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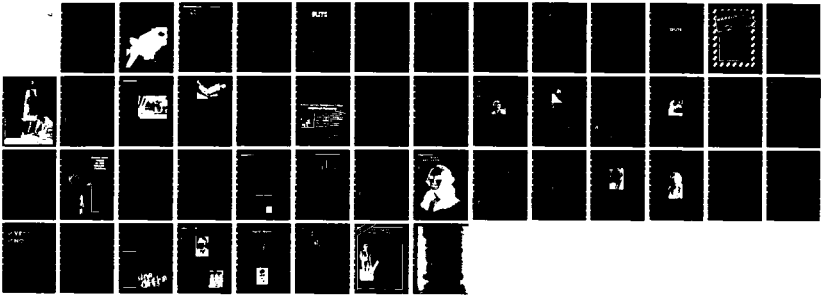
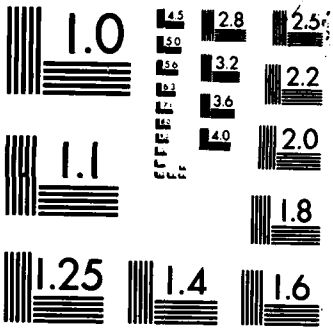




March-April 1984

Program Manager

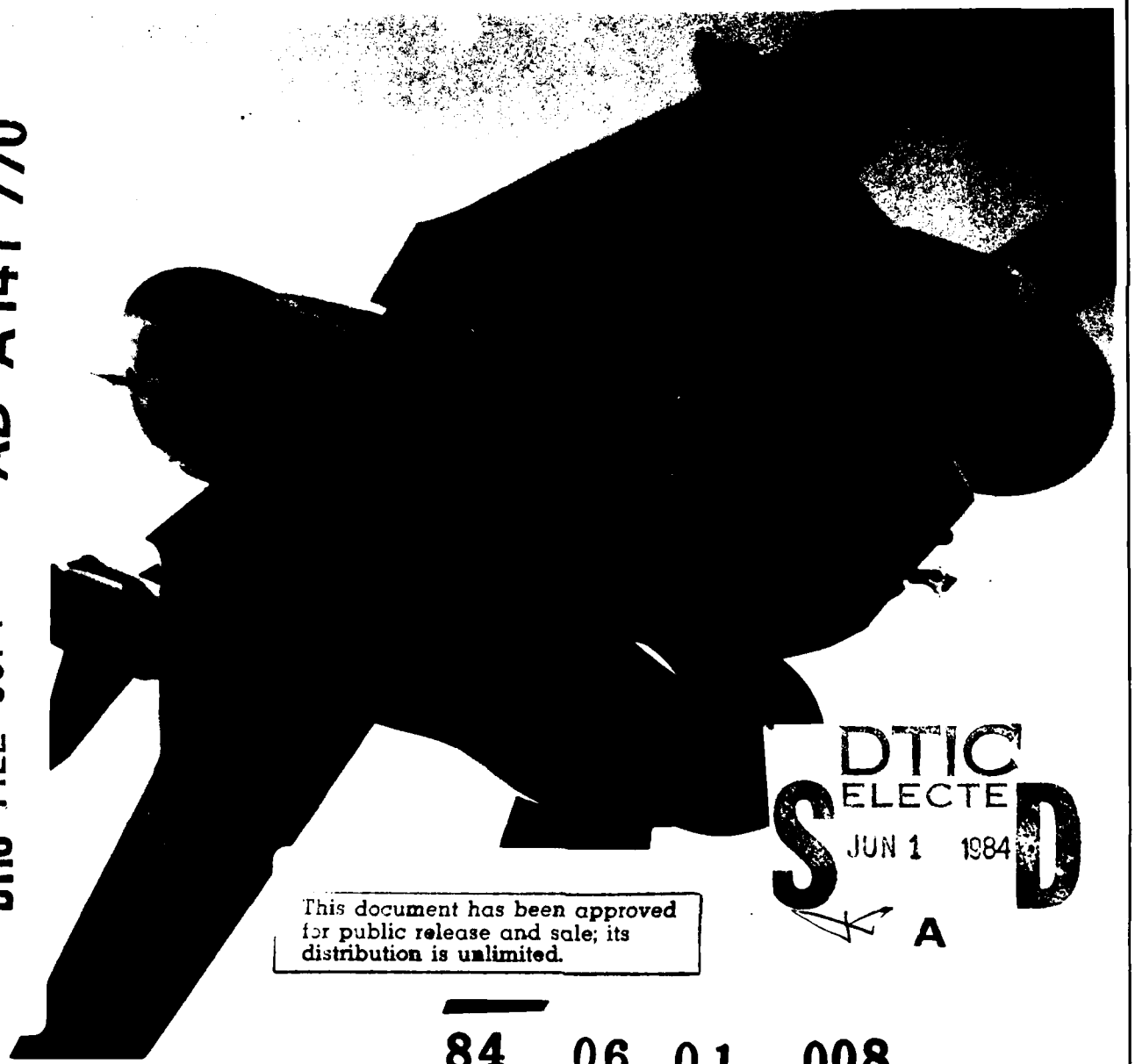
The Journal of the Defense Systems Management College

Second-Source Splits -A Non-Solution?

Communicating in a Noisy World

The Basics of Weapon System Warranties

Toward Realism in Funding for Program Risk



CONTENTS

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Cover: *Navy F-14 Tomcat on the tail of a Navy F-4 during air combat exercises. (Photo courtesy Dick Moye.)*

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Second-Source SPLITS An Optimum Non-Solution

Brent Meeker

The government often buys identical equipment from two or more manufacturers. In some cases, the government even subsidizes a manufacturer in production of a piece of equipment that is already being bought from another manufacturer. This has the primary purpose of expanding the mobilization base, but it affords an opportunity for competition between manufacturers. Since the purchased items are identical (and function), the competition is primarily in price, and the government's expected gain in fostering competition is lower overall price.

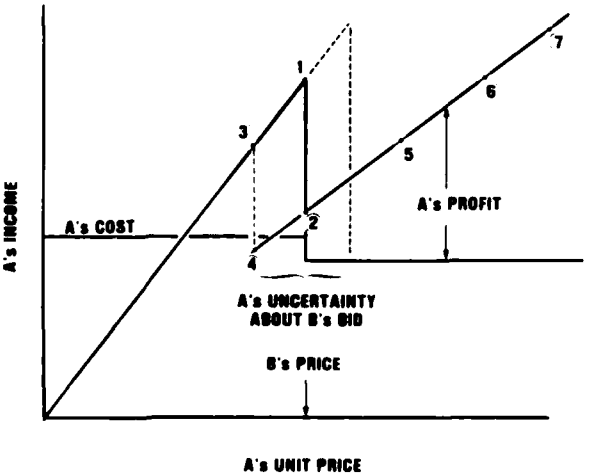
In order to motivate competition, it is common for the government to award 60 percent of a year's purchase to the lower bidder and 40 percent to the higher bidder. It has been pointed out by Solinsky that this practice is defective. (See Kenneth S. Solinsky, "Controlled Competition for Optimal Acquisition," *Systems Management Review*, Vol. III, No. 2, Summer 1980, pp. 47–55.)*

He gives three reasons:

1. A fixed-quantity split results regardless of whether the price difference is small or large.
2. One or both companies could decide that the smaller quantity is sufficient, resulting in no competition since they would feel no compulsion to be low bidder.
3. There is no incentive for a 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.

These are certainly serious defects, particularly number 2 in the event *both* companies decide that the smaller quantity is sufficient. In that case, bids tend to be the *higher*, a reverse competition. Instead of the competing companies are motivated by profit, reverse competition *will* be the case as shown by Figure 1. This diagram shows how the income of manufacturer A will vary as a function of the unit price he bids. The theory is that A will try to bid for point 1, i.e., the highest price at which he can still get 60 percent of the buy. But because of the discontinuity of the split and because B's bid cannot be known with certainty, there is great danger of A ending up at point 2 when trying for 1. Since A is not foolhardy, he will allow for some range of uncertainty in B's bid (indicated by the dotted lines A's income would follow were B's bid to vary). Contractor A will then bid for the point 3 rather than 1. Even having made an allowance, there is of course *some* chance that B's bid will be lower than allowed for, in which case A would end up at 4, perhaps losing money. But note that if A bids at point 5, he will be sure of getting at least as much profit as at 3; the uncertainty here is that if B's bid is higher he will make even more money. But, having given up on trying for 60 percent of the buy, A might as well bid at 6 where he is sure of making as much profit as at 1, the naive optimum. And if 6 is a good bid, is not 7 even better, and so on, as much as the market will bear? Obviously, B can follow the same line of reasoning and also conclude that bidding high is best.

