

The Role of Operations Research/Systems Analysis in Defence Policy and Programming Decisions **

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The very fact that so many of us are here to participate in this conference on Operations Research is an indicator of the importance we attach to this relatively new and still expanding field. All of us recognize that Operations Research techniques are especially useful tools in problem solving in business, Government and the military. A discussion of the role of Operations Research and the related field of Systems Analysis in national defense policy and programming decision processes seems especially appropriate at the opening session of this conference. As you know, Operations Research as an organized form of research first found application in the review of individual military weapons systems and their effectiveness just over forty years ago. From that relatively narrow beginning has evolved a discipline whose future exploitation and utility you will explore over the next several days.

I plan to review very briefly the historical development of Operations Research and Systems Analysis as tools in the defense decision-making process. Then, I will give you an overview of their application to today's military and defense problem solving by discussing the use of these techniques at the headquarters level by the United States Navy. Obviously, in such a brief period, I cannot cover all applications, specific techniques, or all of the groups involved in such a complex process.

A review of the historical development of Operations Research/Systems Analysis reveals that the use of the basic concepts of Operations Research is not new; it originated with the first attempts to use the scientific approach to solve problems. We are still seeking, through modern analysis, to answer the three questions posed by John Dewey in his examination of the problem solving process in 1910.¹

- What is the problem?
- What are the alternatives?
- Which alternative is best?

As I noted earlier, Operations Research, as an organized form of research, began in Great Britain in the late 1930s with the review of individual weapons systems.

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- In 1937, civilian scientists, under the leadership of Sir Robert Watson-Watt, were hired to teach British military personnel how to use the newly-developed radar to locate enemy aircraft.

- By 1939, at the outbreak of the war in Europe, Britain had the nucleus of an Operations Research organization. As the war progressed, the size and scope of the staff expanded. This staff represented many disciplines-Physical Sciences, Mathematics, Statistics, Biology, Physiology and others.

- By 1941, the British Operations Research group included American scientists who later performed Operations Research for United States military forces.

Because of the urgent need to effectively resolve a number of strategic and tactical problems and to provide a basis for decision making, the research conducted by this group was broadened to include almost every phase of military operations, including convoy, anti-submarine warfare, anti-air warfare and even civil defense operations. The research on (military) operations gave rise to the name "Operations Research" (A name Sir Watson-Watt claimed to have originated),

Following the British lead, Operations Research groups were established in Australia, Canada, and the United States.

The first Operations Research activity in the United States was formed in March 1942 at the Naval Ordnance Laboratory. It was concerned primarily with mine warfare; its work culminated eventually in the aerial mining of Japanese-controlled waters from Singapore to the Japanese home islands. The establishment of this group was the beginning of a rapid growth of Operations Research activity in the U.S. Navy.

By mid 1942, the U.S. Air Force, then the Air Corps, also formed a prototype group, and, by 1945, had 26 Operations Research groups with over 400 officers, enlisted personnel and civilian analysts.

The U.S. Army did not make as much use of Operations Research, but by 1944, it did have a few evaluation groups, primarily concerned with operations in the Pacific.

At the end of World War II, many U.S. military Operations Research groups disbanded, but some were retained or reorganized. A number of former military analysts began using their skills in Government and various civilian organizations. The adaptation of Operations Research techniques to the analysis of business operations caught on quickly, for in a highly competitive economy, there is strong impetus to make business and industrial operations more efficient, and thus, more profitable.

For the U.S. military, there were new problems which emphasized the need for the continuation of Operations Research efforts. It didn't take long for quantitative analysis to become institutionalized within our Department of Defense. The Navy expanded on the existing Operations Research Program. The Army created the Operations Research Office, administered by Johns Hopkins University, and the Air Force was instrumental in the establishment of the Rand Corporation. Rand's efforts to relate Air Force needs to budget allocations and to fashion strategic concepts led to use of another concept, Systems Analysis.

Let me turn to definitions for just a moment. The difference between Operations Research and Systems Analysis is one of emphasis. Operations Research is used to find optimum ways to use the resources available to solve the operational problems encountered. Operations Research techniques are usually applied to the solution of well defined problems. Systems Analysis, on the other hand, is somewhat less technically oriented and deals with problems of greater complexity and more uncertainty. It looks at solutions that might not take effect for several years, dealing also with overall direction rather than with the details of near-term operations. Systems Analysis takes problems that are not defined and attempts to define them. Systems Analysis has been said to relate to Operations Research as strategy relates to tactics. On the other hand, a classic definition of Operations Analysis (as opposed to Operations Research) is "a scientific method of providing executive departments with a quantitative basis for decisions regarding the operations under their control."²

It was not until the early 1960s that Systems Analysis came of age in the United States Department of Defense. In January 1961, Robert S. McNamara became Secretary of Defense and introduced into the highest levels of the defense decision process the analytical techniques which the

military services themselves and their research groups had pioneered. He named Charles Hitch, a noted economist and Rhodes scholar, to the post of Defense Comptroller. Hitch was to initiate major innovations in defense planning, including heavy reliance on the techniques of Systems Analysis. In April 1961, Hitch appointed a young economist, Dr. Alain C. Enthoven, to head the Systems Analysis Office under the Deputy Assistant Secretary of Defense for Programming. In 1962, Enthoven was assigned the new post of Deputy Assistant Secretary of Defense for Systems Analysis, a recognition of the importance Secretary McNamara attributed to this capability.

