroacoustic community has been a key reason for the superiority of U.S. submarines. However, with the end of the Cold War, investment in U.S. warships is declining, as is the investment in research and development associated with those warships.[124] With these reduced budgets, the technical community that has maintained the superiority of U.S. submarines is becoming fragmented as positions are eliminated and key facilities are closed due to lack of funds.[125] This fragmentation of the community caused concern among managers responsible for submarine hydrodynamic and hydroacoustic research. Based on this concern, the author identified the key strategic issues facing the Submarine Hydrodynamic/Hydroacoustic community.

This research found that the key questions facing the Submarine Hydrodynamic/Hydroacoustic community are:

- How can the Submarine Hydrodynamic/Hydroacoustic community reduce the time and cost currently required to perform the research and development necessary to field products?
- How can the Submarine Hydrodynamic/Hydroacoustic community maintain and nurture technical expertise of the hydrodynamic and hydroacoustic workforce?
- How can the Submarine Hydrodynamic/Hydroacoustic community attain the synergistic goals of reducing programmatic volatility and achieving stable funding?

[124] "National Security Assessment of the U.S. Shipbuilding and Repair Industry," U. S. Department of Commerce, May 2001, p. 68.

[125] ibid. p. xii.

The issues were identified in this research using a combination of facilitated planning meetings, interviews and surveys. The ethnographic interviews were conducted with 27 senior managers across Navy, academia, and industry that are involved in Hydrodynamic and Hydroacoustic research supporting the U.S. Submarine force. In addition to soliciting information on key issues facing the community, these interviews solicited information on products produced by the Submarine Hydrodynamic/Hydroacoustic community and on lessons learned with respect to the success or failure of those products.

A survey tool was generated from the results of the interviews. There were 43 managers involved in Hydrodynamic and Hydroacoustic research who completed the survey successfully. Analysis of the survey results identified the issues listed above as the key issues facing the Submarine Hydrodynamic/Hydroacoustic community. The survey also yielded valuable information on the lessons learned and products produced by the Submarine Hydrodynamic/Hydroacoustic community.

A. CONCLUSIONS

Below are answers to the research questions posed at the beginning of the thesis in light of analysis of the interviews and survey results:

What are the overarching strategic guidelines within which the Submarine Hydrodynamic/Hydroacoustic Community operates? The Submarine Hydrodynamic/ Hydroacoustic community must operate within the context of the federal acquisition system, Department of Defense guidance and the Navy's Sea Power 21 vision. These rules and visions are not necessarily conducive to the stable funding environment that the community perceives as important for maintaining the Navy's technical expertise in Hydrodynamics and Hydroacoustics. Nor do reduced budgets necessarily mean that the cost to perform a given R&D task is reduced.

How has the Submarine Hydrodynamic/Hydroacoustic Community developed and promulgated strategic plans? Past plans developed by the Submarine Hydrodynamic/Hydroacoustic community have been complex, classified descriptions of

annual operations and associated budgets. After development of these plans, there has been no particular effort to promulgate the plans, given the classification levels and the size of the resultant document. This research indicates that future plans should remain classified, but that they should be performed in time to impact the federal budgeting process and should be widely distributed

Are the current strategic planning processes adequate? Few individuals use the annual plan and those who expressed an opinion were unanimous that significant improvements could be made to the strategic planning process.

Is there a need for a revised strategic planning effort? The initial planning meetings with the Hydro Sub Group identified the need for a revised strategic planning effort. The survey respondents were unanimous that that significant improvement could be made to the strategic planning process, indicating that the process should be revised and improved. This thesis research did not focus on a recommended process for future planning efforts, but on developing the overarching strategic issues. This identification of strategic issues is the heart of the strategic planning process.

What are the key issues facing the Submarine Hydrodynamic/ Hydroacoustic Community? The three key issues facing the Submarine Hydrodynamic/Hydroacoustic Community are as follows:

- How can the Submarine Hydrodynamic/Hydroacoustic community reduce the time and cost currently required to perform the research and development necessary to field products?
- How can the Submarine Hydrodynamic/Hydroacoustic community maintain and nurture technical expertise of the hydrodynamic and hydroacoustic workforce?
- How can the Submarine Hydrodynamic/Hydroacoustic community attain the synergistic goals of reducing programmatic volatility and achieving stable funding?

