

PROJECT RAND AND AIR FORCE DECISIONMAKING

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## PROJECT RAND AND AIR FORCE DECISIONMAKING\*

Project RAND participates in a very broad way in Air Force matters. It represents a rare and unusual relation between a military organization and a civilian private organization--so unusual that in today's parlance, one might even say that it is a happening. Where did Project RAND come from?

It is an outgrowth of the Air Corps' experience in World War II with scientists, engineers and technologists. At the conclusion of the war, General Arnold correctly perceived the contribution that civilian scientists and engineers had made to the Air Corps conduct of the war, and he judged it important that it continue. As a result of his vision, an effort known as Project RAND was established in 1946 at the Douglas Aircraft Corporation in Santa Monica, California; quickly a lesson was learned. The things that the United States Air Force asked Project RAND to study required access to the forward thinking, the new ideas, the intentions, and the thrust of private industry. People identified with Douglas would go to competitive companies in industry and ask "What are you doing in the future?" Gimbels was indeed asking Macys to tell. The apparent conflict of interest very clearly indicated that this management arrangement was not an appropriate way to conduct Project RAND.

In 1948, with the aid of a grant from the Ford Foundation, Project RAND and all of its people were removed from Douglas Aircraft and established as The Rand Corporation, a private, nonprofit research corporation. The name has nothing to do with Sperry Rand, Remington Rand, Ingersoll-Rand, or Sally Rand; it is simply the acronym R and D or, as some wag once said, R and No Development.

In the beginning the Air Force contract for Project RAND amounted to about 95% of the corporate business; there was a small involvement with AEC and from time to time with other clients. Over the years the distribution of support has changed rather dramatically, partly because the Air Force has changed, partly because Rand as a corporation has changed, partly

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because the world has changed. As of today, the Project RAND contract approximates 30% of the corporation's business; another 20% is with other DoD clients, notably ARPA; and the remaining 50% is in nonmilitary work but still largely with the Federal Government. Cutting the pie in a different dimension, 90% of funding comes from the Federal Government and the other 10% from state, local governments, foundations, etc.

The Rand Corporation is chartered under the law of California as a private not-for-profit organization to do research in the public welfare. Therefore, we are prohibited from doing work of any kind that would give a proprietary advantage to a profit making company or industry. Many sources of funds are closed to us unless a client will permit free publication of the research results that it sponsors.

The arrangement between Project RAND and the Air Force is formalized in Air Force Regulation 20-9, which has been modified a few times over the years. There are some important words in it. In paraphrase--Project RAND is defined [in this Regulation] as a portion of The Rand Corporation to assist the Air Force in improving its efficiency and effectiveness . . . The Rand Corporation is an independent, not-for-profit organization devoted to research in the interest of national security and the welfare of the United States . . . Rand is an entity devoted to public service and the research that would support that public service. The regulation continues by noting that Project RAND represents a continuing investment by the Air Force in objective research and analysis, that Project RAND is to maintain both a technical and nontechnical capability in a broad range of matters of concern to the Air Force, including such things as mission, organization, threats, strategy, tactics, operation, technology, and resource management. Notice the broad involvement implied by such statements. First, the Air Force looks on Project RAND as a continuing investment; it looks on us to do objective analysis; it counts on us to maintain over time both a technical and a nontechnical capability; and it looks to us to address problems in a broad range of subject matters.

AFR 20-9 establishes a mechanism whereby the Air Force can ask Project RAND to undertake studies. On the other hand, Rand management is also given substantial leeway to institute and inaugurate its own

research efforts. The net of the matter is that the resulting research program is a matter of discussion between both parties. Project RAND works for the Deputy Chief of Staff for R&D at the Air Staff, but it interacts broadly with the Air Force.

