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A Practitioner's Guide to Systems Analysis

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Writing on the basis of his own experience as a systems analyst on the Air Staff in Washington, Colonel Tibbetts describes the functions, clients, and performers of systems analysis in a service headquarters. In this deceptively breezy article, far more incisive and introspective than his casual style suggests, the author discusses the problems and shortcomings of systems analysis from one Pentagon practitioner's viewpoint, but he also makes a persuasive case for the utility of analytic processes in complementing other inputs to decisionmaking.

A PRACTITIONER'S GUIDE TO SYSTEMS ANALYSIS

by

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What Do "Analysts" Do? Each of the service staffs in Washington has an internal capability to perform systems analysis, or access to outside analytical agencies, or both. The Air Force has the Assistant Chief of Staff, Studies and Analysis, with a professional staff of nearly 100 officers and civilians. In addition, the Air Staff can call on the Rand Corporation, Analytical Services (ANSER), and other not-for-profit concerns.

The Army employs the Assistant Secretary of the Army (Operations Research) for many analyses, while "farming out" additional work to such as the Concepts Analysis Agency (CAA) in Bethesda, Md.

Navy and Marine Corps efforts are largely handled by the CNO's Systems Analysis Division (OP-96) or the Center for Naval Analyses.

These groups routinely perform analyses of a variety of subjects. The subjects addressed can be loosely grouped into three general areas: (1) Analyses of major force issues, (2) Supporting studies, and (3) Technical papers and "minianalyses."

Analyses of major issues are the bread and butter studies that address the essentials of a military service. For the Air Force, they would include analyses of the manned bomber, a new tactical fighter, or an improved ICBM. For the Navy, major force issues would include the Trident, aircraft carriers, and the F-14 fighter. Major Army issues might be the total number of infantry divisions, the SAM-D system, or a new tank. As might be expected, the Marines' major force issues are amphibious assault operations and supporting tactical aircraft.

Supporting studies tend to focus on side issues that are pertinent to a major force question or on the service's normal operational activities. They are normally done as "in-house" attempts to illuminate a question, but they may be directed from a higher level. Included in this category are system survivability studies, management improvement schemes, operational histories, or case studies. In general, supporting studies provide backup material for major force issues but do not address these issues explicitly.

Technical papers and "minianalyses" are typically undertaken in response to a detailed question from a higher level or in support of a planning/programing action by a collateral staff agency. A technical paper, for example, could address the question of electronic countermeasures gear for a new bomber or the capability of a new sonar system. A minianalysis might be done to show the incremental contribution of an air defense squadron or a tank company, the main thrust being information for use by a planner or programer who may be contemplating a phaseout action.

Who Asks for Analysis? If someone were to attempt to count the pages of analysis emanating from the Washington area in 1 year, he might get the impression that analysts advertise in the newspaper and do their work gratis. Nevertheless, the fact is that these analyses are *usually* undertaken with useful and noble purposes in mind.

Studies of major force issues are often requested by the Deputy Secretary of Defense in his role as titular head of the Defense System Acquisition Review Council (DSARC). These analyses are normally answers to questions arising from a DSARC meeting, and they are scheduled for completion just prior to the next DSARC consideration of a particular system (usually 6 to 12 months hence). Each service, of course, addresses its major force issues routinely each year as part of the planning/programing cycle and at any other time that a service chief might feel uneasy. In recent years the Assistant Secretary of Defense (Program Analysis and Evaluation) has reentered the picture with a device called a "selected analysis."* The selected analysis normally begins with a novel question concerning a major mission area. In most cases, though not all, selected analyses address questions of service interdependence. The B-52/Harpoon issue, for example, arose in this fashion in 1971, when OASD (PA&E) requested that the Air Force determine whether it could assist the Navy with protection of merchant convoys. Other current efforts in this category include modernization and increased readiness of reserve forces and the plan to designate the Military Airlift Command as single manager for all DOD airlift.

Requests for supporting studies, technical papers, and minianalyses originate at all levels in the DOD. With the exception of the predictable scramble which always occurs during the Program Objectives Memorandum (POM) cycle, these analyses are performed more or less randomly. They may be undertaken with no more at stake than the inquisitiveness of the ranking O-6 in the office or the hyperenthusiasm of a young mathematician who wants to build a new model.

