

Ronnie Shephard Memorial Address

David Schrady
28th ISMOR

Thank you David (Faddy). I am honored to have been asked to give the Ronnie Shephard Memorial Address.

I met Ronnie in Monterey in the early 1980s when he came to the Naval Postgraduate School (NPS) for a short course in defense resource management. I had known that Ronnie was one of the pioneers of British operational research and was delighted to meet him. Subsequently I enjoyed numerous ISMORs where he was the learned and very gracious host.

In 1987 I was coming to the end of a 13 year period of administrative rather than academic activities at NPS and was going to take a sabbatical to find out if there was life after administration. I wrote to Ronnie Shephard regarding the possibility of a sabbatical at the Royal Military College of Science. I did not realize that while he was then on the RMCS campus, he was working for Royal Ordnance rather than the College at that time.

In any event, Ronnie spoke to RMCS and put me on to Mike Bathe in the Systems Assessment Group. With the support of his dean, Steven Humble, my wife and I were afforded housing on the campus and thus began a wonderful period of time for us. We bought a rusty Fiat saloon from someone in the bar at the Bell Hotel in Faringdon and explored England, Scotland, and Wales on weekends. We had a wonderful time.

And I learned so much during the sabbatical. I learned that “bubbles and squeak” is something you eat. I learned that a pint of bitter isn’t bitter at all and is in fact intoxicatingly good. I learned

to *shed-ule* my time and to use the word *brilliant* often in my conversation.

Seriously, I had a stimulating time with Mike Bathe and his faculty. The answer to the question about life after administration was that teaching came back pretty readily, but research was much more difficult to get back into.

But enough of this, tonight I want to talk about the history of education in operations research and the role of the Naval Postgraduate School in this. I will use operations research and operational research interchangeably.

Beginnings of Operations Research

Operations research has its origins in the study of military operations. The British, specifically the Operational Research Society, mark the year 1937 as the birth of operational research. Operational research began when, having developed radar, scientists were then asked to develop procedures for its use in a new, effective air defense system. This was research to improve operations and a new employment of the scientific method and scientific personnel. When war came, this innovation of tasking scientists to study operational military problems was extended to many other areas of military operations.

These developments were watched in the United States by both the Navy and the Army Air Corps. In a letter dated 27 January 1942, at the start of the German U-boat campaign in the Atlantic, Navy Captain Robert Carney recommended that an antisubmarine warfare group be established within the Atlantic Fleet. The Antisubmarine Warfare Unit of the Atlantic Fleet was established on 2 March 1942. A month later, with Philip Morse from MIT and six other civilian scientists on board, the Unit took the name Antisubmarine Warfare Operations Research Group,

ASWORG. Things were moving very fast, but the situation was quite serious. In a letter to the Chief of Naval Operations Admiral Ernest King, Chief of Staff of the Army General George Marshall wrote, “The losses by submarines off our Atlantic seaboard and in the Caribbean now threaten our entire war effort.”

The ASWORG developed tactics used in searching for submarines, devised plans for escorting convoys of ships, recommended the best depth setting for depth charges used against submarines, and contributed significantly to the ebb and flow of measures and countermeasures in the Battle of the Atlantic. With the decline of the submarine threat, ASWORG was renamed the Operations Research Group in October 1944, after expanding its studies to include strategic mining, anti-air warfare, and other areas of naval warfare.

The use of operations research in World War II was considered by the Navy to have been quite valuable. In his final report to the Secretary of the Navy on the US Navy in World War II, the Chief of Naval Operations, Fleet Admiral Ernest King, wrote that operations research “made it possible to work out improvements in tactics which sometimes increased the effectiveness of weapons by factors of three or five . . .” Admiral King also noted that the Operations Research Group would be renamed the Operations Evaluation Group (OEG) as more closely descriptive of its functions, and that he was taking action to insure its uninterrupted continuation into peacetime.