Figure 1. Manufacturer A's Income as a Function of His Unit Price Bid for a 60/40 Split Function



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*Kenneth Solinsky, who wrote the original on second-source splits, has been given the opportunity to comment on Mr. Meeker's article. His response will appear in a future issue of *Program Manager*.

Solinsky saw this problem and focused on the discontinuous character of the split as its source and a smoothly varying split as its solution. I will show that this is a specious analysis; a smoothly varying split can foster reverse competition even more surely than a 60/40 split and, in fact, the one used in Solinsky's example does so. In spite of this, reverse competition did not occur in the procurement Solinsky cites. The reason it did not is unrelated to the way of splitting the buy, as will be explained.

Solinsky's Example: A Poor Non-solution

The example Solinsky gives is

$$f_A(x) = 1/2\,[\text{sign}\,(x)\,\frac{\arctan\,(75x^2)}{90} + 1] \qquad (1)$$

Where f_A is the fraction of the buy allotted to company A, and the variable x is given by:

$$x = \frac{\text{B's price} - \text{A's price}}{\text{B's price} + \text{A's price}} \qquad (2)$$

Solinsky graphs the function $f_A(x)$ as in Figure 2, but it is more instructive to graph A's income for a fixed value of B's price as was done in Figure 1 for the 60/40 split. A's income is given by

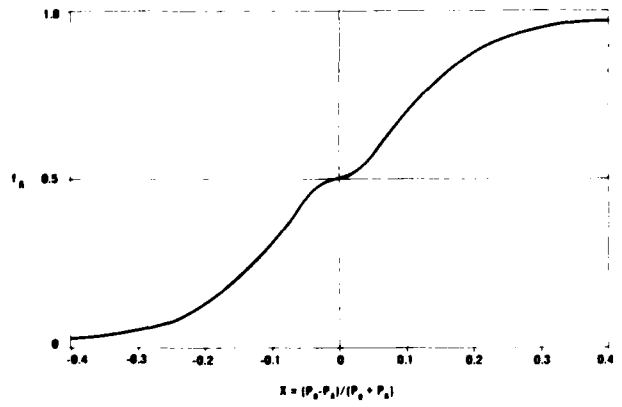
$$\text{A's income} = N P_A f_A(x). \qquad (3)$$

Where N is the total number to be bought and P_A is A's price. A graph of this function is shown in Figure 3, (N is set to 1 for this graph). This curve looks as though it would be very effective in fostering competition. A's best bid would seem to be about 70, undercutting B's price by 30 percent.

However, this overlooks the fact that A's cost of production will also vary as the split varies. This did not make much difference for the 60/40 split, since only two levels of cost occur as shown in Figure 1. But if the split is continuous, then a continuum of costs must be considered. The simplest assumption is that the cost is proportional to the number produced (i.e., the unit cost is constant). A mix of fixed and unit costs is more realistic, but the assumption of zero fixed cost places the most constraint on the split function, $f_A(x)$. Under this assumption, A's profit, I_A, may be written

$$I_A = N f_A(x)\,(P_A - C_A). \qquad (4)$$

Figure 2. The Split Function Used by Solinsky



Assigning a value $C_A = 60$, and, as before, $P_B = 100$, this may be graphed as shown by the lowest curve in Figure 4. Inspection of this curve leads A to the very different conclusion that he should bid 110—about 10 percent above B's price. Assuming B's cost is the same as A's, he can draw the same family of curves for different values of P_A. If A bids 110, B can consult his set of curves and see that he should bid 120. Then, of course, A will see that he should bid 130, and so on. Thus, A and B will bid each other up the family of curves, each one trying to be at the mode of the curve. This mode is always above the point where A's and B's prices are equal, which is at the inflection point just to the left of the mode, so they never reach a stable point where there is no advantage in raising their bid. Even in the limit $P_A, P_B \to \infty$, this mode persists, but for large $P_A + P_B$ another mode also appears which prevents the bids from chasing each other up indefinitely.

As shown in Figure 4, for values of $P_B > 120$, a second mode appears in A's profit function. This mode is at a bid *lower* than B's. For $P_B \geq 190$ this second mode is higher than the mode discussed above. This means that after A and B have bid each other up to, say $P_A = 190$, $P_B = 200$, then A has two choices to increase his profit: He can

Figure 3. A's Income as a Function of Price

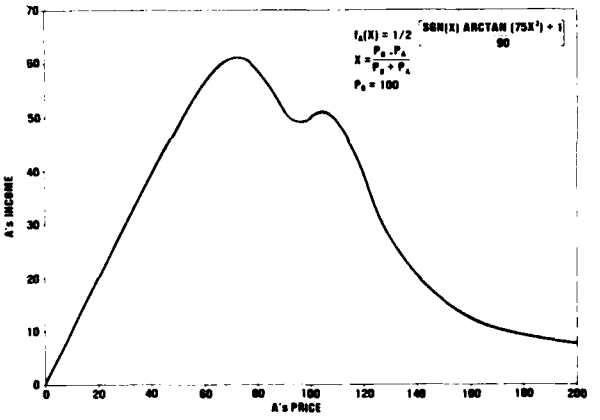
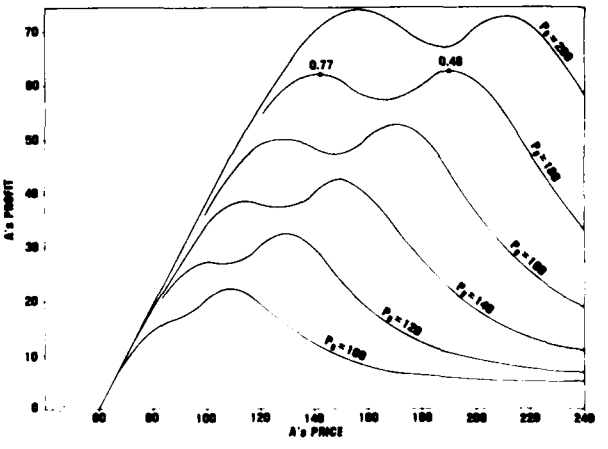


Figure 4. A's Profit as a Function of A's Price for Various Values of B's Price



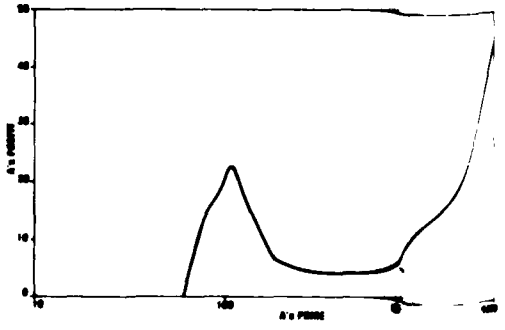
Real people do exercise foresight and adopt strategies, and even if they do not communicate in any other way, they can communicate simply by the way they compete.

raise the bid again to 120 for a profit of 72.8, or he can lower his bid to 155 for a profit of [illegible]. If he takes the latter course (as it seems he should), then A's profit will plunge to about 33 unless he also lowers his bid. B's best counter is to bid 163. This is again the peak of the right mode and so will start over the upward bidding. This upward bidding will lead to prices above 190, at which point either A or B can gain by lowering the bid to the left mode. If A and B merely bid as automatons without foresight or strategy, this cycle of bidding would continue indefinitely.

In practice, it seems more likely A and B would settle by tacit agreement on the inflection point before the right mode. At this inflection point the profits are equal and so they share equally in the buy. Of course once this degree of cooperation is established, it is likely they would cooperate in moving up to higher and higher inflection points. This is a general difficulty with this kind of analysis of behavior. Real people do exercise foresight and adopt strategies, and even if they do not communicate in any other way, they can communicate simply by the way they compete. So, given enough time they can arrive at cooperative behavior even though the situation is deliberately structured to induce competition. The application of this to government procurement is that the bidding should not be iterated too long and that the split function should be structured so that a stable point is reached quickly, without cooperation.