By and large, analysts want to tell the world about what they have done. Obviously, it is not always in the best interest of the Defense Department to print a million copies of sensitive studies and then distribute them widely. In most cases, a fairly close hold is main-

*This office lost a good deal of power in the post-McNamara years. In fact, the Chief was downgraded from an "Assistant Secretary" to a "Director" during 1973. The more prestigious title has been restored, but it remains to be seen whether this is a harbinger of renewed power.

tained on printed studies, both by the service concerned and by OSD.

Should the Congress initiate an investigation of a particular program, the General Accounting Office (GAO) will become involved and will seek copies of material relevant to the program. The normal policy in this eventuality should be complete and candid disclosure of information, including study reports, briefings, and personal discussions.*

What Is the "Process" Used in an Analysis? Armed with a question which either warrants or demands initiation of a "study" or an "analysis," the staff organization charged with analytical matters proceeds with the task. It should be made absolutely clear that this process is not necessarily rapid or organized (at least at the outset). Some of the large analytical staff agencies may have as many as 12 to 15 major studies in progress at one time. Since the "boss" usually requires constant prepping on the major efforts, getting a block of his time to discuss a new study is a problem.**

Figure 1 is a typical wiring diagram of the analytical process from the point of germination forward. Not surprisingly, it bears a strong resemblance to the process detailed by Quade and Boucher in their primer on systems analysis.[1] Note that the modifications are those which tailor the process to the level of a service headquarters. (In plain terms, the setting is the Pentagon.) Some comments about this wiring diagram—representing the *ideal* or *pure* process—are in order.

Given the question, which may have originated in any of a variety of ways, the study group sits down to answer the question, "What's the question?" Quade and Boucher make a special point about this process of problem formulation, and that point cannot be emphasized enough. The question (as posed by the originator) is often, even frequently, so vague that "the process of problem formulation itself has to be the subject of analysis."[2]

In most cases, definition of the question involves an attempt to limit the scope of the analysis rather than to enlarge it. The question, "What is the capability of the F-15?" for example, would probably be narrowed by the study group to read, "What is the capability of the F-15 in the air superiority role in a NATO/Warsaw Pact conventional conflict in 1981?"

As indicated in figure 1, the study group invariably receives a good deal of assistance in defining the question. In studies of major force issues, the service chief (and maybe the Secretary), the chief of the analytical organization, and members of OASD (PA&E) will provide specific (but probably conflicting) guidance.*

Once the question is reasonably well defined, the study group can proceed to a written study plan. The importance of this seemingly innocuous document is crucial. Once the group composes and obtains agreement on a plan of attack to answer the question, it has a tendency to become "locked in concrete." Should the group find itself unable to produce the data and/or comparisons promised

*To do otherwise would be not only dishonest but selfdefeating. The GAO always seems to know the whereabouts and general contents of available analytical products. The services could scarcely afford a charge of noncooperation toward a congressional request.

**From this point forward, I will be addressing the analytical process—and the irregularities in that process—from the point of view of an ex-analyst in Air Force Studies and Analysis. I doubt that the process (and the irregularities) are markedly different for the other services.

*One wag in my group used to say this was a classic example of the difference between guidance and help. In other words, the study group could normally use a little *less guidance* and a little more *help*.