Maintaining knowledgeable people is key to producing successful products, as seen in the response to the survey with respect to lessons learned. During the interview process, it was clear that stable funding and programs were seen as necessary components in the effort to maintain and nurture the technical workforce. This would account for "reducing program volatility and achieving stable funding" being identified as one of the

three overarching strategic issues for the community based on the survey results. With the end of the Cold War, Department of Defense budgets have been reduced significantly, and cost reduction has been a central theme of all the guidelines governing the Submarine Hydrodynamic/Hydroacoustic community. However, past efforts to reduce the cost of developing systems have focused on improved tools in the context of sufficient budgets to fund knowledgeable personnel in the current technology infrastructure. Defense budgets for Hydrodynamic/Hydroacoustic research and development are being cut to reduce discretionary spending by the 50 percent envisioned in the Quadrennial Defense Review and the Navy's Sea Power 21. In this environment, it is advisable to develop strategies to maintain or document the knowledge required to perform the research and development necessary to field products with a significantly reduced workforce.

Survey respondents felt it is more important to maintain stable funding than to ensure funds are most effectively utilized to support the fleet. Excessive focus on spending every penny wisely can result in volatility that damages the ability of the technical community to effectively support the fleet.

What is the consensus on the most valued lessons learned? Research identified that the most important factor leading to success is knowledgeable personnel, followed by clear guidance from upper management and good communication between team members. Several other factors were identified as being important. These were: strong programmatic support with respect to funding, priority and schedule; validated tools; persistence; coordination between science and technology, research and development, and Acquisition sponsors; early, stable definition of goals; sponsor tolerance of risk and realistic expectations; team continuity; community support; and high level focus/attention. The following factors were merely seen as nice to have by a statistically significant majority of survey respondents: integrated multi-disciplinary teams, perceived impartiality of program managers, decision authority/flexibility delegated to lowest appropriate level, frequent reviews with high level management and technical oversight from the Naval Sea Systems Command Ship Design, Integration and Engineering organization (NAVSEA 05).

Again, the survey respondents indicate the primary importance of having knowledgeable personnel, and the high importance of practices that improve team efficiency (clear guidance and good communication). The low ranking of "Oversight from appropriate SEA 05 personnel" is likely due to use of the term oversight, which implies additional external management, increasing cost, and delaying schedule. Further research could show that practices not seen as being strongly aligned with providing a quality product in a timely, cost effective manner are considered to be less important.

What is the consensus on past development of products by the Submarine Hydrodynamic/Hydroacoustic community? The majority of products and tools were identified as successes. The products that were perceived to be distinct failures had been identified during the interview process to suffer from either a lack of knowledgeable personnel, a lack of appropriate oversight, or excessive technological risk.

The key issues for the Submarine Hydrodynamic/Hydroacoustic community have now been identified and a strategy may now be developed to address these issues. It is critical that this strategy be developed in time to convey the strategy to key stakeholders in the time period before the development of the Program Objective Memoranda and Budget Estimate Submissions. With the changes to the budgetary process, this window will only open once every two years.

The Submarine Hydrodynamic/Hydroacoustic community identified that a key issue is reducing time and cost to perform research and development required to field products. Further, the Department of Commerce study and budget constraints associated with the ongoing operations in Afghanistan and Iraq indicate that the overall cost to produce and maintain the products developed by the Submarine Hydrodynamic/Hydroacoustic community may be an even more pressing issue that should be addressed. However, funding for Submarine Hydrodynamic/Hydroacoustic research has been reduced to less than 50% of traditional levels in the past year. This is due in part to budget pressures beyond the control of the community, as well as the successful completion of research and development for several major acquisition programs. In light of the fiscal reality, it is recommended that the community develop and implement strategies to maintain or document the current state of the art. In addition,

it is recommended that the community continue to identify innovative concepts that could significantly reduce the cost of acquiring and maintaining submarines.

The synergistic issues of achieving stable funding and reducing program volatility were also determined to be key. It is recommended that senior members of the Submarine Hydrodynamic/Hydroacoustic Community develop strategies to contribute to the transformation of the submarine forces in support of the Sea Power 21 vision, with an emphasis on reduced cost for submarine systems. Further, it is recommended that a study be performed to quantify the losses in productivity associated with funding extremes, program volatility, and lost capability.