It is also clear from this example that a discontinuous split function can engender reverse competition just as well as a 60/40 split. Solinsky's example, as noted above, seems to hold the prices down to about three times the cost. This isn't very good, but all any competitor can do is force the price down to some multiple of cost. If selling at cost, it is always advantageous to raise the price. However, we haven't seen what happens in Solinsky's example when one bidder, say A, bids a *much* higher price than the other.

Figure 5. A's Profit as a Function of A's Price for $B_B = 100$



What happens is shown in Figure 5. As A raises his price to more than 50 times B's price, he begins to make more profit than B. Of course, this couldn't happen in practice; common sense and fair-profit rules would prevail. But it serves to put us on guard against unforeseen consequences of procurement schemes that are based on unanalyzed intuition.

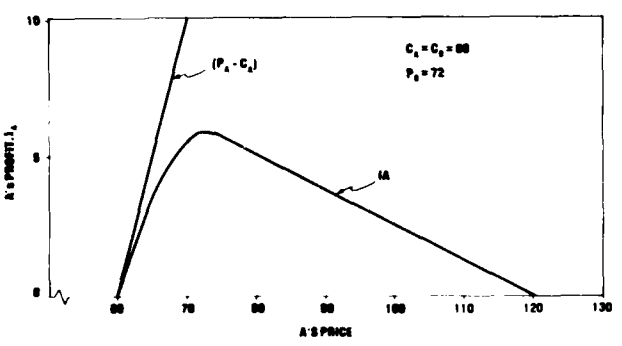
An Ideal Non-solution

How, then, can we design a split function to have the properties we desire? The manufacturers are not influenced directly by the split function, but by their profit. So it is easier to define an ideal profit function and then derive a split function from it. A profit function can be drawn for A only after assuming values for A's cost, C_A, and B's price, P_B. The ideal profit function must be one that has a stable point at a reasonable profit margin above cost. Using the previous example, $C_A = C_B = 60$, a reasonable profit would be 20 percent, or $P_A = 72$. If this is to be a stable point, then it must be the maximum of the profit function for $P_B = 72$. Since the prices are equal, the buy will be split evenly, $f_A = 1/2$, so

$$\frac{I_A}{n} = 1/2\,(P_A - C_A) = 6.$$

Starting from this point ($P_A = 72$, $\frac{I_A}{n} = 6$) on Figure 6, an ideal profit function (per unit of the total buy) can be drawn to the right by the following considerations. Near the maximum, a smooth function is quadratic, so the curve will turn downward like a parabola in each side of the maximum. As A increases his bid, we want his profit to go down. At some price, say twice cost, we are willing to give all of the buy to B (at a price of 72) and none to A. This means the curve goes to zero at $P_A = 120$. I have drawn this part of the curve as linear, since this yields constant motivation for A to lower his price over this range.

Figure 6. Ideal Profit Function



The shape of the curve to the left of the maximum is not very important, and in any case it will be determined from the right part due to the symmetry of the split function.

Having drawn an ideal profit function, the corresponding split function can be inferred from

$$\bar{f}_A = \frac{\frac{1}{n} I_A}{P_A - C_A} \qquad (11)$$

This division has been carried through in Figure 7. The function found in this way is given as function only of P_A, for the given fixed values of C_A and P_B. A split function must be an antisymmetric function of P_A and P_B. Furthermore, it cannot depend on C_A or C_B, because they are unknown to the government. A split function having these characteristics can be derived from equation 11 by replacing the variable P_A by its equivalent x value, where

$$x = \frac{P_B - P_A}{P_B + P_A},$$

and then regarding $\bar{f}_A$ as a function of x rather than P_A. This is shown on Figure 7 by placing the equivalent x scale below the original P_A scale. Since this function was generated graphically, it does not necessarily have any simple analytic expression. However, by adjusting the three parameters of Solinsky's function, as he suggests may be done, the function

$$\bar{f}_A(x) = 1/2\,[1.29 \text{ sign } (x) \frac{\arctan (11x)}{90} + 1] \qquad (12)$$

is found to be a very good approximation. In this form f_A *is an antisymmetric function* of P_A and P_B as required. Since it depends only on P_A and P_B, it is scale-free; that is, it has the same value if all prices are multiplied by the same factor. The family of profit functions which result from using $\bar{f}_A$ are shown in Figure 8 for the example $C_A = C_B = 60$. Note that whenever B's bid is higher than 72 (the stable value), then A's best bid is a little lower than B's. By symmetry, this holds also for B (i.e., B's best bid is below A's). Thus, above the stable point, A and B will be motivated to compete by lowering prices. If A and B have different costs, there will still be a stable point, but it will not be where the prices are equal.

This, then, realizes the objective of defining a split function that engenders competition over a reasonable range of bids and down to a price near the cost. The function is not "optimum" in any well-defined sense. Many other functions do as well and are also simpler. But none are simple enough to allow analysis in closed form, so there is no reason to prefer them to equation 12. We could let the subject rest here except that there is a fatal flaw in this scheme.

Why There Is No Solution

The flaw is that manufacturers do not quote a single unit price for all quantities. Instead, each bidder quotes a price for a set of quantities, ranging from a small part of the total to the whole buy. In effect, his bid is a function that describes what his unit price will be as a function of the number of units purchased from him. Figure 9 shows actual bids for purchase quantities of 360 to 3,500 missile components. Certainly this is a complication, as was recognized by Solinsky. He dealt with it by specifying that the prices to be used in calculating $f(x)$ are the bids for one-half the total buy. What he did not recognize is that the manufacturer can bid a unit price function that will give him the same profit no matter what fraction of the buy he is given (so long as it's not zero). Lest it be thought this is merely hypothetical, consider Figure 10, which shows superposed on the bids of Figure 10 a bid that yields a constant profit of $280,000 (based on a unit cost of $800). This bid is not very different from B's and it certainly doesn't stand out as peculiar or unusual. Given that a manufacturer can submit a constant-profit bid, then obviously, no amount of cleverness in specifying a split function will motivate him. He just doesn't care what the split is.

Is there any remedy for this flaw? One possibility is to require that a single-unit price be bid for a wide range of quantities, say from 100 percent to 30 percent of the buy. The allocation of the buy would be determined by a function such as equation 12 with the modification that if equation 12 would give less than 30 percent to the high bidder, then he is given zero and all the buy goes to the low bidder. This modification avoids the reverse competition of the 60/40 split. Note that any scheme that does not

Figure 7. Derivation of Ideal Split Function

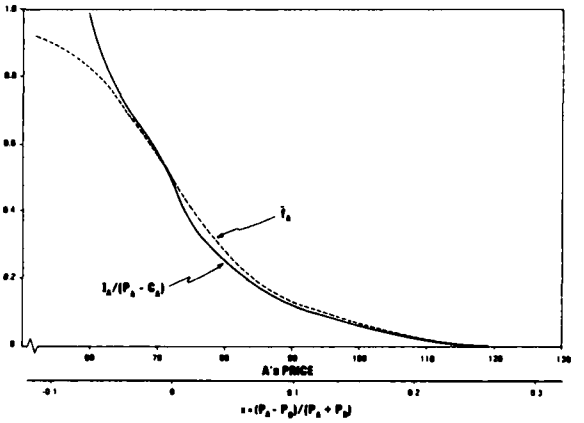
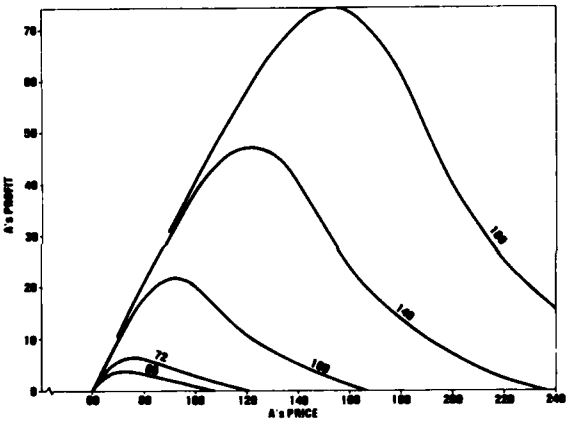


Figure 8. A's Profit as a Function of Price for the Ideal Split Function ($P_B = 72$)



They don't know their opponent's bid for the current year, but they know what it was for the previous year, and so they will be motivated to beat that price.