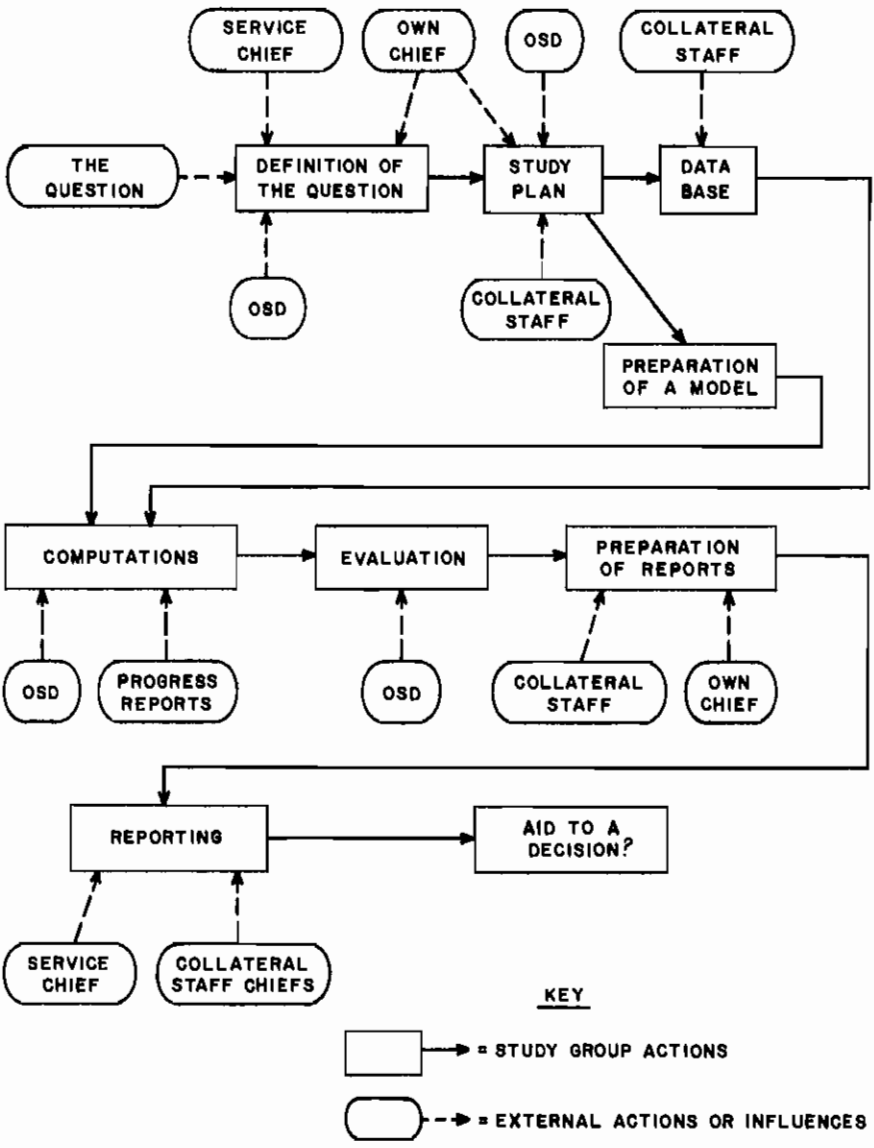

Fig. 1—The Analytical Process in a Service Headquarters

in the study plan, the analysis loses a good deal of its credibility, regardless of any enlightening information which may eventually result. For this reason, study plans are customarily as *ambiguous* as practicality will permit. An alert study director will try to retain as much maneuverability as he can, and an ambiguous study plan is the perfect vehicle for it. However, this scheme is more easily conceived than carried out. If OASD (PA&E) is monitoring the analysis, which is the case with most significant analytical efforts, there will be incredible pressure on the study director to be as explicit and detailed as possible in his study plan. This conflict can usually be resolved by a compromise which is seldom shaded in favor of ambiguity.

Although collateral staff agencies are normally asked to coordinate the study plan, their impact at this point in the process is minimal. The planner, programer, maintainer, or operator who can afford the luxury of such overt, long-range thinking (at the expense of his daily short-fused activities) is a rarity in the Pentagon.

Approval of the study plan sets in motion a veritable flurry of activity. Usually there is a "shotgun blast" of data gathering. At the same time, the model builders unsheath slide rules and desk calculators and begin to toss around some ethereal mathematical expressions.

In most cases, the ultimate quality of an analysis is determined during the data-gathering phase. If the study group can obtain the kind of support it needs to develop realistic threat estimates, scenarios, tactics, and system cost values, the rest of the process falls into place rather neatly. These pieces of data (sometimes in the form of detailed analyses themselves) are usually provided by other staff elements or subordinate commands. The secret is to instill in these "helpers" the same sense of urgency and quality that the study group members ostensibly share. More often than not, a series of face-to-face appeals by the study director is needed to foster this kind of attitude.

As for the process of model building, the name of the game is usually "take what we've got and run with it." There is seldom sufficient time to start from square A with a huge simulation, since the construction of such a monster would consume months (if not a year or more). Normally then, the model-building phase involves *marginal* changes to the existing program, with a view toward generating the outputs and comparisons that were advertised in the study plan.