In the early years, roughly 1945 to 1955, neither OSD nor Air Force had sufficient in-house capability for the broad analyses that were required by major defense policy issues. The situation has changed dramatically; the Air Force has evolved organizations such as the Assistant Chief of Staff for Studies and Analyses. Nonetheless, even with the impressive in-house capability that the Air Force now has, there continue to be problems that demand total objectivity and total freedom from daily pressures. There remain issues that have to be examined completely free from real, potential, or even apparent conflict-of-interest situations that could arise if the study were done (say) by a profit making organization. It is in that special category of projects that Project RAND works extensively.

One way to think of Project RAND is as inside-outsider. We are outsiders in the sense that we are not in the daily life of the Air Force; we don't have to respond to doctrinal pressures or to organizational postures that might be taken. At the same time, we are insiders because we interact with the Air Force extensively and continuously. In order to maintain the essential objectivity, it was deemed important at the beginning to place Project RAND outside of the Washington area--one does not want to be too easily available if he is to minimize involvement with daily operational problems. On the other hand it is still easy to be available in the era of air travel.

I would argue that a sharp advantage for the objective outsider over the in-house group is that of not being influenced by doctrine, assumptions, or traditions. I would stress that there is no issue of competence; it is not a question of the in-house Air Force quality of work versus the external. Rather, it is the matter of being outside, free of the internal pressures, objective, and importantly, of being able to transcend organizational boundaries. Project RAND really does have the opportunity to stand along the edge of the Air Force organization, and to be able to interface with it as needed. This will be very clear when I describe a case study.

While Project RAND works contractually for DCS/RD, we still maintain very widespread contacts throughout the Air Force. Hopefully what we, Project RAND, can provide is perspective and an ability to deal with cross-cutting multidisciplinary problems and to follow any one wherever it might lead throughout the Air Force. At the moment, our research effort is divided into five major programs.

The group of studies in the Strategic Program emphasizes such things as the implication of technology advances for the effectiveness of future strategic forces; possible changes in strategic nuclear concepts and their influence on strategic force structure, doctrine, policies, and options; plus technical studies on strategic weapon systems. A group of studies in the General Forces Program emphasizes the enhancement of Air Force capabilities in the general purpose forces area through the use of advanced technology, and considers trade-offs between cost and capability of alternative force mixes, the use of the reserve forces vis-à-vis regular forces, readiness questions, airlift questions, and interaction with NATO. The Logistic Program concentrates upon identifying and evaluating alternative maintenance and support postures in the logistics area and organizational structures that will support increased effectiveness but decrease costs. A fourth, the Manpower Personnel and Training Program, addresses the broad subject matter of improving the efficiency with which the Air Force uses its human resources. Studies address such things as future manpower supply for the officer corp, the distribution of skills, the educational aspect of maturing the officer corp, and the use of reserve forces. The Acquisition Program is focused on such major policy questions as how to procure weapon systems, what are alternatives to this procurement--such as directed licensing, the effectiveness of present techniques, and the utility of value engineering.

Let us now turn to a particular study and show how the broad principles unfold--a study known as the Computer Resource Management study. To set the background for it, I'll first note how computer technology has infused its way into Air Force matters. In the early fifties, computers were used largely in the R&D aspects of science and engineering. Then the logistics

community noticed them and started to do inventory control and management with computers. Next the computer became part of a weapon system, notably the missile force, then supported command and control, then more deeply into weapon systems. Most recently the computer has become an essential part of fighter aircraft. The computer has worked its way progressively deeper into Air Force matters; this is not particularly surprising because if one has looked at industry, he will have seen a similar kind of gradual pervasion.

As a general observation I note that computer technology has moved so rapidly that we who are in it full time have had a hard time to keep up. For that reason plus the explosive demand for people, there has always been a problem maintaining technical competence and with having an adequate supply of skilled people. The problem is more severe for the Air Force because of certain aspects of its style of managing a career progression. The personnel rotation system for example causes difficulty when one is trying to keep up with fast moving technology; the Air Force concept of "the whole man" makes it hard to stay in a technical specialty. Furthermore, university curricula until rather recently were not geared to train people with adequate backgrounds in computer technology.