Figure 9. Three Manufacturers' Bids for Unit Price of a Safe-and-Arm Device

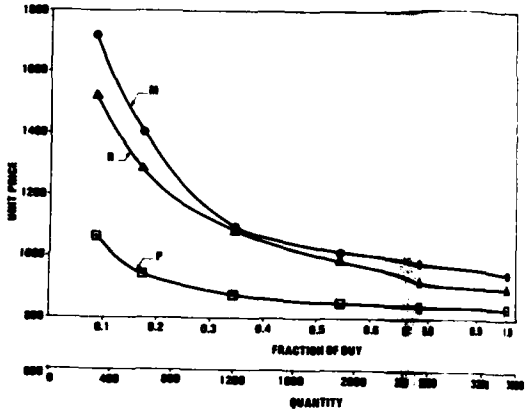
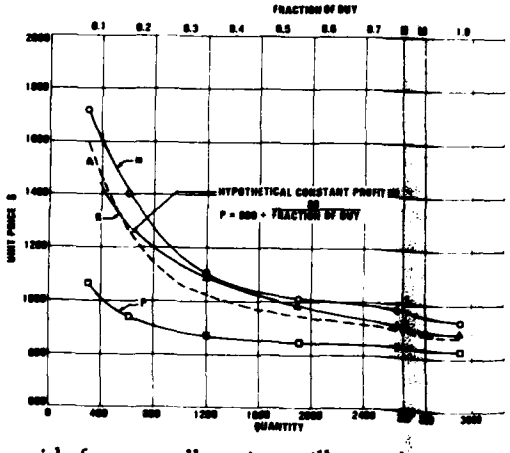


Figure 10. Comparison of a Hypothetical, Constant Profit Bid to Actual Bids



provide for zero allocation will engender reverse competition.

So far the discussion has centered on profit motive and how it can become a motive for price reduction. The procedure for allowing this motive expression has been left implicit. I will now try to make it explicit. In order for the competition to work, at least two conditions must hold. First, the bidders must be aware of the split function. If they are not aware of it they may well suppose that it is of a form that engenders reverse competition. Second, there must be an iteration of the bid. If each competitor only bids once, without knowing the other's bid, then the fact that the other underbids him cannot lower the desired effect of lowering his bid. Procurement regulations forbid this kind of bidding of one contractor against another for a given contract (at least without the contractors' permission), but the same effect comes about when two contractors bid against one another for successive years' procurements. They don't know their opponent's bid for the current year, but they know what it was for the previous year, and so they will be motivated to beat that price. Of course, even in the first year each contractor will make some estimate of his opponent's bid and adjust his own accordingly. But this does not really constitute competition, because the contractors may each overestimate the other's cost and so bid high compared to their own cost. If this does happen, then the high bidder (who is surprised at not being the low bidder) will seek to increase his profit the next year by slightly underbidding his competitor. Note that it may take several years before the prices are driven down to the stable point.

Having stated these two conditions, we may now answer a question raised earlier. Given that the split function Solinsky cites as an example was such as to engender reverse competition (at least up to three times cost), why did the procurement turn out well (total price was 10 percent lower than government estimates)? The answer is that both the conditions discussed above were violated. Just as they are necessary for competition to take place, so too are they necessary for reverse competition. In Solinsky's example the contractors were not told the split function. Thus they might have bid low under the delusion that the low bidder would make more profit. After they had bid and the split function became at least partially known to them, there was no chance for the low bidder to raise his bid. So the fact that the procurement turned out to be cheaper than estimated is more in spite of the split than because of it.

Philosophy

When one considers the conditions that must hold to obtain competition between sources; the possibility that one may be eliminated through that very competition; that even when everything goes as well as possible it may take several years to drive down the price; and that the best outcome to be hoped for is a price near the *higher* of the two competitors' costs, it would seem to be extraordinarily difficult to obtain lower prices through competition. Yet this competition, supposedly, is the unseen hand which guides the private economy to near ideal efficiency. Why is it so difficult to emulate the private economy in government procurements? I don't know the answer, but I'm going to philosophize a little and suggest some possibilities.

So it seems that in the private [illegible]
head-to-head competition we [illegible]

It seems to me the difficulty stems from two factors that often occur together in government two-source procurements, but seldom in the private sector. These factors are that

—The producers make identical products, so the only competition is in terms of price.
—There is only a single consumer who will buy from the source that offers the best value for the price. Other sources will go out of business, because they have no other customer.

Consider how these factors occur in the private sector without inhibiting competition.

Products such as eggs and milk are essentially identical, but the distribution costs are significant, so each producer can be secure in his share of the local market. Products such as beer and cigarettes are also essentially identical, but because there are so many consumers, advertising can create perceived differences and so obtain a share of the market for each producer. Both of these market shares depend on there being multiple consumers.

Each individual is only a single consumer, yet there is intense competition in selling to him. The competition is between different commodities: Shall he buy a Rolls-Royce or a Mustang? Shall he buy a car or go on vacation? Shall he pay his ex-wife or his lawyer? If there were only a single commodity sold by different producers, then he would buy only from the cheapest, and the others would go out of business. But because the commodities are not identical, although they may overlap in their uses, they command different shares of his money. The maker of one commodity may increase his share by lowering his price, but he probably cannot drive anyone else's share down to zero (out of business).

So it seems that in the private sector there is never this direct, head-to-head competition we have been trying to engender. In the private sector, if products are identical then there are "safe" markets consisting of local consumers or brand loyalists. Considering only a single consumer, each commodity he buys fills a different need for him and so commands its share of him as a market. Competition takes place at the borders between these markets. One expands, another contracts. If chicken goes down and beef goes up, I will buy more chicken and less beef, but I will still buy some beef (and not because I want to subsidize beef producers against a possible chicken monopoly). Contractors to the government could also be allowed to compete along borders, instead of head-to-head.

As an example of how government procurement could be made competitive, consider the procurement of air-to-air missiles. In particular, note that as the United States' short-range missile, the Sidewinder, and the medium-range missile, the Sparrow, have evolved, the situations in which they can be used have come to overlap more and more. This seems an obvious border for competition, and in fact, the armed services have tended to purchase more of the less expensive Sidewinder and fewer of the more expensive Sparrow. But this has not been used as leverage to bring down Sparrow prices. The reason such leverage was not used is that the funding was authorized by missile type and then given to separate program managers for acquisition (PMAs) for each missile type. Each PMA can engender competition between two sources for his missile type, but he is not in a position to trade one type for another. In the future, there will be even more opportunities for borderline competition between air-to-air missiles. In Europe, the advanced short-range air-to-air missile is being developed to compete with Sidewinder and Sparrow. In the United States, the advanced medium-range air-to-air missile is being developed to compete with Sparrow, Sidewinder, and Phoenix. At the same time, more advanced versions of Sidewinder and Sparrow, with even broader envelopes, are being developed. Certainly there will be competition among these, but unless policies are changed it will be merely to select one or two of them to be *the* air-to-air missile. After that selection there will be no effective way to engender competition. Instead of making a selection, missiles of different types could be bought, according to their performance and their price, so as to provide the best overall combat capability. This would involve trade-offs of numbers, performance, and readiness within the budget constraint. Of course, it is very likely that some types of missiles would be eliminated entirely at least after a few years, and they would probably be the same ones that would have been eliminated by a selection. The point is that by allowing them to be squeezed out in this border-line competition, the prices of the survivors will also have been squeezed down.

Conclusion

It has been shown that use of a split function of a certain form can engender price competition between two sources of a single commodity, provided they bid a unit price that holds for the whole range of possible splits. It has also been shown that under the current practice of bidding different unit prices for different quantities, it is possible to reliably engender competition by splitting the buy.

Comparisons have been made with competition in the private sector and it has been noted that this competition is commonly for the bigger share of a market in which each competitor has a secure part because of the uniqueness of his product. It is proposed that this same kind of competition, between similar but not identical commodities, could be used to drive down prices in government procurements. It would require the development of split functions that take into acccount not only price, but also performance and readiness. There is now an excellent opportunity to put this into practice in the procurement of air-to-air missiles.