When the data base is sufficient and the computer cards are punched, the group is ready to get to the business of giving birth to an analytical aid for defense decisionmaking. Provided the measures of cost and effectiveness were well chosen, the input factors were not outlandish, and the bandaids were applied to the right portions of the model, a base case evaluation is quickly available for perusal. This run is normally used to satisfy the modeleers that the "numbers" are correct or, in the trade parlance, to insure that the model has no "bugs."*

This computation phase continues more or less sporadically through the remainder of the study's existence. Once the base case is analyzed and plotted, the various (and numerous) sensitivity excursions are run. Hopefully, the measures of cost and effectiveness chosen during the process of defining the question come together and the alternatives can be arrayed in terms of the criterion.

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*Phenomena which constitute "bugs" in a model are almost always beyond the intellectual scope of one who is not a computer programer. I mention the term here only to acquaint the reader with the fact that programers spend a great deal of time in "debugging" sessions.

At this point, the fun begins. I am not certain how it happens, but the fact that a particular study group has *calculations* in hand *always* becomes common knowledge.* Human nature being what it is, the organizations which have a direct interest in the study (OASD, collateral staff, et cetera) then begin the inevitable: "Can you spare a few minutes to brief (General, Mr.) So-and-so on your preliminary results?" It would appear that much time is spent advertising the preliminary results, but little time is spent *evaluating* those results.

However, the evaluation and interpretation phases probably receive more direct and constructive thought than any other. There are always the sensitive input factors such as kill probabilities, reliabilities, total force structures to be considered. Also, in a good analysis, the "driving" assumptions (and the uncertainties inherent in them) are relaxed and tightened to develop a range of results. It has become common practice to present a *range* of results—rather than *point* values—to decisionmakers at all levels. While this may be termed by some an analytical "cop-out," it does give the decisionmaker a chance to insert his own preferences about assumptions, effectiveness values, and so forth, and to observe for himself the changes in the results.

At some point during the computation/evaluation cycle, the study monitors (usually PA&E) are presented a "how goes it" briefing. Redirection and additional parameters of key inputs *always* result from these sessions. If the study director is lucky, he will be able to retain the focus of his analysis and resist any external attempts to force him back to square A. Normally, however, only the *bounds* of the analysis are enlarged by these additional requirements, a fact which is probably useful in the long run, since the finished product will be more likely to address all the relevant concerns.

Reporting, the last phase of the process, could well be the subject of a major research work in itself. No matter how much innovative, imaginative, and illuminating work is done during the analysis, the entire effort will be an exercise in futility if the reports do not convey the truths discovered. Service study groups are becoming increasingly aware of this phenomenon, and they are starting to dedicate the requisite amount of time to this crucial task.

The reporting phase itself usually becomes a blur to the study group. In the Air Staff, for example, some analyses are reported through the various panels (0-6 level), Air Staff Board (two-star level), Air Force Council (three-star level), and the Chief and Secretary in a matter of 3 weeks or less. At each level, naturally, an added (or subtracted) "twist" is applied to the thrust of the report. By the time a major study reaches OSD, therefore, it has been manicured, massaged, and groomed by all the important actors on the service staff. In a word, this process is excruciating. However, in reflecting on it, I can find no readily acceptable cure, except a full bottle of aspirin for pain abatement.

When the process has been completed and the published reports are lying on the appropriate desks, one hopes that the original objective has been achieved: That the study will hopefully reduce uncertainty, be a good "tutorial," and aid a decisionmaker in his deliberations. Unfortunately, the knowledge that this is really the case is almost never forthcoming. It is not the fault of the study group (normally) nor the decisionmaker. The fault lies in the frailties and imperfections of systems

*I once made a concerted effort to conceal the initial calculations of my study group. In spite of great cunning, I received seven calls concerning the results within 24 hours after the first printout was on my desk. For a community of 26,000 people, the Pentagon is a small world indeed.

analysis and those who use and abuse it in the cold, cruel world.

This analytical process has a mechanical resemblance to the theories of Quade and Boucher, *et al.* In the same sense that theirs is a textbook description of the process of systems analysis, my service-oriented conceptualization is just an abstract representation of what ought to be.

When seen in the glare of hard reality, systems analysis as practiced by the service staffs *nearly always* falls short of the ideal. There are many reasons: deficiencies of the analytical process itself, pains common to a youthful science that is often predominantly art, organizational and bureaucratic influences, and the naiveté of analysts themselves. Each of these affects the analytical process at various points and to varying degrees. Based on my experiences and my best recollections, I will relate the errors and the shortcomings of the steps of this process.

