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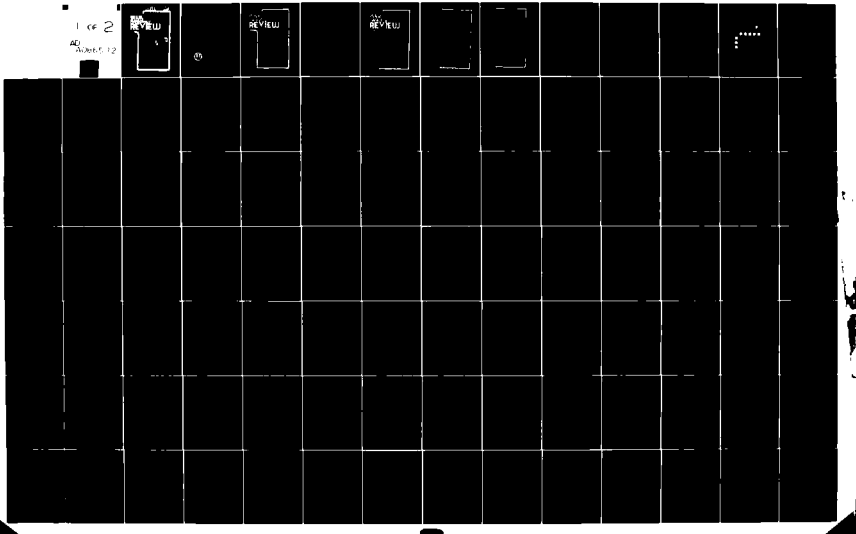

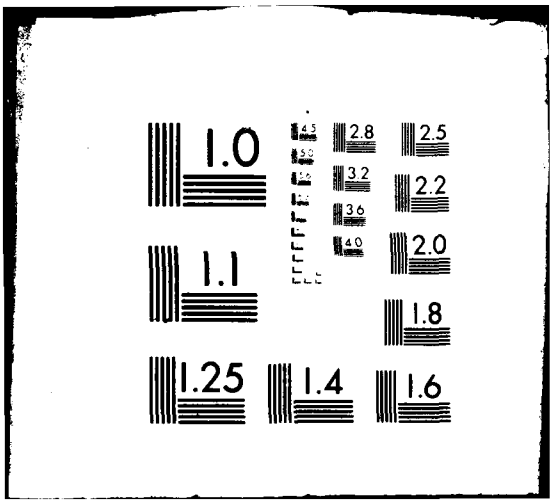
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DEFENSE SYSTEMS MANAGEMENT REVIEW

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Managing the Process

from the editor...

One of the more satisfying aspects of putting together a publication such as the Defense Systems Management Review *is that we have a tangible product to show for our efforts. We can see it, touch it, hold it; we can can point to it and say, "That's what we do." It's a nice feeling.*

It's also a nice feeling to know that what we do has some value, that we serve a purpose beyond simply adding another trickle to the deluge of paper already being generated by the government. We like to think that, in some small way, we are helping to improve the management of systems development and acquisition within the Department of Defense.

It's hard to say if we're really doing that, or if we're just deluding ourselves. One thing we know for certain is that we can't do this job alone—we depend on you. We need your ideas, your recommendations, your solutions to those tough acquisition management problems you face every day. Of course, when you're busy putting out fires, it's not easy to stop and draw up a fire-prevention plan. Yet, that's exactly what we're asking you to do. We're asking you to give someone else the benefit of your experience so that they can either avoid your mistakes or learn from your successes.

Turn to the back of this issue to find out exactly what we're looking for in the way of manuscripts and to get a feel for the style we prefer. We want you to feel that this is your publication and your voice to the acquisition world. Use it.

7 The General Manager of Matrix Organization

Dr. William C. Wall, Jr.

The critical role of the general manager in matrix management is frequently overlooked. Analyses of this technique typically concentrate on the roles of the project manager, the functional manager, and the shared functional specialist. If treated at all, the role of the general manager is examined in a manner that suggests that he may not be an essential constituent in successful matrix management.

It is an undeniable fact that the roles of and the interaction among the project manager, functional manager, and functional specialist are of vital importance to the effective operation of the matrix. The project manager, functional manager, and functional specialist are in the matrix and the state of its health is directly related to their combined effectiveness. Matrix management will not achieve its potential, however, unless it is nurtured by the manager at the top of the matrix—the general manager. He must feel comfortable with the concept and must enthusiastically support and encourage its use. While the general manager has important tasks to perform in his outward orientation to his environment, attention to the matrix may well be the most compelling aspect of his inward orientation. In sum, the general manager must be concerned with matrix management and make a managerial commitment to it. This article examines the role of the general manager in this light.[1]

Matrix Relationships

Matrix relationships are more complex than traditional functional relationships. In the functional organizational structure, relationships are predominantly vertical in nature with few, if any, horizontal or cross-functional aspects. Each major functional group is primarily concerned with its own goals. The matrix changes these traditional patterns by creating new vertical, horizontal, and diagonal relationships among its members. Goal orientation also changes for the

1. This article is based on U.S. Army Missile Command (MICOM) experience with matrix management. Although a commodity commander is not normally referred to as a general manager, the title is more descriptive of his responsibilities in matrix management than the more familiar military title.

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functional members of the matrix in that they become concerned with project goals in addition to their more familiar functional goals.[2] It is the synergism resulting from these interactive relationships that underscores the uniqueness of the matrix concept.[3]

The organizational locations of the managers and the functional specialists are illustrated in Figure 1.

The general manager supervises both the project manager and the functional manager, but he is not a member of the matrix.[4] He has a corporate outlook and does not share his power with anyone. He is solely responsible for the aggregate of projects making up his assigned mission and for the institutional excellence of the combined functional specialties of his command. The general manager has a commodity orientation that is a unique blend of project and functional responsibility.

The project manager is a member of the matrix. He has total responsibility for his project, but lacks total authority. Also, the project manager shares some resources with the functional manager and is dependent upon the functional structure of the command for support and fulfillment of his objectives. The project manager's primary task is one of integrating individual subprogram elements into a unified total program without breaching cost, schedule, and technical performance thresholds.

The functional manager is also a member of the matrix. He is responsible for a total functional specialty and much of his work emanates from project managers. The functional manager must assign priorities to different tasks, and resolve conflicts caused by two or more project managers placing requirements on the same resources at the same time. The functional manager is an adjuvant and must be customer oriented. He receives command direction from the general manager and project direction from the project manager. He must resolve any resultant conflicts.

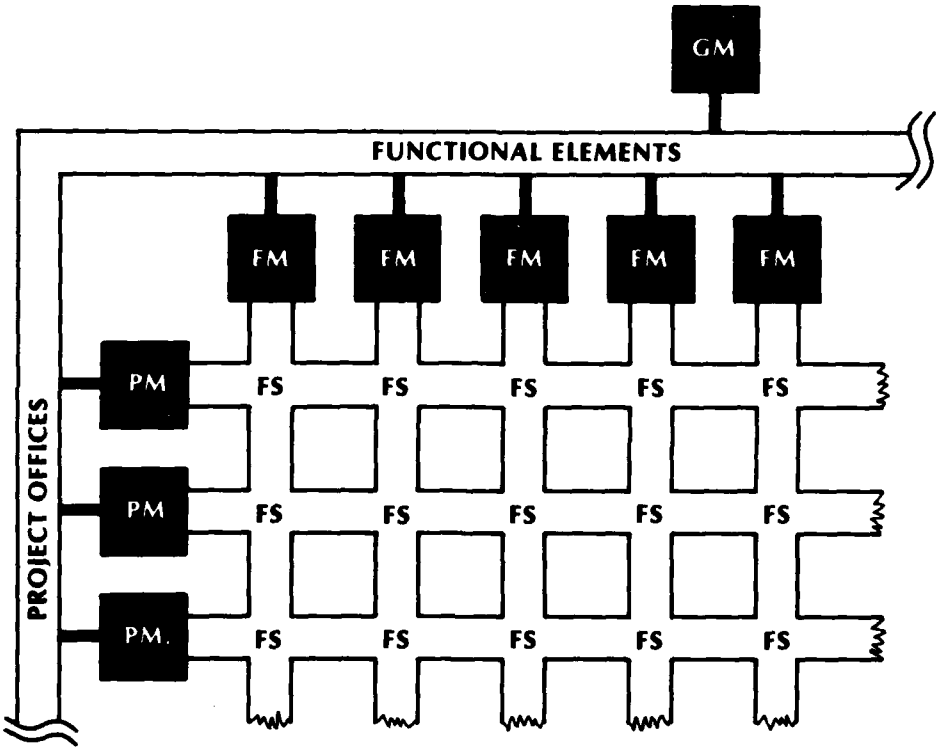
The functional specialist is in the matrix and has membership in two organizational groups. One membership is in the functional organization and the other is in the project organization. Functional direction by the functional manager is transmitted through conventional line authority channels to the functional

2. Norman H. Wright, Jr., "Matrix Management: A Primer for the Administrative Manager," *Management Review* 68 (April 1979): 58–61, (May 1979): 59–62, and (June 1979): 57–58.

3. Excellent descriptions of the integrative aspects of matrix management may be found in Paul O. Gaddis, "The Project Manager," *Harvard Business Review* 37 (May–June 1959): 89–97; Paul R. Lawrence and Jay W. Lorsch, "New Management Job: The Integrator," *Harvard Business Review* 45 (November–December 1967): 142–151; and Gary Gemmill and David L. Wilemon, "The Power Spectrum in Project Management," *Sloan Management Review* 12 (Fall 1970): 15–25.

4. Stanley M. Davis and Paul R. Lawrence, *Matrix* (Reading, Mass.: Addison-Wesley Publishing Company, 1977), p. 47.

FIGURE 1
Matrix Organization



LEGEND:
GM—GENERAL MANAGER
PM—PROJECT MANAGER
FM—FUNCTIONAL MANAGER
FS—FUNCTIONAL SPECIALIST

specialist while project direction by the project manager goes through superimposed project authority channels. The functional specialist has the responsibility of responding to the requirements placed by the project manager while maintaining commitments to functional goals directed by the functional manager. When these two objectives conflict, the functional specialist is faced with the difficult task of resolving all discordant interests.

Matrix management builds in a degree of "purposeful conflict"[5] between the projects and the functionals that must be regularly fine-tuned in order to avoid an unequal distribution of power. A degree of conflict also exists among the projects as they compete with each other for the limited specialized resources available. While matrix management is a high-tension technique that places great demands on the people involved,[6] the potential for synergism and constructive management initiatives among the program participants is high.

The role of the general manager in matrix management is an exacting one. It encompasses the traditional facets, but is compounded by an overlay of new responsibilities generated by the matrix technique. The role consists of four distinct but interrelated aspects.

General Manager as Administrator

As administrator of mission responsibilities, the general manager must be all of the following:

—orchestrator
—evaluator
—decision-maker
—resolver/inducer

These characteristics of this first aspect of the general manager's role reflect a blend of both traditional and matrix responsibilities. The traditional elements are driven by conventional line relationships while the matrix responsibilities are the result of the nontraditional pattern of interaction of the matrix relationships.

The general manager must achieve balance among project managers and functional managers in the distribution of both legitimate power and effective power. The project manager's role as integrator and the functional manager's role as adjuvant must not result in a relationship where the project manager's position is always supported without qualification. To do so defeats a desirable check and balance feature of matrix management. On the other hand, the functional manager should not continually be supported unqualifiedly, for the project manager's ability to "make things happen" will surely erode. Clearly, a balance between these two extremes, one that optimizes the synergism of the matrix organization, must be achieved.[7] The general manager, as orchestrator, is the individual that guarantees this balance in the matrix.

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5. Arthur G. Butler, Jr., "Project Management: A Study in Organizational Conflict," *Academy of Management Journal* 16 (March 1973): 84–101.
6. Wright, "Matrix Management: A Primer for the Administrative Manager," June 1979, p. 58.
7. Butler, p. 94.

The general manager is interested in results. He must set standards of performance for the project manager and functional manager and then evaluate their performance against the established standards. Performance standards are typically articulated in plans and in policy instructions, directives, and regulations. For the project manager, the standards generally set forth performance requirements in terms of system cost, schedule, and technical performance parameters. Functional standards tend to be expressed in terms of aggregate cost and schedule parameters and specific parameters associated with the functional specialty involved. Only the general manager can perform the separate but interwoven tasks of independently evaluating the individual performance of the project managers and functional managers and constructively relating the degree of contribution of these performances to corporate mission accomplishment.

Decision-making is the responsibility of any general manager. Of primary interest here is that decision-making associated with matrix management. The key difference between decision-making in the purely functional context and decision-making in the matrix environment is the wider range of alternatives available to the decision-maker in the latter. The problems requiring solution and decision also tend to be more nonprogrammed than programmed, and decisions must be made more frequently under conditions of uncertainty than of certainty. Arrayed among economic, technical, theoretical, and political considerations, the problems confronting the general manager in matrix management reflect the dynamic environment from which they arise.

Conflict in the matrix is dysfunctional only if it is detrimental to the decision-making process or is deleterious to team effort. It is beneficial if it improves decision-making or enhances team effort.[8] Recognizing its ambivalent aspects and its relationship to the power situation, the general manager controls conflict in the matrix by simultaneously inducing constructive conflict while resolving destructive conflict.

Conflict resolution is a characteristic of the role of the general manager as administrator that is intensified in both scope and complexity as a consequence of matrix management. The new organizational relationships in the matrix, mentioned earlier in this article, create new interdependences that require increased communication. As a result, a greater number of differences emerge and each must be resolved.[9] Conflict resolution is not a search for consensus. Its objective

8. Hans J. Thamhain and David L. Wilemon, "Leadership, Conflict, and Program Management Effectiveness," *Sloan Management Review* 19 (Fall 1977): 69–89. See also Joe Kelly, "Make Conflict Work for You," *Harvard Business Review* 48 (July–August 1970): 103–113.

9. Davis and Lawrence, p. 104.

is development of satisfactory solutions to inherent conflict in the matrix. The existence of inherent conflict is an accepted element of the purposeful conflict of matrix management.

Induced conflict is a constructive management technique and is used to stimulate additional project progress and to challenge people to higher levels of performance.[10] Induced conflict stimulates ingenuity, resourcefulness, and management creativity in all members of the matrix. The creative use of conflict may lead to improved methods, better tools and techniques, and greater individual productivity. It is the general manager's objective to inject constructive doses of induced conflict into the matrix at appropriate intervals.

General Manager as Leader

The leader aspect of the general manager's role requires that he act in two capacities:
—director
—innovator
Both of these elements are traditional functions of leadership, but they assume new significance in matrix management.

Leadership has been defined as the ". . . ability of one person to induce others to cooperate in and contribute to the pursuit of organizational objectives."[11] In the matrix environment, this can become a challenging task because of the divergent views of the participants. A project manager is expected to be the project's staunchest advocate. Goals or objectives that conflict with or that are counter-productive to project goals represent a threat to progress that must be neutralized or worked around. Referred to as "projectitis," this phenomenon of project management is marked by an inability of a project manager to acknowledge any problems but his own.[12] While this may make dealing with project managers difficult, this trait is viewed as an indispensable characteristic of a project manager.

On the other hand, a project manager must also be a team player, for the project derives considerable support from the commodity command of which it is a part. The general manager, as matrix director, must gain cooperation from all participants to assure that they make equitable contributions to organizational objectives.

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10. Thamhain and Wilemon, p. 71.
11. Daniel A. Wren and Dan Voich, Jr., *Principles of Management: Process and Behavior*, 2d ed. (New York: Ronald Press, 1976), p. 529.
12. Gaddis, p. 94.

Matrix management is dynamic and change is certain. For example, project emphasis shifts, key personnel relocate, matrix interrelationships alter, and formal organizational lines modify. It is imperative that management cope with this change by keeping management tools, techniques, and systems current and constructive. Old concepts must give way to new, and subjective techniques must be replaced with objective ones. As leader of the matrix, the general manager must establish a climate that facilitates the development of new ideas and improved work methods. He must cause management initiatives to surface and also be innovative in his own right.

General Manager as Strategist

The general manager must be a strategist. This responsibility requires that he serve in two roles:
—planner
—analyst
Both elements are familiar responsibilities of a general manager, but as in the case of leadership, they have a unique significance in matrix management.

Strategic planning requires definition of command goals and objectives and focuses on areas that should be given special attention, de-emphasized, or eliminated. In matrix management, it is concerned with long-range planning for human resources, for termination of old projects and establishment of new projects, and for continuing modernization of the project-functional relationship. All of these concerns are made more complex by the continuing shortage of people authorized, a desire to limit the aggregate of people assigned organizationally to the project managers, and the commitment to strike a constructive balance between the functions performed by the project managers and those performed by the functional managers. The general manager must face these concerns squarely and deliberately because they crisscross all organizational boundaries within the commodity command.

In addition to the project-functional relationship, the general manager must also monitor the inter-project relationship. A balance of power among the project managers is also essential if inequitable functional support is to be avoided. Allocation of limited resources among the project managers typically requires some degree of trade-off among the claimants, and this responsibility rests with the general manager as analyst.

General Manager as Catalyst

The general manager as the catalyst in matrix management also has two roles:
—synergist
—communicator

Both of these responsibilities relate to the dependence of the project manager upon other people and organizations for support, resources, information, and decisions.

The matrix should result in a synergistic union of project and functional concerns because of the shared human resources. But synergism is not serendipitous and does not occur spontaneously. It must be actively sought and it may only occur in a healthy matrix. To achieve the desired synergistic effect in a matrix may require constant tuning of the variables until the intensive management emphasis of the projects is correctly balanced with the economies-of-scale attribute of the functionals. This management tuning might involve adjustments in such factors as the number of people dedicated to the projects *vis-a-vis* the number of people shared by the projects, distribution of authority and power, and project and functional organizational relationships. The adjustments are made until results are satisfactory. The general manager, by virtue of his position at the top of the matrix, is the only individual with the authority and power to oversee the tuning adjustments that must be made in the matrix and to assure that efforts between the project manager and functional manager are collaborative rather than adversarial.

The general manager is also able to facilitate the communication and coordination process outside the commodity command. For example, the general manager, as communicator, can open doors, provide advanced information, utilize informal communication channels, and add the weight of his personal support to proposals and recommendations. This form of assistance is invaluable to project managers and functional managers and may spell the difference between success and frustration.

Conclusion

The matrix is the most complex of all organizational forms and it is complicated to manage. The matrix is a blend of the traditional or functional structure with the non-traditional, or project, structure. It is not surprising that the general manager's responsibilities, summarized in Figure 2, reflect a similar blend.

Today's technology is crossing traditional organizational boundaries. In matrix organization, management has found a way for people to also cross organizational boundaries easily, effectively, and without being limited by parochial departmental interests. Matrix management is difficult, but it provides the organizational integration and flexibility required by today's complex multifunctional endeavors. Because of its complexity, there is no single key to success and good health in matrix, only essential constituents. The general manager—the manager at the top of the matrix—is one such constituent. ‖

FIGURE 2
Role of the General Manager

ROLE ASPECT	ASPECT ELEMENT	RESPONSIBILITIES
ADMINISTRATOR	ORCHESTRATOR	GUARANTEE A BALANCE OF POWER AMONG PROJECT AND FUNCTIONAL MANAGERS
	EVALUATOR	SET PERFORMANCE STANDARDS FOR ALL MANAGERS AND EVALUATE THEIR PERFORMANCE AGAINST THE STANDARDS
	DECISION-MAKER	MAKE THOSE DECISIONS RESERVED TO THE GENERAL MANAGER
	RESOLVER/INDUCER	RESOLVE INHERENT DESTRUCTIVE CONFLICT WHILE SIMULTANEOUSLY INDUCING CONSTRUCTIVE CONFLICT
LEADER	DIRECTOR	GUIDE THE MEMBERS OF THE ORGANIZATION BY INDUCING THEIR COOPERATION IN AND CONTRIBUTION TO ORGANIZATIONAL OBJECTIVES
	INNOVATOR	CAUSE MANAGEMENT INITIATIVES TO SURFACE AND BE INNOVATIVE IN MANAGEMENT STYLE
STRATEGIST	PLANNER	DEFINE CORPORATE GOALS AND OBJECTIVES
	ANALYST	ESTABLISH AND MAINTAIN PARITY AMONG PROJECTS
CATALYST	SYNERGIST	PERFORM TUNING ADJUSTMENTS IN THE MATRIX TO CAUSE SYNERGISM
	COMMUNICATOR	FACILITATE INTERCORPORATE AND HIGHER AUTHORITY COMMUNICATION

Staff Men Are Finks—and Other Generalizations

16

Bert Karin

This paper was precipitated by a course at the Graduate School of Business at the University of Connecticut. The course, "Management and Organization," required the submission of a series of generalizations.

In writing a generalization I find that, unless it approaches a truism, it requires the implicit understanding that it has flaws, i.e., it will not apply in many cases, or it is limited to certain circumstances. Thus, unless I could write only universal truths that are appropriate for philosophical discussion, rather than real management problems, a brief generalization leaves something lacking. I have therefore elected to comment on my generalizations, perhaps only to clarify them in my own mind.

These generalizations are drawn from both the literature and my own 20-or-so years in organizations, biased, I admit, by the latter. They have no order or priority, except for the first one, nor are they necessarily original.

Incidentally, the title for this paper is taken from one of the generalizations. To those staff men I have known, let me apologize—not all of you are finks.

Generalization: In management and organization, as elsewhere, "Do unto others as you would have them do unto you."

Commentary: To start any series of generalizations about management and organization, I feel I would be remiss if I did not quote the Golden Rule. Management and organization are basically people interacting with one another, and almost any organizational or management problem is a people problem. I believe that any action involving people must pass the test of the Golden Rule first. Is not the janitor's job as important to him, as the chairman of the board's is to him?

Certainly, one can say, "Great!—I learned that in Sunday School at the age of 7, so what's new? How does that help me manage?" And to some extent that's right. But, I submit that most of us frequently forget the Golden Rule when faced with a knotty management problem. And, if we did harken back to it a little more often, many "people" decisions and actions would be both easier and more effective.

Let me cite some examples:

The Japanese—and other Orientals—are commonly known to be tough businessmen and hard negotiators. However, they almost always remember to let

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the other person "save face." This is a part of their culture, their life style, their way of doing business. Is this not a derivative of the Golden Rule? Would not union/management negotiations, boss/employee relations, customer/supplier problems, etc., be helped by this attitude?

I once joined an organization in a management position. I was shown to my office, introduced to my secretary and subordinates, and wished good luck. That was all. After 3 days, late in the afternoon, another manager dropped into my office and said something like, "I've watched you for a couple of days and you're kind of a babe-in-the-woods. No one is giving you a hand getting going. I feel sorry for you. I'd like to help. Let's chat a while." We sat and talked for hours. I have never forgotten this simple act of kindness. Among other things, it paved the way to a reasonable harmony between our two organizations, which had been at each other's throats prior to that time. Would the same result have happened anyway—without him dropping in to chat? Perhaps. I don't know.

These two examples can be supplemented by millions, and I will leave this to the philosophers and "management specialists." About all I would say further on the subject is to relate the famous legend of Hillel (a rabbi, and contemporary of Jesus), who was asked by some boorish individual to teach him all of Judaism while he stood on one leg. Hillel agreed to do so. He then recited the Golden Rule and said, "This is the essence—all the rest is commentary. Now go out and learn." Likewise, in management and organization "people" problems, the Golden Rule is the essence; when faced with hairy problems, perhaps starting there will help.

Generalization: The organization chart cannot and does not reflect the true structure of an organization.

Commentary: Organizations, regardless of their functions and goals, represent a complex matrix of interdependent people, functions, and goals. Furthermore, except for atrophying organizations, they are in a constant state of flux. (The naive interpret this as being "all fluxxed up.") Thus, at best, the organization chart can reflect a fuzzy picture of organizational relationships at only one instant of time.

Unfortunately, many people attach a biblical significance to organization charts. The reasons are many. The chart is usually drawn neatly and carries some authority's signature, and this appeals to the very human desire for "order," and respect for authority. The chart also represents, to those within the organization, some means of recognizing their own little niche in the scheme of things—an answer to the constant question, "Where do I fit?"—a sense of security. And, to the outside world, it represents a neat, easy, and naive way of recognizing "authority," "chain of command," etc.

Am I suggesting the organization chart be abandoned entirely? No. It is necessary and important, particularly in large organizations, as a first step away from anarchy, a system under which any organization is doomed. However, it should be recognized as a fuzzy picture, subject to change at any moment, a point of departure, a threshold, "views through a soda straw rather than with a wide-angle stereo X-ray lens."

Generalization: In decision-making, "history" is of little consequence. Only "present status" and "future" are important considerations.

Commentary: The recent (I believe) cliche, "Today is the first day of the rest of your life," is as applicable to business decision-making as it is to individual mental health. Frequently, we are so preoccupied with events of the past that clear analysis of future implications of a decision are obscured.

One might erroneously infer from this generalization that a study of history is worthless. Not so! Historical analysis is of considerable value in gaining insight into cause and effect. But, historical data are simply reflections of the past—facts that are not subject to change until a science-fiction time machine is invented. No decision today will alter yesterday's fact.

History is very useful in defining the "present status." For example:

The balance sheet in an annual report is a reflection of historical data defining (in part) present status of a company at the end of a particular fiscal period; its balance sheet for the next period may look entirely different.

