

AIR FORCE OPERATIONS ANALYSIS

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INTRODUCTION: Air Force Operations Analysis (OA), as military operations research was often termed in the Air Force, began in the Army Air Force in World War II (see section below). After the war it was decided to continue operations analysis sections in the major commands, which led to procedures for "steady state" systems of analyst recruitment, training, rotation, etc. The Air Force became a separate service in 1947, and its AFR 20-7 regulated the OA program until 1971, when the OA office in Air Force Headquarters, which had been the focal point for implementing AFR 20-7, was merged into the Air Force Studies and Analyses office (which has had several titles and organizational settings since its creation in the mid-1960's). The latter office served informally as a focal point, and inter-office technical exchanges continued in the course of business and at meetings of professional societies. However, with the rapid changes of the defense establishment in recent years, the need for a more formal arrangement became clearer: in 1993 the Air Force created a Directorate of Modeling, Simulation, and Analysis with the Air Force Studies and Analyses Agency serving as its field operating agency. The directorate was expanded in 1997 to the Directorate of Command and Control that included an Associate Director for Modeling, Simulation, and Analysis with the Air Force Studies and Analyses Agency continuing as a Field Operating Agency.

In World War II, 245 analysts had been in the OA program at one time or another, the peak strength having been 175. With the war's end most of the analysts returned to universities, laboratories, or other civilian pursuits. Brothers (1951) reported that by January 1946 there were only a dozen left, about half of whom were finishing final reports, etc. As a

stable program was established, numbers grew. By 1951 there were 70 assigned, with 95 authorized.

There was very rapid growth in the 1960s as the Office of the Secretary of Defense institutionalized military operations research as systems analysis, which increased the need for cost-effectiveness studies, etc. Also, the Air Force began to train significant numbers of uniformed analysts. The total number of Air Force analysts generally continued to increase, at a somewhat slower rate, through the mid-1980s.

In 1988 an Air Force personnel database showed 476 civilian analysts in the operations research analyst career series. There were probably about as many uniformed analysts in roughly comparable military occupational series. With the end of the cold war in the late 1980s there began a general decrease in the size of the Defense Department, including military operations research. Air Force civilian analyst levels reported at the end of 1993 were about 20% lower than 1988 levels, and still declining. By the end of 1993 Air Force civilian levels in career series relevant to analysis were about 20% lower than 1988 levels, then declined a bit more before recovering to level off at about that level.

WORLD WAR II AIR FORCE OA: Brothers (1951) noted that the 245 Air Force OA analysts (professional personnel, not including clerical and administrative staffs) of World War II were distributed over 26 OA sections, one with every combat air force plus several with other overseas Air Force headquarters and several with Air Force training establishments in the continental U.S. Studies were of many types:

"offensive ones dealing with bombing accuracy, weapons effectiveness, and target damage . . . defensive ones dealing with defensive formations of bombers, battle damage and losses of our aircraft, and air defense of our bases. . . studies of cruise control procedures, maintenance facilities and procedures, accidents, in-flight feeding and comfort of crews, possibility of growing vegetables on South Pacific islands, and a host of others."

The first and largest of the OA sections was that at the Eighth Air Force. McArthur (1990) gave a detailed account of its work and much information

about the analysts, with emphasis on the mathematicians. In its foreword, Miser noted:

"During the two and a half years of existence of the Eighth Air Force section, forty-eight persons with scientific and technical training were involved, representing more than a dozen specialties; mathematicians were the largest subgroup, with fifteen persons, thirteen of whom stayed with the section for six months or more.... It should be noted that the mathematicians were functioning, not just in a mathematical role, but as scientists, developing theories about actual phenomena and applying them to problems of operations, policy, and plans."

Brothers (1954) gave an account of the well-known improvement in bombing accuracy to which these analysts contributed. The commanding general had asked, "How can I put twice as many bombs on my targets?" In 1942 less than 15 percent of the bombs dropped fell within one thousand feet of the aiming point. The rate improved gradually, and within two years had reached 60 percent. Some of the analytical recommendations that played a part in this were the nearly simultaneous release of their bombs by all the bombardiers (instead of the practice of each bombardier aiming and releasing his own bombs), the salvoing of bombs instead of presetting them to release in a string, and the decrease in the number of aircraft per formation from a range of 18-36 to a range of 12-14.

The successful work of this first section made other Army Air Force commands aware of the OA concept and led to the establishment of the other OA sections. Those sections also had their successes, all of which led to the postwar continuation of OA in the Air Force.