Finally, there is the issue of maintaining and nurturing the technical expertise in the community. Significant cuts in submarine research and development funding have taken place between the fall of 2002 and the present time. There are not sufficient funds to pay for all the people who represent the breadth and depth of competencies required to maintain the Navy's current Submarine Hydrodynamic/Hydroacoustic technology base. It is critical that senior leaders in the Submarine Hydrodynamic/ Hydroacoustic community develop and implement strategies to retain the critical technical competencies required for near-term Navy needs, and develop a vision for how critical capabilities could be reconstituted to support future needs.

B. SUMMARY

The Submarine Hydrodynamic/Hydroacoustic community represents a resource that is critical to national security. However, reduced amounts of non-discretionary funds within the Department of Defense are resulting in fragmentation of the capability that has led to the superiority of U.S. Navy warships, particularly submarines.

Investment of 3 percent of revenues into research and development is indicated to maintain healthy renewal of technology, with some industries (e.g., the aircraft industry) maintaining research and development budgets on the order of 12 percent of revenues. The level of investment in research and development for the shipbuilding and repair

industry is 1.23 percent of revenues. The case must be clearly made that this insufficient level of re-investment in research and development will have a devastating effect on the future superiority of U.S. submarines.

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BIBLIOGRAPHY

"2001 Quadrennial Defense Review," 30 September 2001 [online] www.capitol.northgrum.com/files/qdr2001.pdf, p. iv, accessed 2 September 2004.

Allison, Michael and Jude Kaye, "Strategic Planning for Nonprofit Organizations: A Practical Guide and Workbook," New York, NY, John Wiley & Sons, 1997.

Ancona, Deborah et al. "Managing for the future: organizational behavior and processes." South-Western College Publishing. Cincinnati, OH. 1999.

Ansoff, H. Igor. "Corporate strategy; an analytic approach to business policy for growth and expansion." New York, McGraw-Hill, 1965.

Ausiello, David, "CNO Introduces "Sea Power 21"," Navy News Stand, Story Number: NNS020614-02, Release Date: 6/14/2002 10:11:00 AM, [online] http://www.news.navy.mil/search/display.asp?story_id=2081, accessed 20 August 2004.

"Biometrika Tables for Statisticians," Vol.1, 3rd ed., by E.S.Pearson and H.Q.Hartley, Cambridge University Press, Cambridge, 1966.

Bryce, David J., "Introduction to Strategic Management," BYU Marriott School of Business of 3 September 2002, slide 7 of 8 [online] marriottschool.byu.edu/teacher/BM499/Bryce/Intro%20to%20Strat%20Mgt%20(Sep 3).ppt, accessed 29 August 2003.

Bryson, John M. and Farnum K. Alston, "Creating and Implementing Your Strategic Plan: A Workbook for Public and Nonprofit Organizations." San Francisco: Jossey-Bass, 1996.

Bryson, John M., “Strategic Planning for Public and Nonprofit Organizations,” San Francisco, CA, Jossey-Bass Publishers, 1995.

CJCSM 3170.01A, “Operation of the Joint Capabilities Integration and Development System” Enclosure A, 12 March 2004 [online] http://www.dtic.mil/cjcs_directives/cdata/unlimit/m317001.pdf, accessed 19 August 2004.

Clark, Vern, "United States Navy: Chief of Naval Operations - Top Five Priorities: Status Report on CNO Guidance for 2002,” published 2003 [online] http://www.chinfo.navy.mil/navpalib/cno/cno-top5-report2003.html, accessed 2 September 2004.

Clark, Vern, letter to the Honorable Ike Skelton of 27 Feb 2003, Enclosure (1), "Navy FY04 Unfunded Programs List.”

Coleman, Hugh W., “Experimentation and uncertainty analysis for engineers.” 2nd edition. John Wiley and Sons, New York, NY. 1999.

Coser, Lewis A., “Masters of sociological thought: ideas in historical and social context,” 2nd edition, New York, Harcourt Brace Jovanovich, 1977.

Covey, Stephen R. “The Seven Habits of Highly Effective People: Restoring the Character Ethic.” Fireside. New York, NY. 1989.

Crockett, Charles R., “Updated Propulsor Minimum Core Capability,” July 2003.