The name of a company, its logo, its advertising style, its location, its mode of operation, its people at any one time, reflect history up to that present status. However, the decisions at that present status may rightfully be a radical departure from history. A company may spend millions, for example, to change its name, its logo, or its "image." These millions may well have a significant impact in the future; they will not, however, change the past.

The firearms industry is reviewing its present status and making business decisions for the future in light of probable firearms control legislation. Our history as a gun-slinging nation is of value in defining present status, but it would be absurd to define a future firearms market by extrapolation from historical data.

Other examples abound, ranging from defining future capital equipment, to selection of toilet tissue for the rest rooms.

This generalization has been criticized, rightfully, as perhaps "seeing the world as it should be, rather than as it is." Precedent-minded people do abound in every organization. But part of the fun of being a manager is attacking precedent. If people can be made to realize the manager is helping shatter precedent, fine; if they can't, I believe it's even more fun. A book I read recently is entitled *The Management Game*. It is a game, and games are fun—and since there's real money involved, it's even more fun than Monopoly.

A word of caution though—"shattering precedents," "stirring the pot," "innovation," "creativity," and all those things are great, but judicious timing and testing of business decisions are equally important. The hot-shot executive dynamo who comes into an organization and makes sweeping decisions, without first listening carefully, can create a disaster. Also, the management consultant who can tell you all that's wrong and how to fix it after a brief visit is like a "eunuch giving sex counseling." His advice, at a substantial fee, is worth no more than your own sea-lawyer's (every organization has at least one) who knows exactly what "they" ought to do.

Generalization: The "best" is the enemy of the "good."

Commentary: Anything invented by man can be improved; the inventor, and others, usually try to do so, thus creating a never-ending program whose pot of gold is always just over the horizon.

This generalization is applicable to new products, new systems, new procedures, new anything in organizations. In new products, inventors are usually lousy engineers—they cannot leave well enough alone. One of the most frequent complaints of sales organizations with the R&D staffs is that they have all kinds of things on the horizon but nothing new that can be sold *now*. It takes almost superhuman effort sometimes to get an inventor or engineer to stop improving his product before it is released for production. As someone trained in technical disciplines, I find I have to make a conscious effort to be sure I'm not always improving something simply to avoid cutting the umbilical cord.

Programmers have the same problems—a little more time and they can give you a program that is so much better. In the meantime you have no program at all.

Recognizing when something is "good enough" and doing something about it is a major challenge of the manager.

My comments should not be construed as advocating no improvement programs. Quite the contrary, improvement is a never-ending challenge. However, when this challenge interferes with getting a good new product out of the shipping room, or a new good system implemented, "improvement" must take on a secondary role, and an appropriate schedule for implementing a second-generation product (or system) is required.

Generalization: Most staff men are finks.

Definition: A good staff man is one who can stand behind the people who are pushing the buttons and whisper advice into their ears, suggesting which buttons to push; refraining, except in the most dire emergency, from reaching out and

pushing a button himself; refraining from saying "I told you so" when the button-pusher makes a mistake, or griping when he doesn't take advice; telling the chief button-pusher about the overall results achieved by his button-pushing Indians objectively, without telling him "I recommended Button A, then Button B, and he pushed B first, which caused the disaster." Most staff men do just the opposite, and fink (tattle) to the chief button-pusher.

Commentary: Recognizing that most staff men are finks, I get most work done through the line, and avoid creating staff positions. In taking over a new management job, one of the first things I do is look at the "staff" functions and people. I can be a ruthless axe-wielder, in this regard.

I spent a year and a half as a staff man. The only people reporting directly to me were an assistant and a secretary. The first 6 months were agony for me, and for the line. I simply didn't understand my role, as I have defined the staff role above. When my function finally dawned on me, the next year was one of the most rewarding I have had. My staff position ended when I told the chief button-pusher that I was no longer necessary—the line could handle it. Fortuitously, there was a good line position for me to go to. Did I make my recommendation because the line position was available? Perhaps—but I don't think so.

Generalization: The unforgivable sin of the manager of a profit-center is losing money without recognizing well in advance that he will lose money, and making someone above aware of it, and doing something positive to minimize the loss.

Commentary: Almost anything else can be forgiven, and usually will be. His job is to protect the stockholders' equity, perpetuate the enterprise, and make a profit. The last of these is the most visible.

The manager of a profit-center is in the same position as the captain of a ship. It matters not that the captain was asleep in his cabin when the young helmsman steered the ship aground. The captain is to blame. There may be explanations, but no excuses. On the other hand, if the captain radios the commodore that he is in a hurricane and may be driven aground, that's an entirely different matter.

Generalization: The key to creative thinking is separation of "ideative" (blue sky, unstructured, uninhibited) thinking from "judicial" (assessing worth) thinking.

Commentary: Books and articles abound on creativity. (That in itself is creative—making money by writing about creativity.)

There is no one formula for creativity. An attitude that completely ignores the "judicial" aspect temporarily, however, is required. One never knows where the germ of a creative idea may come from. This germ can be and has been

obliterated by assessing worth too early. The formal brainstorming sessions that came into vogue some years ago recognize this; both negative and positive comments are a "no-no" during these sessions.

What may be a crazy idea at its outset may very well become quite profound when coupled with other thoughts of the originator or others.

Generalization: Successful administration appears to rest on three basic skills, technical, human, and conceptual.

Corollary—Management Performance depends upon fundamental skills rather than personality traits.

Commentary: It is quite normal to judge a man by his personality, and we frequently confuse the worth of a manager with the worth of his personality. Each of us develops an individual personality. That personality may be good or bad but, in either case, personality is not a good measure of management skills.

I have dealt with managers of very widely divergent personality traits. I can't point to any single personality trait I consider to be essential to a good manager. When I try, I find someone who is a very good manager and is almost totally lacking in that particular trait.

Many years ago, when I was appointed to a supervisory position, my boss took me aside. He counseled me that I could no longer be "one of the boys"; I couldn't play cards with them at lunch, etc., and still be effective in my new job. I took his advice, initially, then I found he was wrong. *His* personality was such that *he* could not be one of the boys and still be effective. *Mine* was such that I could. Incidentally, I consider him to be a good manager, despite the fact that some of his personality traits are totally different from mine, and, in fact, bother me a little.

My own personality is lacking in many respects, as is everyone's. For example, I frequently appear to be angry when I'm not really angry at all. I discovered this a long time ago when one of my subordinates told me he was very distressed because I was angry at him, and he didn't know why. In fact, he was so distressed he was thinking of quitting, but decided to talk to me first. It all came out okay; we both learned something. I can't change my personality, but it does help to know what it appears to be to the outside world.

A manager I respect highly has the looks and personality of a gangster. Nonetheless, he is a very effective manager.

Generalization: The absence of "dissatisfying conditions" does not necessarily contribute to job satisfaction or motivation. Conversely, the absence of "motivational factors" does not necessarily cause "dissatisfaction."

Commentary: I like carpeting in my office. I have it at home, I enjoy it, it gives me a pleasant feeling. Nonetheless, I don't think the absence of carpeting in the office would make me do any worse job.

Conversely, if I had a magnificent office, a movie star for a secretary, a company-chauffeured Cadillac at my disposal, an unlimited, unaudited expense account, and every convenience known to man, would I do a better job? I doubt it.

One medium-sized company I know of once had a policy that everyone must punch a time clock. Everyone—including the president—did this. I am sure that this practice was only for outward appearances and that no one whose job required a flexible time schedule was ever penalized because of his time card's appearance. Some of the executives were naturally embarrassed and dissatisfied with the entire matter, as were other people. The policy has been changed (the president died), and this source of dissatisfaction was removed. However, I see no difference in the performance levels of the individuals attributable to removal of this dissatisfaction.

Parkinson says that when he enters a plant (or office) where everything is beautifully arranged, there is just the right amount of space for everyone, the files are orderly, etc., he believes the company is on the road to failure. Why? If they have the time to spend on "perfect" systems and niceties, then they are not doing the real job. I look at it a little differently. I believe the company has spent too much time on removing dissatisfaction rather than supplying motivation.

Incidentally, I like a *little* chaos in my organizations. It frustrates me sometimes, but it is also stimulating. I believe if there is no chaos—if everything is absolutely orderly—something is wrong. In the military there is a saying, "If the troops aren't bitching, they're not up to snuff." I believe this to be true.

So while I don't advocate having people work under dissatisfying conditions, removing dissatisfaction will not motivate them; if they are motivated, a little dissatisfaction won't hurt. Given a choice, I'd rather spend time on motivational factors than on removing dissatisfaction. Also, removing dissatisfaction is like punching a pillow; as soon as one lump is down another pops up.

Generalization: The amount of time spent in final decision-making on expenditures is inversely proportional to (some power of) the amount involved.

Commentary: This is one of Parkinson's Laws, which I personally tested about 10 or 12 years ago. I was then a member of a U.S. Government agency contract awards board. The board's function was to review and pass on all contracts let by this agency. These varied in scope and expenditure; the board reviewed everything from repair of toilets to multimillion-dollar R&D or production contracts.

I had just read Parkinson's book, and the concept intrigued me. I kept a simple record at each board meeting over a period of months. I noted the dollar amount of the proposed contract and the time the board (including myself) discussed the pros and cons. I subsequently plotted the data and found Parkinson to be absolutely correct. His reasoning for the cause of this seemingly contradictory behavior (spending more time on small amounts of money than on large) is basically that people can relate to small amounts more readily, because their personal lives involve small amounts.

I believe this same reasoning applies in other areas, as well. For example, the preoccupation with the wall paint colors for the lobby or plant as contrasted with the selection of plant machinery.

Generalization: In selecting people for positions of higher responsibility, we tend to see the attributes of the outsiders and the shortcomings of our own employees who may be candidates.

Commentary: Despite the Peter Principle, managers do worry about elevating a man or woman above their capacity. Thus, when they are assessing a person they know, his shortcomings rather than his attributes are assessed, so as to ensure that they are not promoting him beyond his capability.

The individual within an organization is generally seen in terms of his or her present position. The person and the job somehow become merged in our minds into one and the same thing. When we see the person, we see him in his present role. If he is being considered for promotion, his present job is a shortcoming. We see him as a foreman rather than a superintendent, or a manager rather than a V.P.

How many very good secretaries, fully capable of assuming higher positions, have been passed over because in our minds they are secretaries, rather than individuals with tremendous potential?

The outsider has not been fused into our mind in any particular role; indeed, the resume, references, psychological assessment report, and everything we see relates to the outsider as an individual. We see the job and look to the person for those attributes needed for the job. And, any shortcomings in the outsider are either deliberately or unintentionally obscured by both parties.

Additionally, particularly in management positions, we want new thoughts, creativity, fresh approach and all those other goodies, or the position wouldn't be open to begin with. The outsider represents something really new, as contrasted with our own people, who are old hat.

Generalization: Those who frequently complain about delegation of authority are often exhibiting a manifestation of the "perfect-organization syndrome."

Definition—The "perfect organization" is where complete authority and responsibility are delegated to my level; and from my level down there is absolute dictatorship.

Commentary: People need crutches to rationalize their own shortcomings. One convenient crutch is, "Management doesn't delegate authority." I have found that, despite a clear delegation of authority (is there ever really such a thing?), people can do what needs to be done. Perhaps not every time, but generally, if something needs to be done, an individual can make it happen, even if he is low man on the totem pole.

I once attended a seminar where I heard an interesting statement that has stuck in my mind: "If you want to be a manager (foreman, V.P., board chairman) begin to act and think like a manager (foreman, V.P., board chairman)." The speaker cited the example of a bank teller who wanted to be a branch manager. She began to act and think like a branch manager, and a year or two later she was one. I'm sure there are many more examples. In most cases the individual may not have thought about it quite that way, but the end effect was the same. Delegation of authority did not inhibit the teller who wanted to be a branch manager, and it need not inhibit anyone else. And I don't mean shafting or going around your boss. What do I mean? Unfortunately, I haven't found a single answer—that's where creativity comes into play.

Along these lines, how does one delegate authority? I have found one way that helps both me and my subordinates. They have a very simple ground rule that's so simple it drives some up a wall. I tell them to assess the situation. If they were in my job would they want to get involved? If the answer is "yes" or "maybe," see me about it. If it is "no," proceed on your own. At first, the "maybes" overshadow the other two answers. With time, some people will answer "yes" more frequently and others "no"; "maybes" begin to disappear. The "no" answerers want my job or one like it—and I hope they get it someday.

Generalization: Meaningful goals are those that are achievable, with stretch.

Commentary: I am suspect of any manager who always meets his goals. I am equally suspect of those who rarely meet their goals and have seemingly good reasons for not doing so.

Both types are lacking—the former somehow manages to convince people that his goals are meaningful, when they are not. They are readily achievable; they do not require stretch. The latter sets goals using rose-colored glasses.

Unfortunately, managers are frequently not judged individually, but on a relative basis, and it may be necessary within a particular organization to play some game, which everyone recognizes. If the game plan requires everyone to meet all their goals, then the individual manager would be advised to minimize

the stretch required. On the other hand, if the goal-setting process requires a rosy picture of the future, the impossible goal is proper. So, one needs to temper the ideal with the reality of the particular organization of which he is a member.

Generalization: Individual goals often conflict with one another; however, they are nonetheless valid. For example "high profits" and "perpetuity of the enterprise" are valid, but conflicting, goals.

Commentary: Any organization can have (and must have) conflicting goals. These can be conflicting between departments or conflicting for the total organization. Likewise, personal goals conflict with one another.

Consider the total organization. High profit for a profit-making organization is a perfectly reasonable goal. Perpetuity of the company is also a reasonable goal, to protect the stockholders' equity. One could readily increase profits by eliminating R&D expense, but this would be in direct conflict with the perpetuity goal. Or, one could invest so heavily in R&D as to seriously affect profit.

(I recognize that clever accountants can do such things as carry R&D expense in inventory and make the profit appear good anyway, but these ploys are simply that—ploys. Betting on the "come" does pay off sometimes. It depends upon how sporting the manager is as to how many ploys he will resort to.)

Individual department goals are almost always conflicting. For example, the production department always wants a good supply of raw material available for the line; the materiel department wants to purchase when prices are right. The sales department would like to deliver immediately from stock; the finance department looks with horror on finished goods (money) on the shelves sitting idle, and so on.

An individual wants a high salary and security. He can get a high salary at a "job shop" (temporary help) or by being a consultant. But the medical plan, retirement benefits, etc., come with a lower salary in a regular job.

So—goals conflict! And somehow these conflicts must be resolved. That's why management exists.

Generalization: The control (or audit) functions of management are in conflict with the operational aspects, i.e., those that produce the end product or service.

Commentary: We frequently look upon people as simply another asset to be manipulated, disciplined, and controlled. We see them as trying to get away with something if they are not closely controlled.

While there are immature and evil people in this world, I believe the overwhelming majority are decent people who, properly motivated, actually derive personal satisfaction out of doing a good job. The malingerer, the agitator, the

person always looking for a way to cheat the company, is the exception rather than the rule.

I'm not saying that we're all virtuous, honest, and saint-like. We're human—and we take home some paperclips and stationery, we overstay lunch, and we cheat on expense reports, sometimes. But despite this, most of us want to do a good job.

So what? I see the control or audit function of management sometimes overshadowing the operational function. We can spend so much time and money on control and audit that the operational aspects are lost. It's been said that it costs the U.S. Government $2 to spend $1. I have no idea as to the validity of the figures. However, I do know that there are so many checks and balances in the government bureaucracy as to dishearten many a good person who becomes preoccupied with career survival rather than doing a good job.

There are many areas where very tight control is essential. For example, I managed a plant producing explosives and hazardous chemicals. There was no question about absolute, unwavering adherence to the safety regulations—in letter and spirit. Immediate dismissal of anyone who deviated was required. I would expect the same discipline of the airline people who check airplane safety features. However, the control and discipline necessary in explosive plants or in aircraft maintenance shops is not necessary in the vast majority of jobs, and is frequently counterproductive.

Perhaps the philosophy applied by many large retail firms might be applicable in other areas. They calculate the cost of controlling theft to various degrees and compare it with the value of the stolen merchandise. They then arrive at a tolerable level of theft. While the term "tolerable level of theft" is itself a sad commentary on human nature, it is a practical approach to doing business.

So since most people want to do a good job, control them to the degree necessary and accept a tolerable level of mistakes, malingering, or cheating.

Generalization: Any group of more than three or four people needs a leader, and some semblance of organization.

Commentary: Groups need leaders. The leader need not necessarily be the highest ranking individual. The leader does not necessarily need to be designated in advance; he can emerge from within the group. Tacit agreement as to who the group leader is, is sufficient.

Major William Mayer, a U.S. Army psychiatrist who did an intensive study of the Korean War POWs and brainwashing techniques, had some interesting comments on this problem. The Chinese Communists used a very simple technique to help destroy the POWs' will to resist—they simply separated out from

the rest of the POWs those who had leadership potential. The number of potential leaders only represented a few percent of the total prisoner population. The very survival of these men depended upon someone assuming leadership, and no one did. As a result, many *literally* curled up and died, and for no known medical reason. Major Mayer ended a lecture on the subject with a plea for people to assume leadership when there is a void, and to support leadership when it is there.

The Korean POW story is an extreme example of the consequences of lack of leadership. But the lessons are applicable in any organization. Two or three or even four people can function without an explicit or implicit leader. Any larger group needs someone to lead or simply moderate the group. There is a natural resentment to the individual who always takes charge and is a self-appointed chairman. However, I would rather have an egomaniac in charge than no one at all.

In highly structured organizations, the ranking people will usually lead the group. However, this is far from universally true, for a variety of reasons. There are also many meetings, conferences, or simple bull-sessions among organization men and women whose purpose it is to decide something. No one outranks another; there is no "organizational chart" leader. A simple crutch to beg the question is a statement to the effect that "they" haven't delegated "us" the authority. Whereas, if someone assumed leadership, on an *ad hoc* basis, the problem could be solved without the question of delegation of authority ever arising. If necessary, someone in official authority can be advised of the decision, the reasons therefore, and asked for a simple approval to proceed. In many cases, even that isn't necessary.

So, dammit, stop griping about delegation of authority. Go lead or support a leader. ‖

Goal Programming As an Aid to Resource Management

28

Dr. Daniel A. Nussbaum

The winner of the 1978 Nobel Prize in economics, Dr. Herbert Simon, said that decision-making is the one commonality that permeates all levels of administrative organizations.[1] Decision-making is surely a well-known facet in the organizational life of the Department of Defense. It is also a daily fact of life within resource management activities.

There is a ubiquitous need to identify, classify, quantify, and justify the Department of Defense's need for the resources necessary to accomplish its mission. This need is more pronounced in a resource-scarce environment, and is particularly acute in a zero-based budgeting (ZBB) or zero-based programming (ZBP) environment.

A central issue in the process of allocating scarce resources among competing activities is judging between two requirements and determining which one has the greater merit. There is the need to rank one issue against another and, by repeating this process, to prioritize a list of issues. Without this prioritization stage, resources may be unwisely applied. Further, without analysis of the issues, prioritization cannot be accomplished in an orderly, coherent, logical fashion. It is through the structured use of analysis and analytical tools that we gain insights into the system that we are responsible for managing. It is with these tools that we can test the sensitivity of our solutions to changes in our assumptions. In effect, analysis leading to prioritization can provide for better management of our resources.

It can be argued that the Department of Defense has always prioritized its objectives, since the need to allocate scarce resources forces choices to be made, thereby imposing an orderly system. For example, for several years DOD has described economic analysis as "a systematical approach to the problem of choosing how to employ scarce resources . . . designed to assist a manager in identifying the best new programs to be adopted."[2]

An activity that emphasizes prioritization is zero-based budgeting, which has two core concepts—arraying the budget in discrete decision units, and then ranking these units. All agencies within the executive branch of the Federal Government must present annual zero-based budgets. Therefore, methods for ranking

1. H. Simon, *Administrative Behavior* (The MacMillan Co., 1965).
2. Department of Defense Instruction 7041.3, *Economic Analysis and Program Evaluation for Resource Management*.

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the decision units will be generated and used because, if the prioritization cannot be done, neither can ZBB.

Among the techniques for prioritizing are mathematical programming techniques, including the well-known linear programming (LP), an extremely versatile prioritization technique as long as the problem at hand can be formulated algebraically and the conditions of linearity are met.

There is, however, a limitation inherent in LP that is not often recognized; the fact that LP problems must have exactly one objective function. This assumes that all the objectives of an organization can be subsumed into a single function, or that they all can be addressed along a single benefit scale. This is the so-called multi-attribute problem. In the private sector of the economy, this single scale is usually profit maximization. There may be, however, additional goals in the private sector. For example, a firm may want to minimize layoffs and/or to sustain no more than 20 percent unused production capacity. These goals may not be complementary; they may even be contradictory.

The standard DOD objective is to maximize readiness while efficiently using resources. There is, however, no single measure of readiness. No single dimension captures all that we mean by "readiness." In truth, DOD has varied goals to achieve. Among these goals are the following:

—Maintain high level of personnel training.
—Minimize deadline equipment.
—Meet Leach Amendment requirements.
—Achieve high staffing percentage, perhaps by personnel category.
—Accommodate budget constraints.

It must be recognized that these goals are not mutually complementary. Moreover, they are not simultaneously achievable. Finally, some goals have greater urgency than others; that is, there is a priority.

I would like to point out that it may be normal that the Department of Defense lacks a single, overall measure of utility that encompasses everyone's beliefs about readiness. It may not be due to our unwillingness to tackle the problem or to our analytic ineptitudes. We may be battling a task that falls under the shadow of Arrow's "Impossibility Theorem." In essence, this mathematical theorem says that the search for an overall utility function that conforms to certain individual considerations may be fruitless. Even when the individual considerations are held to be innocuous by the individuals, there may not be an overall utility measure that satisfies all considerations.[3]

3. K. Arrow, *Social Choice and Individual Values* (John-Wiley, 1963).

Goal programming (GP) addresses precisely these issues of multiple goals. From the earliest GP work in 1961 by Charnes and Cooper until the present, GP has formulated constraints as goals and seeks to optimize their achievement. The steps in formulating a goal program are as follows:

—Isolate the decision variables—those variables the user can control and whose values dictate the outcome of the decision.

—Determine the goals/objectives of the decision-maker. These include, but are not limited to, accommodating resource constraints, achieving certain outputs, and adhering to regulatory and statutory requirements.

—Place the goals into priority levels. For example, all statutory requirements constitute absolute, or Level 1, priorities in the sense that no proposed solution is executable if it fails to comply with these goals. Each priority level contains at least one goal. If a priority level contains more than one goal, the decision-maker has the option of cardinally ranking these goals against one another, or of assuming equal importance of all goals within the priority level.

—Construct algebraic links between the decision variables and the goals in a similar fashion to what is done in linear programming. In this formulation, each constraint (goal) has two deviational variables associated with it. These new variables represent the amount by which we overachieve and underachieve our goals. Obviously, since no single goal can simultaneously be overachieved and underachieved, at least one of the deviational variables associated with each goal will be zero.

Goal programming seeks values of the decision variables that produce minimal values of the deviational variables. For example, a statutory budget constraint would be restated as the goal of minimizing any overachievement equal to zero. Moreover, the statutory nature of this goal convinces us to place the highest priority on its achievement. This minimization is accomplished by using standard mathematical methods, which are adaptations of LP algorithms. Upon accomplishment of this first minimization, GP proceeds to the goals of the next lower priority level and optimizes there, while at the same time ensuring that there is no degradation to the solution achieved in the previous step. The procedure continues until all levels of priority have been addressed.

It must be noted that if each of the goals in a GP is thought of as a constraint in the LP sense, then it is entirely possible that the GP solution will not simultaneously satisfy all of the constraints. In the language of LP, the solution is infeasible. This would mean that the problem under investigation is overconstrained and therefore inherently infeasible as an LP. Nevertheless, there is a GP solution. Goal programming provides a best solution in the sense of minimizing deviations from our goals. The result will be the best solution available, given the goals and their priorities.

Following is an example of GP. Suppose that the defense budget is \$120 billion, to be spent between two areas known as "mission" and "life-support." Additionally, suppose that each \$1 billion spent in the mission area causes 8,000 man-years (MY) to be used, while each \$1 billion spent in the life-support area causes 12,000 MY to be expended. There are also some managerial constraints in the system: There is a ceiling of 900,000 MY; there are statutory floors of \$20 billion and \$40 billion in life-support and mission, respectively. Finally, we spent \$45 billion in life-support last year and would like to achieve a \$50-billion level this year. In discussing this problem with managers, the following goals, in priority order (from highest to lowest), were stated:

G1: Do not exceed the budget of \$120 billion.
G2: Eliminate overtime; that is, do not exceed 900,000 MY.
G3: Meet the statutory mission floor.
G4: Meet the statutory life-support floor.
G5: Utilize as much of the budget as possible.
G6: Meet the life-support goal of \$50 billion.