Definition of the Question. In spite of the warnings issued by the founders of systems analysis, which have been echoed by all their descendants, we are still not very adept at deciding what the *real* question is. More important, we are too often guilty of addressing the *wrong* question. Frequently, we manipulate the study objective so that we can analyze what we already know how to handle or have done before.

Part of this problem is the inherent ambiguity which increases as a question makes it descent through the bureaucracy. The original question at times becomes a victim of the "barnacle effect," by which the interpretations and slants of each echelon are fastened to the question as it proceeds from the hands of one analyst to another.

All too frequently, we analysts fail to *analyze the question.* Too often, we accept the question as a given and then apply little thought to the objective of the system involved or the real structure of the decision at hand. For example, two important studies of the Airborne Warning and Control System (AWACS) shed some needed light on the potential of AWACS in a European conflict, but they failed to get at the heart of the necessary characteristics of command and control in such a conflict: integration and orchestration of varying systems employed by various nations. A more detailed and methodical approach to the question–more time, more thought, more emphasis–might have led to discovery (or at least isolation) of the real question. As it turned out, we made a case for the AWACS *per se,* which was useful but hardly comprehensive. The real question–how to provide effective command and control in Europe–remains.

Another area of often slipshod performance in formulating the problem is the common practice of assuming away significant facets of the question. We are almost uniformly careless in this respect. When faced with what seem to be intractable issues, we take the easy way out by making an assumption.

There is a very definite need for useful assumptions because there are some problems for which we truly have no neat analytical methods. However, the use of a major qualifying assumption or constraint should come only after a concerted effort to explore the issue as a part of the analysis. We ignored the contribution of the Army's surface-to-air missiles (SAM's) in our continental air defense studies for years, even though including the SAM's was obviously fundamental to consideration of air defense as a *system.*

Another of our failings in the formulation phase is the tendency to forget that a truly adequate measure of effectiveness is an elusive quarry. There is a pathetic tendency in the analytical business to seek measures of effectiveness which are unique and "catchy," rather than descriptive and useful.

This tendency explains our

predilection toward such eye-catching measures as exchange ratio, bombs dropped, and penetrators killed. What we forget is that such measures are only inputs to a much more fundamental question: What was the *output*? In other words, we determine with infinite precision who won the battle and appear puzzled when we are asked, "Who won the war?"

I am not making a pitch for ethereal effectiveness measures. "Yards of FEBA movement per hour" as a measure would excite an analyst but would dumbfound a decisionmaker. What is needed is a return (or perhaps an initial introduction) to the idea of relating effectiveness to the fundamental objective (desired output) of the system.

Development of the Data Base. According to almost any practitioner of systems analysis, the search for feasible alternatives is a *sine qua non* of useful analysis. It is my contention that parochialism, favoritism, and downright stubbornness operate to reduce the development and consideration of alternatives in the typical service analysis.

The analysts are not at fault here, nor is the analytical process necessarily out of step. The failing is a direct result of the established bureaucracy refusing to consider alternatives to entrenched, parochial programs.

It is inconceivable that the Air Force would actually consider, even internally, the heresy of a modified B-52 as an alternative to the B-1. Or, would the Navy staff propose serious consideration of upgraded Polaris submarines as an alternative to the Trident? Would the Army examine objectively the improved Hawk as an alternative to the SAM-D, or would the Marines consider Navy/Air Force close air support for amphibious operations? Alternatives such as these are not raised by the service analysts or by senior service officials. They are almost forcibly *injected* by OASD (PA&E), when a well-structured analysis would have finessed the critics by considering the alternatives at the outset. Granted that some of the alternatives may be incredible and unrealistic, they should be so proven in explicit terms as stated alternatives in the study and not dismissed summarily.

Other portions of the data base create similar crises of credibility. Threat estimates are particularly troublesome, and this is a shortcoming of both the art and the artists. One of the greatest of all uncertainties is the enemy threat, especially a threat projected 10 or 15 years into the future. Yet we habitually issue a panicky call into the wilderness for a threat estimate, accept what is handed to us, and pin our results completely to a single-point projection that often appears to be the handiwork of someone who has not updated his figures in 26 years.