Dahmer, Douglas -- interview of April 2002.

Defense Acquisition University, “DoD Business Transformation: Meeting the Security Challenges of the 21st century” of 9 September 2003, [online] http://dod5000.dau.mil/DOCS/DoD Business Transformation Brief Ver 7.ppt, accessed 2 September 2004.

Director, Operational Test and Evaluation, “FY98 Annual Report: SEAWOLF SSN 21 CLASS ATTACK SUBMARINE AND AN/BSY-2 COMBAT SYSTEM” [online] http://www.globalsecurity.org/military/library/budget/fy1998/dot-e/navy/98ssn21.html, accessed 7 August 2003.

“DoD Business Transformation: Meeting the Security Challenges of the 21st Century,” Defense Acquisition University [online] www.dtic.mil/ndia/2004test/mon/transformation.ppt, accessed 2 September 2004.

Drucker, Peter Ferdinand, “The Practice of Management.” New York, Harper, 1954.

England, Gordon, ADM Vern Clark, James L. Jones, "Naval Power 21… A Naval Vision,” October 2002, [online] www.chinfo.navy.mil/navpalib/people/secnav/england/navpow21.pdf, accessed 19 August 2004.

“FY 2004 Defense Planning Guidance, April 2003,” [online] www.oft.osd.mil/library/library_files/document_129_Transformation_Planning_Guidance_April_2003_1.pdf, accessed 2 September 2004.

Goldstein, Daniel, “SUBTECH Process” presentation of 31 March 2004.

Hoyle, Jeffery W., “Application of a Commercial Product Development Practice to Military C4I Systems Product Development,” Naval Postgraduate School, Monterey, CA, March 2002.

"James Fein Detailed as Carderock Division Executive Director," 6 June 2002 [online] http://www.dt.navy.mil/pao/excerpts%20pages/2001/feindetail3_01.html, accessed 2 September 2004.

Johnson, Stephen -- meetings from January 2004 through July 2004.

Learned, Edmund Philip, et al., "Business policy: text and cases," Homewood, Ill., R. D. Irwin, 1969.

Maier, Mark W., Eberhardt Rechtin. "The art of systems architecture," CRC Press LLC, Boca Raton, FL. 2000.

Memo "Submarine RDT&E Requirement and Priority Definition Documents," Ser N77/1U651534 of 30 October 2001.

Montgomery, Douglas C., "Introduction to Statistical Quality Control," New York, NY, John Wiley & Sons, Inc., 2001.

Nahmias, Steven, "Production and Operations Analysis," New York, NY, McGraw-Hill, 2001.

"National Security Assessment of the U.S. Shipbuilding and Repair Industry." U.S. Department of Commerce. May 2001.

"NAVSEA Warfare Centers Alignment," NSWC, 2 September 2003 [online] http://www.nswcdc.navy.mil/docs/Alignment.doc, accessed 2 September 2004.

NDIA staff, "2000 Presidential Election: George W. Bush's Views on Defense" October 2000 [online] http://www.nationaldefensemagazine.org/article.cfm?Id=286, accessed 2 September 2003

Perreault, William D., “Basic Marketing: a global-managerial approach.” 13th edition, The McGraw Hill Companies, Inc., 1999.

Purtell, L. Patrick. “Unsteady Hydrodynamics of the Maneuvering Submarine” [online] http://www.hpcmo.hpc.mil/Htdocs/UGC/UGC98/papers/2d_chal/, accessed 6 June 2002.

Spangler, Caral, Office of the Under Secretary of Defense (Comptroller) “Role in the Budget Cycle,” 14 May 2003, [online] bmc.ida.org/2003/presentations/T7-PPBSChanges-CaralSpangler.ppt, accessed 2 September 2004.

Spradley, James P., “The Ethnographic Interview,” 1979, Holt Rinehart and Winston.

“Strategic management,” revised 19 August 2003 in Wikipedia, the free encyclopedia, [online] http://www.wikipedia.org/wiki/Strategic management, accessed 29 August 2003.

Submarine Future Studies Group, "Submarines... the Road Ahead." July 2000.

“Submarine Hydrodynamic/Hydroacoustic Plan,” Hydro Sub Group, 1998-2001.

“Submarines: The Road Ahead,” Future Concepts Working Group, 1999.