If we frame this as a standard LP problem it looks as follows: Let L be the number of billions of dollars spent in life-support, and let M be the number of billions spent in support mission. Then we seek values of M and L that

$$\begin{array}{lrcl} \text{Maximize } M+L & & & \\ \text{Subject to} & M+ \quad L & \leq & 120 \\ & L & \geq & 20 \\ & M & \geq & 40 \\ & L & \geq & 50 \\ & 8{,}000M + 12{,}000L & \leq & 900{,}000 \\ & M,\ L & \geq & 0 \end{array}$$

Notice that these constraints force M and L to be, at least, 40 and 50 respectively. Unfortunately, these values violate the fifth constraint, the one on man-year constraint. Therefore, this problem is infeasible when framed as a standard LP problem. To recast the problem as a GP, we must accompany each inequality above by a negative and positive deviational variable (N and P respectively). The value

of N reflects the negative deviation, or underachievement, from the goal. Similarly, the value of P reflects the positive deviation, or overachievement, from the goal. Then each goal takes the form of an equality:

G1:	M	$L + N_1 - P_1 =$	120, minimize P_1
G2:	$8{,}000M + 12{,}000L$	$+ N_2 - P_2 =$	900,000, minimize P_2
G3:	M	$+ N_3 - P_3 =$	40, minimize N_3
G4:		$L + N_4 - P_4 =$	20, minimize N_4
G5:	$M+$	$L + N_5 - P_5 =$	120, minimize N_5
G6:		$L + N_6 - P_6 =$	50, minimize N_6

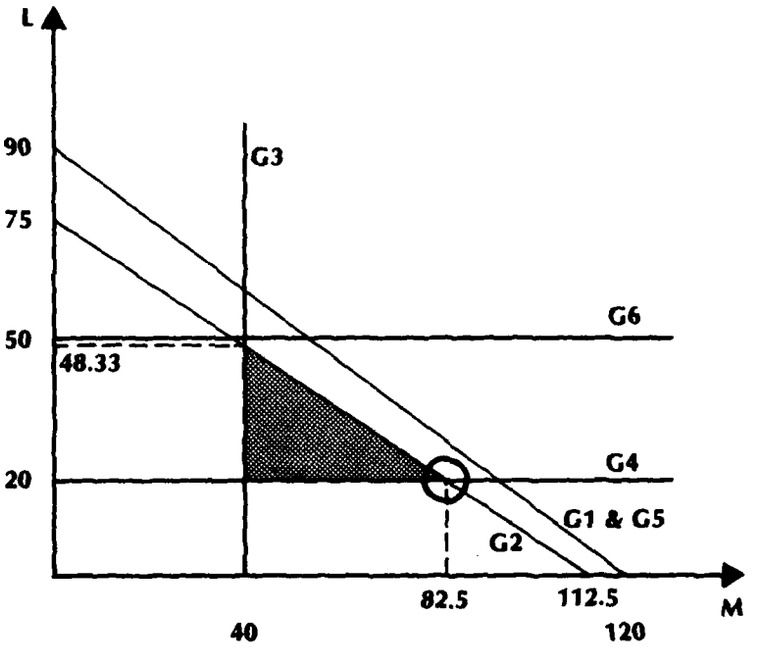
Because there are only two variables, the problem is amenable to graphical techniques. Figure 1 is the resulting graph.

The results of using GP analysis are $M = 82.5$ and $L = 20$. This means that $102.5 billion of the available $120 billion is used, but more importantly, the budgetary, overtime, and statutory floor goals have been met. These are, according to the ranking of our goals, the most important. If we had ordered our goals differently, we would have arrived at a different solution. Naturally, the actual DOD budget is more complex, with more goals and linkages. This only means that there are more equalities, that graphical techniques are not applicable, and a computer routine must be used.

All of this is within our reach. Technical details can be found, for example, in Ignizio[4] or Lee.[5] There is no technical bar to the implementation of this technique into the Department of Defense resource management arena. ‖

4. J. P. Ignizio, *Goal Programming and Extensions* (D. C. Heath and Co., 1976).
5. S. M. Lee, *Goal Programming for Decision Analysis* (Auerbach Publishers, 1972).

FIGURE 1
Graph



A Proposal on Acquisition Management Information

34

Fred E. Rosell, Jr.

There can be little argument that the acquisition process has lost credibility during the past several years. The reasons for this are many, but one of the major reasons has been identification with unrealistic information.

Major causes of unrealistic information include competitive budgetary pressures and the inaccessibility of realistic information. Since budgetary pressures are caused partially by uncontrollable political factors, they are beyond the scope of this paper. The issue I address in this paper is the second cause, the inaccessibility of realistic information and its impact on acquisition process credibility.

System acquisition management (SAM) decisions made by major program managers are based on the best information available in the program management office (PMO). Because of personnel and cost limitations, the amount and currency of SAM information available in the PMO is limited. To obtain more complete and more current information for making better and more realistic decisions, the program manager must seek additional external SAM information. This brings him face to face with the problem of inaccessibility of information.

The Inaccessibility Problem

Basically, the problem has developed as the result of the interaction of four factors: the increasing need for SAM information, the availability of modern tools for processing information, the nature and existence of SAM information, and the nature and location of information sources.

Need for SAM Information. Implementation of Office of Management and Budget (OMB) Circular A-109[1] and increasing emphasis on improving the system acquisition process have both contributed to the increased pressure for more and better SAM information.

Modern Information Handling Tools. Extensive improvements in data processing and communications systems have provided new capabilities for rapid handling and processing of information. This has resulted in new vistas for information and increased pressure for better utilization of existing information.

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1. Office of Management and Budget Circular No. A-109, "Major Systems Acquisition," April 5, 1976.

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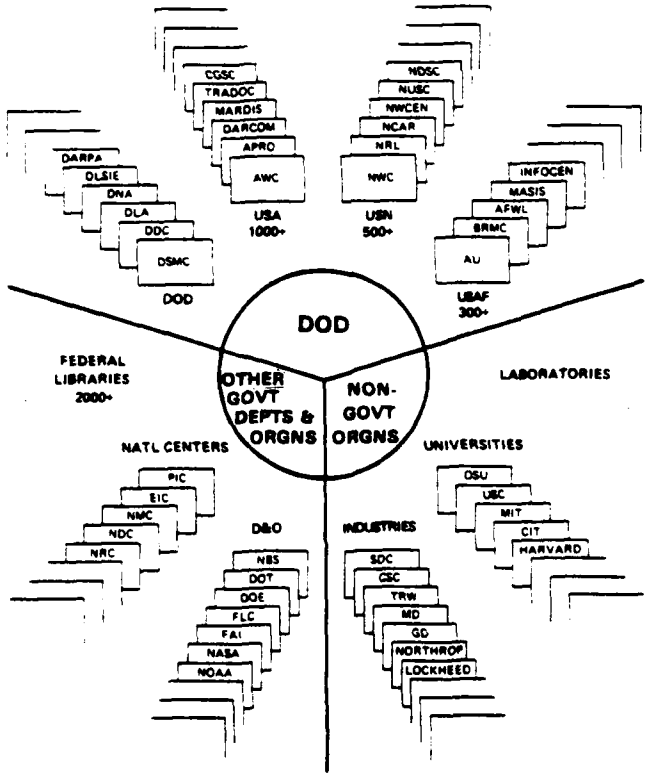
Nature/Existence of SAM Information. SAM information exists largely as kernels of information embedded within the overall mass of universal information. To be used effectively, the SAM information must be located, extracted, analyzed, and refined into a form suitable to fit the user's needs.

Nature/Location of Information Sources. The sources in which SAM information is embedded number in the thousands (Figure 1). These sources are scattered, unconnected, often redundant, and uncoordinated. Each source has its own individual system for accessing the information. Much of the pertinent SAM information has not been specifically identified with the system acquisition process or cataloged in a manner that enables it to be retrieved readily. Many different

FIGURE 1
SAM Information Sources Are Numerous



non-standard indices are used for cataloging the information. Much of the information is in data bases that are accessible only through manual search, or through a combination of manual and limited computer search.

It is possible to conduct searches of these scattered, obsolescent sources in a rudimentary manner provided that there are no constraints on time, manpower, and cost. However, it is the interfacing of these incompatible, obsolescent information sources with the modern information handling tools that make up the inaccessibility problem.

The Proposed Solution

The information system proposed here is intended to solve the inaccessibility problem by providing to the user a system for access to each of the major sources of SAM information, but, to the user, the system would appear to have a single point of access. This will provide the program manager, or other user, with easy access to the information he needs so that his decisions can be based on the best and most current information available.

System Development Concept

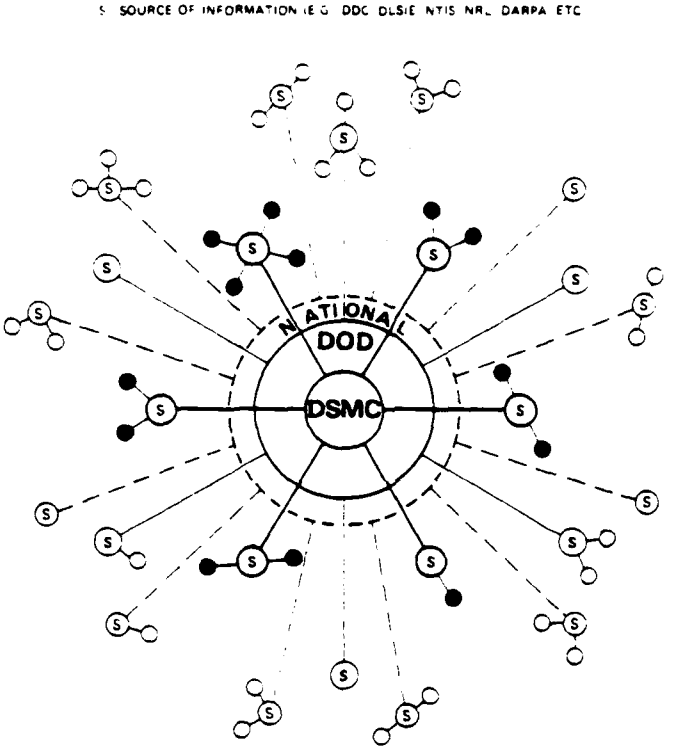
The concept calls for evolutionary development of the system acquisition management information service center (SAMISC) in three stages, as indicated in Figure 2.

First Stage. A basic system will be developed to service primarily the Defense Systems Management College (DSMC) and to provide a proven baseline system for expansion into a Department of Defense (DOD) system. The DSMC system will provide for access to existing sources of acquisition management information. These sources may be either single in nature, or already netted with other information nets. In the latter case, the existing net may provide the DSMC system with access to several sources.

Second Stage. A DOD-level system will be developed to net with other DOD sources and to function as a prototype for expansion into a national system if feasible and desirable. The DOD system will add existing sources to those accessed in the first stage. Again, these may be either single sources or multi-source nets.

Third Stage. A national-level system, subject to sponsorship of the Federal Acquisition Institute (FAI), or other federal agency if desired, may be developed to service all of the Federal Government and non-governmental organizations and agencies involved with acquisition management information. If developed, the national system would encompass all of the DOD system and add numerous additional sources to the DOD net.

FIGURE 2
Three-Stage System Development Concept



Information Services Concept

The services concept is similar to that of the legal information services provided by the U.S. Air Force-operated federal legal information through electronics (FLITE) system authorized by DOD Directive 5160.64.[2] The SAMISC will provide a single point of contact for users needing access to acquisition management information. The SAMISC will be contactable electronically at all times; contact by other means, e.g., telephone, will also be available during normal

2. Department of Defense Directive Number 5160.64, "Federal Legal Information Through Electronics (FLITE)," October 9, 1974.

operating hours. Provision will be made for storage of queries during periods outside of normal operating hours.

SAMISC users will not need any special training for use of the services. Response time during normal operating hours will be limited only by the capabilities of the data processing and communications systems employed.

Each query will elicit one of two responses. If the requested information is available electronically in the SAMISC system, a direct reply to the query will be made with specific information. Otherwise, the requestor will be provided information as to the best source(s) of the specific information.

System Design Considerations

Two major factors have significant influence in the design of the system. First, the information services center must be compatible with the informational needs of DSMC, DOD, and the Federal Government; in the long term this implies a national-level system. Second, electronic media are replacing microform media; this will make the information more accessible for analysis by a small group of people, and will facilitate processing and dissemination.

To minimize risk, it is planned to utilize state-of-the-art technology. To keep costs reasonable and to conserve time, existing data processing systems and communications systems will be used insofar as practical. At the same time, strong consideration will be given to adapting the system for accommodation of five recognized important trends in information transfer systems.[3] The first of these, electronic media replacing microform media, has already been mentioned above. The other four are as follows:

—The trend of scientific bibliographic information systems toward becoming a comprehensive, international, cross-disciplinary and integrated data resource accessible through single access points;

—The trend of information analysis services becoming increasingly as important as a component of total technical information systems;

—The trend of factual data services toward becoming the highest payoff area for increased scientific and technical information service;

—The trend of information access becoming more dependent on direct user interaction with the system.

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3. Jerome T. Maddock, *et al.*, "DDC 10 Year Requirements and Planning Study, Volume II: Technical Discussion, Bibliography and Glossary," pp. 56-57, Auerbach Associates, Inc., June 13, 1976.

System Benefits

It is anticipated that the SAMISC will result in substantial benefits to DSMC and users of the system. Major benefits will include:
—Improved management of information resources;
—Improved performance of acquisition research and information dissemination missions;
—Improved execution of the DSMC educational mission;
—Increased visibility and communication among acquisition managers (DOD and industry);
—Provision of: a framework for unifying SAM information sources, SAM information users, and SAM information; a single point of access for all SAM information; a vehicle for defining, preserving, evaluating, translating, and transferring the SAM experience from each major system acquisition program to all ongoing and subsequent acquisition programs.

System Affordability

As is customary with any new system, it is necessary to ask if we can afford these benefits. Affordability of the SAMISC was examined in terms of three factors: cost savings, reasonableness of cost, and time savings.

System Cost. Rough estimates of the cost of development, test and operation of the three stages of the evolutionary system indicate that the total cost will be on the order of $24 million over a period of about 16 years. This total cost will include $2.5 million for development and test of the DSMC-level system over 6 years, and $2.0 million for operation of the DSMC system for an additional 4 years.[4]

Cost Savings. Two assumptions were made regarding cost. First, an average of 150 major DOD acquisition programs will be in process at any time. Second, each of these major DOD programs will be spending an average of x dollars annually for systems acquisition information of the type that would be available through the SAMISC.

Let's consider system benefits only to the 150 major DOD acquisition programs. The cost of development of the DSMC-level system will be less than an annual expenditure of $3,000 by each major DOD acquisition program. Similarly, the cost of developing the DOD-level system would be less than $6,000 per

4. Fred E. Rosell, Jr., "Accessibility of System Acquisition Management (SAM) Information, Milestone I," Briefing for Department of Research and Publications, Defense Systems Management College, December 21, 1978.

year, and the national-level system less than $10,000 per year.[5] On this basis, the national system annual cost for each major program would be less than the cost of one GS-5 secretary.[6]

Likewise, the $2 million annual cost of operating the national system after development would be less than an annual expenditure of $15,000 by each major DOD acquisition program. This is less than the cost of one GS-9 technician per major program.[7] The cost of operating the DSMC-level system would be less than an annual expenditure of $4,000 per year for each major program.

It is necessary to emphasize that these are rough estimates of cost based on development of similar systems. Even if the system cost estimates should prove to be underestimated by 100 percent, the cost of developing the DSMC-level system would still be substantially less than an annual cost of $10,000 for each major program.

Cost Reasonableness. To determine if the cost of an information system is reasonable, it is helpful to compare its cost with the cost of a few existing systems of comparable complexity. The Library of Congress, with computerized listings exceeding 600,000 and about 13,000 information resources, has an annual operating budget of $128 million;[8] this is 64 times as large as that of the proposed national-level system. The National Technical Information System (NTIS), with computerized listings exceeding 600,000 and annual acquisitions of about 60,000, has an annual budget of $22 million;[9] this is 11 times as large as that of the proposed national-level system. The Defense Technical Information Center (DTIC), with holdings exceeding 1.2 million documents and annual acquisitions of about 30,000, has an annual budget of $14 million;[10] this is seven times as large as that of the proposed national-level system. The National Aeronautics and Space Administration (NASA), with holdings of more than one million documents,[11] has

5. Fred E. Rosell, Jr., "Development of a System Acquisition Management Information Services Center (SAMISC)," Briefing for Commandant, Defense Systems Management College, January 17, 1979.

6. Salary of GS-5 secretary ranges from $11,243 to $14,618 per annum, General Salary Schedule, October 1979.

7. Salary of GS-9 technician ranges from $17,035 to $22,147 per annum, General Salary Schedule, October 1979.

8. Telephone information provided by various offices of the Library of Congress, November 6, 1978.

9. National Technical Information Service, "Current Published Searches from the NTIS Bibliographic Data File," U.S. Department of Commerce, January 1978, and telephone information provided by Budget Office, NTIS, November 6, 1978.

10. Fred E. Rosell, Jr., "Trip Report—Visit to Defense Documentation Center (DDC), May 16, 1978," Defense Systems Management College, May 24, 1978, and telephone information provided by various offices, Defense Documentation Center, November 6, 1978.

11. Fred S. Dyer, "Federal Information Systems," *AGARD Lecture Series No. 69, How to Obtain Information in Different Fields of Science and Technology—A User's Guide*, pp. 4-6, North Atlantic Treaty Organization Advisory Group for Aerospace Research and Development, May 1974.

an annual budget of between eight and nine million dollars for its scientific and technical information facility and seven technology utilization centers;[12] this is about four times as large as that of the proposed national-level system.

Time Savings. One assumption is made regarding system utility: If the SAMISC can provide systems acquisition information to major DOD acquisition programs more expeditiously than they themselves can obtain or develop the information, then the SAMISC will save some time for these programs. Suppose the system saves each program a minimum of just one week of time each year. Even with this conservative estimate, the SAMISC would then be saving the equivalent of three program years of time annually.

So far we have been very conservative and have considered the savings only for the 150 major DOD programs. Now, if we add to these savings the potential savings in cost and time from all of the other potential DOD users, and potential non-DOD users, we must conclude that we cannot afford to not afford the SAMISC.

Recommendation

The following action is recommended:
—DOD proceed with development of the DSMC-level SAMISC as the first stage in the evolutionary development of the DOD-level system;
—DSMC be designated as the focal point for DOD system acquisition management information;
—FAI be encouraged to sponsor, or to arrange a sponsoring organization for the national-level system. ‖

12. Telephone information provided by various offices of the National Aeronautics and Space Administration, October 16, 1978.

The Inefficiency of Sealed-Bid Competition

42

James M. Corey

When purchasing many of the less complex goods and services for the Federal Government, acquisition managers often use the sealed-bid competitive process. That is, the specifications are issued, firms submit bids, the low bidder wins, and all of the bids are made public.

The benefits of this approach are well known—the sunshine of public oversight discourages graft and favoritism. The costs of this approach are less visible and, therefore, less appreciated.

Economists claim that public disclosure of bids stunts competition, which in turn results in higher prices. The difference between these higher prices and the lower prices that would be paid in a more competitive environment are the costs of the sealed-bid procedure. Paul Cook expressed the predominant economic view when he said that it would "be hard to find a device less calculated to foster open and aggressive competition among sellers."[1] The purpose of this paper is to review the rationale for claiming that these costs exist.

Oligopoly Pricing—The Theory

In a highly competitive market with many sellers, sealed-bid competition is not likely to cause serious inefficiencies. It is only in the oligopolistic markets that problems occur. Oligopolistic markets are those markets with so few sellers (from 2 to about 6–10 firms) that the price and output decisions made by one will affect the price and output decisions (and profits) of the other firms. Usually, barriers to entry, such as large-scale economies, powerful brand names, or formal cartel restrictions, keep the number of firms in the market from increasing. Examples of national oligopolies in the United States include the electric generator, steel, aluminum, and light bulb industries. Various other oligopolies exist in more limited geographical markets where the costs of transportation are great; common examples are cement, brickmaking, and milk production.

Many theories have been developed concerning the difficult problem of oligopoly pricing. All contain the common suggestion that oligopoly firms together can behave as if they were one monopolistic firm. That is, they can reduce output to a less-than-competitive level, and increase price above the competitive level to the point where the aggregate profits of the firms are maximized.

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1. F. M. Scherer, *Industrial Market Structure and Economic Performance* (Rand McNally, 1970), p. 210.

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To perform in this manner, complete cooperation of all the firms is required when setting the prices and aggregate production level, and when parceling out market shares.

The problem, from the oligopolist's point of view, is that any firm can reap higher short-run profits by cutting its price and significantly increasing the quantities sold. If the price-cutter were adamant in keeping the price at the low level, other oligopolists would be forced to reduce prices in order to regain lost sales. Once all had lowered their prices, each would be selling a slightly higher quantity at a lower price, and aggregate profits would be less than before the price war.

Simple game theory illustrates the pricing jungle of oligopoly (Figure 1). Assume that the market consists of two similar firms, X and Y. Each can price goods at either \$10 or \$12 (P_x = 10, 12 and P_y = 10, 12). Each quadrant represents one course of action that the businesses can take; the profits that each firm earns during that course are designated by π_x and π_y.

FIGURE 1
Two-Firm Game for Oligopoly Pricing

	$P_y = 12$	$P_y = 10$
$P_x = 12$	$\pi_x = 6$ $\pi_y = 6$	$\pi_x = -2$ $\pi_y = 9$
$P_x = 10$	$\pi_x = 9$ $\pi_y = -2$	$\pi_x = 1$ $\pi_y = 1$

If one further assumes that each firm will act to increase its own profits, an equilibrium solution exists. For example, if the beginning situation was the northwest quadrant, each firm would be earning \$6 profit. X could earn \$9 profit by reducing his price to P_x = \$10 (southwest quadrant). Once in this position, Y would incur losses of \$2, and would react by lowering its price to P_y = \$10. Consequently, action would stabilize in the southeast quadrant with both firms earning profits of \$1.

If one assumes that managers of X and Y could coordinate activities (perhaps through a cartel), each would establish a price of \$12 and hold it there in order to

earn $6 profit (northwest quadrant). Each would have to suppress the urge to cut prices in order to gain those short-run $9 profits. In this idealized model, as in the real world, coordinated action is the key.

Oligopoly Pricing—The Real World

In the United States, we depend primarily on the free-enterprise system for goods and services. A prerequisite for free enterprise is competition; competition, by definition, excludes cooperative behavior among oligopolistic firms. Consequently, active cooperation is labeled "collusion" and is outlawed by the Sherman, Clayton, and Federal Trade Commission Acts. Nonetheless, even though active price coordination is illegal, there exist legal means whereby oligopolists can tacitly coordinate their behavior. These include:

—*Price Leadership*. Tacit agreement is made among the firms to follow the price made by one leader. In a well-disciplined oligopoly, the effect will be a relatively stable, comfortable environment with high profits.

—*Markup Pricing*. Tacit agreement is made for members to price their goods at a certain percentage markup over a (usually common) cost of production. In effect, the oligopolists are imitating each other in establishing cushiony prices and therefore are discouraging active price competition.

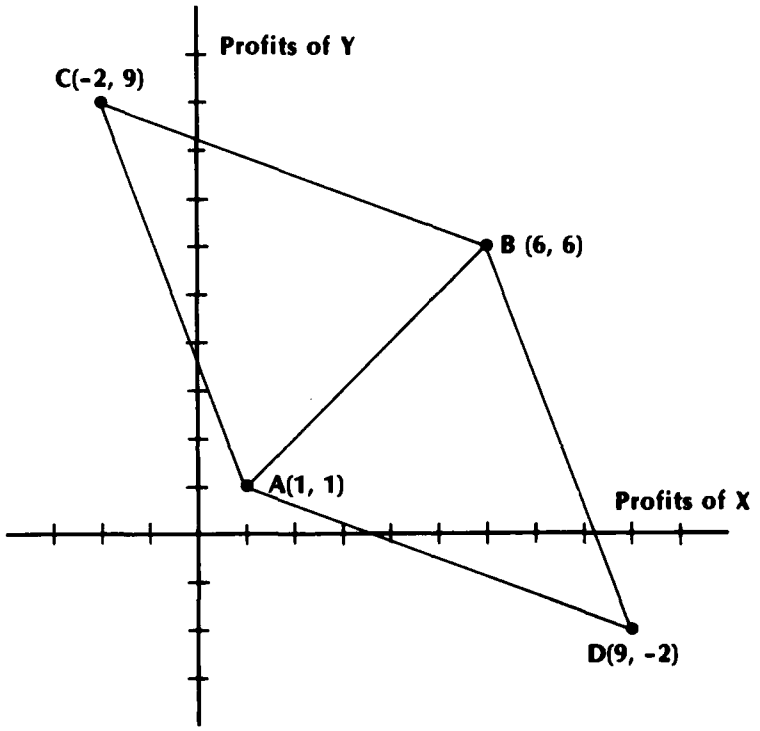
—*Focal-Point Pricing*. Tacit agreement is made among oligopolists to establish prices at certain benchmarks, e.g., always ending the price with $.99 (price equals $1.99, $2.99—never $2.25). Among other things, the large discreet jumps for prices tend to stabilize them and to discourage vigorous price competition.

These pricing strategies serve as a means of communicating to each firm what the others are doing. This exhibitionism signals what the coordinated price is and provides (a varying degree of) mutual assurance that no single firm is undercutting the group by selling at a lower price.[2] The incentive to cheat is extremely strong; if one is given the opportunity to break discipline without his cohorts discovering the fact, the probability of a price reduction is high. However, if the oligopolist knows that his cheating will be discovered, the probability of faltering price discipline is substantially reduced.