Computing is largely a commercial industry; it is not a defense industry. While defense establishment exploits computers extensively, computing is not a defense oriented industry in the sense that the aerospace industry is. Thus companies have tended to train their own people; but more importantly, they have competed aggressively for the supply as fast as it became available--so much so that an Air Force person could quickly find civilian job opportunities. As fast as the Air Force produces trained computer people, industry has been willing to beckon. Thus, the Air Force, partly because the world has had problems, and partly because it has special internal circumstances, has had serious skill problems in trying to deal with the computing matter.

What has happened is that the Air Force inevitably depended very heavily on industry to carry a burden it could not handle internally. As industry

won contracts, the vendors tended to ally themselves with segments of the Air Force--those that work in avionics tend not to be in command and control, those that are in command and control tend not to be in logistics. There has been no force to produce within the Air Force uniformity of management procedures, or uniformity of management controls to deal with computer affairs. Everybody has been doing it differently; and as a matter of incidental interest we identified ten different ways in our study that an ingenious Air Force organization could use to get itself a computer. Which it chose was pretty much up to the management of the organization trying to get the computer and was selected to optimize progress toward the goals rather than to conform with preferred management practices.

Software has been especially troublesome to the Air Force as it has been for everyone. Software has vigorously bitten everyone in the world, and the Air Force did not escape. As the computer has progressed through various functional areas--from R&D to aircraft--it has tended to involve a different set of contractors each time; thus, the Air Force has continuously paid for new ones to come up to speed. Because personnel policies tend to keep an individual in his own specialty, a ballistic missile person (for example) tends to stay there but not necessarily in the same technical speciality. The Air Force has also been paying for self-education. Regrettably, the Air Force has not had 25 years of experience in computers; it has had 5 years of experience five times. One can be charitable about the matter but at the same time lament it because it has created a problem of bringing an Air Force cadre up to speed in a critical new technology. Because computery has moved so rapidly, neither the Air Force nor any other organization could afford to take 25 years to educate itself on computers.

The broad problem for the Air Force is how one manages its present computer resources and how one creates proper controls so that new systems based on computers can be developed and implemented. The overall difficulty has been visible to outsiders for some time; particularly, a few of us in Project RAND could see it because of our continuing interaction with the Air Force. Because we were watching and interacting with industry at the same time as with the Air Force, we could see the contrast between them. The



developing problem was also visible to the Information Processing Panel of the Air Force Scientific Advisory Board, because like the Project RAND people, members of the Panel knew what was happening in the world and were also watching the Air Force scene. It was very clear that a major difficulty was coming.

About 1968, there were conversations between individuals from Project RAND and from the Air Force Scientific Advisory Board with the Secretary of the Air Force and other top officials. The discussion catalyzed a committee that was subsequently known as the Select Committee on Computer Technology Potential; its charter was to examine the whole issue and to tell the Air Force what to do. It heard from industry and so was informed on the steps being taken there; it listened to various segments of the Air Force. The Committee did correctly identify some problems, but unfortunately the Air Force was not ready to respond to its findings.

In looking back and wondering why the recommendations were not acted on, it strikes me that the Air Force as an organization just was not ready to accept the fact that computer technology is so completely pervasive in its affairs. It did not yet comprehend that computers were really different from other technologies. The Air Force did not realize that computer technology had to be dealt with in a coordinated standard way, that there was just no other technology in every aspect of the Air Force affairs or in every part of an organization's activities. Computers deal with information; information is a universal commodity; everybody has to use information; and so the computer inevitably is going to turn up everywhere--it is all that pervasive. An event of such scope has never occurred in the history of mankind; and thus, it is no surprise that organizations have had trouble coping with it. The Air Force, being to some extent a group of independent organizations that interact with one another only at the uppermost management level, has had unusual difficulty in accepting the fact that computers have to be dealt with in SAC the same way as in NORAD, the same way in the Air Force Systems Command, the same way in Logistics; and in each instance, dealt with by consistent management attitudes and procedures.