Origin of Operations Research Education

Now I want to talk about the origin of education in operations research. In 1950, as one of the items on the list of post-World War II things to do, the Chief of Naval Operations directed that an education program in operations research be established for naval officers. The Superintendent of the Naval Postgraduate School

was instructed to set up a one-year curriculum in operations research at an appropriate civilian institution; MIT was suggested. The Superintendent made inquiry to several civilian universities without finding any interest. In December 1950, he and the Director of the OEG, Dr. Jacinto Steinhardt, submitted a joint proposal that recommended the establishment of a six-term graduate degree curriculum at the Naval Postgraduate School. Steinhardt, who had joined ASWORG in November 1942, helped design the initial curriculum. After considerable discussion, the Chief of Naval Personnel approved the recommendation with the stipulation that the curriculum might have to be changed if it proved to be too difficult for the naval officer who had not specialized in higher mathematics. The first class of nine officers began their studies in August of 1951.

The curriculum was built on mathematics and the physical sciences, and emphasized the techniques that had been used successfully in wartime operations research. The curriculum was directed by professors from the Physics and Mathematics departments. The only open literature available was Morse and Kimball's book "Methods of Operations Research," published in 1950 as the unclassified version of their 1946 classified OEG report of the same title. Of course, since the curriculum was at the Naval Postgraduate School, the classified reports of the OEG and other sources were also used in the program of instruction.

The first class graduated in January 1953. Experience gained with the first class led the Superintendent to propose a revised curriculum of eight terms (2 years). The expanded curriculum allowed incorporating an experience tour at a functioning operations research group, greater coverage of proven operations research methods, and inclusion of work on digital computers. An NCR 102A arrived at the School for use in instruction in 1954, and in 1961 the School received the first CDC 1601 machine produced. The experience tour is a six-week period at roughly the midpoint

of the curriculum in which students go off campus to an organization that does analysis for practical experience and assistance in developing their thesis research subject. Both the experience tour and the thesis are curriculum requirements to this day. While the degree has always been in operations research, the original name of the curriculum was operations analysis.

Growth of Operations Research

The early 1950s saw many developments in the field of operations research. The journal, *Operational Research Quarterly*, first appeared in the UK in 1950. The Operations Research Group at Case Institute of Technology was created in 1952 and a two week short course on operations research was given there in June 1952. The Operations Research Society of America was founded in 1952 and the first issue of the *Journal of the Operations Research Society of America* appeared in November of that year. The Institute of Management Sciences was founded in 1953 and its journal, *Management Science*, appeared in 1954. Professor Morse set up the Operations Research Center at MIT in 1955. Also in 1955, MIT and Johns Hopkins University gave their first degrees in operations research and Case Institute of Technology followed in 1957. Many regard the book “Introduction to Operations Research” by Churchman, Ackoff and Arnoff to be the first textbook in operations research. It appeared in 1957, six years after the start of the NPS curriculum.

As the field of operations research developed, so did the curriculum at NPS. Linear programming, inventory control, queuing theory, game theory, and war gaming were added to course work in probability and statistics, search theory, underwater acoustics, and electromagnetic radiation. Throughout the 1950s an interdisciplinary committee of Physics and Mathematics faculty administered the curriculum, and its focus was on the development and evaluation of tactics and systems. A large percentage of the

theses written were classified. Over the years the curriculum benefited from inputs from graduates and sponsors. The program has always enjoyed a close coupling with its clients, sponsors, and alumni. Applications were and still are emphasized to insure relevance and bridge the gap between theory and the real world. The masters degree is the terminal degree for the vast majority of military officers. It is appropriate then that the NPS masters degree in operations research is robust, includes an internship (the experience tour), and independent research (the thesis).

By 1960 it was apparent that operations research was growing in importance and that a more appropriate arrangement should be made for the faculty teaching in the curriculum. The Department of Operations Research was created in 1961 and grew to 47 faculty members by the end of its first decade in response to the rapid growth of student inputs. In the summer of 1965, Robert F. Rinehart, from the Mathematics Department at Case Institute of Technology, became the Provost of the Naval Postgraduate School. Dr. Rinehart had been one of the pioneer operations researchers as a World War II member of the Navy's ASWORG.