SUPREJET removal, "Commerce Business Daily Issue of August 24, 1995 PSA#1417,” [online] http://www.fbodaily.com/cbd/archive/1995/08(August)/24-Aug-1995/Jsol017 .htm, accessed 7 August 2003.

"Strategic Management,” Wikipedia, the free encyclopedia, [online] http://en.wikipedia.org/wiki/Strategic_management#Historical_development_of_strategic_management, accessed 19 August 2004.

Sykes, Kevin, "'CarTech' Looks to Future for Carrier Program," The Flagship, 28 August 2003 [online] http://www.flagshipnews.com/archives_2003/aug282003_6.shtml, accessed 2 September 2004.

Taylor, Frederick Winslow, 1856-1915. "The Principles of Scientific Management," Mineola, N.Y. : Dover Publications, 1997.

"The history of strategic planning and management: Strategic development and public organizations," 14 October, 2002 [online] http://www.martinwebster.info/content/sisp/the_history_of_strategic_planning_and_management.html, accessed 29 August 2003.

"Two approaches to strategic management." 24 October, 2002 [online] http://www.martinwebster.info/content/sisp/two_approaches_to_strategic_management.html, 29 August 2003.

U.S. Department of Commerce, "National Security Assessment of the U.S. Shipbuilding and Repair Industry of May 2001: Executive Summary" [online] http://www.bis.doc.gov/DefenseIndustrialBasePrograms/OSIES/DefMarketResearchRpts/shipbuilding_and_repair.pdf, accessed 29 September 2003.

"What is Lean?" [online] http://www.leanadvisors.com/Lean/demo/lean_concept/lean_concept_lean.cfm, accessed 2 September 2004.

Winston, Wayne L. and S. Christian Albright, "Practical Management Science," second edition, Duxbury Thompson Learning, 2001.

Wolfowitz, Paul, "Defense Acquisition" Memorandum Ser U16167-02 of 30 October 2002.

APPENDIX A – RESULTS OF INITIAL PLANNING MEETINGS WITH THE HYDRO SUB GROUP – MARCH 2002

A. STRENGTHS, WEAKNESSES, OPPORTUNITIES, THREATS

Table 10. I. Strengths, Weaknesses, Opportunities, and Threats: Mission and Vision[126]

Strengths • Individuals passionate about their piece	Weaknesses • No consensus on mandate • Mission is tactical – reactive • Past sloganism has not involved community
Opportunities • Virgin territory (Bryson, p. no failed strategic plans)	Threats • Lack of focus will leave community vulnerable

[126] c.f. Bryson and Farnum, 1996, p. 19.

Table 11. II. Strengths, Weaknesses, Opportunities, and Threats: Fiscal and Human Resource Management[127]

Strengths	Weaknesses
• 6.4 funding consolidated (from 93R) • 6.5 funding all in TeamSub, NAVSEA • 6.1-6.3 funds in ONR, DARPA, who understand business • The good people have funding	• Management can't/won't make decisions • Resource sponsors have little flexibility • 6.4 funding paper studies, not large scale demonstrations, validations • Human resources tends to be inflexible • Low morale • The good people are overburdened
Opportunities	**Threats**
• Raise fuss because community is falling below core capability • Make case for hydro investment required to make desired 'packages' reality	• Future resources under attack • External stakeholders satisfied with paper studies, leaving community without necessary validation experiments • Could lose capability to perform tests • Missing POM and PR windows because community does not understand process

[127] c.f. Bryson and Farnum, 1996, p. 20.

Table 12. III. Strengths, Weaknesses, Opportunities, and Threats: Communications[128]

Strengths	Weaknesses
• SUBTECH presents well • H/HTC perceived as objective • H/HTC TeamRooms/VTC transcend geographic boundaries	• Technical community assumes others understand their political and technical universe • Inconsistency – tendency to obfuscate • Internal strife diluting message
Opportunities	**Threats**
• Planning process can create/strengthen important networks (e.g., with weapons community)	• Lack of focus will leave community vulnerable to further depredation • Current methods of communicating alienating important sponsors, future community assets

[128] c.f. Bryson and Farnum, 1996, p. 21.