Another aspect that undoubtedly has had some consequence is software. In the late sixties, software was beginning to nibble at people; while the

astute observer noticed it, software problems had yet to bite hard. Because most software efforts were concealed and not separately identified in contract matters, the whole software issue was slow to surface in the Air Force. In contracts for example, software was considered as an incidental thing expected to materialize; it was the vendor's problem to deal with, and the Air Force at that time did not appreciate the special attention that it needed. Software was never separately costed because its importance for management attention was not perceived. There was no good data on how much the Air Force was spending on software, (and as a parenthetical remark there still is not). The software problem was not particularly visible, and while some people saw it coming, they tended to be the same individuals who were observers not only of the Air Force scene but the industrial scene as well.

Finally, the software problem struck and it hit hard at aircraft. When computers became essential components of an avionics system and when software became a critical aspect of the operational effectiveness of an aircraft, then the Air Force noticed the problem. There were briefings at the Air Staff level in 1973 that documented what came to be called "software disasters." Aircraft were unable to fully perform their mission because some aspect of the on-board computers was causing trouble; desirable and essential changes in software to support new mission functions were not being implemented for years. The severity of operational difficulties captured the attention of the Chief of Staff and in January of 1975, General David C. Jones asked Project RAND to examine the computer matter in a broad way throughout the Air Force. We were asked to concentrate on organizational policy and management questions, and to provide him with actionable recommendations by mid-1975.

Given that the study was to be done in six months, one cannot spend very much time in coming up to speed. Therefore, as part of unfolding the story, it is important to note the assets that Project RAND had in responding to the request. The point is especially important because it illustrates a wonderful example of interaction and intimacy between two organizations.

The three principals<sup>\*</sup> involved in the study had had long and continuous involvement with various parts of the overall problem. Through Project RAND

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and also through the Air Force Scientific Advisory Board, one had been watching the Air Force computer scene unfold since the mid-sixties, had been looking at the whole management question and trying to relate what was happening in industry to receptive ears in the Air Force. Another had correspondingly long experience in the logistics activities of the Air Force and especially with its computer involvement in that area; and the third had the same long involvement in Air Force avionics and the difficulties that had been arising there. Each of the three had over ten years intimate interaction with parts of the Air Force computer problem, an asset of enormous importance. A group of ten others with involvements of many years knew other important parts of Air Force computer usage, notably in command and control, and communications.\* All had an awareness of what had been happening in the industrial world, and what was being done with computers in it. Importantly, we had tracked the changing management arrangements and procedures that industry had found necessary. So we were able to move into the action ready to go--and that proved fortunate.

Another asset was a broad set of personal friendships with individuals throughout the Air Force with whom we had interacted over a period of many years. As a group, we had good acceptance, a second asset of import. Finally, we had an extensive background knowledge of the issue. We knew how the problem had started, and why it existed. We were knowledgeable about past attempts to deal with it; we knew organizational attitudes toward past attempts; we had perceptions of why earlier efforts had not succeeded. Overall, there was zero coming-up-to-speed time.

The study was conducted by visiting approximately ten Air Force programs, each selected because it had a large computer component. For example, we examined the Advanced Logistics System plus a number of weapon systems projects such as B-1, F-16, AWACS, and the Airborne Command Post. We visited commands such as NORAD and SAC; we went to the Data System Design Center. We tried to pick projects that appeared to be going well and successfully, and ones that were considered to be in trouble or headed for it. We interviewed individuals extensively throughout the Air Force--at the Air Staff,

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\* This group consisted of L. Catlett, M.R. Davis, R.S. Gaines, R.A. Pyles, R.N. Reinstedt, A.I. Robinson, D.K. Shelton, H.J. Shukiar, G.K. Smith and R. Turn.

in System Project Offices, in major commands at AFSC and in its product divisions. We attempted to talk with anyone who had a view on the subject, had an idea of why the problem existed, or had ideas on how it could be fixed. This latter aspect was crucial because we had to produce for General Jones solutions that he could implement, that the Air Force would accept, and that would work in the Air Force. Since one can easily have a variety of seemingly good ideas that are of little value to an organization, it was important in our conduct of the study to get a perception of potential receptivity for any proposals.