With the arrival of Robert McNamara and the "Whiz Kids" to the Department of Defense in 1961, systems analysis became a centerpiece of defense decision-making. Systems analysis combined quantitative analysis and economic analysis while attempting to determine the cost effectiveness of defense programs. Both the Operations Research Department at NPS and the Navy acknowledged this paradigm shift. At NPS economists were hired and economics and systems analysis courses displaced many of the physics courses that were still in the curriculum at that time. The name of the curriculum was changed to operations research and systems analysis. Also in this time period, the Navy found that it was unsuccessful in many of their arguments with the Secretary McNamara and reevaluated its own decision-making processes. One result of this reevaluation was the establishment in

1966 of the Systems Analysis Division of the Office of the Chief of Naval Operations. The first officer to head this division was Rear Admiral Elmo Zumwalt, later Chief of Naval Operations. The Systems Analysis Division, today the Assessment Division, became the sponsor of the curriculum at the Postgraduate School, an arrangement that remains in place today.

Also in 1966, the Military Operations Research Society (MORS) was formally established though such activities among military analysts had been underway since 1957. MORS serves as the classified professional forum for military operations research practitioners. MORS has also been a long-standing supporter of Ronnie's International Symposia on Military Operational Research.

At NPS the student body was initially composed entirely of naval officers. In its second decade of operation, the program was opened to Army, Marine Corps, Air Force, Coast Guard, and international officers. In the late 1960s, the Army sent large numbers of officers to the program and it became their primary source of educated analysts. While over the years 99% of NPS students have been enrolled in the masters program, a doctoral degree program was established in 1971.

In the late 1970s, the Chief of Naval Operations reemphasized tactical competency and this led to renewed interest in tactical analysis. The curriculum again adapted to its clients' interests. There was a reduction in systems analysis content in order to reemphasize tactical analysis. It was a rebalancing of the original emphasis on tactical analysis and the mid-1960s emphasis on systems analysis. The curriculum name was changed back to its original name, operations analysis. In 1986 a second curriculum leading to the master of science in operations research was created. The operational logistics curriculum was sponsored by the Deputy

Chief of Naval Operations for Logistics who was himself an NPS operations analysis alumnus.

Today

Operations research is now used widely and at a number of levels in the US Navy and the other military services and defense agencies. At the headquarters level, the Navy uses operations research in modeling and simulation, warfare capability assessments, requirements determinations, investment balancing, manpower modeling, recruiting, cost analysis, and inventory management. In the Fleet, operations research is used in exercise reconstruction, battle experiments, campaign analysis, war gaming, strike planning, logistics support planning, readiness, and tactical analysis.

Today the Naval Postgraduate School curriculum involves courses in computation, probability, statistics, data analysis, optimization, stochastic processes, and simulation as well as military operations research courses such as combat modeling, search and detection, war gaming, joint campaign analysis, and others. Each course contributes to the ability of graduates to be productive in their assigned organization immediately on arrival. While the courses are important, perhaps most important is their collective impact on the common sense of the graduates. One academically marginal student had a very successful experience tour and was commended by his host organization for his insightful work. The student confessed that his work involved little more than common sense, but he also noted that his common sense was no longer what it had been.

I conclude by noting that to date there are 4300 alumni of the graduate education programs in operations research at the Naval Postgraduate School. The impact of these officers on the analyses, decision making, and leadership of their military services has been

remarkable. Alumni include officers who are or have been the Chairman of the Joint Chiefs of Staff, the Secretary of the Air Force, the Secretary of the Army, the Chief of the Turkish Navy, the Vice Chief of the Korean Navy, the Chief Defense Scientist of Singapore, the Chairman of the Board of Directors of the New York Stock Exchange, and many more.

Thank you.