These coordinating devices allow a continuum of market solutions to exist between competition (lowest price, highest quantity) and collusive oligopoly (highest price, lowest quantity). In Figure 2, firms *X* and *Y* of the previous exam-

2. The Federal Trade Commission recently accused four oligopolists with signaling price changes via newspaper stories in order to coordinate prices (see "Makers of Antiknock Additive Hit By FTC for Price Signaling in the Press," *Wall Street Journal*, 1 June 1979, p. 14). Even though price signaling in the press may be illegal, and price signaling via public sealed bidding is legal, the economic effects of each are identical; both activities reenforce collusive-like behavior.

FIGURE 2
Mapping of Profits for a Two-Firm Oligopoly



ple are viewed again. Point A shows the competitive solution to their oligopolistic market (corresponds to the southeast quadrant in Figure 1); point B shows the collusive solution when maximum cooperation occurs (corresponds to the northwest quandrant in Figure 1). Points C and D follow analogously and correspond to the northeast and southwest quandrants, respectively.

The line connecting A and B represents points where the oligopoly firms are charging equal prices and sharing equal profits. It is the "profit path" that firms X and Y would follow in going from no collusion (A) through the various degrees of price "coordination" to complete collusion (B). One can imagine our (legally behaving) U.S. oligopolies as lying somewhere along this path—those with little pricing discipline would lie close to point A, and those with more discipline would lie further from A.

Sealed-Bid Competition

The rationale behind Paul Cook's indictment of sealed-bid competition is now established. One could add this procurement technique to price leadership, markup pricing, and focal pricing, and call it the "price coordinator *par excellence*"; anything the former three pricing strategies do for the oligopolists, sealed bidding can do as well or better. When one takes bids and makes them public, a perfect transfer of information occurs among the oligopolists. The probability of a cheater being caught is 100 percent; therefore, the probability of cheating is extremely low. If secret negotiations were used, the oligopolists would be denied this valuable intelligence, and would certainly break pricing discipline more often.

The economic question for the acquisition managers then becomes: Are the costs incurred by supporting coordinated oligopolistic behavior greater or less than the costs that would be incurred due to increased favoritism and graft if more contracts were secretly negotiated? I am unaware of empirical tests of this question. However, the following evidence indicates that the efficient solution may be to negotiate more secret contracts and have less sealed bidding. Private firms desire to maximize profits and therefore have a strong incentive to minimize costs. They practically always use secret negotiations instead of sealed bidding. Consequently, secret negotiations are likely to be the more efficient alternative.

Conclusion

More than any other group in defense, acquisition people operate within and around private enterprise. They need to know, and must impart to other managers, the facts of life involved in dealing with the free markets. The foremost of these facts is that some markets do not fit the "perfect competition" mold, and are better explained by the oligopoly models.

In order to operate efficiently, the Department of Defense must adapt policies to the real-life situation and, when necessary, lobby for modern acquisition policies that do not limit its abilities to perform in the most efficient way. ||

47 Controlled Competition for Optimal Acquisition

Kenneth S. Solinsky

In the procurement of specialized or "state-of-the-art" systems, often there are a limited number of companies capable of meeting the government's requirements. In such cases, a conflict exists between the short-term financial considerations that favor obtaining the entire buy from the lowest-priced responsive and responsible offeror, and the long-term financial and industrial mobilization considerations that favor maintaining multiple sources. This conflict has traditionally been resolved by determining the quantity split between the prime and the alternate sources, e.g., 60 percent for the prime and 40 percent for the alternate, then negotiating two sole-source contracts. The underlying assumption here is that the prime source will bid the lowest price. This approach, while preserving the production base, fails to introduce competition into the process, and therefore results in higher prices for the government.

A simplistic way to ensure that there is a degree of competition in the award is to announce that two sole-source awards will be made, with a predetermined majority of the procurement quantity, e.g., 60 percent, going to the company submitting the lower-priced, responsive and responsible offer. Although, theoretically, this technique does interject a degree of competition into the process, it is defective for the following reasons:

—A fixed-quantity split results regardless of whether the price differential is small or large.

—One or both of the companies could decide that the smaller quantity is sufficient, resulting in ineffective competition since they would feel no compulsion to be the low bidder.

—There is no incentive for a new company to approach the price it estimates a more experienced competitor will submit. A corollary to this is that an established manufacturer, knowing a competitor cannot beat his price, has no incentive to submit his best offer.

Author's Note: I would like to acknowledge the dedicated efforts of Major Carl Messenger, who was the contracting officer for the procurement cited in this paper. I also want to acknowledge contributions made by people of the U.S. Army Electronics Command's Night Vision Laboratory, Procurement Directorate, legal office, and command group, whose support and comments made this procurement strategy both possible and successful.

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During May through February 1978, a procurement approach was formulated and successfully implemented by the U.S. Army Electronics Command (ECOM) to achieve effective competition while preserving the industrial base which, at the time, was limited to only two qualified producers. In this approach, the quantity split was determined as a mathematical function of the difference in prices actually proposed. The mathematical function was designed to create a balance between minimum near-term procurement costs and effective industrial mobilization.

The Procurement Approach

At the time of this particular procurement cycle, only two companies were qualified to produce a sophisticated night vision system. One company had been the development contractor and, up until the time of this solicitation, had production contracts totaling about 6,900 units. The second company was the alternate source established to provide competition and an industrial mobilization base. Before the issuance of this solicitation, the second company had production contracts for about 2,900 units.

When this solicitation was issued, the monthly production rates at the first and second sources were approximately 230 and 40, respectively.

Under the provisions of the production plan, a sole-source contract was to be awarded to each of the two qualified producers for a total of 10,284 systems and 3,608 spare critical components.[1] The production plan stated that the quantities to be awarded each company would be based on competitive-range bids. Furthermore, the secretarial determination and findings (D&F), which authorized procurement by negotiation, stated that "such division will be made by evaluation of competitive-range bids and determined based on price and/or other factors considered to be in the best interest of the government." Because each contract was for 2-year multiyear awards, a sole-source ASPR deviation was obtained under 3-216.

Relating Price Difference to Quantity Split

Before the solicitation was issued, a mathematical equation was devised that could be used to determine the proper split of the procurement quantities between the two companies based on the difference between their proposed prices. This equation represented management's assessment of an equitable balance between the short-range goal of procuring the current quantity at the lowest possible price, and the long-range goal of maintaining a competitive industrial base.

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1. For simplicity, this paper will not specifically address the split of the 3,608 spares, which was handled as a parallel action identical with the splitting of the 10,284 systems.

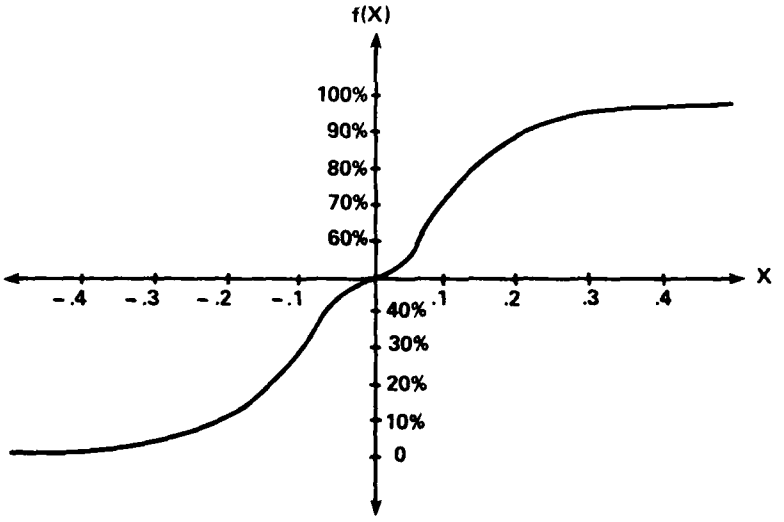
The equation used to determine the quantity split as a function of the difference in proposed prices was as follows:

$$\begin{array}{l}\%\text{ of procurement} \\ \text{quantity for Company A}\end{array} = f(x) = \left[\frac{x}{|x|}\left(\frac{\arctan(75x^2)}{90}\right)+1\right] 50\%$$

$$\text{Where } x = \frac{\text{Company B Price - Company A price}}{\text{Company B price + Company A price}}$$

This equation is represented graphically in Figure 1.

FIGURE 1
Equation Used in ECOM Procurement



The symbol x was chosen as the difference in proposed prices divided by the sum of the proposed prices. This was done to reflect the fact that the significance of a given price difference is actually dependent on an item's price. For example, the difference between two prices for an item of $1,000 and $2,000 is more significant than a difference on some other item of $10,000 and $11,000, even though in both cases the actual difference is the same. Also, by dividing by the sum of the prices, the equation becomes independent of who is called Company A and who is called Company B.

Partly because it was considered desirable for both companies to be producing at comparable rates and partly because of the difference in experience between the two companies, it was decided that the split should be a mild one if the prices were close. The curve is therefore relatively flat in the 50-percent split range.

It was determined that in order to be a viable producer and thus become an active part of the industrial mobilization base, a company would need to receive at least 10 percent of the award. It was felt that jeopardizing the industrial base by awarding less than 10 percent to a company could only be justified if the price difference was great. With the equation used in this case, a 90 percent–10 percent split occurs when one company's price is 50 percent higher than the other's.

In determining a quantity split as a function of a price difference, it is important that the functional relationship used accurately reflect management's acquisition concepts.

The equation presented in appendix A is of the general form:

$$f(x) = \left[\frac{Ax}{|x|} \left(\frac{\text{arc tan } B|x|^c}{90} \right) + 1 \right] 50\%$$

By changing the constants, A, B, C, this general equation can be modified to meet a wide range of management concepts. This is shown in Figures 2, 3, and 4.

FIGURE 2
Effect of Changing A While Keeping B = 75 and C = 2

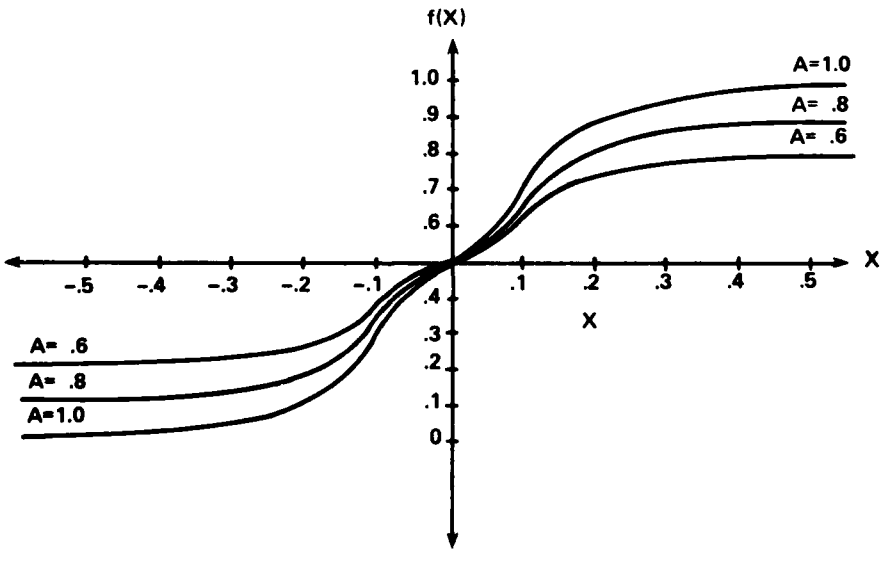
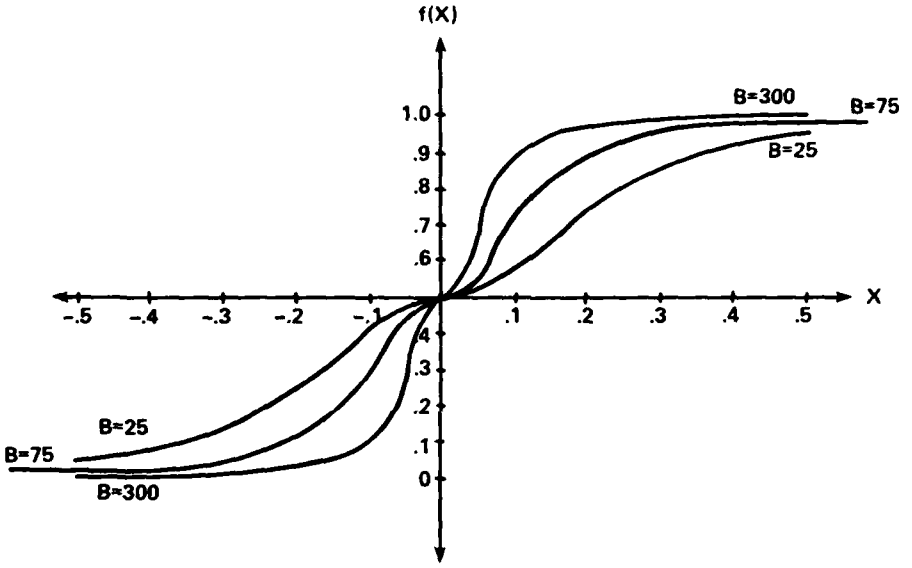


FIGURE 3
Effect of Changing B While Keeping A = 1 and C = 2

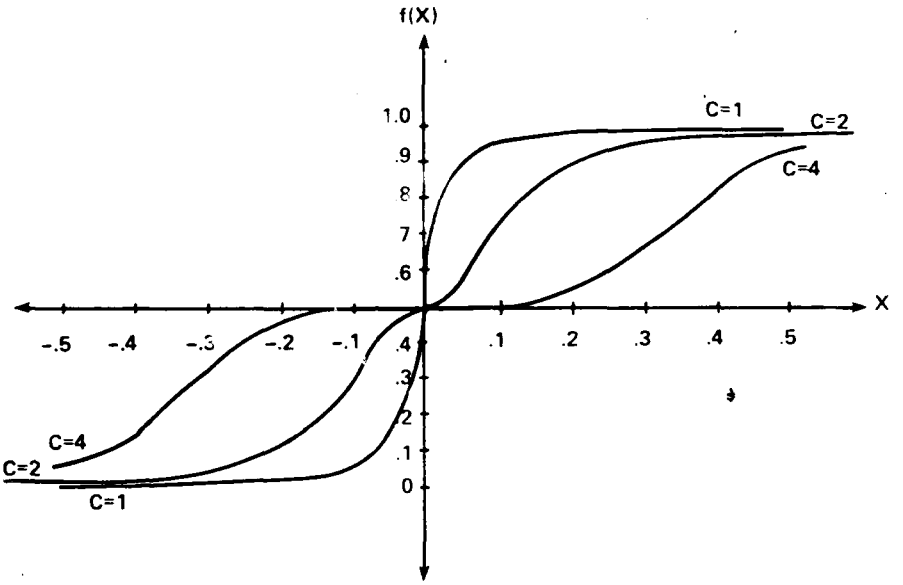


In tailoring the general equation to a specific procurement, all three constants (A, B, and C) should be varied in combination to achieve the desired relationship between the price difference and the quantity split.

This general equation can accommodate a large number of situations, but there are circumstances when you might find that it cannot be adapted to the needs of a specific procurement. In such cases you can develop any other relationship that will relate the price difference to the quantity split. While it is desirable that the relationship between price difference and quantity be plotted as a continuous function, this is not essential. Step functions, ramp functions, and tables are some other ways of expressing the relationship. The important thing is that before issuing the solicitation, an explicit relationship must be written to relate the difference in proposed prices to a split of the total procurement quantity.

Although the procurement strategy presented in this paper deals with splitting a procurement quantity between two producers, the concept is easily expandable to splits among three or more producers. To do this for three companies, you must determine the split between Companies A and B as a function of their proposed prices, then determine the split between Companies B and C as a function

FIGURE 4
Effect of Changing C While Keeping A = 1 and B = 75



of their proposed prices. (The equation used to determine the split between Companies A and B need not be the same as that used to determine the split between Companies B and C.) Three equations are then established: one relating the percentage for Company A to the percentage for Company B; another relating the percentage for Company B to the percentage for Company C; and the third reflecting that Companies A, B, and C combined receive the entire procurement quantity. These three equations can then be solved simultaneously to find the percentage of the total procurement quantity that each company receives. This can be expressed mathematically as follows:

Let p = portion determined for Company A relative to the total for Companies A and B combined.

Let p' = portion determined for Company B relative to the total for Companies B and C combined.

Then:
$$\frac{\text{portion for Co. A}}{\text{portion for Co. A + portion for Co. B}} = p$$

$$\frac{\text{portion for Co.B}}{\text{portion for Co. B + portion for Co. C}} = p'$$

$$\text{portion for Co. A + portion for Co. B + portion for Co. C} = 1$$

Solving these three equations simultaneously yields:

$$\text{portion for Co. A} = \frac{pp'}{1-p+pp'}$$

$$\text{portion for Co. B} = \frac{p'-pp'}{1-p+pp'}$$

$$\text{portion for Co. C} = \frac{1-p-p'+pp'}{1-p+pp'}$$

If there are more than three companies, say n companies, among which the total procurement quantity is to be divided, you could form n equations with n unknown quantities, which could be solved to give the portion of the total procurement to be awarded to each of the n companies.

The Solicitation

In the case of the ECOM Procurement, both Section D of the solicitation (RFP) and an executive summary that accompanied the solicitation explained how the quantity to be awarded each contractor would be determined. The solicitation was very specific in this regard, and even contained a detailed illustrative example; it did not disclose the equation to be used. The equation was withheld because it was felt that the contractors should submit their best price, in competition with each other, rather than trying to jockey for position on a mathematical curve.

The solicitation instructed the prospective contractors to submit prices for seven quantity ranges. These ranges, which ran from 2–2,000 units at the low end to 12,002–14,000 units at the high end,[2] encompassed all possible splits of the

2. Because the contracts were to be 2-year, multiyear awards, it was necessary to request separate range bids for each year. Thus, the actual solicitation has ranges from 1–1,000 units to 6,001 to 7,000 units, for the first year, and identical ranges for the second year. The ranges were then combined to give the effective ranges indicated above.

total Army procurement, plus additional requirements that might have been generated by other government agencies or foreign military sales (FMS).

It was stated in the solicitation that, for purposes of determining the quantity split, the price proposed for the range encompassing one-half the total procurement quantity would be used. The solicitation also instructed each manufacturer to indicate the dollar amount of government-furnished equipment (GFE) to be used on a resultant contract; also that this amount, along with the dollar amount for separately priced software, would be applied on an amortized basis to the proposed hardware prices. Additionally, it was stated that if an offeror's price was greater for a quantity range larger than that used in the split determination, the government had the right to award a quantity within the evaluated range.

Sequence of Events

Upon receipt of the proposals, the pricing portions were extracted and locked in a safe. The technical portions of the solicitation were evaluated, and technical discussions with each offeror were conducted. After the discussions, each offeror was informed of agreements reached between the government and the other company, and told that the government was willing to have similar agreements with him concerning terms, conditions, and technical requirements. At the completion of this process, each company was requested to submit updated pricing information. The pricing proposals were then opened and found to be adequate. No additional requirements materialized from other government agencies or from foreign military sales, so the total procurement quantity remained equal to the Army's requirement of 10,284 units. The range that encompassed one-half the total procurement quantity was, therefore, range C, 4,002-6,000 units. The prices quoted by each company for range C, after adjustment to reflect GFE and software costs, were put into the mathematical equation; the quantities to be awarded each contractor were determined; and the contractors were notified.

From this point on, the procurement process followed conventional procedures leading to two sole-source awards. Proposed labor hours, material usage, and yield rates were evaluated by the cognizant technical personnel, and audits were performed. Procurement pricing personnel reviewed the information provided and made inputs to the contracting officer. In the case of the company with the lower offer, his price was found to be fair and reasonable, and further negotiation was unwarranted. With regard to the higher-priced offeror, price negotiations were entered into and, after a modest price decrease, agreement was reached. Two fixed-price, sole-source contracts were subsequently awarded.

Results

The two contract awards totaled nearly $74 million. This represents a savings of approximately $7 million from budget estimates, and is attributable to the introduction of competition. Perhaps what is even more significant is that it was the "alternate source" who submitted the lower price and thus captured the majority of the procurement. Had a conventional procurement strategy been used in awarding the two sole-source contracts, the major quantity would have been designated for the more established producer who had been the low bidder in the past, and who was projected to be the low bidder on this procurement. All this means that the use of this innovative procurement strategy resulted in a government savings of approximately $7 million; the introduction of effective competition into the procurement; and the continuation of an established mobilization base.

Note also that, as a result of the competitive element in this procurement approach, the time required for price negotiation, particularly with the low offeror, can be reduced, thus shortening the entire procurement cycle.

Conclusion

The simple technique of splitting a procurement quantity between two or more producers based on a fixed ratio (e.g., 60 percent vs. 40 percent), is often ineffective and inequitable; however, by developing a functional relationship between the proposed prices and the split of the total procurement quantity, effective competition can be introduced in a controlled manner. Management can then strike an optimal balance between the benefits to be derived from competition, and the benefits to be derived from an industrial mobilization base. ‖

Buying Commercial: What Works and What Doesn't

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Dr. Richard A. Stimson
Marilyn S. Barnett

The Defense Logistics Agency (DLA) buys large volumes of commercial and near-commercial products for the military services—approximately $8 billion in fiscal year 1978. Therefore, DLA has been closely involved in the push by the Office of Federal Procurement Policy (OFPP) to re-evaluate the role of government specifications in acquiring commercial products. The OFPP policy release in May 1976 established a program for the acquisition and distribution of commercial products (ADCP). Several studies and papers, such as the Report of the Commission on Government Procurement in 1972, have been written concerning the desirability of eliminating government specifications. Their conclusions, for the most part, are not supported by research results and have not been operationally tested. Rather, they stem from anecdotal stories concerning poorly written specifications such as the one for mouse traps. Generally, a complete evaluation of the advantages and disadvantages of specification buying is lacking. A further discussion of these issues can be found in the *Defense Management Journal*, October 1976.[1]

The DLA has been operationally testing the "buy-commercial" policy through an incremental pilot test approach. The test is designed to provide documented cases of commercial acquisitions without traditional specifications. This "learn-as-you-go" approach permits the flexibility to adjust quickly to "what works"; and, at the same time, prevents catastrophic failure that could result if premature full-scale acquisition were attempted in an environment of uncertain policy.

Early pilot test acquisition techniques, such as scrubbing down 20-page towel and underwear specifications, won a great deal of popular acclaim. They received mention at a presidential press conference,[2] made the front page of the *Wall Street Journal*,[3] and were publicized in *Business Week*[4] as the beginning of a reverse in bureaucratic red tape.

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1. Richard A. Stimson and Marilyn S. Barnett, "Buying Commercial: Why Not?" *Defense Management Journal*, Vol. 12, No. 4, October 1976.
2. "Free Enterprise Day Interview with the President," *Presidential Documents*, July 7, 1978.
3. Kenneth H. Bacon, "Military-Industrial Complex Becoming a Wee Bit Less So," *The Wall Street Journal*, September 22, 1978.
4. "Searching for Tools in the Inflation Fight," *Business Week*, No. 2555, October 9, 1978.

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The notion of a government program that actually reduces paperwork or complexity is wonderfully seductive. But reduced complexity as an objective has to be measured against DLA's primary mission—supplying the right item to the soldier who needs it. Consequently, the test includes customer feedback to validate the results of new acquisition techniques.

We will explore the acquisition techniques used and the preliminary results obtained, and conclude with an assessment of future application of these techniques in commercial product acquisition.

DLA Study Design

Seventy-two items were selected for the test. Table I lists representative examples that cover a broad range of DLA commodities. The items were selected so as to involve all six of the DLA buying centers located in Virginia, Ohio, and Pennsylvania.

The following criteria were used in selecting the items:

—Currently procured to a federal or military specification.

—Reasonably high level of annual usage, preferably in excess of $10,000 so that several buys could be conducted in a formally advertised environment.

—Reasonable potential of locating acceptable commercial items.

Although the sample size (72) appears small in relation to the total 1.9 million items managed by DLA, the first two criteria narrowed the field of candidates considerably. We found only about 10,000 specification items with annual demand over $10,000. This constitutes 0.5 percent of the DLA item population.

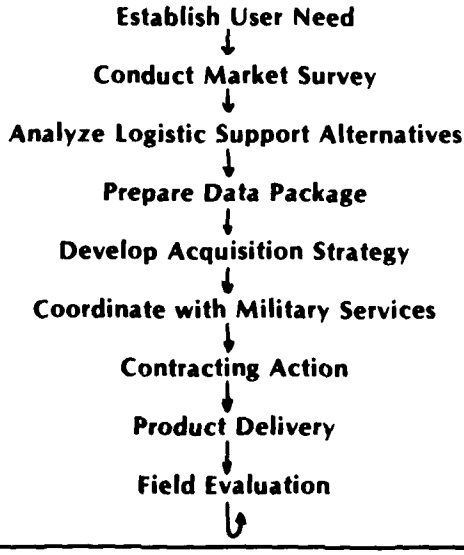
Once the candidate items were selected, the analysis in each case has generally followed the steps shown in Figure 1.