POSTWAR AIR FORCE OA UNDER AFR 20-7:

Brothers (1951) recalled that the Air Force, having decided to establish a peacetime OA program, also decided on the basis of wartime experience that it needed an analysis unit in the headquarters. The unit would have two functions: to furnish scientific assistance to the Air Staff, and to serve as a focal point in the air force-wide OA organization. The Air Force AFR 20-7 established the OA Division in Headquarters, USAF, and authorized Air Force

commanders to establish OA offices in their commands, getting needed help from the Headquarters OA office.

From the OA low point of January 1946, it had grown by mid-1951 to ten offices in field commands plus the headquarters office. The 95 authorized professional positions were mostly civilian (under Civil Service), as at that time there were few uniformed analysts available. The RAND corporation's work at that time emphasized problems of the far future, freeing the OA offices to work primarily on current and near-future problems. However, when analysts were needed in the Korean War, some came from RAND (and a smaller "think-tank" also), as well as from OA.

By the mid-1950s, the headquarters OA office had 25 professional positions divided among five "teams." Two of the teams were primarily concerned with implications of new types of weapons: one with atomic and nuclear weapons, and one with ballistic and cruise missiles. A third team dealt primarily with deriving information about combat operations from tests, exercises, etc. A fourth team integrated inputs from the previous three teams to use in assisting Air Staff planners. The fifth team maintained liaison with the existing field OA offices and helped commanders who wished to establish new field offices where they did not yet exist.

The field OA offices were organized according to the same general principles. There should be analysts available to study combat operations and related problems, as well as others with understanding of new technology and its implications for new weapons. Most of the growth in the OA program at that time came through the establishment of new offices, rather than the enlargement of existing offices.

It was only near the end of this period — the decade of the 1960s — that the situation began to change markedly, through the combination of two developments. One came fairly abruptly when the Kennedy administration institutionalized "Systems analysis" (used to denote operations research on broad systems problems) in the Office of the Secretary of Defense, which greatly increased the demand for cost-effectiveness studies from the services. The other came throughout the decade as the increase in computer hardware and software capabilities led to great increases in the

development, size, and use of computer simulation models.

The headquarters OA office was caught up in both of the above trends, which made it more difficult to devote as much effort as desired to the analysis of operations in Vietnam. Also, in the mid-1960s, a new and larger office of Studies and Analyses was formed from an office that had been set up in the late 1950s to operate what for that time was a large computer simulation model. It had been difficult to acquire the data and manpower to make effective use of that model, and the resources of that office became available to staff the new office created to meet the growing need for cost-effectiveness studies.

The newer office of Studies and Analyses and the smaller headquarters OA office (about 35 professionals at that time) both reported at high levels, required the same kind of competent analysts, used operations research techniques. These similarities suggested the merger of the smaller OA headquarters office into the larger office, and it was finally accomplished in the first six months of 1971.

THE 1970S AND 1980s: The Studies and Analyses office chose not to continue implementation of AFR 20-7. The immediate consequences were not striking. The field OA offices continued, though a few made slight changes in name. Most of the other trends noted above continued, or even accelerated. There was proliferation of computer simulation models and of their use in large studies. Air Force analysts no longer had the semi-annual OA technical symposia, but made increasing use of the multi-service classified symposia of the Military Operations Research Society.

The bulk of the studies dealt with future weapon systems and future force posture. The difference in emphasis between RAND and the in-house Air Force analytical offices that had prevailed in the 1950s diminished, to a large extent because of the impact of the institutionalization of systems analysis in the Defense Department (in which RAND "graduates" had played a significant role).

There continued to be very highly classified studies of "black" systems. There continued to be an effort to obtain, and thus to study, weapon systems exploiting the latest technology. The primary war in this period remained the "cold war," until, suddenly, it was "won."

ISSUES: The issues that now confront military operations research in the United States generally are important to all of the services. The major issues reflect one or more of the forces currently shaping future military operations research and analysis: the decrease in size of the defense establishment; the rich menu of technological options now available but not yet exploited, or even well understood; the still unsolved management problems of reducing undesirable duplication of models, simulations, and studies; the still challenging problem of formulating affordable programs of verification and validation of models and simulations, as prelude to determining suitable use of the models and simulations; etc.

Such issues have contributed to organizational changes in the Department of Defense. In the Air Force, the major recent organizational changes have been the creation of the Directorate of Modeling, Simulation, and Analysis, and its expansion to the Directorate of Command and Control. These have led to the formation of the Air Force Analytical Community Steering Group (AFACSG), chaired by the Commander of the Air Force Studies and Analyses Agency. The AFACSG is working to reduce study redundancy and make other management improvements in the spirit of the former AFR 20-7.

See **Battle models; Military operations research; RAND Corporation.**

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