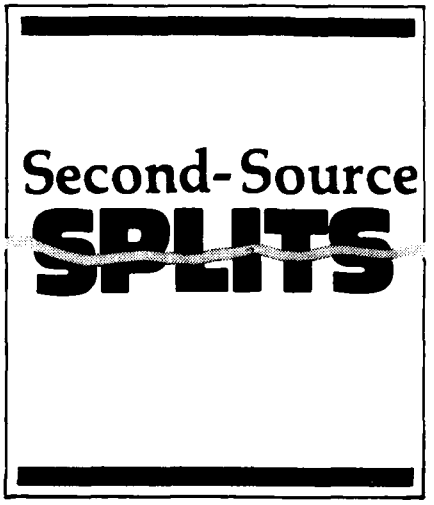
Counterpoint and Response

This is a well-written, thought-provoking article that emphatically presents both the importance and the difficulty of creating an optimum scheme for splitting the quantities in a dual-source, competitive procurement. While it appears to be both logical and mathematically rigorous, the conclusions derived from the mathematics are seriously flawed due to two faulty assumptions that are implicit in the arguments. The faulty assumptions are (1) that profit on the current contract is the sole determinant of corporate competitive pricing strategy and (2) that the government contracting officer is a passive price-taker who does not scrutinize the contractor's price proposal and aggressively negotiate a fair and reasonable price.

With regard to the assumption about profit, research has clearly shown that profit on the current contract, while important, is only one of many factors considered in corporate pricing strategy. (See "So, What Does the Defense Contractor Really Want?" *Program Manager*, March-April 1983.) Other factors such as prestige, gross sales, use of idle capacity, future business, etc., may be more important to the contractor than near-term profit. This reality tends to invalidate much of Meeker's arguments relative to profit maximization as a pricing strategy. That is not to say that a company will *never* use a near-term profit maximization strategy, but such a strategy should not be considered to be universal as the article implies.

Even if one or both contractors in a dual-source competition pursued a low-quantity, high-price profit-maximizing strategy as suggested by Meeker, the government contracting officer is not likely to act as a passive price-taker. He will probably be quite suspicious of large differences between the prices offered by the two contractors or of large differences between the prices offered and the government estimate. Negotiation with one or both contractors, while perhaps not as effective as aggressive price competition, will serve to minimize the effect of a profit-maximizing strategy if one is encountered in the first place.

Therefore, I believe the Solinsky approach has much greater validity than Meeker attributes to it. While I agree with Meeker that *any* split formula, including Meeker's, that does not allow for a zero quantity is susceptible to "reverse competition," I feel that we have safeguards in the



form of cost and price analysis and negotiation to protect against such an occurrence.

Finally, Meeker's recommendation that we compete products against one another (i.e., Sidewinder vs. Sparrow; AMRAAM vs. Sidewinder, Sparrow, and Phoenix; or even A-6 and F-14 vs. F/A-18) has *some* merit. But this approach must be used cautiously. Increased logistics support costs and/or reduced readiness may cost us much more in the long run than we save by competing similar, but different, systems. Finally, in this regard, those of us in the acquisition business must always remember that our mission is not to acquire what appears to be the cheapest mix of weapons, but rather to support our operating units with the *proper* mix of weapons to assure victory in combat and to provide these weapons at the lowest fair and reasonable cost.

Dual-source competition has many proponents and is gaining in popularity because it is perceived as an effective means of reducing cost. It must be recognized, however, that dual-source competition is difficult at best, and that the issue of how to split the quantities between the two sources is but one of many difficult issues to be wrestled with in executing such a strategy.

Commander Benjamin R. Sellers, SC, USN

Commander Sellers is an instructor in DSMC's Business Management Department. His article, "Second Sourcing: A Way to Enhance Production Competition," appeared in the May-June 1983 issue of Program Manager.

Mr. Meeker Responds:

I am in almost complete agreement with Commander Sellers' counterpoint. I didn't write the paper to advocate a strategy of procurement competition through pricing. I wrote it rather as a *reductio ad absurdum* refutation of Solinsky's paper, which I thought exaggerated the importance of the split function. My major conclusion was that it is impossible to engender competition with profit as the motive by splitting the buy. I am well aware of instances in which the existence of a second source resulted in a drastic price cut by the primary source. The point of my paper is that such cuts are probably *not* motivated by profit; hence the form of the split function used has little effect. Commander Sellers suggests several possible motives not directly related to profit: prestige, future business, and gross sales. These certainly seem plausible to me, and I would like to hear some discussion of how our procurement policies should relate to them.

On one point I would like to register disagreement; that is the effectiveness of the government in recognizing and negotiating away excessive prices. The very fact that second-source procurements have resulted in drastic (up to 40 percent) price cuts by the primary source indicates that those prices were excessive. I don't know of any instance of a reverse pricing strategy by a manufacturer but, as I pointed out, such a strategy would not necessarily stand out as excessive pricing.

Alan W. Beck

WARRANTIES:

A Few Basics on the Latest Hot Topic

Increasing emphasis over the past few years on reliable performance and low support cost of weapon systems is reflected in a shift of policy toward increased use of warranties to obtain more reliable systems and components. Since 1981, the Department of Defense (DOD) Acquisition Improvement Program has directed emphasis on incentives to improve reliability and support. In late 1983, Congress put language in the 1984 DOD Appropriation Act to require purchase of a warranty unless DOD approves a waiver and notifies the Armed Services and Appropriations Committees of the intent to waive warranty requirements. The DOD FY 85 budget request asks for repeal of this warranty requirement; but whatever happens to that issue, now is the time for us to review some of the basic concepts, considerations, and cost implications of warranties.

Basic Concepts

Prior to the 1984 DOD Appropriation Act, government policy has been *not* to buy a warranty automatically. Normally, the government inspects and frequently tests items prior to acceptance. After a government official signs the DD Form 250 to accept the items, the risk related to performance and the responsibility for maintenance passes to the government, except for latent defects, meaning those that could not be reasonably detected through inspection.

A warranty can be purchased when economically justified. Warranties are used to pass on responsibility for repair or replacement within a set warranty period for covered failures of supplies, services, or data.

Standard contractual language is available for buying a warranty for supplies, systems, services, data, or construction. Contracting officers are authorized to modify these standard clauses as appropriate for a particular procurement. Generally, the warranty must specify the extent of coverage to indicate what components or characteristics are warranted, the time period of warranty, the specific responsibilities of the contractor, the remedies available to the government, and the procedure for processing warranty notice.

Several special warranty/responsibility contract clauses are sometimes used in system acquisition contracts. In the logistics support area, various warranty efforts have aimed at reliability, life-cycle support cost, mean time between failure (MTBF) and other areas. With early application and emphasis, such a warranty can motivate a contractor to design in less failure potential so that he will have to spend less to fix items during the warranty period. One example of this concept is the reliability improvement warranty (RIW), where the contractor has contractual responsibility for design, production, and initial support on a fixed-price type of contract. An RIW may be used with an MTBF guarantee specifying achievement of specific MTBF goals at particular times, with specific contractual consequences for failure to meet the required goal.

Other special clauses are selectively applied to specify contractor responsibility for system performance. In some cases, one prime contractor is integrating major components being developed by various other contractors as government-furnished equipment (GFE). If the prime contractor agrees that the GFE performance specification is adequate, a Total Systems Performance Responsibility (TSPR) clause is often written to put full responsibility on the prime to correct any performance problems within the contract price. Where the GFE has lower risk, such as when previously developed, and with a mature specification, program offices sometimes use integration responsibility clauses to ensure that the GFE components are properly integrated without creating any degradation in the GFE performance. Such a clause is called Total System Integration Responsibility (TSIR). These special clauses are all written and selectively applied for particular contracts. Corrections, as with other types of warranties, are at no increase in contract price.

■ *Mr. Beck is a Professor of Industrial Management in the Business Management Department, School of Systems Acquisition Management, at DSMC.* ■

Application Considerations

For a warranty to be effective, it must consider the user's environment. The old joke about the parachute being guaranteed says a lot for the uselessness of a warranty to a front-line fighting unit. If a weapon won't function in combat, the unit's motivation is to fix it—not to send it back for replacement or cheerfully refunded money.

The contractor must also be concerned about the environment. Uncertainty over the skill levels of personnel handling the equipment makes contractors uneasy, because mishandling or improper use will cause failures. Contractual language has to be included to indicate use and conditions that will or will not be covered. Perhaps warranty coverage should be restricted to certain units at certain controlled locations. If this were the case, contractors would price the warranty lower, yet they would still be motivated to produce items with low/no failures.