Table 13. IV. Strengths, Weaknesses, Opportunities, and Threats: Leadership, Management and Organization[129]

Strengths	Weaknesses
• We know what is needed • Requirements are solid, where exist	• Cultural gap between management and technical performers – management not selected from technical community • Technical performers often over-polish inputs – delivering the perfect product too late • Value network doesn't promote Hydro R&D • Most hydro performance not specified (e.g., maneuvering, propulsor 'objectives') • Syndrome described in 'Innovator's Dilemma'
Opportunities	**Threats**
• Should be able to make case that things are broken, need to be fixed	• 'Ice' ceiling resulting in restricted upwards mobility – loss of promising managers • Most hydro can be ignored as convenient (CAIV) • 'We can get the job done by going slower' – fleet reluctant to admit to deficiency • External stakeholders don't appreciate long lead time required to develop trained talent

[129] c.f. Bryson and Farnum, 1996, p. 22.

B. BARRIERS TO STRATEGIC PLANNING[130]

Barrier	Ways to Address
Competitive organizations defending rice bowls	• Reduce defensiveness by explaining community-wide threat • Model existing situation and acknowledge benefits derived from 'tension', where exist
"You don't understand, Trust Me" from technical community	• Make sure strategic process open to technical community • Solicit layman explanations from key individuals (Ammeen, Boswell) • Other
Lack of understanding regarding acquisition environment	• Assess DAWIA certification status • Encourage key individuals to obtain DAWIA certification (SPRDE III)
Distrust between competing communities	• Reward people who bridge organizations • Respect intellectual property • Shift paradigm from 'us vs. them' to 'Hydro vs. Uninformed world'
Reluctance to perform strategic plan before announcement of new Hydro Czar	• Include entire community – will likely include future Hydro Czar

[130] c.f. Bryson and Farnum, 1996, p. 23.

C. EXPECTED COSTS OF STRATEGIC PLANNING[131]

Costs (direct and indirect)	Ways to Manage Costs
Strategic Planning Team (5 people, 1 man-week each)	• Already part of 'Doing Business'?
Hydro Group (7 people, 1 man-week)	• Already part of 'Doing Business'?
Conference facilities for Hydro Sub Group	• Cost TBD, funded by 93R? Held at H/HTC?
Communication	• Archive documents on TeamRoom • Maximize use of VTC for non-local participants • Traveling brief to communities when have achieved 90% solution
Inter-organizational cooperation (56)	• $30K TBD from 93R
Inter-organizational cooperation (ARL/NSWC)	• Honest evaluation of demographic pursuing Hydro fellowships

[131] c.f. Bryson and Farnum, 1996, p. 24.

D. EXPECTED BENEFITS OF STRATEGIC PLANNING[132]

Benefits (direct and indirect)	Ways to Enhance Benefits
Clear, compelling vision and strategy	• Keep unclassified • Keep concise • Brag on process to rest of TeamSub • Maximize exposure of 'thesis' to open doors otherwise closed to community
Increased understanding of acquisition realities	• Explore ways to utilize Communities of Practice (DAU) to train even those not designated as acquisition workforce • Brief case studies to community to enforce importance of knowing the rules
Understanding that community performance can be scientifically improved	• Develop analogy to propulsor improvement • Explore what would be required for members of technical community to move 'up'.
Connection to past efforts, future visions of external stakeholders	• Use 'thesis' to interview past actors (DeMars, Bowman, Fein, etc.) • Connect to current movers (N77, CNR, 08)
Articulation of clear need	• Articles in internal vehicles regarding process (NAVSEA briefing, Wavelengths, etc.) • Leverage PD21 participation in ONR Naval-Industry Partnership Conference • Leverage NPS efforts to promote PD21 curriculum • Other venues for making case, depending on outcome and maturity of story

[132] c.f. Bryson and Farnum, 1996, p. 25.

E. SHOULD WE PROCEED WITH THE STRATEGIC PLANNING PROCESS?[133]

	Readiness Criteria	
	Process has strong sponsor(s) *There are high level individuals who want the effort made (e.g., Program Executive Officer, Submarines*)	Yes
	Process has strong champion(s) *There are people involved in the process who believe the strategic planning process itself will yield benefits*	Yes
	Resources are available	Yes
	Process is within our mandate	Yes
	Benefits outweigh costs	Yes
	Process will have real value for organization *Will have value if works*	Yes
	Process will be linked to operational plans and budget *Key will be phasing planning/socializing to allow impacting POM and PR efforts*	Yes
	Based on the above answers, should we:	
	Proceed	Yes
	Figure out how to change each no to a yes first	Yes*
	Forget about strategic planning	No

* Strengthen sponsor and champion support

[133] c.f. Bryson and Farnum, 1996, p. 26.