The use of Systems Analysis in the Department of Defense had changed since first introduced by Secretary McNamara. During the McNamara era, the Office of Systems Analysis primarily originated studies and recommendations and reviewed proposed forces and programs. It now tends also to examine broad strategic and economic problems while still paying attention to the details of weapons selection. The Department of Defense Systems Analysis Staff is now designated as the Office of Defense Program Analysis and Evaluation.

With that historical background in mind, I will now move to an area I am most familiar with and the main section of my remarks- Operations Research/Systems Analysis in the U.S. Navy, and its role in the decision-making process.

At the center of the Navy's in-house headquarters level Systems Analysis and Operations Research capability is the Systems Analysis Division of the Office of the Chief of Naval Operations, an organization which I headed for two and one half years prior to assuming my present assignment. The role of this organization goes beyond the specific applications of Operations Research and Systems Analysis techniques, but, nonetheless, the tasks assigned are indicative of contributions made by these techniques to the decision process. The Systems Analysis Division is one of three divisions- a Program Planning Division and a Fiscal Management and Budget Division being the other two- which are directly subordinate to the Director, Navy Program Planning, a senior Vice Admiral who is responsible for supervising and coordinating the entire Navy program planning, budget and study effort. His office must ensure that the functions of planning, programming, budgeting and appraisal are integrated to achieve a balance of individual programs which lead to a balanced Navy.

Maximum current and future capability and effectiveness within given fiscal constraints are the principal goals.

The Navy's Systems Analysis Division was established in 1966, a relatively recent addition to the headquarters organization supporting the Chief of Naval Operations. It was established in order to provide the CNO with a direct capability to evaluate specific Navy programs and to examine the effectiveness of alternative programs and proposals. It plays a major role in long-range mission and program evaluation and forecasting, in resource allocation and program formulation, in providing an ongoing overview and critical analysis of the progress of new systems developments and in providing background information for policy level decisions. The Systems Analysis Division is a highly effective and responsive organization which performs a vital role for our Navy. It generates within the Navy a better understanding of actions necessary to meet competing requirements and provides effective presentations of requirements and program alternatives to senior decision makers.

The Division maintains a close liaison with the Program Analysis and Evaluation Office in the Office of the Secretary of Defense. It works closely with the other divisions in the CNO's organization in coordinating the overall Navy program planning and study effort. The Systems Analysis Division coordinates and assists in analysis work conducted in other Navy staff offices, as well as in supporting organizations throughout the Navy.

The formal statement of responsibility for the Division enumerates some forty-five functions which are carried out by the Division. In addition to the liaison and assistance mentioned above, the Division is involved in such tasks as:

- Evaluating the requirements of current and future Navy and Marine Corps missions and assessing our capability to meet assigned tasks.
- Determining programming actions and new capabilities required to improve mission performance and capability, including necessary force levels, mix of forces, specific weapons systems and personnel and support requirements.

- Defining planning, programming and policy issues which must be resolved in order to provide for a balanced and capable force.
- Developing, reviewing, and refining computer war gaming models. War gaming techniques are applied to the analysis of naval warfare tasks and associated tactics and weapons systems.
- Assessing the threat to the ability of the Navy to carry out its mission, including identification of options for meeting this threat.
- Carrying out studies that analyze and validate functions such as costing, production schedules, and contract performance of Navy programs-with emphasis on major weapons systems.
- Acting as central coordinator for the Department of the Navy Studies and Analysis Program.

The Navy's Operations Research and Analysis Program is also supported strongly by groups in headquarters support and field organizations. The efforts of these groups are tailored to support the missions of their parent organizations and are usually directed to the solution of problems in specific mission or weapons systems areas.

Key among the Navy's analytical support organizations is the Center for Naval Analyses, an independent non-profit civilian organization operated under contract in support of the Navy's total studies and analysis effort. This organization provides a dedicated, highly professional group of analysts with a capacity to undertake comprehensive analyses of a broad range of military issues, policies and problems.