A major conclusion was that the Air Force difficulty in dealing with computer technology is a consequence of not following an orderly development process in the acquisition of its computer-based systems. After the fact, such a statement appears to be a terribly simplistic characterization of the problem; what we had noted was that the Air Force was failing to do in its computer systems what it had learned so well to do in its hardware acquisitions. The Air Force understands how to develop an airplane or some other item of hardware, but it had stumbled when it moved from the hardware arena into one where information, procedures, algorithms and computers were the items of concern--things which one could not feel, touch, smell or see. The failure to follow an orderly development process had been complicated by an internal skills problem. Had there been an adequate cadre of Air Force officers alert to the problem, probably an orderly process would have evolved one way or the other, but there was not. The two aspects unfortunately had a symbiotic consequence more negative than either separately.

We concluded that it would be important to focus responsibility at the Air Staff level for computer management and computer policy issues; but we believed it also important to retain the decentralized Air Force capability to design and implement computer-based systems. It exists partly in AFSC, partly in major commands, partly in the Data System Design Center, and in a few other places such as Special Operating Agencies. We were emphatic that we did not want the Air Force to create a computer czar--a czar in the sense that he would preside over all decisions on computer matters. The Air Staff focal point should concern himself solely with computer management, and with computer policy questions; he must not be an advocate of any system, only an advocate of a way of managing.

From such a point of view specific suggestions follow. We recommended that the Air Force create an Assistant Chief of Staff, a carefully considered choice. We did examine a variety of ways by which focalization could be accomplished, and decided for a variety of reasons that an ACS would be the appropriate choice. We recommended that all computer-based systems above certain thresholds of size or funding be developed through normal Air Force channels for such efforts, DCS/RD and AFSC. In the course of the study we quickly discovered that one shortfall of implementing a computer system is inadequate attention to the requirements generation at the beginning; often the end user would abdicate the requirements generation process to the system developer. What would happen is that the system developed would be one that reflected the developer's perception of what the user wanted instead of a carefully considered specification drafted by the user. We recommended that the requirements generation process, especially at the Air Staff, had to be strengthened and for the few places in the Air Staff for which there is no requirements generation capability, we urged that specific groups be established.

At the Electronic Systems Division the computer experts had been directed to help System Project Offices and program offices. There is a group of specialists that can be loaned out or become a permanent part of a SPO to help on technical questions and to help with management decisions that involve computer details. We extrapolated the concept and recommended that in each AFSC product division, there be created a Center of Expertise.

Finally, the Data System Design Center is in a curiously anomalous position. It has belonged to the Comptroller at Air Staff, and as such it was an operating agency connected to a staff agency. Since we had argued that all computer system development ought to be through a development channel, we concluded that DSDC should be transferred to AFSC as a new product division. This has proved to be the most controversial recommendation.

The final recommendation was that the single manager structure be strengthened throughout the Air Force, particularly in Commands that are heavily involved in computer system development. The single manager ought to be to the Command what the Assistant Chief of Staff focal point is to the Air Staff, but in addition he has responsibility for computer operations.

He should be the individual to whom the Commander can turn in decisions that involve computer matters.

The Air Force has acted on some recommendations and in September 1975 the Assistant Chief of Staff for Communications and Computer Resources was established.\* The action incorporated two disciplines that are gradually merging. While we took the view that there was no urgent reason to put them together, the Air Force action did put them under a common responsibility at the Air Staff. Members of the study group will continue to interact with the new ACS as he defines his scope of responsibility and identifies the details of the position.

Such is the Computer Resource Management Study. It represents a successful outcome of a study effort between two organizations that have almost 30 years of continuous and productive interaction. It reflects the broad studies that Project RAND can undertake and illustrates how essential it is to have broad access across the Air Force in order to address some problems.

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\* AFKR at the Air Staff