APPENDIX B – SURVEY REGARDING STRATEGIC PLANNING FOR THE SUBMARINE HYDRODYNAMIC/ HYDROACOUSTIC COMMUNITY – AUGUST 2002

1. What is your age?

- ☐ 20-29
- ☐ 30-39
- ☐ 40-49
- ☐ 50-54
- ☐ 55 or older

2. What is your grade?

- ☐ O-5; GS-12/13; ND-04
- ☐ O-6; GS-14/15; ND-05
- ☐ O-7 or above; SES
- ☐ Other, Please specify _____

3. With which RDTEN Budget Category(ies) do you work?

- ☐ 6.1 – Basic Research
- ☐ 6.2 – Applied Research
- ☐ 6.3 – Advanced Technology Development
- ☐ 6.4 – Demonstration and Validation
- ☐ 6.5 – Engineering and Manufacturing Development
- ☐ Other, please specify _____

4. How many years and in what role did you work/have you worked in the submarine Hydrodynamic/Hydroacoustic Community?

Technical

☐ 0-4 ☐ 5-9 ☐ 10-14 ☐ 15-19 ☐ 20-29 ☐ 30+

Management

☐ 0-4 ☐ 5-9 ☐ 10-14 ☐ 15-19 ☐ 20-29 ☐ 30+

Total

☐ 0-4 ☐ 5-9 ☐ 10-14 ☐ 15-19 ☐ 20-29 ☐ 30+

5. Do you agree or disagree with the following statements?

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Agree
I am actively involved in the Hydrodynamics/Hydroacoustics Community.	☐	☐	☐	☐	☐
I am familiar with the Submarine Force's 4 Strategic Concepts.	☐	☐	☐	☐	☐
I am familiar with the 3 pillars of CNO's Sea Power 21 vision.	☐	☐	☐	☐	☐
I participated in developing a strategic plan for the community during the past 5 years.	☐	☐	☐	☐	☐
I am familiar with the strategic plan(s) developed during the past 5 years.	☐	☐	☐	☐	☐
I have found the strategic plan(s) useful in guiding my efforts.	☐	☐	☐	☐	☐
The Hydrodynamic/Hydroacoustic community effectively develops strategies to address key issues.	☐	☐	☐	☐	☐
I believe significant improvements could be made to the current strategic process.	☐	☐	☐	☐	☐

6. What attributes would enhance the effectiveness of a strategic plan for the Hydrodynamic/Hydroacoustic community?

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
Finalize plan in time to impact POM papers (Apr/May of odd years).	☐	☐	☐	☐	☐
Keep unclassified to allow wide distribution.	☐	☐	☐	☐	☐
Keep classified to allow more detailed descriptions.	☐	☐	☐	☐	☐
Limit distribution to allow management flexibility.	☐	☐	☐	☐	☐
Post plan and accompanying brief in central location for easy access.	☐	☐	☐	☐	☐

Over the past few months, interviews were conducted with members of the community to elicit ideas on the major issues facing the community, as well as outstanding successes and failures with which the community has been involved. The following questions ask your opinion about the issues and successes/failures identified in these interviews.

7. In your opinion, what are the three most important issues facing the Hydrodynamic/Hydroacoustic community?

☐ How can we maintain/nurture technical expertise of the Hydrodynamic/Hydroacoustic workforce?

☐ How can we maintain/nurture high quality, knowledgeable leadership in the community?

☐ How can we reduce the R&D time and cost currently required to field products?

☐ How can we successfully transition technologies from S&T to R&D/Acquisition?

☐ How can we spark innovation and excitement within the community?

☐ How can we reduce program volatility?

☐ How can we achieve stable funding?

☐ How do we ensure that basic research continues to support improved tools and future innovations?

☐ How do we market Hydrodynamics/Hydroacoustics to make Navy relevance clear?

☐ How do we ensure funds available are most effectively utilized for the fleet?

☐ How can the Hydrodynamics/Hydroacoustics infrastructure become more flexible?