Pipeline time and contractor repair time are major concerns with warranty items that must be shipped back to a contractor's plant for repair. Additionally, sufficient extra units must be available for spares. Some offices have structured language to incentivize contractors for a low maximum allowable average repair-turnaround time.

Changes in a system are a big consideration, because they may affect the warranty price. Where we desire changes to lower life-cycle costs, the program will need carefully thought-out language to encourage, yet control, changes.

Type of contract must be considered in evaluating probable benefits of warranty coverage. Normally, we consider a warranty to be on a firm-fixed-price basis where the contractor fixes defects at no increase in price. Warranties may, however, be applied in incentive contracts where both parties are sharing in costs. For cost-reimbursement environments, the application and benefits of a proposed warranty should be carefully questioned. Separate performance incentives may provide the desired improvements without an extra warranty.

Duration of the warranty is a key issue. It should be long enough to provide the desired motivation for delivery of high-quality, low-failure items. Once the warranty period is over, the buyer picks up support responsibility, so all support preparation must be properly planned and ready. As with some appliances, one can buy extended warranty protection, but it might be smarter to have this priced in advance, with competition.

Cost Implications

Competition is a powerful tool to both reduce warranty cost and improve performance. Planning for competition with selectively applied warranties, where they make sense, can provide significant cost benefits.

We pay for warranties. Contractors can be expected to charge according to the risk they see for future warranty corrections. The old saying, "If you want it bad you'll get it bad," applies to estimating and agreeing on warranty prices. Time should be taken to determine where the risks are and what should or should not be done to mitigate the cost risk on the contractor.

The positive side of warranty cost is that, once established, there can be less delay later in arguing fault and negotiating a contract deal to have repairs done. There is a lesser requirement for future program dollars to correct problems, since many are covered by the warranty.

Administrative costs of contracting for and later managing a warranty can easily be higher than initial estimates if the contractor is nervous about the risk and extent of potential warranty notices.

Doing It

Putting warranty language together requires good strategy planning between requirements, logistics, contracts, and budget personnel. Help from those with experience is always useful. The Air Force has established a Product Performance Agreement Center (ASD/PM-PPAC) at Wright-Patterson Air Force Base, Ohio, to collect and share information on various warranties.

With thoughtful planning, use of an appropriate warranty can help us obtain more reliable, higher-quality systems.

The Tower of BABEL

System Support and Readiness

Major [illegible]

Defense logisticians can learn a lot about successfully achieving a high degree of system support and readiness by studying the biblical account of the Tower of Babel. It is a fascinating, if brief, story of ancient development and production effort.

After the great flood, the Bible tells us that "The whole world had one language and a common speech." The people agreed upon a common goal of a city "with a tower that reaches to the heavens." Their research and testing indicated that brick and tar were more reliable building materials than the alternative stone and mortar. And so they proceeded through the early program milestones with minimal schedule and cost variances because they had effective communications, total consensus on their goals, and successful confirmation that they were using good production materials and techniques. The Lord recognized their success, but was displeased with their motives. He noted that "If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them." God decided he had to kill the program. His method was simply to "confuse their language so they will not understand each other." With their communications rendered ineffective, cooperation became impossible. They abandoned the project and retitled the tower "Babel" (which means confusion).

As in the Tower of Babel, it is critical in a defense program that people in the differing disciplines communicate with one another. But it doesn't take long to realize that each discipline has its own jargon and objectives. Sometimes it appears we don't really want to communicate because our goals are so different. The design engineer wants to get operational hardware on the ramp. He wants it to outperform anything we've seen before, and he wants to meet his deadlines and budget. The "loggy" is more concerned with how often the system is going to need servicing or will break; how long it takes to test, service, or repair; and how much it will cost for the next 20 years to keep it operational. The logistician who claims he understands and can communicate with design engineers bears careful watching. Either he is deluding himself and is therefore ineffective, or he is an invaluable asset to the program and should be guarded jealously. The more common situation is one in which the logistician attending an engineering session finds himself in a modern version of "Babel." Of course, an engineer would rather take a beating than climb into the loggies' tower for a logistics summit conference. They speak different languages; they have different objectives; they want to test different system characteristics; they come from totally different backgrounds.

The basic tools for bringing the logistics and engineering together are already in place. The Integrated Logistics Support Plan (ILSP) is the key document, and it is needed early on. It should receive full engineering review and consensus. It should clearly state supportability requirements such as built-in-test (BIT) effectivity, mean time to repair (MTTR), mean time between failures (MTBF), mean time between maintenance (MTBM), and operational availability. It should address how those parameters should be achieved and tested.

The logistics support analysis (LSA) is another tool that we can use to help build a strong tower—if government engineers and logisticians apply it sensibly, and if contractor engineers and logisticians use it conscientiously in an integrated manner where each understands the other's needs and desires. The LSA marriage of the logistics and engineering disciplines is a forced one. Consensus is not automatic, and is probably not even achievable. Consensus, then, has to be replaced by control.

Logistics for our modern "tower" must be built with more viable control points within the contractor and government program offices. The time has arrived for the contractor to include, within his program office, a supportability manager with equivalent status to the program engineer. The supportability manager should be responsible for the three functional areas of logistics, reliability, and maintainability. He (or she) should be in place early in the demonstration/validation phase if not already present in concept exploration. By the time detailed design is begun, he should have a staff of highly active maintainability engineers, reliability engineers, and logistics managers. The supportability staff should be working closely with the design engineers, reviewing each drawing, attending design review meetings, and recommending supportability changes as required. The supportability manager should have disapproval authority on any design or design change. Only the program manager or higher authority should be able to override his veto if the program engineer and supportability manager cannot agree.

Within the government, a similar position would be desirable; however, it would be more difficult to obtain. The Air Force has attempted to move reliability and maintainability into the logistics area, but DOD has resisted this movement. Further, the latest DODD 5000.39 still excludes reliability and maintainability from the logistics elements, but has added "design interface" to address the critical relationship between logistics and engineering disciplines such as R&M. It is incumbent upon the deputy program manager for logistics to review and insist on coordination of all R&M requirements, plans, and changes. He needs to bring the reliability, maintainability, and logistics building blocks together, because his tower rises or falls on how well they fit. He needs to monitor the contractor's progress. He should insist on seeing all reliability and maintainability reports and get a monthly summary of all supportability change requests with a record of their disposition.

Along with fine-tuning communication and applying controls where consensus is difficult to achieve, the defense logistician must confirm that the results meet the objectives. The old, established system of waiting until the design and prototype fabrication are complete before testing reliability and maintainability has not resulted in highly supportable "towers." It is important to have early confirmation of reliability and maintainability design success. We should use extensive modeling of the thermal and vibration environment. We need to allocate sufficient time and funds to perform burn-in of components, subassemblies, and assemblies in order to find reliability problems early and fix them while costs are still relatively low. We should require the contractor to use built-in-test in checking out his breadboard electronics and factory test equipment. We should ask for a built-in test effectivity demonstration on one of the first development systems. Let reliability qualification tests and maintainability demonstration simply prove to the operational world what we have worked hard to design, build, and prove to ourselves.

Throughout each phase of the program, the defense logistics manager must periodically step back and evaluate his effort. How good is the communication of logistics requirements? How adequate is the logistics control or influence of the system design and production process? How timely and sufficient is the confirmation of supportability parameters?

These assessments could make the differences between fielding a system that towers over its predecessors in supportability and readiness, as opposed to a system that only becomes a modern "Tower of Babel."■

■*Major Merchant is an instructor in the Technical Management Department, School of Systems Acquisition Education, at DSMC. He is a graduate of PMC 83-2, and this "think piece" was written in partial fulfillment of the requirements of that course.*■

The U.S. Army War College Curriculum for Research, Development, and Acquisition

What Are We Telling Army War College Students About Acquisition Management?

Lieutenant Colonel Gerald L. Pauler, USA

Army War College graduates are assigned to positions where their understanding of military management systems contributes significantly to mission accomplishment. During their academic year, what do they learn about the systems for research, development, and acquisition?