In this regard, we accord considerable undue reverence to the intelligence supplier. We forget that he, too, is fallible, and we fail to acknowledge (and to analyze) the uncertainties of feasible enemy capabilities. Over the course of numerous iterations of the capability of SAC's bombers to penetrate Soviet air defenses, we were almost continuously at odds with the intelligence community over the possibility of pulsed doppler fire control systems in Soviet advanced interceptors. We knew that the results of the studies were extremely sensitive to this capability, but we could never convince the intelligence people that a clear statement of the likelihood of such a development was a necessity.

Adequate cost estimates for "rubber" (not yet built) systems are another item in short supply. In spite of the fact that cost overruns associated with several systems have received great publicity in recent years, the services still do not know how to calculate life-cycle costs with any degree of accuracy.

There are two basic reasons, as I see it, for the paucity of reliable and

accurate cost estimates. First, the *only* source which could be considered remotely capable of developing good estimates is the *contractor*. Understandably, defense contractors are extremely reluctant to expose their true financial picture. Such a procedure would leave no room for adjustment if unpredictable variations were to affect the real cost. Second, the service program management offices are understaffed and overqueried, underpaid and overworked. They are pitifully dependent on the contractors for cost estimates, and they do not have the methodologies for either developing or checking the estimates.

There is little an analytical group can do in the way of performing cost analyses independently. Occasionally, a bright young analyst will take the initiative and attempt to construct cost verification models, but he remains dependent upon the contractor and/or program office for basic data. In view of the ancient maxim of computer programs, "Garbage in, garbage out," the result is a cost estimate which features some announced analytical legitimacy, but no great necessary relation to the truth.

Modeling and Computations. The world of modeling and computations is a puzzle of the first magnitude to someone whose background has been mainly operational. A quantitative mother gave birth to and nursed systems analysis. The idea of "number-crunching" remains the epitome of the process. One should not scoff at quantification, because the numbers array can be cardinally important to a decision. There is no analytical story as powerful as that told with realistic quantification. The problems lie with the means and the motivations which give substance to the process of generating the numbers.

When a new study establishes a definite requirement for quantification, a special breed of men called the "modeleers" appears on the scene as if by magic. The modeleer, be he military or civilian, government employed or privately funded, always comes equipped with a mathematical model (usually one he designed himself). *He will cheerfully do whatever is necessary to fit your question to his model.* Here is one of the most insidious and dangerous common practices in the entire world of analysis. Because of the pressure of time, the ready availability of a fancy equation, and the boundless confidence of the modeleer, many a study has resulted in a barrel of numbers that tells only a half-pint story.

Unfortunately, there is often no recourse. The development and verification of a computer model to examine faithfully such massive interactive situations as the air defense battle in Europe, for example, would require 1 or 2 years. One model used by the Air Force in bomber penetration studies took over 3 years and a million dollars to make. For this reason, it is understandable that most study groups elect to jury rig the available tools. The deadlines for service analyses are measured in months at best. The optimum solution, of course, is to free the modeleers from other mundane tasks to allow them, under close supervision, to design the proper tools. Unfortunately, very few service analytical agencies can afford such luxury.

Even when a useful and well-developed model is available, we have a tendency to immerse ourselves in the details of the "representation of reality" and to neglect consideration of whether it represents reality *well*. This, alas, is a communicable disease that strikes every analyst sooner or later. I can remember being 2 days from a report deadline on an air defense study, with all the data "in the can," when a modeleer casually informed me

that the results assumed that 20 percent of the manned interceptors were recovered at Bomarc bases.*

Evaluation. While the formulation, planning, modeling, data-gathering, the really difficult part of an analysis, are transpiring, most of the interested parties (outside the study group) typically exhibit overwhelming nonchalance. The scene changes, however, once the study results are on display.

First, the study monitors from OASD (PA&E) usually enter the picture with a pocketful of additional questions.** Without fail, these questions (if answered) call for another ream or two of analysis. Additionally, the denizens of PA&E have an irritating habit of trying to pry *absolute* effectiveness values from an analysis.