The analytical process started with an assessment of the user need. Generally, current specification requirements served as a point of departure together with

TABLE I
Representative DLA ADCP Candidates

Automotive gasoline	**Handkerchiefs**
Automotive radiator hose	**Indoor thermometer**
Bath towels	**Librium**
Cap screws	**Medical x-ray film**
Chain saw	**Sodium chloride**
Cloth gloves	**Solder**
Electrical conduit	**Soy sauce**
Fireman's boots	**Sugar**
Fuses	**Undershirts**

FIGURE 1
Steps in ADCP Pilot Test



discussion with selected military users. The next step was to determine availability of comparable commercial products, evaluate differences, and determine acceptability. The depth of market research and the techniques applied varied from item to item. The most comprehensive job of market research was performed by the Defense Fuels Supply Center for automotive gasoline, because this pilot procurement was valued at approximately $20 million. Table II lists the sources of data obtained by Defense Fuels Supply Center during the market survey phase.

TABLE II
Market Data Sources

1. **Joint Department of Energy/American Petroleum Institute data.**
2. **Motor Vehicle Manufacturer's Association data.**
3. **State of Maryland technical data (consumer-oriented).**
4. **American Society of Testing and Materials.**
5. **"In-House" data from military laboratories.**
6. **Petroleum producers.**

Based upon the results of the market research, several different "buy-commercial" techniques were developed and coordinated with the military services. Table III reflects the alternatives used in the pilot test. A more detailed discussion of these alternatives can be found in the *Defense Management Journal* of July 1978.[5]

TABLE III
Alternate Acquisition Strategies

ALTERNATIVE	EXAMPLES OF APPLICATION
Multiple award schedule	X-ray film Food service equipment
Brand name or equal/ purchase description (commercial item description	Bath towel Plumbing supplies
Non-government standards	Fuses Automotive gasoline Electrical conduit
Tailored government specification	Forklift trucks

Discussion

A common thread running through the alternate acquisition strategies was reduced reliance on detailed specification of requirements, and greater dependence on established commercial practice.

In some cases, existing General Service Administration multiple award schedules were used, as in the case of photographic film. On medical x-ray film a quasi-multiple award schedule (simultaneous sole-source indefinite delivery type contracts with all four United States manufacturers) was established based upon substantive military service justification that multiple source, brand name film was required.

Beyond these items, however, significant development of additional DLA multiple-award schedules is still under review. There are several disadvantages to the multiple-award approach, such as lack of competitive pricing and the subjective nature of selecting among the variously priced items to meet requirements.

Further, the type and extent of justification required to set forth the basis for negotiation is a troublesome area. Past Comptroller General decisions reject justification that is solely based on providing the user a variety of products to

5. Richard A. Stimson, "Tapping the Commercial Marketplace," *Defense Management Journal*, Vol. 14, No. 4, July 1978.

meet individual needs, unless the multiplicity and complexity of items is so great that it is not possible to determine which individual item best meets varying needs.[6]

The General Accounting Office (GAO) has also ruled concerning the extent of justification required to exercise the statutory exception to formal advertising when obtaining competition is impracticable (10 USC 2304(a)(10)). The Comptroller General determined that negotiation based upon this exception contemplates *impossibility* of drafting adequate specifications, not difficulty or inconvenience.[7] These findings seem to disallow inactivating existing specifications unless one can objectively document that the specification no longer adequately meets government needs.

A similar problem develops in the use of brief, salient characteristic purchase descriptions (pending DOD guidance will designate these as commercial item descriptions, or CIDs), which are coupled with a commercial market acceptability requirement. The market acceptability concept is the cornerstone of the "buy-commercial" hypothesis that brief descriptions, reflecting commercial practice, can substitute for government specifications. It assumes that products which have passed the test of competition and have been accepted in the commercial marketplace should also be acceptable to the government consumers; thus, extensive quality requirements in a specification are unnecessary. Results of DLA attempts to contractually invoke a market acceptability requirement are discussed in the next section of this paper.

Another acquisition approach tested was the use of existing non-government standards. Apart from ADCP, the DOD Standardization Program encourages the use of these standards wherever possible.[8] A traditional problem, however, has been the lack of product-oriented specifications in some commodities, and incomplete documents for procurement (e.g., lacking a quality control section) in others. Additionally, non-government standards have been the target of restraint-of-trade allegations from consumer activist groups and individual companies. The Office of Management and Budget has prepared a draft circular that would set rules for government participation in standards-producing organizations.

Further, the Federal Trade Commission has published a proposed trade rule which, if adopted, would mandate adherence to criteria such as open meetings, a grievance redress system, and product hazard disclosure.[9]

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6. General Accounting Office, Decisions B-121929 and B-122682, February 7, 1956.
7. General Accounting Office, Decisions 76-2CPD462 and 77-1CPD361, December 3, 1976, and May 24, 1977.
8. DODI 4120.20, *Development and Use of Non-Government Specifications and Standards*, December 28, 1976.
9. "Standards and Certification: Proposed Trade Regulation Rule," *Federal Register*, December 7, 1976.

The American National Standards Institute (ANSI) is leading the fight on behalf of non-government standard producing bodies to prevent the issuance of the trade rule. The ANSI claims that if the trade rule as it now stands is published, the production of non-government standards will be significantly reduced, and some standards groups may go out of business. In view of this turbulent situation, it is uncertain at this time how much reliance can be placed on non-government standards for furthering the ADCP program.

The remaining pilot test alternative was use of a tailored specification approach. Specification tailoring is the process of evaluating individual specification requirements and deleting or modifying non-commercial requirements. DLA is using a new fork-lift truck specification in the pilot test prepared by the Army. A unique feature of the specification is a commercial market acceptability requirement built into the document:

> The truck shall be a commercial model...The fork lift shall be the latest model of the manufacturer's standard commercial product and shall have been in production, marketed, and in use for a minimum of one year preceding the solicitation for procurement.[10]

As with the non-government standard approach, specification tailoring is established DOD policy.[11] Therefore, since this technique represents a less radical departure from the past, fewer pilot test complications could be expected.

Results

Results were evaluated in terms of price, quality, small business impact, and bidder response.

Price. One of the driving factors behind the "buy-commercial" policy was to get a better buy for Uncle Sam. Due to the variety of factors and conditions (such as overall economic conditions and trends, inflation, and market forces that contribute to price differences), it's very difficult to isolate and assess the effect of the change in buying techniques on price.

Table IV compares prices paid on seven selected ADCP items with the most recent specification buy. These items were selected randomly from the pilot test program using the criteria that there was less than a 10 percent variation in *quantity* between the two buys. The specification prices were adjusted for inflation using the Department of Commerce Producer Price Indexes for selected products to compensate for the time lapse between the older specification buys and the

10. MIL-T-52932, Specification for Trucks, Lift, Fork, Gasoline Engine Driven, August 24, 1977.
11. DODD 4120.21, *Specifications and Standards Application*, April 9, 1977.

TABLE IV
Specification vs. ADCP Price Comparisons

ITEM	A SPECIFICATION PRICE	B SPECIFICATION PRICE ADJUSTED FOR INFLATION	C ADCP PRICE	D DIFFERENCE (C-B)
1" conduit	$ 1.88	$ 2.17	$ 2.20	$ (.03)
Rubber gloves	17.90	19.87	24.99	(5.12)
Bed sheet	3.45	3.59	3.48	.11
Drawers	.99	1.01	.94	.07
Worcestershire sauce	9.85	10.07	8.01	2.06
Powdered sugar	.27	.28	.28	-0-
Cap screws	1.14	1.38	1.53	(.15)

Higher ADCP price shown in ( ).

most recent ADCP buys.[12] Column D shows the difference between the specification prices adjusted for inflation and the ADCP prices. As these seven cases illustrate, there are no across-the-board price trends, but rather a fairly even mix of higher and lower prices on the commercial buys after adjusting for quantity differences and inflation.

In an effort to control all variables affecting price except the method of specifying requirements, the fuel buying center recently structured a special test buy of fuel oil. Simultaneous solicitations for burner fuel oil were released—2.5 million gallons procured to a federal specification, 2.5 million gallons procured to a non-government standard. The prices bid by 17 suppliers on the two solicitations were identical in all cases. Obviously, the federal and industry specification requirements were so close that there were no substantive product differences and, hence, no price differential.

On some items where both the method of description and the contracting technique were modified, price decreases on the commercial buys were realized. For example, on hydrated aluminum sulphate the technique changed from a definite quantity, federal specification, to an annual requirement-type contract, non-government standard acquisition. Table V compares the unit price on this test buy with a previous contract and shows an estimated $4.92 per bag decrease in cost on the ADCP buy.

12. Department of Commerce, "Selected Business Statistics," *Survey of Current Business*, December 1978.

TABLE V
Aluminum Sulphate Price Comparison

Date	SPECIFICATION BUY	ADCP BUY
Quantity	2 August 1978	4 January 1979
Purchase price	2,900 bags	25,000 bags (est.)
Transportation costs	$13.92 (FOB destination)	$7.50 (FOB origin)
	0.00	1.50 (est.)
Total cost	$13.92	$9.00

Additionally, lower prices were generally obtained in selected commodity areas where significant changes were made to specification marking, packaging, and item characteristic requirements. Table VI depicts price comparisons on all ADCP clothing and textile buys.

With the exception of the electrical worker's rubber gloves, where the price increased substantially as a result of a tight industry capacity situation, lower ADCP prices compared with specification prices adjusted for inflation were obtained. In some cases, there were substantial quantity differences that impacted the ADCP price. In other cases, however, past specification requirements for marking, packaging, and item characteristics were significantly changed to conform with commercial practice. Consequently, analysis of cost savings cannot

TABLE VI
Clothing and Textile Price Comparisons

ITEM	A SPECIFICATION PRICE	B SPECIFICATION PRICE ADJUSTED FOR INFLATION	C ADCP PRICE	D DIFFERENCE (C-B)
Towels	$ 1.24	$ 1.46	$ 1.12	$ .34
Drawers	.99	1.02	.94	.08
Undershirts	1.16	1.18	.90	.28
Bed sheets	3.45	3.57	3.45	.12
Cloth gloves	2.28	2.35	1.81	.54
Rubber gloves (elec.)	17.90	18.40	24.99	(6.59)
Fireman's boots	22.30	23.79	20.00	3.79
Protective shoes	16.03	17.92	15.60	2.32

Higher ADCP price shown in ( ).

stop with a look at purchase price alone, but must consider price quality trade-offs and user satisfaction as well.

Quality. Delivery of initial ADCP items began in August 1978. Quality and customer feedback is being assessed for each of the items as usage experience is gained. Adverse comment on the quality of the item itself has only been received on the undershirt test item. The item was bought using a commercial item description that called out a laundry test for shrinkage. Samples of the delivered commercial products have been tested and they conform to the commercial description requirements; however, there have been several user complaints regarding unacceptable shrinkage. Resolution of this matter is still pending. Additionally, one instance of the receipt of irregular undershirts was reported. The supplier has agreed to correct this error. The only other quality problem has been in the area of commercial packaging. This occurred on items such as bath towels, underwear, and bed sheets because the commercial containers crushed when stacked, and also contained varying quantities per package that caused warehouse handling difficulties. We believe adjustment of future contractual requirements can resolve this problem.

These kinds of problems, which have been incrementally encountered on some of the commercial description buys, point out long-term difficulties that could be experienced when this technique is implemented on a large scale. Writing a concise description of requirements while at the same time minimizing potential quality risks is an extremely difficult task. It requires extensive knowledge of the grades of quality available in the market, and an ability to sort out the essential item characteristics which combine to make a quality product.

Quality feedback has been uniformly good on test items procured to non-government standards such as conduit, conductor splices, and sodium chloride. Eighteen pilot test items have been contracted for using this technique.

On food items such as soy sauce and Worcestershire sauce, customer feedback indicates the commercial item is superior to the specification item in terms of quality and user satisfaction. These ADCP buys incorporated a commercial market acceptability requirement that restricted competition to known commercial producers. This surfaced a serious ADCP problem, interface with established socio-economic programs.

Small Business. Socio-economic policies complicate a government buyer's ability to obtain the best buy. In his testimony before the Subcommittee on Federal Spending Practices and Open Government, the director of OFPP recently stated: "To put it bluntly, nowhere is there a more blatant contradiction between the fundamental mission of buying the best goods at the most reasonable prices and distorting that goal with socio-economic objectives which likely add short-run costs, limit competition, distort the marketplace and even conflict with each

other." He goes on to recognize that "we cannot turn our backs on the use of a $100 billion-a-year tool to work on the nation's critical problems."[13]

There is a contention underlying the conversion from formal specifications to commercial descriptions. It is that more commercial businesses, particularly small businesses, will be able to compete for government business because unique government requirements will be eliminated.

In the DLA pilot test procurements, however, there has not been an influx of new commercially oriented small businesses. On 42 commercial buys, there were 21 contracts awarded to small businesses. This contrasts with 22 small business awardees on the last specification buy of the same items.

The greatest small business response (primarily negative) came from current small business suppliers to DLA who had never expanded their markets to the commercial sector. Letters of complaints, bid protests, and appeals from small businesses and/or the Small Business Administration resulted from the ADCP buys for undershirts, soy sauce, food service equipment, steak sauce, microscope slides, and forceps. The letters state that the "market acceptability" requirement will eliminate small suppliers in the future. This presents a dilemma. At stake is the validity of the market acceptability assumption underlying the buy-commercial policy. Waiver of the market acceptability requirement for these supplies could be granted. However, the government would be vulnerable to poor quality because specification quality requirements are essentially deleted when a conversion to a commercial description is made.

Additionally, there is no statutory basis for excluding non-commercial suppliers on the basis of no market acceptability unless it can be established that existing government specifications are insufficient to satisfy government needs; and further, that those needs are identical to the civilian user and are based on actual experience, engineering analysis, or logic. The Comptroller General upheld an Air Force determination of this kind in *Essex Electro Engineers, Inc.*[14] If these conditions are met, commercial-market acceptability can be treated as a matter of technical acceptability of the product.

Many of the DLA items do not conform to the aforementioned criteria. The government-only suppliers have performed acceptably under the specifications; yet, it is uncertain what will happen to long-run quality if specifications are relaxed. A longitudinal study is required to assess this situation.

The OFPP has discussed establishing phase-in or transition periods to allow affected small businesses to develop a commercial market capability. It has urged

13. Lester A. Fettig, "Statement by the Administrator for Federal Procurement Policy, Office of Management and Budget, before the Subcommittee on Federal Spending Practices and Open Government Senate Committee on Government Affairs," March 2, 1979.

14. General Accounting Office, Decision B-191116, October 2, 1978.

the Small Business Administration to assume an advocacy role in helping companies make a switch to a diversified marketing strategy. However, there have been no operational procedures developed for these actions to "mainstream" government-only small businesses into the commercial marketplace.

Present guidance suggests that the contracting officer should consider all problems identified through market research and impact analysis, and develop the solution most advantageous to the government. In practice, however, the current flexibility to make these essentially subjective decisions is difficult to exercise. Buyers are governed by regulations. Changes in regulations will be required to resolve the conflict between a philosophy of using complete baseline specifications that permit all suppliers to compete, and the buy-commercial policy that advocates simplified specifications supplemented by restrictive commercial market acceptability criteria.

Bidder Response. Finally, an important objective of the buy-commercial policy was to obtain increased bidder response on government procurements. On 42 commercial buys, the DLA obtained a net increase of 79 responsive bids over previous buys of the comparable specification item. The test-buy for chain saws highlighted the fact that an overly restrictive federal specification can adversely impact competition. Last April, the DLA buying center in Richmond (DGSC) was not able to obtain bids on a chain saw solicitation. The manufacturers contacted indicated that the specification requirements did not reflect commercial practice. The DGSC developed a commercial description, solicited in August, and obtained seven responsive offers.

However, the specification issue is only one part of the problem; there are many additional disincentives beyond government specifications. The General Accounting Office confirmed this in a recent survey of the ADCP efforts in the clothing and textile area.[15] Table VII is a list of several disincentives associated with government business that GAO developed as a result of interviews with the clothing and textile industry.

Conclusion

The DLA ADCP pilot tests have provided several cases illustrating the advantages and the pitfalls of buy-commercial techniques. The results to date lead to the following conclusions:

Price. Based on a "null-hypothesis" approach, no definitive purchase price savings can be predicted solely as a result of changing the method of technical

15. General Accounting Office, "Preliminary Draft Report on Opportunities and Problems Involved in Meeting the Military's Clothing and Textile Needs with Commercially Available Items," February 28, 1979.

TABLE VII
Government Contracting Disincentives

Lack of continuous contractual relationships.

Inability to compete with established government contractors.

Inadequate lead times.

Solicitation at the wrong time.

Mandatory requirements placed on government contractors, e.g., equal employment opportunity programs.

Government low-bid philosophy.

Excessive paperwork requirements.

Undue delays in resolving problems.

description. Substantive price changes did occur when technical requirements were altered. These price changes must be evaluated as a trade-off against changes in quality.

Quality. Use of brief commercial descriptions requires assumption of some degree of risk that the quality of the delivered items will be acceptable even though quality has not been precisely defined. Acceptable non-government standards and tailored specifications appear to lessen the risk of unacceptable items.

Small Business. The DLA ADCP cases do not reflect an adverse impact on the small business community when data is examined as a whole; however, when specific cases are examined in terms of the individual small business that has totally concentrated on the government market, use of the established commercial market acceptability philosophy will undoubtedly cause problems. Unless there is a fundamental shift towards encouraging government-only suppliers to establish a commercial capability, long-term use of brief descriptions coupled with market acceptability requirements will not succeed except where all potential bidders already have market acceptability.

Response. Increased bidder response was obtained on the ADCP buys. It is difficult to pinpoint whether this can be attributed primarily to the change from specification to commercial description except in specific cases where definite deficiencies in the prior specification were uncovered. Correction of these faults,

using a tailored specification, for example, might have achieved the same response. Additionally, a great deal of publicity and priority attention was given to the test buys. Newspaper articles, pre-invitation notices, and pre-bid conferences explaining the new techniques certainly contributed to the increased response.

Summary. Data collected so far are insufficient to support a firm conclusion concerning the discontinuance of government specifications in favor of various forms of purchase descriptions. The DLA pilot test is continuing so that sufficient data can be obtained to make a conclusion.

The data collected on non-government specifications does seem to support this form of document as a viable procurement instrument. Results suggest that a selective approach for improving poorly written specifications, based upon comprehensive market research, would achieve the goals of the buy-commercial program. ||

69 The Impact of Energy Costs on Acquisition Contracting

Vaughn R. Pleasant

In fiscal year 1977, the energy consumed by the Department of Defense (DOD) was equal to or exceeded by its civilian contractors in terms of both the cost of energy expended, and the amount used. It has been 5 years since the Middle East oil embargo of 1974, and the United States has reluctantly adjusted to inflated energy prices spawned by the increase in the cost of oil. The full impact of the crisis has yet to be realized. The Alaska oil reserve has had a mitigating effect on the fuel shortage, but many feel that its impact will simply defer the crisis. The increase in price notwithstanding, very little visual change is apparent: Americans traditionally make and buy the largest and least economical cars in the world; industry passes on high energy costs for poorly insulated buildings inefficiently heated with outdated power plants.

While the Department of Defense has initiated myriad programs to reduce energy consumption "in house," little progress has been made in influencing conservation in the commercial sector. At present, little or no incentive exists for contractors to reduce overhead costs because costs are often baselined on historical data, i.e., how much was spent in the past on utilities. In addition, no corresponding measurement is taken on the contractors' progress and/or compliance with national energy conservation objectives.[1]

In July 1977, the President issued Executive Order 12003, which required each federal agency to:

> Exceed minimum statutory requirements for vehicular fleet average: FY 1978, 2 miles per gallon: FY 1979, 3 miles per gallon; FY 1980, 4 miles per gallon.
>
> Reduce by FY 1985, for all existing buildings, the average amount of energy used per gross square foot by 20 percent from a 1975 baseline.
>
> For all new construction, reduce by FY 1985 the average amount of energy used per gross square foot by 45 percent over 1975.
>
> Develop a 10-year agency management plan to be updated annually.
>
> Provide an annual progress report on goal achievement.

1. Ivan J. Tether, *Government Procurement and Operations.* (Cambridge: Ballinger Publishing Company, 1977) pp. 63-92.

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A significant cornerstone to the present energy program is the transition from more expensive and scarce fuels, such as petroleum and natural gas, to coal. It is significant that since 1973 two laws, the Energy Supply and Environment Coordination Act of 1974 (PL 93-319), and the Energy Policy and Conservation Act of 1975 (PL 94-163), have been enacted. These laws direct certain installations burning oil and natural gas to convert to coal. PL 93-319 states that any power plant in the early planning stage must be designed and constructed with the capability of using coal as its primary source. PL 94-163 authorizes the Department of Energy (DOE) to prohibit any power plant and major fuel-burning installation from burning natural gas or petroleum products as its primary source. Presently being considered by the U.S. Congress as a part of the National Energy Act is an amendment that would require appropriate new and existing power plants and major fuel burning sources to convert from oil or gas to another fuel source such as coal, or to use new technology.

To properly analyze contractor compliance with energy conservation, intragovernmental coordination is needed to transcribe goals and policies into specific requirements sufficiently detailed to measure progress against stated objectives. In reviewing DOD 5000-series directives on defense production management, no specific references are apparent that direct an assessment of the contractor's energy conservation program. Considerations come close to addressing the aspects of energy conservation, but fail to specifically treat energy conservation separately in line with DOD objectives. It is during the early stages of the systems acquisition process that energy conservation must be considered and weighed with regard to timely cost and environmental constraints.

Programs such as "Should Cost," Defense Acquisition Regulation (DAR) 1-337, and "Design to Cost," DAR 1-338, oriented to life-cycle costing, DAR 1-335, are positive steps toward implementing cost effectiveness throughout the total life of the system. However, energy conservation has yet to be totally institutionalized into the fabric of design-to-life-cycle costs, DOD Directive 5000.28. DAR 1-339 states that:

> (a) The Energy Policy and Conservation Act requires that Federal procurement policies governing requirements determinations and source selection decisions provide for consideration of (i) conservation of energy and (ii) the relative energy efficiency of alternative goods or services capable of satisfying the government's needs.
>
> (b) The energy conservation and energy efficiency criteria shall be applied in the determination of requirements and source-selection decisions whenever the application of such criteria would be meaningful, practical, and consistent with agency programs and

operational needs. Under this policy, energy conservation and efficiency criteria shall be considered for application along with price and other relevant factors in the preparation of solicitations, the evaluation of offers, and the selection of bids and proposals for award.

(c) With respect to the procurement of consumer products, executive agencies shall take cognizance of energy use/efficiency levels and prescribed energy efficiency standards as they become available.

GAO and DCAA Initiatives

It is interesting to note that during 1974 and 1975, representatives of the General Accounting Office (GAO) visited 75 federal installations, and monitored their energy management programs. The GAO reported that while facility management officials "had been active in attempting to conserve energy," much more could be done. Criticisms of program management at certain facilities included:[2]

—The total lack of a formal conservation program.
—The failure to assign program management responsibility to a single individual or group, or failure of an appointed individual to devote significant time to conservation efforts.
—The lack of monitoring to the extent that the success or failure of the program was not measurable.
—The lack of independent review of existing programs.
—Infrequent or incomplete inspection of temperature and lighting levels.
—Inadequate efforts to spur employee cooperation in conservation measures.

In general, the GAO report called for greater leadership, and more aggressive promotion of energy conservation. To date, the primary thrust to reduce energy conservation has been directed at internal operations. This is due in part to limited authority over the private sector and the lack of specific guidance on how best to measure energy conservation. The operation of the Department of Defense requires consumption of vast amounts of energy. Energy uses can be identified in two discrete areas, one related to the energy used internally by the Department of Defense, and the second related to energy consumed by industry in the process of manufacturing DOD equipment and facilities. The internal energy requirements of the Department of Defense are estimated at 1.8 percent of

2. Neuman Frederick, "DOD and Energy Savings," *Government Executive*, Volume II, No. 1, 1979, p. 38.

the total energy demands of our country, and 80 percent of the total energy consumed by other federal executive agencies in fiscal year 1977. Our internal conservation program is goal-oriented with procedures for monitoring results of our direct energy consumption, but this is only a fraction of the total DOD energy needs. The material, supplies, and equipment facilities of our forces represent a vast amount of energy required by the private sector in the manufacturing process. These energy needs are not subject to direct control and monitoring by DOD; however, DOD has encouraged manufacturers of defense supplies to voluntarily conserve energy used in defense production.

A positive effort was taken in 1974 by the Defense Contract Audit Agency (DCAA) through the institution of an audit review of over 200 DOD contractors. The audit review was in response to the President's request that American industry, through a voluntary program, reduce energy consumption by 5 percent. The goal was to ascertain if defense contractors had responded to the President's request. These internal audit reviews resulted in recommendations to further reduce energy consumption. Likewise, the director of the Defense Contract Audit Agency notes that the initial audit reviews resulted in like recommendations.