Common Overview Instruction

For academic year 1984, the Army War College curriculum includes ten major courses of instruction that make up the common overview. The courses are organized to support four general themes: The Professional; National Security Policy; Preparation for War; and Conduct of War. Course five, "Leadership of the Army and Management of its Supporting Systems," has the specific educational objective of preparing students to command, lead, manage, and staff principal Army organizations and systems. This course addresses "how the Army runs" and is the one uniquely Army course in the common overview. The Department of Command, Leadership, and Management is responsible for this 5-week course. Here, all students receive instruction on Army management systems, which include the research, development, and acquisition system and the Army logistics system. The instruction is presented in three modes: descriptive seminars, guest lectures, and case-event exercises.

The seminar lessons are process-oriented. Supporting lectures focus on current issues. The case studies are used to apply previous experience as well as current instruction to realistic analytical methodology.

Headquarters of the U.S. Army War College, located at Carlisle Barracks, Pa.

Seminar Instruction

Each year's War College resident class consists of about 250 students, divided into seminar groups of 15 or 16 students for classroom instruction and interpersonal exchange. About 75 percent are from the Army. The remainder includes a few government civilians, representatives of the other services and the reserve components, and a dozen or so select military representatives of foreign nations. Seminar instruction is faculty-led and designed to describe how Army systems operate and interface. In the research, development, and acquisition system seminar, an overview of organizational structure, policy, and procedures is presented to provide a forum for discussion of specific aspects of the Life-Cycle System Management Model. The overview is based on student briefings on Army Regulation 1000-1, "Basic Policies for Systems Acquisition"; Army Regulation 70-1, "Army Systems Acquisition Policy and Procedures"; DOD Directive 5000.1, "Major Systems Acquisitions"; and DOD Instruction 5000.2, "Major Systems Acquisition Procedures." The specific aspects discussed are the determination of mission needs and the concept-based requirements system; preplanned product improvement; reliability, availability, and maintainability; and developmental and operational testing. A chart of Life-Cycle System Man-

■*Lieutenant Colonel Pauler is a member of the Department of Command, Leadership, and Management at the U.S. Army War College.*■

agement Model (see illustration) provides a focal point for understanding the flow of documents, decisions, decision reviews, and testing that takes place during the four acquisition phases of concept exploration, demonstration and validation, full-scale development, and production and deployment. Integrated logistics support is introduced at this point as a transition to a seminar on the Army Logistics System.

The logistics system seminar ties in with the research, development, and acquisition system seminar by examining how the total Army (active and reserve components) is properly equipped, adequately sustained, and efficiently modernized. Learning objectives include understanding the basic structure and management process used to provide responsive logistic support. Emphasis is placed on materiel system fielding plans and integrated logistics support involved with modernizing the force.

Following these process-oriented seminar periods, lectures focus on materiel system management issues.

Lectures

The Deputy Chief of Staff for Research, Development, and Acquisition and the Deputy Chief of Staff for Logistics provide their viewpoints on materiel system management issues to the entire class. A joint question-and-answer period is held so that students can explore selected areas in greater depth.

The learning objectives for this period include becoming familiar with current materiel system philosophy and techniques as well as issues involved with research and development funds. Understanding current trends, capabilities, and limitations is inherent to the lectures. Central points to be answered during the lectures include "What materiel system issues will require the most management attention in the next few years?"; "How well is the materiel system absorbing the increased flux of new equipment?"; and "Is equal emphasis being given to (1) obtaining system performance, schedule, and cost objectives, and (2) attaining reliability, availability, and maintainability goals and integrated logistics support?"

War gaming is an important part of the Army War College curriculum. In these exercises the students learn to use the products of the acquisition process, to which they are also given an introduction.

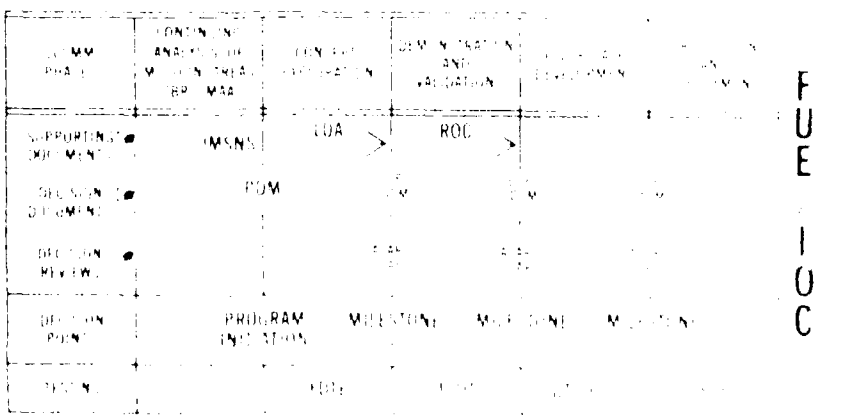
At the conclusion of the lectures, the students should understand the current issues affecting materiel system management structures and processes. This knowledge is then applied to case studies.

Materiel System Fielding Exercise

Case studies using examples from the Bradley Fighting Vehicle System program provide an exercise emphasizing the acquisition, distribution, and sustainment of major new systems. Seminar subgroups organize to role-play force modernization efforts undertaken by the U.S. Army Development and Readiness Command (DARCOM), the U.S. Army Forces Command (FORSCOM), and the U.S. Army Europe (USAREUR). Faculty instructors act as Headquarters, Department of Army, or other agencies as required.

Central points to be developed during case analyses include answering the following questions: "What are the major commands' positions on force integration and its effect on distribution, facilities, and maintenance?"; "Can the various management systems deal effectively with current problems while developing a proactive management strategy for dealing with future problems?"; and "Are current fielding/sustainment systems capable of effectively reacting to real-time change brought about by extensive influence such as congressional budget reviews and shifts in political alignments?"

Life Cycle System Management Model (LCSMM)



The exercise builds on all previous instruction and helps the student develop a better understanding of fielding and sustaining new equipment.

Instructional Support Materials

An important backup to all instruction on Army systems is *Army Command and Management Theory and Practice*, a reference text for the Department of Command, Leadership, and Management. This text is updated each year and sent to all Army general officers. It has 29 chapters devoted to understanding how the Army runs. Three of them are directly related to the materiel system: "Materiel System—Research, Development and Acquisition," "Materiel System—Logistics Policy and Procedure," and "Materiel System—Logistics Operations." Other chapters such as "The System View of Organizations," "Army Planning, Programming, Budgeting and Execution," and "Army Decision System Technology" also contribute to understanding research, development, and acquisition processes.

The chapter on research, development, and acquisition examines the system using the following logic:

—Determine and document the needs.
—Obtain funds.
—Conduct research and development.
—Acquire hardware.
—Conduct tests.
—Assess progress.

The Army's Office of the Deputy Chief of Staff for Research, Development, and Acquisition provides primary information for updating this chapter. The chapter now includes a section on industrial preparedness. Future versions will also include more on the concept-based requirements system as a result of emphasis from the U.S. Army Training and Doctrine Command (TRADOC).

The primary reference for the case event exercises is *Force Integration*, a Department of Command, Leadership, and Management special text. This text was developed to assist accomplishment of five force integration case study events: Background, Authorization Documentation, Manning/Training, Materiel Systems Fielding, and Installation Modernization. This text emphasizes the complexity of Army management and the importance of understanding horizontal as well as vertical linkages between systems. It makes clear that the greatest challenge facing the Army is the simultaneous reorganization and equipment modernization efforts currently under way. Each case study event is interwoven in order to gain a better understanding of how decisions in one system affect other Army systems. Background material includes articles on "Army 86," "The Concept Based Requirements System—The Bradley Fighting Vehicle Case," and "New Clout for Mechanized Infantry: The M2 and Airland 2000 Tactics."

Other special programs support instruction. A videotape and brochure explaining the latest status of the Department of Defense Acquisition Improvement Program, developed by the Defense Systems Management College, is an important complementary instructional effort. This videotape explains in detail the six consolidated acquisition improvement program initiatives emphasized by former Deputy Secretary of Defense Paul Thayer: program stability, multiyear procurement, economic production rates, realistic budgeting, improved support and readiness, and encouragement of competition. Videotapes such as these, combined with optional lectures, contribute significantly to student understanding of acquisition processes.

Army students can expect materiel acquisition assignments.

The U.S. Army War College conducts several optional lecture programs, one of which is entitled "Brehon Burke Somervell Management Lecture Series." This series of lectures aids the students in developing and expressing an enlightened, balanced, management philosophy. One of the lectures for this academic year was given by Raymond C. Tower, President of FMC, the prime contractor for the Bradley Fighting Vehicle System. Mr. Tower is in a unique position to explain materiel systems management from the contractor's perspective.