This problem is a thorny one, and it has no immediate solution. Analysts are usually happy to feel they have somehow been able to arrange *relative* effectiveness values skillfully. To announce absolute results (how many kills for the F-15, how many targets destroyed by Polaris, how many tanks stopped by the TOW) is to answer the question: How much is enough? There is no way to achieve absolute results. Experienced analysts will stand firm on the thesis that a *relative* ranking of the alternatives is the best one can achieve.

Second, while we have attained a reasonable degree of competence in analyzing alternative weapon systems for a given mission, we are still groping for ways to examine the interdependence and synergistic effects of multiple systems in a large-scale conflict. As James R. Schlesinger mentions in his contribution to the Quade and Boucher text, this problem is one which demands attention.[3]

I can think of three cases of this type where good analytical methodologies could provide some sorely needed illumination: (1) The relative effectiveness of bombers, land-based missiles, and sea-based missiles in the execution of the SIOP; (2) Proper "orchestration" of the diverse forces (especially command and control) which would be employed by NATO in a conventional conflict with the Warsaw Pact; (3) Approaches for another U.S. involvement in a counterrevolutionary war.

Reports and Reporting. Social psychologists have known for years that a bad idea can be peddled in a fancy box. Conversely, a grand innovation can be ignored because its packaging is a bit wrinkled. Service analysts are becoming more aware of this human frailty, and they are resisting their natural urge to throw a completed study into the air and then run out from under it. Other problems in the business of reporting remain, however.

First, a service analytical group cannot operate in isolation from the rest of the staff. Their "thing" must gain at least a modicum of acceptance from collateral offices before it goes to the Chief. This process requires a "briefing gauntlet" through which the study group must proceed en route to the top. It largely goes without saying that the final product thus bears (at times) little resemblance to the initial report. The vehicle which eventually reaches the Chief features all the marks of compromise, parochialism, preordained

*I should explain that the Bomarc was an unmanned interceptor deployed with the Aerospace Defense Command in the 1950's and 1960's. A "Bomarc base" consisted of 18 covered silos, a launch control building, and various smaller structures. If a runway existed on the premises, it was purely coincidental and absolutely no fault of the Bomarc, which was, of course, nonrecoverable. The point is, the modeleer had never even seen a Bomarc.

**There is no requirement for these questions to be either relevant or answerable. They are often thrown in to cloud the issue or to delay the completion of the analysis. Some of the questions, however, do bear heavily on the substantive issues involved, and these are treated most seriously by the study group.

conclusions, and occasionally even petty bickering.*

Second, and most important, a completed analysis automatically triggers what is commonly known as the "adversary process." In the case of a major force issue, the adversary is normally OASD (PA&E). This office usually proceeds with one or both of two adversary methods: (1) A counter-analysis, or (2) A detailed critique of the service analysis. In either case, the study group is forced to defend its *analysis*. Note that the emphasis is on defending the analysis, not the weapon system at issue.

Another important adversary is the General Accounting Office (GAO), which is chartered to investigate a major program at the request of any member of Congress. Again, the normal approach by the GAO is a detailed review of the service analysis.

The adversary process as practiced in Washington is a travesty. I have seen counteranalyses and study rebuttals, developed by any number of agencies, that at best were overwhelmingly irrelevant. My AWACS study group was engaged in a 6-month running battle with a GAO consultant who insisted (based on demonstrably inaccurate calculations) that the AWACS was seriously deficient in an ECM environment. Our question, which we considered essential, went largely unheeded: Deficient compared to what? Any other alternative for command and control in the scenarios examined was not just deficient—it was useless.

The point of all this is that quarrels over assumptions, scenarios, costs, effectiveness values, et cetera, of a system tend to distort the real question: Can the system meet the objective more efficiently than other alternatives? Too often the analysis, rather than the system being analyzed, becomes the focus of attention. This occurred in DSARC deliberations of the AWACS in early 1974, when the Air Force analysis of AWACS came under simultaneous attack from OASD (PA&E), the GAO, and a member of the U.S. Senate. In the furor, the well-ordered management process which had characterized the AWACS program was nearly destroyed.

Cheer Up! There's Hope! It is easy to criticize systems analysis as both an art and a science. These deficiencies are real, and the list is far from complete. They appear again and again in analyses done by the most reputable organizations. Some of the more glaring errors, when discovered in key situations, have brought a good deal of discredit to systems analysis at the service level. The deficiencies in the process, however, can be and are being overcome to some extent by the real and potential value of rigorous and complete systems analysis.