Although CNA was not established until the early 1960s, one of its major components, the Operations Evaluation Group (OEG), is a lineal descendant of one of the first Operations Research groups organized by the Navy during World War II. The early recognition of the unique value of the ability of an organization like OEG to provide an independent, unbiased, scientific viewpoint paved the way for general acceptance of Operations Research/Systems Analysis techniques throughout the Navy.

CNA provides Operations Research in support of the Navy in a variety of ways. Its work includes considerations of both narrow and immediate as well as the very broadest long-range problems of the Navy. Representatives of CNA work throughout the Navy, with major force and fleet commanders, with units such as experimental aircraft squadrons, as well as in the Office of the Chief of Naval Operations (OPNAV) on major studies. CNA's work for the Navy is coordinated through the Systems Analysis Division.

Several conditions are essential if an Operations Research or Systems Analysis organization is to be an effective and credible contributor to any decision making process. The group must have.

- The necessary personnel, properly trained, qualified and motivated.
- The freedom to operate objectively, honestly and independent of any outside influence. There can be no directed answers or preconceived solutions.
- The group's leader must have direct access to senior decision makers for consultation, guidance and presentation of results.

These conditions have been met and are major contributors to the United States Navy's effective and highly responsive Systems Analysis organization.

The mix of personnel and their backgrounds and qualifications vary with the organization. In the Center for Naval Analyses, civilian professionals outnumber the naval officers by about six to one. These civilians are men and women with advanced degrees in one or more academic or technical fields; many have long years of practical experience in their fields. They have an established reputation for independence, objectivity and credibility. The naval officers in their midst ensure full and accurate military input to studies and analyses. These military officers, and their fellows in the Systems Analysis Division, represent the full spectrum of academic and professional backgrounds. All warfare specialties and supporting staff disciplines are represented. Especially valuable are those officers with a strong operational background - men who know the fleet, the ships, the aircraft, the submarines, the weapons systems, and who also

know intimately the environment in which our equipment operates and where our personnel work and live. The majority have graduate degrees; at least half have an advanced degree in the field of Operations Analysis. Of greatest importance, however, is the fact that each was selected for his current assignment on the basis of sustained superior professional performance and academic capability.

Our naval officers gain their Operations Research/Systems Analysis training primarily from two sources. One source is at the undergraduate level. Since 1959, a naval Operations Analysis course has been taught to prospective officers at the U.S. Naval Academy. This course does not by any means produce experts, but it does enable our future officers to have a familiarity with the subject early in their career. Other officers major in this field in our civilian universities. The second source, and the most valuable one, is the graduate program in Operations Analysis which has been taught at the Naval Postgraduate School in Monterey, California, since 1951. This program produces a trained officer who is an immediately usable asset to the Navy. Officers graduating from this curriculum alternate assignments to operational billets with those jobs requiring a subspecialty in Operations Analysis. The program has an outstanding reputation—a reputation that has been enhanced under the able direction of Dr. Jack Borsting (Provost and Academic Dean) and Dr. David Schradly (Dean of Academic Planning and Dean of Information and Policy Sciences), both of whom have had a long association with national and international Operations Research and Systems Analysis organizations. The Naval Postgraduate School maintains a military viewpoint and provides the student with a thorough survey of tactical, strategic, procurement and weapons-system problems.

Personnel in our Navy Operations Research and Systems Analysis groups are guaranteed the opportunity to do their work as objectively and independently as possible. The President of the Center for Naval Analyses is guaranteed independence under the terms of his contract. In the Navy, he reports directly to and responds only to the guidance of the Director, Systems Analysis Division and to his immediate superior, the Director Navy Program Planning. These two officers, in turn, enjoy direct access to the Vice Chief and the Chief of Naval Operations, thus

guaranteeing their freedom from any attempts at undue influence on the part of other staff officers.

CONCLUSIONS

If my presentation has sounded like a sales talk, in a sense, it is. I believe a viable analysis program is a valuable management tool for almost any large organization military, Government, business or industry. Definitive analysis is essential in the defense decision making process, just as it is in an enterprise where the bottom line is profit or loss. For the U.S. Navy, as with any military organization, analysis techniques provide an invaluable means for insuring that we effectively use the assets available under given fiscal or other constraints. But, some words of caution:

- Operations Research/Systems Analysis is not decision making itself; it is simply a tool to be used in the decision making process.

- Analysis guides and assists but does not dominate defense policy and programming *decision*.

- It is one of several, albeit, a very valuable tool which is useful to the decision maker.

In the final analysis, decision making is based on judgment- with the person making the decision weighing all factors and information available and applying knowledge gained through experience in order to reach the best possible solution or decision.

REFERENCES

- (1) Dewey, John, HOW WE THINK, 1910
- (2) Morse and Kimball, METHODS OF OPERATIONS RESEARCH, Mitt Press, 1951.