Late in 1976 it became obvious that greater energy conservation was needed, and DCAA embarked upon a new operation audit program to identify additional energy savings opportunities. Early results of these audits disclosed that energy conservation programs have a simple beginning and grow, with the proper endorsement, into innovative technical efforts that challenge an organization's engineering and management capabilities. The report goes on to state that some organizations have accepted the challenge and, with aggressive management, have pursued energy conservation opportunities to the fullest. However, audits have disclosed that other organizations have not fully pursued their management responsibilities, forsaking conservation opportunities that would save energy in the national interest and increase an organization's competitive advantage through reduced product cost. These initial audits have disclosed a number of defense contractors who have serious energy conservation programs that are goal-oriented and supported by top management. These programs have produced automatic reductions in the energy usage, while others have resulted in window-dressing paper mills of inactivity.

On the positive side, the audit cites one contractor whose program cost $43,253 to institute 38 energy savings opportunities that will save $518,000 each year in abated energy cost. These dollars and costs are meaningful to the taxpayer, but more importantly, this one aggressively managed company will lessen the national energy draw by approximately 47 million kwh. or 161 billion Btu. or, better yet, the equivalent of 27,758 bbl. of oil each year. Here's a customer-oriented supplier becoming more competive, thereby serving the owner of the company as well as the national interest.

On the other hand, it was noted that suppliers whose programs were not aggressive have slackened since the initial audit in 1974. Forty-one of the 70 reviews completed to date have recommendations for those companies to institute energy savings opportunities that will result in annual savings of $18.3 million and reduce energy consumption by 4,112 billion Btu. each year. While the dollar savings in greater efficiency are an immediate benefit to owners of these organizations through reduced cost, the increased competitive price advantage benefits the owners, the customer, and in the case of DOD, the taxpayers. The 4,112 billion Btu. saved as a result of the DCAA recommendations could supply the electrical power needs of a community such as Saint Michaels, Maryland, with 1,456 customers, or supply homeowners with the equivalent of 29.8 million gallons of fuel oil.

It is significant to note that these auditors possess no special training in energy conservation, but utilize the information available from all sources. For example, one government supplier had an energy conservation program in effect for some time, but had not performed a comprehensive survey designed to identify additional conservation opportunities. The efforts by the Defense Control Audit Agency to identify potential cost savings through energy conservation is minuscule in relation to the vast amount of wasted energy expended in the acquisition and production of DOD materiel.

Using Suggested Remedies and Conclusions

Using the DCAA as an example and point-of-reference, energy conservation programs could be monitored within the present structure of DOD organizations charged with evaluating and analyzing contractors' management programs and cost and pricing systems. Pre-award surveys could include an assessment of the contractor's compliance with DCD and national energy conservation goals with specific comments on the company's own established energy policies, procedures, and objectives. The Defense Contract Administration Services Management Area (DCASMA) industrial specialists and the price analyst could present a joint assessment of the contractor based on pre-established parameters and/or checklists. The fact that energy is being considered in the pre-award survey would have the effect of motivating energy conservation. Where contractors continue to pass on excessive overhead cost to the government due to inefficiency and/or a general lack of good energy conservation policy, the government should base line cost on an average of reasonable rates within a geographic area, thus creating an incentive for conservation and capital investment in more modern and efficient systems. This is in compliance with DAR 1-339, which requires that federal procurement policies governing requirements determinations and source selections provide for conservation and energy, and the relative efficiency of alternate goods or services capable of satisfying government needs.

The recently published U.S. Air Force Energy Plan contains a list of items that may be considered in determining the extent of contractor compliance to energy conservation goals and objectives. Listed below are a few questions that impact on overhead cost, and could result in reducing utility rates and G&A cost.

—Use of suspended ceiling?
—Use of automated chimney dampers?
—Use of individual lighting in lieu of overall lighting where practical?
—Ceilings and walls light colored in work areas for power lighting requirements?
—Economy-size cars and trucks used, where practical?
—Car pools encouraged with incentive?
—Temperatures kept at the lowest possible level?
—A suggestion program to reduce energy?

As a result of large-scale abuses and incidents brought to the attention of the Office of the Secretary of Defense, contract administration personnel have been advised that contractors who purchase or lease passenger vehicles larger than necessary are in violation of DAR 7-203.35, which provides the mechanism to question or disallow excessive vehicle cost. Contract negotiators have been advised that when negotiating new contracts and forwarding pricing-rate agreements, an attempt should be made to obtain the contractor's agreement to limit the size of passenger vehicles purchased or leased by the contractor to specified standards. DAR Section XX, Part 10, "Monitoring Contractor Cost," and the contract clause at DAR 7-203.35, "Notice of Intent to Disallow or Not Recognize Cost," provide the mechanism to question or disallow excessive vehicle cost. This should help contracting officers to obtain a reasonable policy from contractors when buying or leasing a vehicle.

It should be noted that State governments have lead the way in aggressive action to reduce energy conservation and waste. The State of California has enacted a bill which prohibits the purchase of any passenger vehicle for State use that fails to obtain an overall 18 miles per gallon. State government procurements that normally seek to award the contract to the lowest responsible bidder now recognize energy conservation in the decision to award. Because the least expensive processes are often the least efficient, money saved at the initial, lower acquisition price is usually insufficient to justify increased operating cost.[3]

For many reasons, including the higher acquisition prices of energy-efficient items, lack of awareness, and bureaucratic tradition, many governmental purchasing agencies continue to buy goods, and construct support facilities that consume unnecessarily large amounts of energy. Reduction of energy consumption

3. Lloyd J. Dumas, *The Conservation Response*, Lexington Bonho, Kentucky, 1976, pp. 256-278.

requires a means of identifying the energy efficiency of prospective purchases, and a means of selecting items that are relatively efficient. Equally significant is the consideration given to energy consumption during the conceptual stage of the life-cycle system. To make intelligent assessments on energy-efficient systems or products, it is necessary to exploit myriad research projects concurrently underway in the government and civil sector.[4]

To cite a few examples, the U.S. Air Force energy plan includes programs designed to reduce flying hours through the elimination of non-essential flights, and the use of flight simulators. In other exploratory work, the Air Force is attempting to anticipate what its future requirements will be when energy and aircraft cost constraints affect current training practices. Significant efforts in the commercial and military sectors are underway to improve aircraft performance and efficiency through modification in airframe structure to reduce drag. Such modification to the B-52 involves installing B-52-A wing vortex generators, and aligning aileron vortex generators. For some aircraft, such as the C-141, that are structurally different from B-52 aircraft, drag can be reduced by removing the vortex generators from the wings. The Air Force is actively engaged in modifying C-141 cargo aircraft in the stretch program that extends the fuselage for increased loadbearing. Such modifications are expected to reduce fuel consumption with the possible application to commercial aircraft. The Navy, on the other hand, is actively involved in desalination projects, synthetic fuels, and hydrogen/nuclear energy. A method to use sea water for air conditioning along coastal regions is also being studied.

It is important that program managers and staffs be aware of ongoing energy conservation projects that have the potential for significant impact on major acquisition programs. There is evidence that massive research by several governmental agencies is underway in the area of energy conservation. However, much like medical research, it is often fragmented and decentralized, with limited cross-communication within the research community. Several State and Federal agencies require contractors to conform to legislation, regulation, and policy for energy conservation measures. Much of the guidance and direction militates against acquisition deadlines, environmental objectives, and requires management decisions on trade-offs. While environmental considerations are deeply rooted in the acquisition process, energy conservation has taken a back seat and has only recently become formally introduced into integrated logistics support planning. One solution to the decentralization of energy conservation programs

4. Allan L. Howard, "Energy and The Future," American Association for the Advancement of Science, Volume XII, 1973, p.184.

and initiatives might be a periodic conference chaired by the Department of Energy to review governmental agency progress against their own goals and objectives, with the added requirement that each agency publish a pamphlet on policy guidance, directives, etc., relating to energy conservation.[5]

With the recent sharp increase in crude-oil prices, ways must be found to reduce energy-intensive processes, follow-on support cost, and to reassess the need for items when expenditures prove too expensive for the net return. It is necessary that personnel involved in systems acquisition take advantage of state-of-the-art development as early as possible to realize the greatest advantage in energy savings. Because many high-dollar systems will be in service for many years after initial production, care must be taken to consider alternatives carefully, even at the expense of the pressures of the day.

The continuing challenge to design and produce the most economically efficient product will become more accute as energy resources become more scarce and costly. ‖

5. Samuel M. Dix, *Energy* (Grand Rapids: Energy Ed Publishers, 1977) pp. 175-205.

77 A Look at the Independence of Federal Contract Research Centers

Lieutenant Colonel Timothy J. McGrath, USAF

A basic principle, stressed over and over again in management and leadership schools, is that you cannot give a person responsibility for a task without, at the same time, providing him or her with the authority necessary to carry it out. Yet, the Department of Defense and, in particular, the Department of the Air Force, spends hundreds of millions of dollars each year for the services of Federal Contract Research Centers (FCRCs), and by following the tenet that these organizations should be "independent," violates this principle every day.

During the past decade, FCRCs have been both attacked and defended in published literature. Essentially, these arguments have centered around either the cost of their services ($279 million in FY 1976[1]), the quality of these services and the resultant products, or whether the work should be contracted out to other organizations. This paper will not address any of these controversies, but will examine the working relationships that have been established between the FCRCs and the government. It will be seen that, in some instances, these relationships lead to an independence that is not only unnecessary, but may also be detrimental to the successful achievement of objectives.

Federal Contract Research Centers are special, non-profit institutions that assist the Department of Defense by providing analyses and evaluations used for planning, for systems engineering and technical direction, and for research and technology development. They tend to have the following characteristics.

> —They exist primarily to perform work for the Department of Defense.
> —They have no commercial affiliations and undertake little or no work for private industry.
> —They are usually funded by sole-source annual contracts, which implies a DOD attitude of responsibility for their continuance and stability.
> —They have continuous privileged access to data of the government and industry in their fields of work (in exchange for which they accept stringent limitations upon their scope of activities and range of customers).[2]

1. "Think Tanks Overhauled," *Armed Forces Journal*, September 1976, p. 28.
2. "How Federal Contract Research Centers Aid DOD in the National Defense Mission," *Commanders Digest*, October 23, 1975, pp. 3-4.

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The list of active FCRCs includes such familiar names as the Applied Physics Laboratory of Johns Hopkins University, the Institute for Defense Analyses (IDA), and the Aerospace, MITRE, and RAND Corporations.

Essentially, the mission of an FCRC is to provide technical expertise that is not available from in-house DOD resources. Being relatively independent, i.e., being neither a formal part of the government nor of private profit-making industry, FCRCs are supposed to have the unique advantage of freedom from the momentum and pressures of internal command relationships.[3] This independence is thought to provide the government with more objective evaluations and assessments than would be obtained if political or profit motives had to be considered.[4] While this may sound commendable, an examination of the working arrangement established by this independence points out a potentially serious management problem.

Organizational Structures

For the purposes of this discussion, the tasks performed by FCRCs will be separated into two broad functional categories: specialized research and systems engineering.

Specialized research is, simply stated, scholarly investigation into and analysis of technical concepts. Typically, the task to study a particular phenomenon is assigned by the government official in charge of the FCRC contract. The final product of this task is a study or concept paper, generated entirely (or almost entirely) by FCRC personnel. The quality of the paper is solely the responsibility of the FCRC. The government needs only to provide guidance, as necessary, to the FCRC concerning the purpose of the study.[5] The relationship between the government and the FCRC is straightforward, with clear-cut lines of responsibility and authority as shown in Figure 1. Positive control of the activities of the FCRC can be maintained.

Systems engineering, however, is a quite different situation. It may, and often does, traverse the entire spectrum of systems acquisition from conceptualization, design, and contract preparation, to coordination and direction of contractors, and final testing and evaluation of the product. In this case, under the best of circumstances, a task is established by a senior officer who has overall authority over both the FCRC contract and the corresponding government organization.

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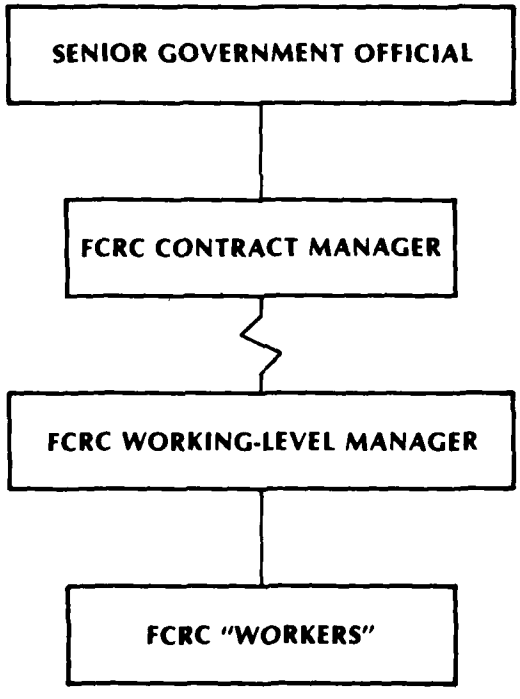
3. L. Edgar Prina, "The Navy First Used Think Tanks During World War II," *Armed Forces Journal*, September 28, 1968, p. 20.
4. James Hessman, "Federal Contract Research Centers: DOD's Cerebral Reserve," *Armed Forces Journal*, September 28, 1968, p. 6.
5. Prina, *op. cit.*, p. 20.

FIGURE 1
Specialized Research Organization



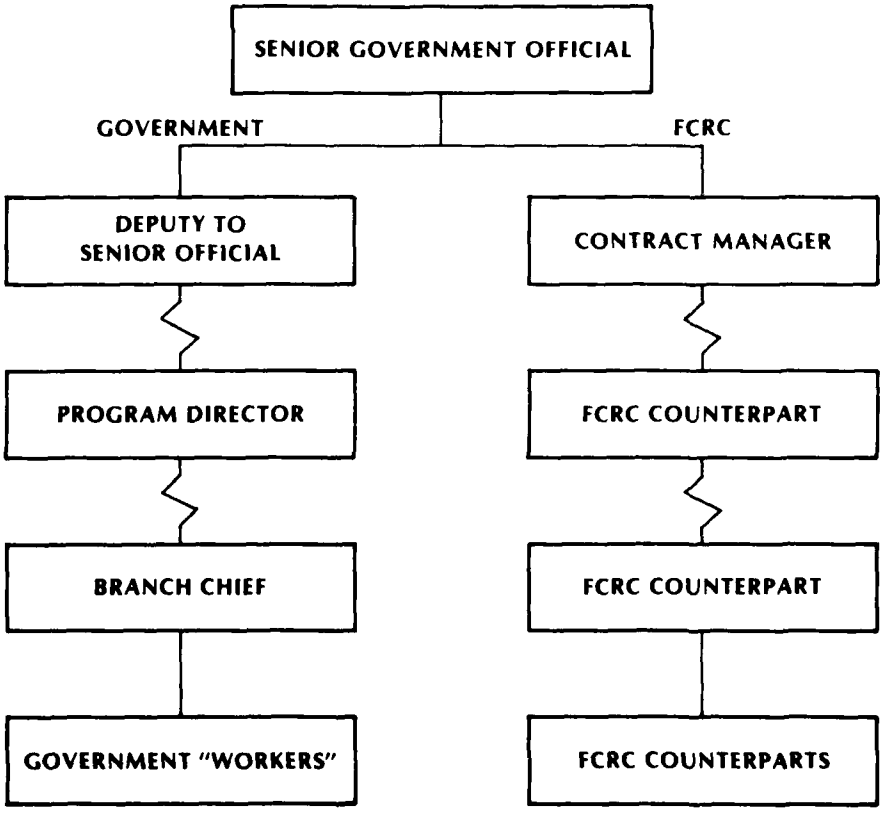
The FCRC must then provide the required technical information in a timely manner so that the government program director may contract for the services of a private corporation and, after the contract is awarded, evaluate the progress of the contractor as design and development of the system advances. Notwithstanding this dependence on the FCRC, it is the government program director, not his FCRC counterpart, who is ultimately held accountable for the success or failure of the program.[6] If the program director is not also the person in charge of the FCRC contract, he can find himself in a very difficult management situation. The

6. William Leavitt, "Aerospace Corporation, USAF's Missile/Space Planning Partner," *Air Force and Space Digest*, October 1967, p. 82.

more layers there are in the chain of command, the more the problem is compounded. The branch chief is the hindermost government manager in this situation, and is probably many layers removed from the senior government official who has authority over the FCRC contract. For him, these problems may become insurmountable. This situation is depicted by Figure 2. The dashed lines imply a requirement for coordination and consultation between members at each level.

The root of the problem is the organizational independence of the FCRC employees from the government managers at every level, save at the very top. While the branch chief, who may be a captain or major, must rely upon his FCRC

FIGURE 2
Systems Engineering Organization



counterpart for support, his only recourse if that support is unsatisfactory is to buck the problem up the chain of command to the senior official, who may be a lieutenant general. You may judge for yourself the probability that the branch chief (and his subjective premise) would be successful, or that all of the intervening layers of management would be willing to pass this information to the very top of the government organization. The branch chief finds himself in an awkward position, indeed.

Now it can easily be argued that all persons involved, both in the government and in the FCRC, are working for the same person, and that, in the final analysis, they will all be striving toward the goal set by the senior official. While at first glance this may seem to be a reasonable argument, it flies in the face of available evidence concerning the motivations of men and women and the workings of organizations. Let's examine what we have done to the branch chief depicted in Figure 2.

It is a basic pre-supposition of this paper that the branch chief is being held responsible by his superiors for the timely delivery of a product of some kind. The government is not looking for an assessment of whether the product is desirable; that decision has already been made.

It is also assumed that in the detailed definition and creation of this product, the branch chief needs, indeed must have, the cooperation not only of his own immediate subordinates, but of his FCRC counterpart and corresponding subordinates as well. The problem arises because the branch chief has the authority to control only the actions of his own subordinates; the contributions of the members of the FCRC are essentially out of his control.

Responsibility and Authority

Given a conflict of directions from the branch chief and the FCRC hierarchy, the FCRC member has little choice concerning whose direction to follow. It could be argued that such a conflict will not occur; that the work required of the FCRC member will be the same regardless of the source (government or FCRC) of the directive. This may or may not be true. In any case, the potential for conflict is there because of the manner in which the chains of command are structured.

Returning to the very top of the organization structure depicted by Figure 2, assume that the senior official has determined that a particular product is to be produced and has directed that the required efforts begin in both the government organization and the FCRC. Each level in the hierarchies of the two distinct entities will now subdivide the overall product into specific tasks for each of the organizational elements (corresponding to their particular expertise and functions). Additionally, the manager at each level will redefine and modify the guidance received from above in light of the specific environment in which he

perceives himself to be operating.[7] Naturally, part of his consideration will involve the manager's parochial motivation to limit any problems that could cause harm to his own organization.

Assume, for example, that an FCRC manager perceives that, in accomplishing tasks toward the end product, some "harm" could come to the FCRC, such as a reduction of manpower or even the dissolution of his own unit, or that some "good" could occur, such as an increase in manpower or funding. Can he honestly be expected to be totally objective in this situation? Can he really be expected not to evaluate the impact of each proposed alternative on the FCRC itself? It is hardly likely.

Given a conflict of this sort, and it will occur sooner or later, the manager will be in the frustrating position of having to choose either to be loyal to his FCRC organization or to follow the wishes of his governmental counterpart. It is a position we ought not to put this manager in—but, we do. The two distinct chains of command provide the environment and potential for this conflict.

A Political Organization

As we have seen, the branch chief has been placed in a situation wherein he must contend with two formal organizations in order to accomplish the job expected of him. Since these two organizations are lateral, their coordination will require the emergence of a position of control over both, a "super leader," if you will. But how does the branch chief establish himself as this "super leader," over his FCRC counterpart (assuming they are the only two contenders for the position)? He does not have any control over the tangible inducements to the FCRC members for cooperation; we have a nonauthoritarian relationship existing in a presumed authoritarian environment. The formal relationships established by the branch chief's employer do not put him in even a figurehead position with respect to his FCRC counterpart. Denied formal control, the branch chief must rely on persuasion, social rewards, and goodwill to effect cooperation. Any agreement must be maintained severally by the two managers.

The need to use persuasion introduces a political factor that greatly complicates the problems of the branch chief. He must seek a concrete program of action that (1) is adapted to the technical problem at hand, (2) that considers the internal condition of his own branch and the members of it, and (3) that is constantly vulnerable to the majority and minority opinions of the FCRC managers and, depending on the strength of these managers, their subordinates as well. The

7. Chester I. Barnard, *The Functions of the Executive* (Cambridge, Massachusetts: Harvard University Press, 1966), pp. 231–233.

branch chief's ability to control any adverse impact of these views within the FCRC organization is extremely limited. His leadership quality must be greater than would otherwise be required, since his only inducement to cooperation is persuasion.

The branch chief *should* be able to concern himself with the technical problem at hand and the technical activities necessary to solve that problem. He should not have to concern himself with intraorganizational politics and should not be placed in a position that requires such concern, especially when it is his own organization that has control over these circumstances through the FCRC contract.

Summary and Conclusion

Federal Contract Research Centers perform two distinctly dissimilar functions for the Department of Defense. In spite of the very real differences between these two functions in terms of the interorganizational coordination and cooperation required, the DOD applies the same philosophy of independence to all FCRCs, regardless of mission. In the case of specialized research, organizational independence is probably beneficial, since it would appear to foster the desired climate of objective, creative research and scholarly thought, freed from the pressures of governmental command relationships. In addition, authority and responsibility for product quality and timeliness are properly relegated to the FCRC managerial hierarchy who can be called to account for any failures in performance without fear of "finger pointing" at lateral organizations.

On the other hand, in the case of systems engineering, organizational independence of the FCRC can be detrimental to the orderly progress toward governmental goals. It would appear that a philosophy, appropriate in one arena, has been allowed to spill over into another, where it is not appropriate. When FCRCs are used to perform systems engineering tasks, their members should be placed under the direct control of, and responsible for their performance directly to, the individual government managers they are tasked to support. This direct control should be established at every level in the hierarchy, be it the branch chief, the division chief, or the program director.[8] To continue to allow systems engineering tasks to be independent of the authority of the person responsible for the project is to continue to endorse a climate of reduced efficiency and lessened effectiveness. ‖

8. A prepublication reviewer of this article opined that the recommended solution borders on being illegal, since the government cannot "buy" staffs as suggested. Nevertheless, the managerial problems cited remain and, if required, a change in the law should be pursued.

R&D Project Marketing in the Defense Laboratories

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Dr. Robert Munk

President Carter issued a directive in 1977 requiring the defense laboratories to demonstrate the merits of their programs and investigations in a competitive environment. This directive unleashed a flurry of marketing efforts by laboratory personnel, which contributed to significant increases in the FY 1979 and FY 1980 funding allocations for the laboratories. These efforts were undertaken in response to the presidential directive, on the premise that each laboratory had to compete against other laboratories for a finite and presumably limited budget. However, other changes were instituted in the same time frame that produced a greater volume of business than the laboratories had anticipated or have been able to accommodate. The changes that collectively affected laboratory operations in FY 1979, FY 1980, and for the near-term future, were as follows:

1. The total defense R&D budget was increased, both in current-year and constant dollars.
2. The number of authorized personnel billets in the laboratories was decreased.
3. The use of on-site contractor personnel was severely restricted.
4. Program documentation requirements were increased, and a more rigorous interpretation of contracting procedures was instituted.
5. Requirements were imposed on the laboratories to allocate defined proportions of their budgets for contract efforts, and to establish set-asides for small business and for minority business procurements.

The net effect of the changes instituted by the Carter administration was to increase the total financial resources available for allocation to the laboratories; to require the laboratories to allocate a greater proportion of their technical manpower resources to contract definition, documentation, and contract supervision tasks; and to function with a smaller staff. To compound the problem, the laboratories were exhorted to assume a more aggressive and adventurous science policy, but with lessened informal interaction with researchers from the industrial sector. A more rigorous interpretation of the defense acquisition regulations (DAR) was imposed on the laboratories to eliminate the former practice of utilizing industry personnel as extensions of the laboratory staffs under actual or *de facto* personal services contracts; major barriers were established against the acceptance of unsolicited proposals from industry; and the laboratories' abilities to

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issue sole-source contracts to performers of known competence were severely constrained.

The combined results of the various directives and decisions were to increase the workload of the laboratories as a whole, and to impose new tasks and responsibilities on the laboratories' technical staffs. The operant interpretation of the rules and regulations also reduced the laboratories' ability to follow their own technical pursuits without extensive external reviews and audits.

The foregoing combination of actions and effects has produced uncertainties regarding the desirability of encouraging further R&D project marketing efforts by laboratory personnel. To establish whether the laboratories' new business capabilities have been saturated, or whether other considerations dominate the decision process, the nature of defense R&D must be examined; the roles and functions of the laboratories must be analyzed; and the dynamics of defense R&D must be reflected.

Classic marketing theory, applied to an organizational model representative of the defense laboratories, would indicate further marketing efforts to be counterproductive. However, classic marketing theory does not apply to the defense laboratories, and the special considerations that pertain to the laboratories create a need for increased emphasis on R&D project marketing as a direct consequence of the recently imposed pressures. I intend to identify the particular factors and rationales that underlie the need for an increased emphasis on R&D project marketing.

To place the discussion of R&D project marketing into a meaningful perspective, let's summarize the roles and functions of the defense laboratories.

The defense laboratories have traditionally provided the scientific and technical leadership upon which has been built a solid technology base for both the military and private sectors. Approximately one-half of the federal investment in R&D, and almost one-third of the total national investment in R&D by both public and private sources, has consistently been allocated for defense R&D, which is conducted under the cognizance of the laboratories (Table I).