My experiences during the last year of my tour in the analytical business convince me that some new perspectives are developing among analysts, their collateral staff counterparts, and decisionmakers themselves.

Analysts at the service level, partly because of better theoretical preparation and partly because of trials by fire, are becoming much more sophisticated about the role and value of their product. They are becoming aware of both the strong points and the practical deficiencies in the analytical process.

Fortunately, the analysts are beginning to advertise their product as "a *way* of looking at the problem." They are becoming acutely aware that the best of analyses can hope to provide increased visibility of only a portion of complex issue.

In terms of providing the experience

*There may be no practical recourse. Analysts are a part of the staff, as are operators and planners. The Chief demands, and certainly deserves, a broad consensus across the staff on major force issues. The analysts are not equipped to provide all the relevant information concerning decisions on major force issues.

and skills necessary to attack a gigantic problem, analytical groups are starting to organize along interdisciplinary lines. This approach has been recommended by the purists for years, but service analytical agencies are only now realizing that a bomber study group, for example, should include persons other than bomber pilots and that the next good idea may come from a most unlikely source.

Most significantly, service analysts are coming to grips with the fact that nonquantitative issues are often the dominant forces in a decision situation. A well-structured and explicit treatment of these issues (albeit without numbers) is invaluable to the decisionmaker, and the analysts are finding ways to perform the treatment. For example, we successfully approached the value of AWACS as an early warning capability in Europe by observing in a verbal fashion air activity in East Germany and Poland prior to the initiation of hostilities.

There has been an abrasive relationship between analysts and their collateral staff counterparts for years. Analysts have viewed the operators, planners, and maintainers as short-fused, short-range doers who are literally unable to think in analytical terms. The analysts, on the other hand, have been viewed by the collateral staff as picayune stumbling blocks to rapid coordination of crucial policy positions.

This relationship is still volatile, but I am convinced that the collateral staff people are seeking greater awareness of the scope and details of major analytical efforts. It can only help the entire process, for the team approach to analysis from inception to publication lends strength and credibility to the product. In particular, collateral staff inputs in the fields of tactics, operational concepts, logistics modes, and intelligence can be a welcome boon to the analyst.

The essence of systems analysis is its structured, disciplined method of viewing the many facets of a situation requiring a decision. Systems analysis is designed to supplement intuition and reasoned judgment.

My conclusion is that decisionmakers at all levels are learning to view analysis from this perspective. They are becoming adept at recognizing the biases, quirks, and shortcomings of the analytical process. They are also coming to recognize that a questioning attitude is the key to both the understanding and the use of analysis. Finally, I think that DOD decisionmakers are at last becoming aware that *an analysis* can never address the manifold issues associated with a major weapon system. This welcome awareness has been 14 years in coming.

For years a reminder which has adorned the wall of the office of the Assistant Chief of Staff, Studies and Analysis, HQ, USAF, may have become a self-fulfilling prophecy:

> The mission of Studies and Analysis is to *shed a little light*— and don't you ever forget it!

BIOGRAPHIC SUMMARY

Col. Larry N. Tibbetts, U.S. Air Force, received his B.A. degree in English from DePauw University in 1956 and his M.A. degree in public administration from George Washington University in 1968. Entering the Air Force in 1957, he was first assigned to undergraduate navigator training and later served with various fighter intercept squadrons as a radar observer. In 1964 he was assigned to Headquarters NORAD as Plans Staff Officer. He attended Air Command and Staff College in 1968, which was followed by a tour of duty in Southeast Asia with the 366th Tactical Fighter Wing. He was subsequently assigned as an analyst at Headquarters, USAF/Studies and Analysis from 1970 until 1974 after which he attended the Naval War College, Class of 1975. He is currently the Deputy Assistant for Colonel Assignments at Headquarters, U.S. Air Force.

NOTES

It should be obvious to the reader that my personal experience was the primary source of the text of this paper. I have tried to document faithfully these recollections. For any errors in describing agencies or groups, I am responsible. For any discussions about the thrust of my remarks, I am available.

1. E.S. Quade and W.I. Boucher, *Systems Analysis and Policy Planning* (New York: Elsevier, 1968), p. 33.
2. *Ibid.*, p. 36.
3. *Ibid.*, p. 368.