☐ Other not listed above _____

8. The following factors have been mentioned as being critical for successful programs or missing in unsuccessful programs. Please indicate their importance, in your experience.

	Critical To Success	Important	Nice to have	Unimportant	Counter-productive
Clear guidance from upper management	☐	☐	☐	☐	☐
Frequent reviews with high level management	☐	☐	☐	☐	☐
Knowledgeable personnel	☐	☐	☐	☐	☐
Validated Tools	☐	☐	☐	☐	☐
Community Support	☐	☐	☐	☐	☐
Early, stable definition of goals	☐	☐	☐	☐	☐
Strong programmatic support ($'s, priority and schedule)	☐	☐	☐	☐	☐
High level focus/attention	☐	☐	☐	☐	☐
Coordination between S&T, R&D and Acquisition sponsors	☐	☐	☐	☐	☐
Persistence	☐	☐	☐	☐	☐
Sponsor tolerance of risk	☐	☐	☐	☐	☐
Integrated multi-disciplinary teams	☐	☐	☐	☐	☐
Technical oversight from appropriate SEA 05 personnel	☐	☐	☐	☐	☐
Team continuity	☐	☐	☐	☐	☐
Good communication between team members	☐	☐	☐	☐	☐
Decision authority/flexibility delegated to lowest appropriate level	☐	☐	☐	☐	☐

	Critical To Success	Important	Nice to have	Unimportant	Counter-productive
Perceived impartiality of program managers	☐	☐	☐	☐	☐
Realistic expectations	☐	☐	☐	☐	☐

9. How would you rate the hydrodynamic/hydroacoustic efforts associated with the following products?

	Technical and Programmatic Success	Technical Success	No Opinion	Programmatic Failure	Programmatic and Technical Failure
Albacore	☐	☐	☐	☐	☐
ATSOL/Advanced Sail	☐	☐	☐	☐	☐
NOO AUV (Seahorse)	☐	☐	☐	☐	☐
AN/WSQ-9	☐	☐	☐	☐	☐
Seawolf WAA fairings	☐	☐	☐	☐	☐
Seawolf trials	☐	☐	☐	☐	☐
Automatic control	☐	☐	☐	☐	☐
Maneuvering Objectives	☐	☐	☐	☐	☐
Seawolf neutral angle	☐	☐	☐	☐	☐
Virginia Class neutral angle	☐	☐	☐	☐	☐

10. How would you rate the following propellers/propulsors?

	Technical and Programmatic Success	Technical Success	No Opinion	Programmatic Failure	Programmatic and Technical Failure
I3B (original 688 propeller)	☐	☐	☐	☐	☐
I3M (TE mod)	☐	☐	☐	☐	☐
I3 tip mod	☐	☐	☐	☐	☐
LA Hybrid	☐	☐	☐	☐	☐
Advanced Hybrid	☐	☐	☐	☐	☐
Suprejet	☐	☐	☐	☐	☐
Suprelite	☐	☐	☐	☐	☐
Seawolf propulsors	☐	☐	☐	☐	☐
Virginia-Class propulsor	☐	☐	☐	☐	☐
PSAM	☐	☐	☐	☐	☐
ASPS	☐	☐	☐	☐	☐
ASDS	☐	☐	☐	☐	☐

11. Please rate the utility of the following tools the Navy (ONR and 93R) have helped fund to support the Hydrodynamic/Hydroacoustic community?

	Extremely Useful	Useful	No Opinion	Useful but with major shortcomings	Not Useful
UNCLE	☐	☐	☐	☐	☐
H/HTC	☐	☐	☐	☐	☐
Multi-Vortex	☐	☐	☐	☐	☐
MDAT	☐	☐	☐	☐	☐
PDAT	☐	☐	☐	☐	☐
IAM	☐	☐	☐	☐	☐
Kokanee	☐	☐	☐	☐	☐
Cutthroat	☐	☐	☐	☐	☐

12. Please check all that apply:

☐ I would be willing to participate in a follow-up survey

☐ I would like to receive a summary of survey results

☐ I would like to receive an executive summary of the strategic plan

☐ Do not follow-up or send me results

13. Your answers will be kept confidential. However, if you want to be sent results of this survey or would be willing to participate in a post-planning evaluation, please enter your e-mail address:

Thank you for participating in this survey!

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