The impact of defense R&D derives only in part from the magnitude of the investment. The nature of defense R&D, with its inherently long-term orientation, its intrinsically high-risk content, and its relative flexibility with regard to costs, has always enabled the laboratories to reach further into the unknown, and, when successful, to produce greater advancements than could be sought by other, more rigidly constrained organizations. The key criterion embodied in the laboratories' charters and missions, and by which the laboratories' performances are assessed, is scientific advancement. The long-range effectiveness of the laboratories may be determined by measuring our technology level against that of other countries. In the short-term perspective, the laboratories' objective

TABLE I
Comparison of Total National R&D, Total Federal R&D, and Defense R&D Budgets, FY 1973-FY 1979

	(Obligated Dollars, in Billions)						
	1973	1974	1975	1976	1977*	1978*	1979*
Total National R&D	30.3	32.3	34.6	37.4	40.8	-	-
Total Federal R&D	16.8	17.4	19.0	20.8	23.8	26.3	27.9
Defense R&D	8.9	9.6	10.3	11.9	11.8	12.7	13.8
Defense R&D as of:							
Total National R&D	29.4	29.7	29.7	31.8	28.9	-	-
Federal R&D	53.0	55.2	54.2	57.2	49.6	48.2	49.5

(U.S. Bureau of the Census, 1977: Tables 1011-1014); *(columns 5-7, U.S. Bureau of the Budget, 1979b:306).

becomes one of effectively managing a scarce resource, namely innovative scientific talent, to produce superior solutions to recognized problems, and to establish a technology base that extends man's command over his environment.

The defense laboratories are specifically chartered to establish such a technology base by:

—Maintaining national competence in areas of technology peculiar to military needs;

—Providing technological capabilities for quick response to unpredictable needs and opportunities;

—Providing a working interface between military commanders and planners on the one hand, and the technological community on the other; and

—Acting as advisors in the defense research, development, test, and evaluation program.[1]

The defense R&D laboratories address every discipline in the physical sciences, most of the disciplines in the life and biological sciences, and some of the disciplines in the behavioral sciences. No single laboratory controls all of the work that must be performed to establish and maintain a leading position in any

1. U.S., Department of Defense, Blue Ribbon Defense Panel, *Report to the President and the Secretary of Defense on the Department of Defense*, July 1970.

given discipline, and most weapon systems depend on a mix of technological inputs from a number of laboratories. The laboratories thus tend to be relatively interdependent, and the competitive forces within the laboratory system are largely subordinated to other considerations and factors.

Laboratories may compete against each other for specific roles on programs or as advocates for alternative missions and mission implementations. However, the time scale entailed in defense programs, and the uncertainties inherent in establishing technical objectives for weapon systems that will enter the inventory some 10 to 15 years after the R&D project is initiated pose such incalculable risks that a consensus among laboratories is required before significant funds are provided for a new scientific or technological area of investigation. The laboratories' interdependence is consequently based both on the need for mutual technical support in ongoing projects, and on the need for scientific endorsement for new scientific initiatives from peers in the other laboratories.

The essence of laboratory operations has always been, and will continue to be, scientific innovation and technical initiative. These are embodied in "new project initiatives," "project advocacies," "R&D project development efforts," and "R&D project marketing programs." The multiplicity of terms that describe the activities that translate scientific concepts into projects or programs in the defense laboratories is indicative of a problem in comparing such activities to counterpart efforts in industry. I use the term "R&D project marketing," although it may be the least accurate and most controversial of the above terms. However, marketing is a recognized and well-defined function in the industrial sector, and thus provides a convenient point of departure for the discussion of the subject activity.

The aspects of laboratory operations that differentiate its marketing efforts from industrial marketing are summarized as follows:

The defense laboratories are precluded from working for profit. Contractual incentives are thus generally inapplicable other than in terms of the total budgets available to the laboratories. Competitive incentives do apply, but predominantly in other than economic terms. The growth of the laboratories is also constrained by internal and external factors, such as personnel billet limits and level-of-effort discretionary budgets. These considerations impose an upper limit on the rate at which work may be programmed. Product performance and marketing effectiveness thus do not lend themselves to translation into near-term organizational growth in the laboratory environment, or into direct extrinsic rewards.

Industrial marketing is oriented toward profit, volume of business, market share, and return on investment. In these respects, the differentiation of laboratory R&D project marketing and industrial marketing is readily apparent.

A less obvious, but more significant, factor differentiating R&D project marketing from industrial marketing is the orientation toward risks. Industrial marketing is predicated on the adherence to, or the bettering of, accepted risk/return ratios; such ratios are not only indeterminate in defense R&D, but the economic returns from defense R&D investments are not a major consideration. Defense R&D project marketing has been identified as an activity that does not produce direct financial rewards, that tends to be risk-seeking rather than risk-avoiding, and that places greater emphasis on cooperation than on competition. It does, nonetheless, serve a vital function and produce significant rewards.

Let's now look at the specific purposes served by R&D project marketing, and rewards to which it may lead. The literature on defense R&D marketing is meager; the function is implemented on a self-appointed basis by laboratory personnel whose official positions do not include responsibility for marketing. In fact, the need for a managed marketing activity is a new consideration for the laboratories. In the past, laboratory personnel have believed that competent technical performance would engender necessary support, and that a sound program would attract the necessary capital.

Recently implemented defense R&D policies and decisions have been intended to emphasize technical and programmatic merits of new project proposals by externalizing the approval decisions. If, as presumed, capital were the limiting resource, the larger number of projects competing for each funding increment could be expected to produce the desired improvement in the quality of approved projects. Because capital is not the limiting resource, a more complicated situation has emerged. The importance of effective R&D project marketing has increased, but for other than economic reasons.[2]

I have completed a study that shows that R&D project marketing provides the essential stimulus for research productivity and for effective contract performance in the laboratories. The general management principle that relates organizational health and viability to continuing growth (or, when such growth is precluded or constrained, to a continuing revitalization of purpose) was shown to apply to the laboratories as it does to all organizations. The research showed that, because of the constraints on growth and the limited opportunities for salary and grade advancement in the laboratories, a continuing revitalization of purpose is essential. The viability of the laboratories as technical organizations that can attract and hold highly qualified technical personnel has been shown to rest on intrinsic rewards that are meaningful to those personnel, such as rewards

2. R. Munk, "R&D Project Development in Governmental and Institutional Laboratories" (Ph.D. dissertation, United States International University, 1979).

deriving from perceptions of personal creativity and productivity, and from peer recognition among technical innovators.

Prior research identified two categories of R&D personnel whose joint talents are needed in the formulation and promulgation of new R&D projects: basic researchers and applied researchers/developers.[3] While both categories are predominantly oriented toward intrinsic rewards, their motivational needs have been shown to be distinctive: The motivational needs of basic researchers are essentially internalized and generally independent of externally mediated rewards; applied researchers/developers, on the other hand, derive motivation and satisfaction from specific outcomes directly attributable to their efforts.

A special dynamic has evolved in the defense R&D system over the years, whereby the motivational needs of both groups are fulfilled when aggressive and imaginative R&D project marketing efforts are undertaken. Such efforts are initiated by a few applied researchers/developers who provide an essential communications link between basic researchers in the laboratories and mission-oriented personnel in other elements of the Department of Defense. These people may be called "technological gatekeepers."[4] Most of the important technical ideas that influence new initiatives within the laboratories have been attributed to them; they are the keys to the laboratories' technological growth and relevance as elements in the defense R&D community, and to continuing operation as sound organizational entities.

Technological gatekeepers are characterized by their broad range of contacts with colleagues outside their own organizations, and by their interests in a multiplicity of subjects, in which they maintain currency through discussions, correspondence, and the review of scientific journals. New information tends to be brought into the organization by a technological gatekeeper. It is then disseminated through other gatekeepers to other members of the organization. A well-developed network of technological gatekeepers is the most effective mechanism to develop support for R&D projects. Interactions with colleagues outside the immediate group are factors that enable research interests to be related to project needs, and for projects to find solution approaches in the basic research efforts that are conducted by the laboratories on a sustained basis.

Research conducted by T. J. Allen indicates that:

—The best source of information for R&D project support lies in the internal information channels of the laboratory.

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3. J. Galbraith and L. L. Cummings, "An Empirical Investigation of the Motivational Determinants of Task Performance: Interactive Effects between Instrumentality-Valence and Motivation-Ability," *Organizational Behavior and Human Performance*, August 1967.

4. T. J. Allen, "Information Flow in Research and Development Laboratories," Working Paper 316-68, Sloan School of Management, Massachusetts Institute of Technology, 1968.

—The best way to keep the project team abreast of outside developments lies in understanding and making proper use of the existing information system. This involves use of the technological gatekeepers who are linked directly to other communications networks.
—People are more likely to communicate with those located near to them. The positioning of individuals and groups will therefore either promote or inhibit communication.

Communication channels provide the mechanism for the transfer of information among members of the group. The arrangement and number of channels may differ with each configuration of the communication network, as will the effectiveness of the group as a problem-solving entity. A synthesis of Allen's and other communication network studies established the specific criteria to be applied in organizational design to attain optimal R&D project marketing capabilities. Such capabilities would be provided by a core group of technological gatekeepers maintained in a central location, and with functions that place them near the apex of the laboratory's information-flow network.

Since R&D project marketing is a relatively protracted process entailing extensive planning and the use of planning instruments, association of the gatekeeper core group with the laboratories' planning function would best fulfill information flow criteria. The core group should also be at a sufficiently high level in the organizational hierarchy to benefit from the upward flow of communications. With project decisions being made in the context of the planning, programming, and budgeting system (PPBS), which is coordinated by the laboratories' planning and/or project management staff, further support is provided for the centralization of the R&D project development responsibility in conjunction with laboratory planning and/or project management operations.

The need for communications with the research departments imposes one further criterion in organizational design—to also attach technological gatekeepers to the respective research departments, or to have such personnel contained within the various departments. A centralized core group of technological gatekeepers, interfacing with counterparts distributed throughout the organization, fulfills the multiple criteria for effective internal communications.

External communications must also be facilitated. Although defense R&D laboratories are discrete physical entities with a management, a staff, and a plant, and which operate within the bounds of a charter and a budget, in functional terms they are an element of an extended organization. This extended organization is diffused throughout the DOD and, in some cases, extends to other federal agencies such as the Department of Energy, the National Aeronautics and Space Administration, and the National Science Foundation. Depending on the degree of controversy that may attend to a national policy objective (U.S. involvement

in Southeast Asia in the 1960s–70s), a military requirement (the neutron bomb), or an R&D objective, presidential decisions and congressional concurrences or compromise inducing nonconcurrences have varying impacts on the demands for R&D project products. The frequent controversies that accompany the definition of R&D objectives have produced something of a protagonist system, with checks and balances, as the basis for decisions on defense R&D matters. In such a system, the laboratories could not marshall the necessary resources to individually create demands for their respective products, or even to determine which of the evolving external needs to address in applying internally controlled resources.

In the early stages of the project planning process, the laboratories join other organizational entities in the DOD, channeling their endeavors toward a chosen mission-related R&D objective. The laboratories, as the research elements, essentially enter into partnerships with their prospective "customers," which represent a multiplicity of organizational entities. In fact, the customer relationship only comes into being when funds are allocated for the project; until that time, all of the organizational entities involved share a common interest in selecting the most effective team members for the respective roles in the joint advocacy. The interdependence of organizations in the R&D project marketing process produces the special conditions that enable the laboratories to fulfill their customers' needs, and to establish appropriate and sufficient intrinsic incentives for new initiatives.

To have a reasonable probability of success, R&D project proposals must relate directly to a military requirement and demonstrate the availability of the technology that will provide a superior product within reasonable time and at a supportable cost. The technology reflected in proposed solution approaches derives from the laboratories, which develop the baseline technologies in their sustained discretionary (block-funded) research programs, and produce specific mission-related technological advances in response to externally derived stimuli.

The mutual correlation of external needs and internal capabilities provides the essential impetus for scientific progress. Investigations into the origins of technological initiatives that contributed significantly to the advancement of weapon system technology have revealed that in an overwhelming majority of cases, a group outside the research area, often conducting applications and systems studies, first recognized the need. In only 15 percent of the cases did the group performing research itself first identify the need. Conversely, once the requirements for innovation became known, the research group determined the technical solution alone in 76 percent of the cases and in collaboration with an outside group in 24 percent of the cases. The DOD's requirements for knowledge in science and technology were also shown to be unique, at least at the time of the first recognition of the need. Key R&D workers and supervisors of efforts leading to technological advancements indicated that only some 4 percent of these events resulted from R&D that was not defense-oriented.

For both science and technology, the *a priori* recognition of a defense need provided guidance in achieving by far the largest number of innovations. The examination of growth patterns in innovations provided additional support. Project Hindsight investigators reasoned that if the DOD's requirements were not unique, the growth rate of scientific and technological knowledge should be insensitive to actions taken by R&D managers. They discovered that, in fact, new knowledge increased gradually until R&D managers issued new specifications, whereupon a large number of technological advances were made to achieve the desired performance capability.[5]

The identification of R&D project marketing opportunities does not pose a significant problem for the laboratories. Individual researchers in governmental, institutional, and industrial research organizations exchange information via papers, presentations, and discussions, and tend to be aware of the work conducted by their peers in the scientific community. These exchanges disseminate technical data and lead to a respective awareness of skills, which are frequently translated into project assignments. Such assignments may arise at the instigation of the potential sponsor or the prospective performer, and only incidentally involve the sponsor's and the performer's respective organizations. However, tasks acquired on this basis tend to be limited to the efforts of an individual or of a small team, and do not entail the transfer of significant amounts of capital between the respective organizations.

While projects entailing costs of less than $100,000, and occasionally ranging to $300,000, tend to be available to the laboratories as a result of the individual initiatives of staff members, the acquisition of larger projects requires a concerted effort and a degree of investment. Only a limited number of new project opportunities can be pursued by each laboratory owing to the limited availability of assignable resources. Those opportunities must be carefully selected to provide the most appropriate work for the laboratory.

The defense R&D laboratories have small discretionary budgets (block funds) which may be used to define technical concepts, prepare project plans, and develop budgetary requests, but such budgets are intended to provide only enough funds to enable the initiation of new projects. Project funds are generally required to support R&D efforts beyond the formative stage.

To obtain support for a new project, appropriate project justifications must be developed; user support has to be obtained; and a specific sponsor has to be

5. C. W. Sherman and R. S. Isenson, "First Interim Report on Project Hindsight," Office of the Director of Defense Research and Engineering, Washington, D.C.: Defense Documentation Center, AD64200, June 1966.

identified. A plan is needed to convince a succession of authorities in the chain of command: that the technical, schedule, and cost uncertainties (risks) entailed in the activity are correctly identified and justified by the potential benefits to be derived; that a timely need exists for the product; that the product provides a cost-effective solution to the problem; and that the funding request is directed toward the sponsor with the greatest and earliest need for the product.

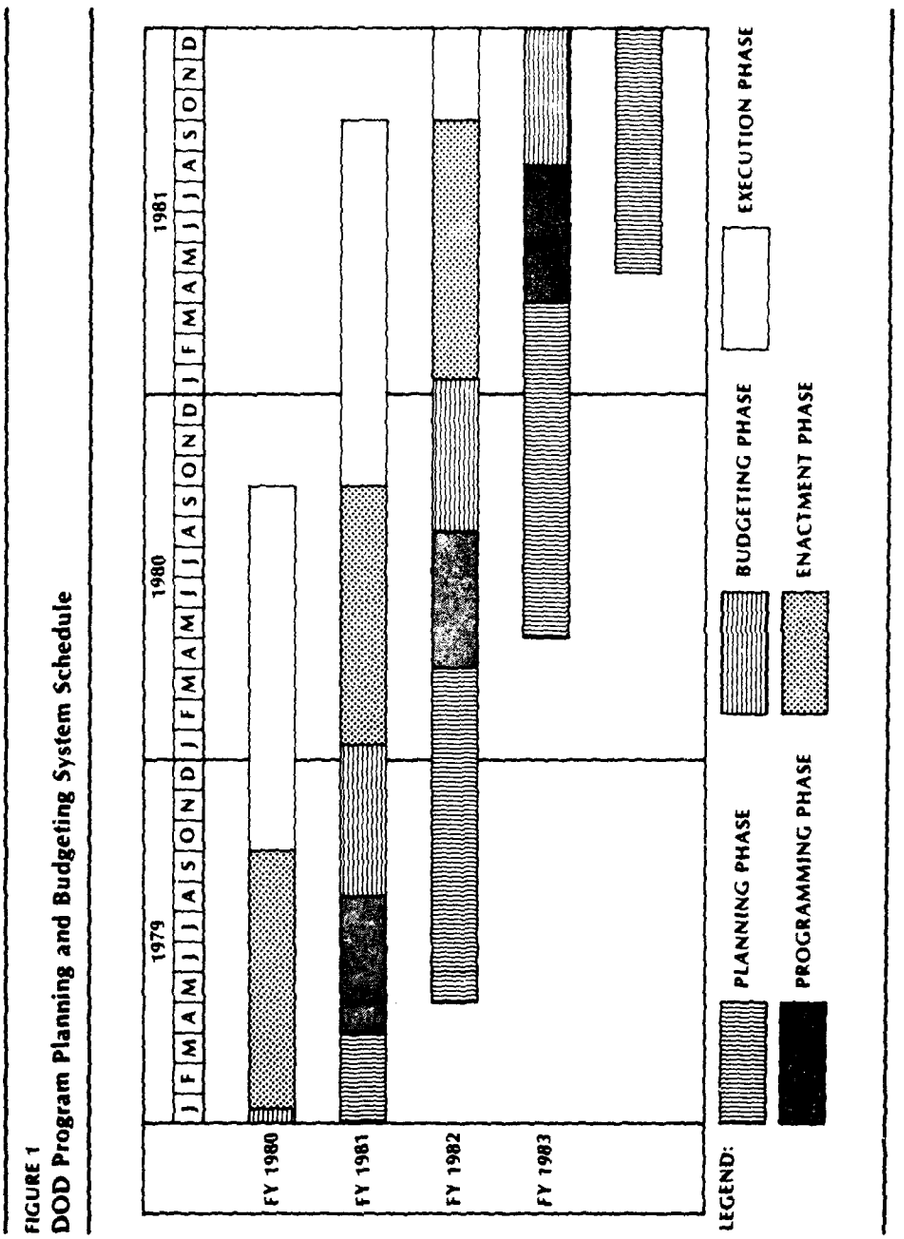
These considerations must be reflected in a host of planning documents which underlie the planning, programming, and budgeting system. Each of the documents that provide inputs to the PPBS is processed at a particular, predetermined calendar date in a 29-month time cycle. This cycle concurrently addresses the budgetary allocations for 4 fiscal years, as depicted in Figure 1. The laboratories' resources thus tend to be committed to programs and projects years in advance. This imposes a unique need for technological forecasting and for normative forecasting in the laboratories. It also imposes the responsibility on the laboratories to identify the best applications for their personnel and physical resources years in advance of actual occurrence.

The long-range commitment requirement imposed by the planning, programming, and budgeting system, and the peculiarities of the PPBS process, introduces the need for a sophisticated and specialized form of marketing in the laboratories. The marketing activity is implemented through written project descriptions and budget requests.

The project documentation passes through a chain of command in which each level has some authority in the review and reprogramming of funds. Project funding is susceptible to alterations at each level. As the decision prerogative affecting the project passes to higher levels in the chain of command, the project data are aggregated with those of other projects, and only portions of the supporting documentation are passed on to the successive decision echelons. The technical investigator's or project manager's ability to influence the decision therefore diminishes as the documentation is progressively abridged and summarized.

The need to provide appropriate information at the correct times via multiple channels for decisions that are based on concise written statements produces a special marketing problem for personnel in the defense R&D laboratories. In most cases, individuals whose interests center on the scientific and technical content of the project will not be familiar enough with the number and variety of documents required by the PPBS to fulfill all of the information needs in a timely manner. Further, the PPBS process differentiates projects on the basis of cost, and establishes modified procedures for project documentation and approvals on the basis of acquisition categories (ACAT). There are four ACATs, with further subdivisions that reflect the characteristics of the particular types of equipment procured by the military services.

FIGURE 1
DOD Program Planning and Budgeting System Schedule



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DEFENSE SYSTEMS MANAGEMENT REVIEW. VOLUME 3, NUMBER 2, SPRING 1--ETC(U)
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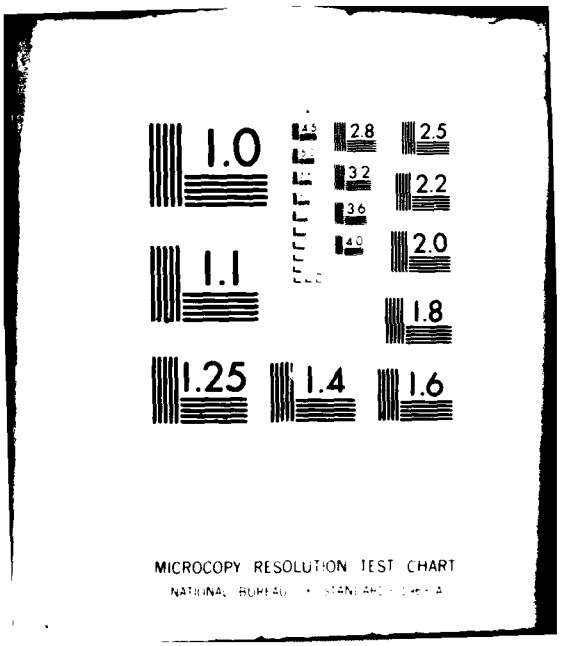
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART

A managerial doctrine termed "project tailoring" is associated with the ACATs. Although project tailoring introduces another variable that increases the complexity of the project marketing task, its overall effect is to provide a balance between total project cost and the cost of managing the project. Project tailoring also relates to the total investment, the amount and type of risk that is allowable in a project, the consequences of project failures, and the criticality of the capability sought.

The variations in the PPBS process add to the need for a team effort in defense R&D project development. Characteristically, such a team will be only partially contained in the laboratory, and with good reason. First, the fragmented project description that emerges in the family of documents upon which budgetary decisions are based does not provide sufficient information for informed decisions. An advocate who has personel access to high-level decision-makers and who can actively promote a program is needed if the constituent project activities are to be effectively represented.

Individual representation of projects at the decision-making level is precluded by economic considerations. However, when a number of projects are integrated into a mission-oriented program, sufficient resources can be applied to support an effective advocacy. The integration of projects into a larger program has two consequences. First, as program cost increases, a larger investment for program development (marketing) is justified. Second, as program cost increases, program documentation requirements become more extensive; program management criteria become more stringent; and program risks have to be reduced. The specific tailoring that applies to the project is thus seen to be predicated on total program cost. Even when total program cost can be estimated by laboratory personnel, judgmental factors enter into the determination of the appropriate tailoring for the program. The correspondence between the program advocate's judgment and the decision authority's judgment on the appropriate tailoring for the program becomes one of the factors on which the success of the program advocacy will depend.

Project tailoring has a pervasive impact on the work content when the project is funded. If the implications of an association with a major program are not correctly assessed by laboratory personnel, the laboratory may find itself burdened with documentation and administrative tasks that compete with and displace constructive technical efforts. Further, if the technology addressed by the laboratory poses higher risks than are otherwise associated with the program's developmental status category, the laboratory may be required to apply an inordinately high proportion of its effort to status reporting and to coordination. These considerations combine with basic internal pressures to form a barrier of resistance to taking on big new problems that are very different from those the laboratory has been addressing. Weinberg has noted that most scientists like to do what they have already done. Relatively few have the intellectual drive and

confidence to venture into new fields.[6] At the same time, in the absence of organizational growth and with limited personnel turnover, established lines of investigation tend to become exhausted, exhibiting progressively decreasing rates of advancement. When scientific and technical personnel are the limiting resource, and the laboratories' *raison d'etre* is to sustain the nation's scientific posture, the need for an aggressive, soundly managed, and centrally coordinated R&D project marketing effort in each of the laboratories is clearly indicated.

The fact that the laboratories' R&D marketing objectives and criteria are totally different from those of industrial concerns has produced considerable confusion regarding the proper role of marketing in the laboratories. R&D project marketing has consequently emerged as one of the laboratories' few functions that is not explicitly recognized in the organizational structure and in the formal management processes for defense R&D. The need for R&D project marketing is generally accepted in the context of constituting an essential advocacy to provide support for new technical initiatives. The satisfactory evolution of the technology base is in turn linked to a continuing emergence of R&D project initiatives. However, if one were to be guided solely by the formal decision process defined in the DOD directives and instructions, such R&D initiatives would be perceived as occurring solely in response to recognized military requirements, and would not, as a rule, include the recognition of scientific possibilities as a stimulus for new missions and generically new military systems. The most creative aspect of the laboratories' function thus appears to be disregarded or subordinated to depict the laboratories as an implementing agent, rather than as a motive force whose efforts may underlie the adoption of new national policies or postures.

In the same context, the competitive aspects of mission definition and of alternative mission implementation approaches are reflected in the literature, but the cooperative needs of the laboratories and of the other elements of the defense R&D community are rarely mentioned.

Stigmas may attend to the concepts that defense R&D is "marketed" by the laboratories, and that marketing may be required for scientific progress to be fostered. The semantic problem embodied in the above statement is far from insignificant. However, the perpetuation of a disciplinary void for a unique and vital function poses an even more serious problem, which can only be resolved by providing accurate and comprehensive information on a very complex process. An organized body of literature needs to be developed on R&D project marketing, or on a suitable synonym; training material and training programs must be developed, and organizational design studies must be conducted to provide the appropriate managerial support and participation for this function. ||

6. A. M. Weinberg, *Reflections on Big Science* (Cambridge: Massachusetts Institute of Technology Press, 1967).

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Improving Weapons in the Fleet

Dr. Robert J. Massey
Jack F. Witten
Dr. Richard I. Henderson

It is important to distinguish between a piece of hardware as a "weapon system" and the much larger "system" which must work effectively to have real-world operational capability. (The term "total system" will be used to denote the larger system of which the weapons hardware is but one element, along with such other elements as technical data, test equipment, support personnel, spare parts, etc.) Not all problems require changes to weapons hardware for their solution.

The conventional process for solving material readiness problems is the following. Something fails. Sailors have to fill out maintenance action forms in order to draw parts to restore the equipment. These reports are processed, often several months later, in a central computer facility. Analysts review the computer printouts to identify trends and to attempt to spotlight problems.

Problems thus identified are studied, and proposed fixes, usually hardware service changes, are defined for the most visible problems. Funds are then sought for development of a change. If all goes well, the change is developed, and change kits are procured and distributed. Then, if installation money and capacity become available, the change is installed. This process (1) takes too long, (2) costs too much, and (3) is biased toward solving problems through hardware service changes, even when they could be solved faster and cheaper through some other element of the total system which supports operational capability. The worst shortcoming of this process is the time required. Often it takes 18 months from the first emergence of a problem until it is recognized by someone who can do something about it, another 18 months to develop the modification hardware and its related support, and then perhaps 2 years before the ship, aircraft, or weapon can get into a facility that can install the change. After a few trips around this circuit—particularly if a change does not solve the problem—the weapon is obsolete.

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Dr. Richard I. Henderson is associate professor of management at Georgia State University. A graduate of the U.S. Naval Academy, he earned an M.B.A. degree from the University of Miami, and a Ph.D. degree from Georgia State.

Why It Should Be Done in Situ

Real-world effectiveness can best be pursued *in situ;* that is, where the weapon or system is operated. The people identifying and solving the problems can be most effective if they are on scene, totally immersed in the hardware's operational environment. One of the central findings of recent research on the innovation process has been the high correlation between exposure of research and development people to users and the real-world success of new processes or products.[1] These studies have confirmed what many naval officers have long suspected, that if research and development people are going to produce things that are useful and practical, they need exposure to the needs they are trying to satisfy.

Another compelling reason for conducting the process *in situ* is that only by so doing is it possible to really deal with problems on a "system" basis. When the innovator is a part of the operational environment, he can solve problems through whatever element(s) of the total system—hardware plus support personnel, technical data, parts, etc.—offer the most advantageous solution. He can modify maintenance practices, change allowance lists for spares, modify the training of technicians, etc. The innovator working *in situ* could normally develop, test, refine, and retest a proposed solution long before the analyst studying computer printouts ashore will even suspect there is a problem.

Why It Should Be Done by the Assigned Crews

Experience in industry in this country and abroad has amply demonstrated the "bottom line" payoff from harnessing the creative capabilities of the work force to solve reliability and cost problems.[2] In the electronics industry, a steep cost-reduction "learning curve" is essential to survival. Texas Instruments (TI) has been a leader in reducing costs of electronic devices, especially calculators and digital watches. All TI workers, including scientists, are trained in work simplification. Mr. Ray McCord, executive vice president of TI, when asked

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1. A good summary of what has been learned from these studies is in Edward B. Roberts, "Generating Effective Corporate Innovation," *MIT Technology Review*, October-November 1977, pp. 25-33. Still useful is a survey article by James M. Utterback, "Innovation in Industry and the Diffusion of Technology," *Science*, 15 February 1974, pp. 620-626. Highly recommended reports of recent studies are Arthur Gerstenfeld, "A Study of Successful Projects, Unsuccessful Projects, and Projects in Progress in West Germany," *IEEE Transactions on Engineering Management*, August 1976, pp. 116-123; Eric Von Hippie, "Users as Innovators," MIT *Technology Review*, January 1978, pp. 30-39; and Roberts, "What Do We Really Know About Managing R&D?" *Research Management*, November 1978, pp 6-11.

2. For a readable overview, see Max Ways, "The American Kind of Worker Participation," *Fortune*, October 1976, pp. 168-171, 174, 176, 180, 182.

what portion of the company's achieved cost reduction, not attributable to increased capital investment per worker, could be accounted for by innovations developed by rank-and-file workers, replied: "All of it."

The Japanese have been particularly effective in harnessing the heads of the blue-collar work force to the task of improving the bottom line. This has been true not only in Japan, but also in Japanese-managed plants in this country. In writing on the success of Japanese products in world markets, August B. Mundel reported that:

> Part of their "secret weapon" has been a psychology that the employee who makes the product knows much about the problems of manufacture, quality, work methods, and industrial health. They have proven that this knowledge, properly channeled, can improve working conditions, output, quality, market penetration, and company profits. The Japanese Q.C. (Quality Control) Circle movement is the embodiment of this psychology and is reported to have hundreds of thousands of members. It uses the minds of its employees and makes use of their abilities and competence.[3]

Under this approach, the workers are trained to identify and solve quality control problems. Small teams consisting of foremen and workers identify major problems within their departments. The circle, a portion of the group, works to understand the causes of the problems and to develop solutions.

Would anyone undertake to argue that the crews maintaining the Navy's advanced weapons do not have native competence at least equal to that of bench workers in American and Japanese factories? If a 19-year-old high school graduate with 2 years of experience can be trusted to do the preflight checks on a $14-million fighter aircraft, he certainly has the competence to participate effectively in improving that process. The crews who "own" and must maintain systems have a far superior understanding of the *non-hardware* elements of the total systems than can ever be acquired by anyone working ashore. It is probably also greater than the understanding which could be acquired by a civilian engineer on temporary duty *in situ*. While the engineers who designed the equipment probably have a superior understanding of the weapons hardware, the knowledge of competent Navy technicians in this area is by no means trivial.

When innovations in pursuit of operational effectiveness are performed by the assigned crews, the bias toward hardware service changes would be reversed. With their superior knowledge of all of the non-system hardware elements of the total system required to support capability, the "owners" would look first for

3. August B. Mundel, "Comments on Education and Jobs: The Great Training Robbery," *IEEE Engineering Management Group Newsletter*, November-December 1970, p. 8.

ways to solve problems without changing the hardware. Major hardware redesign (as differentiated from minor changes such as rerouting a wire) would be a last resort.

A very great advantage of the *in situ* owner-innovators over the conventional problem-solving process is the ability to exploit very minor improvement opportunities. As pointed out earlier, the rate of progress in closing the gap between the design-limited, or potential, performance of the system and what the system actually delivers is a reflection of the cumulative impact of all the problems solved. Industry has found that "breakthroughs" in quality improvement and cost reduction are usually not one or a few big advances but rather the result of thousands of "nickel-and-dime" innovations.

While the current official system certainly does not promote innovation by assigned crews, such innovations are far from rare.[4] Few people have spent many years in the Navy without becoming aware of innovations produced by assigned military personnel which either improved equipment readiness, reduced costs, or both. Most innovations by crews of operating units have, in the past, been more to "beat the system" than to improve it. By the "system" here we mean the standard configuration, standard maintenance procedures, etc. Sailors and marines have shown great ingenuity in making things work, "in spite of the system." What we are proposing would harness the energy, dedication, and creativity formerly invested in beating the system to perfecting the system. When the owning crews beat the system, they solve problems for the particular pieces of equipment assigned to their units. When they improve the system, they solve problems for all units of that system wherever they may be assigned.

Cases of *in situ*, bottom-up innovations seldom receive much publicity, since they are usually undertaken on a bootleg basis at some personal risk to the innovators.

One case which was published, and which was officially sanctioned, involved maintenance innovations at VA-126.[5] Attack Squadron 126 flew transonic F9F8T Cougars and provided instrument training to pilots going through the replacement air group at Naval Air Station Miramar. In 1961, the squadron invited the

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4. An impressive number of innovations have been brought about by crew members and former crew members. These include the revolutionary improvement in gunnery brought about at the turn of the century through the efforts of Lieutenant William S. Sims (see "Gunfire at Sea," Chapter 2 of Elting E. Morison, *Men, Machines, and Modern Times* [Cambridge: MIT Press, 1966]); the Naval Aircraft Maintenance Data Collection System; maintenance requirement cards; configuration management; Naval Aircraft Maintenance Program; portable x-ray equipment; spectrographic analysis of aircraft engine oil to detect incipient engine failures through increases in wear metals; inflatable dunnage—and on and on and on.

5. Material on VA-126 is based on personal interviews with participants in 1962; the article "Squadron View of Fleet Work Study," *Naval Aviation News*, September 1962, pp. 32-35; and recent interviews with two former commanding officers of the squadron.

Fleet Work Study Team to help it reduce the time planes were down for check, reduce maintenance man-hours per check, and improve quality control procedures. The team, a blackshoe lieutenant commander, a chief personnelman, and a chief aviation machinist's mate, spent less than 4 months working with the VA-126 people to help them solve these problems. Team members served as catalysts for applying the common sense of the VA-126 people, the "owners" of the problems. Solutions were found through a combination of the visitors' knowledge of the work study process and the squadron members' technical knowledge of the system and their commitment to do a job faster, easier, and more effectively.

After completion of the project, the VA-126 personnel continued to improve the innovations started with the help of the Fleet Work Study Team. Within a year, average time in check had been cut from 7.6 days to 2.5 days and maintenance man-hours per check from 275 to 100. Quality control gripes went from 20 to 30 per post-inspection test flight to 5.2, and availability of aircraft from under 70 percent to about 85 percent.

The most impressive figures of all related to flight safety. The years rolled by without an accident. In October 1966, 5 years after the visit of the Fleet Work Study Team (and redesignation to VF-126), the squadron passed 55,000 safe flight hours, a new Navy record for single-engine, fighter-type aircraft. The first accident did not occur until years later, after more than 70,000 safe flight hours.

A Proposal for Action

The Navy must move, *now*, to harness the creative capabilities of its sailors and junior technical officers to the task of speeding up achievement of a real-world capability for new systems and equipment. The concept should be demonstrated and shaken down in an experimental implementation, then exploited to the full extent test results warrant.

Selected maintenance crews should be designated as innovation teams. The specific pieces of equipment on which the team is authorized to make changes should be designated in writing by serial number. The officer or petty officer in command of the crew designated an innovation team should be issued a charter analogous to the charters for managers of weapon system development projects. In addition, each team leader should have control of a significant amount of money. Funds can be provided by letting the teams retain all or part of the funds saved through the improvements they accomplish, a practice recommended by the Comptroller General of the United States.[6]

6. U.S. Comptroller General, *Improving Federal Agency Efficiency Through the Use of Productivity Data in the Budget Process*, GAO Report FGMSD-73-33, 10 May 1978, p. 19.

The functions of the innovation teams must be clearly defined in terms of what they are to accomplish, what they are authorized to do, and what they are forbidden to do. Their job should be to identify problems, develop and demonstrate solutions, and document the worthwhile ones to the extent necessary for broader application or further development. *Responsibility for selecting* from this base of demonstrated options should rest with the material systems commands and other organizations currently responsible for such matters. The innovation teams should have full authority to do anything they think useful to the specific pieces of equipment dedicated as experimental hardware for development of capability-improving innovations, but no authority to change anything on any other pieces of equipment.

The authority and responsibility of the team should be almost open-ended. Technical authority should be delegated to the team to the maximum extent possible. Along with this virtually unlimited technical discretion, each team leader should have unfettered authority to spend his budget in whatever fashion he thinks best. All specifications, standards, procedures, etc., except for those directly based in mandatory laws, should be subject to challenge and improvement. A team should be free to effect changes in any aspect of the software or hardware of the total system. Their primary objective would be the pursuit of solutions to identified problems hindering achievement of mature operational capability.

The fact that working maintenance crews would be "double hatted" as innovation teams does not imply that these teams would be typical fleet maintenance crews. The crews designated as innovation teams for important new systems would have specially selected members. The teams could be augmented in terms of skills, and perhaps even numbers of assigned personnel. The leaders of these teams would be carefully selected. Many would be technical officers from the NESEP (Navy Enlisted Scientific Education Program) with years of hands-on experience with related equipment plus training as engineers. For the 32-year-old NESEP lieutenant, being selected as innovation team leader would be comparable to a 44-year-old aviator captain being selected as commanding officer of a nuclear-powered aircraft carrier. It would be a great honor, a great challenge, and an indicator of future career success.

We anticipate some resistance to these proposals, based on the contention that once a few sailors get a license to change things, there will be no way to "contain the contagion," and all configuration discipline will be lost. The result would be a degradation of maintenance and support capability. On the contrary, the innovations advocated herein would strengthen, rather than weaken, configuration discipline. The changes we propose would neutralize the forces that lead conscientious officers and men to make unauthorized service changes. Most

unauthorized changes are made by people determined to get their equipment ready and who see the conventional system as hopelessly slow and ineffective. The proposed process would provide both a means for solving problems quickly "within the system," and a source of information on how to deal with problems without resorting to unauthorized hardware changes. A sailor with a problem would often be able to solve it legally by contacting the innovation team for a particular piece of equipment. The innovation teams for specific types of equipment would be identified to all holders of such equipment, perhaps by decals on the equipment itself.

A multiphase implementation process is proposed, with decision milestones preceding each phase. In the initial phase, the concept would be tested and refined in a single organization. This limited test would be to validate the payoff from the process and identify and solve implementation problems. A product of this phase would be a "transfer package" for implementing the concept in other organizations. The second phase would cover implementation of the concept in a limited number of additional organizations. In Phase II, the training program and other elements of the transfer package would be tested and refined. At the completion of the second phase, the Navy would have the capability to implement, smoothly and efficiently, *in situ* in-house system capability innovation for all systems and equipment.

Summary

New weapons entering the inventory generally have impressive combat *potential* as a result of superior technical characteristics. However, the actual operational capability delivered in the real-world of the fleet environment is usually much below that potential. Closing the gap between the actual operational capability and the design-limited potential capability requires solution of countless problems to reduce failures and the time required to restore equipment when it does fail.

The process of achieving a high real-world operational capability from new weapon systems can be vastly speeded up by tasking selected maintenance crews to perform aspects of the process *in situ*—on the ships, in the squadrons. Benefits to be expected from *in situ* in-house innovation include:

—Achieving full operational capability for new weapons during the early part of their operational life, the period when they enjoy a technical superiority over the weapons they can expect to meet in combat.

—Achieving this superior operational capability at a fraction of the cost of the conventional system with its bias toward solving problems through time-consuming and expensive changes to system hardware.

—Reducing the fleet's dependence on civilian contractors and civil service technical representatives whose availability under combat conditions is questionable.
—Drastically reducing the cost of ownership of weapons as the *in situ* teams devote attention to innovations designed to reduce owrership costs directly, as well as indirectly through improvement in equipment reliability.
—Improving the "quality of work life" for talented enlisted technicians and junior technical officers. The uniformed "David" teams, and their rooters, would get a lot of satisfaction out of beating the "Goliath" of the conventional bureaucratic-contractor approach to solving the problems barring delivery of the full combat potential of modern weapons. If they were permitted to use their higher capabilities in pursuit of real-world operational capability, the Navy might find more of the most talented enlisted technicians and junior technical officers would elect to stay in the Navy, rather than go elsewhere to find outlets for their talents. ||

105 MIL-STD-499A and Its Application to Systems Engineering

Elmer L. Peterson

Prior to 1966, the U.S. Air Force practiced a structured approach to system engineering by using the detailed procedures and formats contained in AFSC Manual 375-5.[1] Unfortunately, the use of these procedures did not readily promote tailoring (sizing) by either the Air Force or industry. The result was excessive detailed documentation that was difficult to manage, time-consuming to read and, because of its great bulk, was not well-used by the engineering and technical management community for whom it was intended.

After several frustrating experiences by both the Air Force and industry, a more general approach to systems engineering and its management was created This approach was initially titled, "MIL-STD-XXX, Systems Engineering Management." This new document, which was widely circulated throughout industry, received a wide range of comment.

The document was controversial in that it represented a radical departure from the old way of doing business. Instead of prescribing forms and detailing procedures, as was the case with AFSCM 375-5, the new document simply described the system engineering process and laid out a checklist of "principles." This part of the change was welcomed by the industry reviewers. The controversial parts were two additions. The first of these added new requirements in reviews, engineering integration, and in technical program planning and control, including a function called "technical performance measurement." The concept of technical performance measurement is one of identifying critical technical parameters that are important to program success, then tracking their development, assessing how well their development is progressing, making predictions about whether or not the parameter can achieve technical success (within the allocated resources), and then using these data to assist in managing the technical program. The concept is an excellent one and it has become widely used throughout industry. At first, however, industry expressed reservations about the feasibility and usefulness of this new management tool. The second significant change called for the contractor to have his system engineering and engineering

1. Air Force Systems Command, AFSCM 375-5, "Systems Engineering Management Procedures" (Washington, D.C.: Government Printing Office), 10 March 1966.

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management processes "validated" by government inspectors in much the same way that cost and schedule control systems were being validated.

Owing in large measure to the concern expressed by the industry reviewers, the Director of Defense Research and Engineering issued a memorandum[2] identifying the new standard as MIL-STD-499, and placing a ban on its use except for test applications on the F-15 and B-1 programs. Later, a third program, the airborne weather reconnaissance system, was added as a test case.

The new MIL-STD-499 was hailed by its drafters as "the specification approach" to systems engineering and engineering management. Its key objectives were as follows:

—Definition of the most cost-effective system and program;
—Design integrity;
—Complete definition of design requirements;
—Increased efficiency of system/cost effectiveness;
—Planned consideration of all mission-derived requirements;
—Integration of all engineering disciplines.

The new approach differed from the old AFSCM 375-5 approach through the following characteristics:

—Explains what to do, not how to do it;
—Permits contractors to use their own internal system engineering process, rather than a specified process;
—Requires a minimum of documentation by:
  —A series of technical reviews and audits;
  —Use of contractor's internal documentation;
  —Documentation not fixed-formatted;
  —Only selected documents are deliverable.
—Greatly reduces deliverable data:
  —Only that necessary for integration;
  —Deferred delivery of data;
  —Summary data, versus incremental;
  —Only that needed for visibility.

The test program for MIL-STD-499 did not go according to plan. It was withdrawn from the B-1 program very early because of funding limitations. It was also withdrawn from the airborne weather reconnaissance system after the contract-definition phase, on the request of the system program director. The F-15 program was the only one to complete the test application.

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2. Director of Defense Research and Engineering, Memorandum for the Assistant Secretary of the Air Force (R&D), Subject: Systems Engineering Management - Military Standard, 12 July 1969.

Brigadier General Benjamin N. Bellis, the F-15 Program Manager, was quite complimentary in his appraisal of the results of the test.[3] In particular, General Bellis liked the series of preliminary and critical design reviews which were part of the new management technique outlined in the MIL-STD.

The Air Force test team members, on the other hand, were quite critical of the standard. In particular, they questioned the usefulness of validating the contractor's systems engineering. The test was aimed at validating the contractor's internal procedures, but it appeared to the test team that they were validating people capability instead of procedures. After much debate, the requirement for validation was dropped when the standard was subsequently updated.

Several deficiencies in the standard were also discovered during the test. The main deficiency was that the standard did not address integrating the logistics support function with the system engineering process. Since the logistics support costs are usually the major part of a system's life-cycle costs, this deficiency was a serious one. Another deficiency was that the standard did not address problem analysis and program change management. The subsequent update of the standard corrected these and other identified deficiencies.

It was also discovered during the test that no attempt was made to tailor the standard to fit the particular needs of the specific program. The program offices did not want to tailor the standard because they were afraid they might leave out something important. Contractors, in preparing proposals under competition, would not tailor (and in fact, even *added* requirements in their system engineering management plans) for fear that they might be considered nonresponsive. From this experience, it was obvious that a way was needed to "force" tailoring. Consequently, when the new standard was being drafted to include all of these lessons learned, a new format was devised. In the new format, Section 5 (which contains the detailed requirements) contains only the requirements for a system engineering management plan. The detailed descriptions of the system engineering process and the technical program planning and control functions were all moved to an appendix which was made "nonmandatory." A summary of the content of the appendix is as follows:

10. This nonmandatory appendix provides specific tasks which may be selected to fit program needs. The scope and depth of the specific tasks chosen for application shall be consistent with the needs of the program. . .
10.1 Technical Programming Planning and Control. . .
10.1.1 Development of Contract Work Breakdown Structure. . .

3. Brigadier General Benjamin N. Bellis, Letter to Major General Gossick, 5 February 1971.

10.1.2 Program Risk Analysis. . .
10.1.3 System Test Planning. . .
10.1.4 Decision and Control Process. . .
10.1.5 Technical Performance Measurement. . .
10.1.6 Technical Reviews. . .
10.1.7 Subcontractor/Vendor Reviews. . .
10.1.8 Work Authorization. . .
10.1.9 Documentation Control. . .
10.2 System Engineering Process. . .
10.2.1 Mission Requirements Analysis. . .
10.2.2 Functional Analysis. . .
10.2.3 Allocation. . .
10.2.4 Synthesis. . .
10.2.5 Logistic Engineering. . .
10.2.6 Life-Cycle Cost Analysis. . .
10.2.7 Optimization. . .
10.2.8 Production Engineering. . .
10.2.9 Generation of Specifications. . .

This format change is very significant. When MIL-STD-499A[4] is included in a request for proposal, the only task required of a contractor is to prepare a system engineering management plan. The program office, in order to include specific tasking to perform systems engineering analysis or any of the technical program planning and control tasks, must physically extract the desired tasks from the nonmandatory appendix and include them in the statement of work. This forces the drafter of the statement of work to evaluate the tasks and, in the process, to accomplish a degree of tailoring. In the 5 years since the new standard has been published, there is evidence that tailoring is taking place and that the revised format is successful.

In summary, MIL-STD-499A represents an evolutionary development reflecting a large investment in time, manpower, and analysis of lessons learned. It appears to be successful, in that people are using it and there have been no complaints concerning its use. In large measure, MIL-STDs can be looked upon as management by exception. That is, if the wheel doesn't squeak, don't grease it. ‖

4. MIL-STD-499A, Engineering Management, 1 May 1974, Superseding MIL-STD-499, 17 July 1969.

109 Some Tips on Our Style

The editors of DSMC's quarterly *Defense Systems Management Review* and of *Program Manager*, the College's bimonthly newsletter, are interested in your thoughts on policies, trends, and events in the areas of program management and defense systems acquisition. We invite you to send us articles so that your valuable experiences can be shared. We are interested in lessons you have learned through your acquisition ventures—both successful and otherwise.

Without delivering absolute pronouncements, beyond the demand for good grammar, we here offer some tips to prospective authors on the College's publication "style." There is, of course, no *best* way to do *anything* in journalism, but consistency and uniformity should be uppermost. The renowned stylist William Strunk, Jr., said, "If those who have studied the art of writing are in accord on any one point, it is this: the surest way to arouse and hold the attention of the reader is by being specific, definite and concrete."

Write in the first person, *I, we, our*; use *you* often. Active verbs are best. Beware the overuse of acronyms. Write naturally, like you speak, and avoid stiltedness. Except for a change of pace, keep most sentences to 25 words or less and paragraphs to six sentences. We reserve the right to edit copy but do not make changes just to "leave our mark."

We will try to publish all articles to include your byline and a brief biography. Biographical information should include your current position, any experience you have had in the defense acquisition field, and your academic background. The *Review* sends edited copy to the author before it goes to the printer so that editorial changes can be approved. Where possible, clear articles through your public information office or an equivalent authority. All articles to be published are routinely cleared and reviewed by the Director, Security Review, Office of the Assistant Secretary of Defense for Public Affairs.

The Basics. Double-space your article using one side of the paper only. One double-spaced page, with a 1-inch border on all sides, equals about 250–300 words. Although we are totally flexible regarding length, we prefer 5,000 words, about 20 double-spaced pages, for *Review* material, and 2,000–3,000-word articles, about 10 double-spaced pages, for *Program Manager*. Articles submitted for one publication may appear in the other, and vice versa. The important thing is, don't feel constrained by length requirements; say what you have to say in the most direct way possible regardless of length.

We use figures and charts in the *Review*. Figures, charts, *and* photographs are used in *Program Manager*. We prefer glossy black and white photographs, 5-by-7 or 8-by-10, with brief cutlines. We cannot guarantee the return of photographs. Do not write on the back of photographs. Photocopies of photographs are not acceptable.

Charts and figures should be sharp and clear, with legible information and captions. We prefer camera-ready art, but our graphics people can work with sketches if they are clear and precise.

The stories that appeal to our readers are those taken from *your* own experience rather than stories that are loaded with "researched" information. When you are ready to communicate, do so in plain English.

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Or write us at the Defense Systems Management College, Fort Belvoir, Virginia 22060, Attention: DRI-P. ‖

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