Advanced Courses

Following the common overview, in the 10-week advanced course phase, Army War College students are able to concentrate additional study on specific subjects. Students choose courses from about 50 that are offered. The choice normally is based on extending professional development in preparation for future assignments. Upon graduation, about 20 percent of the Army students can expect assignments to positions directly involved with materiel system management. A much higher percentage of students will be in positions that are affected by the acquisition process. There is incentive to choose advanced courses dealing with those topics.

The Research, Development, and Acquisition Management advanced course examines the entire research, development, and acquisition system. It begins with a focus on Department of Defense and Army policies and principles. Specific sessions are devoted to current combat developments and the concept-based requirements system. Selected acquisition programs for weapon systems and combat support systems are discussed. In conjunction with the Project/Program Management course, a field trip is taken to Aberdeen Proving Ground, Md., for a look at current development and operational testing programs. Another joint session is devoted to understanding the proper relationship between government and industry. The course is concluded with a presentation by the Army Deputy Chief of Staff for Research, Development, and Acquisition.

The Research, Development, and Acquisition Management course complements the Project/Program Management advanced course, which addresses materiel management concepts from the viewpoint of the project manager. The Project/Program Management advanced course is most directly related to the Research, Development, and Acquisition Management advanced course. Its objective is to convey understanding of the functions, responsibilities, and environment of project management and to provide the opportunity to apply management techniques to the solution of problems encountered by program managers. The course covers the concept of program management, its history and rationale, related DOD and DA policies, the acquisition plan, integrated logistics support, and Army and Defense Systems Acquisition Review Council processes, and consideration of key defense and congressional issues in ongoing programs.

The Future Outlook

Today's Army is committed to the acquisition of new and better equipment. With this commitment has come an increase in funding for research and development, along with increased procurement funding. The Army War College faculty in the Department of Command, Leadership, and Management is intensely aware of the importance of materiel system management subjects in the curriculum. Reactions from current students and Army War College graduates have been very helpful in refining elements of this instruction. Members of the Office of the Deputy Chief of Staff for Research, Development, and Acquisition provide input to instruction as well as important insights for updating instructional support materials and advanced courses. Input also comes from the Defense Systems Management College, the Industrial College of the Armed Forces, and a host of Army organizations, including the Training and Doctrine Command and the Materiel Development and Readiness Command.

Such widespread support fosters continuing development of that portion of the U.S. Army War College curriculum devoted to understanding the complex processes involved in research, development, and acquisition of modern weapon systems.

It is through such understanding that the purpose of the U.S. Army War College is achieved—"Not to promote war but to preserve peace by intelligent and adequate preparation to repel aggression."■

Discounted Cash Flow as a Means of Evaluating Multiyear Procurement Requests

Major Mark E. Lacaillade, USAF

The use of multiyear procurement (MYP) is being emphasized by DOD to promote the stable acquisition of weapon systems. Both the "Carlucci Initiatives" and the subsequent Thayer memo have highlighted this strategy. According to Deputy Secretary Carlucci in his May 1, 1981, "Policy on MYP" memorandum, in justifying the use of MYP, the services have to demonstrate "reasonable assurance that cost estimates and anticipated cost avoidance are realistic." Recent congressional actions in denying the majority of MYP requests show that the services have not convinced Congress that savings are adequate.

Traditionally, the services have used constant-dollar and then-year-dollar measures to estimate cost savings: In this paper, I wil look at using discounted cash flow as a way to evaluate MYP requests, an idea that isn't new, but that deserves further development. I will briefly review the concept of discounting, cover the assumptions necessary for its use in the commercial world, its application in the government environment and, finally, some recommendations on its use in MYP requests.

Discounted Cash Flow

The basics of discounting are well known in the commercial world where the time-value of money has to be considered in the analysis of capital budgeting decisions. Sound decisions on the acquisition of capital equipment are necessary for the continued growth of a company.

■ *Major Lacaillade is a Program Element Monitor in the Avionics Development Division, Directorate of Development and Production, at HQ USAF. He is a graduate of PMC 83-2, and this "think piece" was written in partial fulfillment of the requirements of that course.* ■

Net Present Value and Internal Rate of Return

Two basic techniques of discounted cash flow are used to analyze capital alternatives: net present value (NPV) and internal rate of return (IRR). Internal rate of return is not appropriate in the government environment; thus, I will concentrate on NPV.

Net present value is a technique in which the present value of future streams of income, minus the cost of the investment, is calculated using an appropriate cost of capital. Present value is defined as the amount of money one would need now to generate a future stream of money at an appropriate interest rate (cost of capital). This interest rate is sometimes called the "discount" rate; thus the term "discounted cash flow." The commercial world uses NPV to decide on capital investment opportunities. If the NPV of any project is greater than zero, it will add value to the company and should be undertaken. However, there are usually more projects to undertake with positive NPVs than there is money to pay for them, so NPV is used to rank projects. Those with the highest NPVs get selected for investment.

Of course, many assumptions are made when this analysis is done. In the next section, I will examine these assumptions.

Assumptions for Use

One assumption in NPV analysis is that all costs are in current dollars. The concept of base-year dollars is not used. Inflation also is accounted for in the interest rate, or discount rate, that is used in the calculations. (If inflation is high, the cost of money is high and one would use a higher discount rate than when inflation is low.)

The calculation of the discount rate is another area where assumptions have to be made. Ideally, the discount rate should be the cost of capital that a firm would see in the marketplace. In other words, if the firm can borrow money at 10 percent (and the company can obtain all the funds it needs at 10 percent), then this is the discount rate it should use. The use of NPV also assumes the company has the opportunity to invest the initial cost of the project, and the future streams of income from the project, in other investments at the cost of capital rate.

The estimates of the future streams of money are also subject to assumptions. Sales forecasts, cost of materials, labor, overhead, depreciation, salvage value, and tax effects are some things that have to be estimated several years into the future. A particularly difficult area to forecast is the inflation effect on material, labor, and the cost of money. Sensitivity analyses are often done to determine if variability in the input data affects the calculated NPV to an appreciable degree.

Despite all this, NPV is a powerful concept for the commercial world, is well understood, and is in widespread use. It is not, however, used to any great extent in government analyses. In the next section, we will look at the application of NPV in the government environment.

Government Applications

The concept of opportunity cost should be addressed first. Is it reasonable to assume that the government has the opportunity to invest money

in a manner similar to the commercial world? One must first decide who is making the decisions. Since Congress has MYP approval authority, we should equate them to the decision-making level for capital projects in a company. If we do that, one could argue that, indeed, there is an opportunity for Congress to make investments. If Congress does not make the investment in MYP for a weapon system, it can take the difference in cost between the MYP and regular procurement and apply it to (invest it in) some other budget item, whether within the DOD budget or in a social program. On the other hand, because of the pressures on Congress to lower government spending and reduce deficits, one might argue that the short-term (year-by-year) budget process would lead Congress to look at an MYP comparison not as an opportunity to "invest" the difference elsewhere, but as an opportunity not to spend the difference at all.

If one assumes that an NPV analysis is useful, the next question becomes what discount rate to use. David S. C. Chu, Director, Program Analysis and Evaluation, Office of the Secretary of Defense, has suggested, when all else fails, "use 10 percent." This is a reasonable suggestion, since the U.S. Treasury must "borrow" money in the commercial market by selling T-bills, and the rate has hovered around 10 percent lately.

One should also keep in mind that, in contrast to a civilian-world capital project, there would not be cash inflows in the out-years, but cash expenditures. Thus, the NPV that is best becomes the smaller of the present value numbers. Also, the comparison is not among weapon systems (DOD capital projects) but between two methods of contracting for the same weapon system. We are therefore making the assumption that we are going to buy the system, and are trying to decide if we are willing to spend more money up-front to get out-year savings.

This leads to what I feel is the main issue in the use of NPV in MYP analysis. The issue is the question of the true savings (or cost-avoidance) in going with the MYP vice the traditional procurement method. Discounted cash flow is often touted as showing that the actual "savings" for an MYP are not what the services are promoting, and thus the services are misleading the Congress on the value of MYP. I contend that because of the nature of the budget process, the difference between NPVs cannot be construed as the true savings (or cost avoidance) on the program. The process requires DOD to come in each year to request the budget authority to do that year's effort. This is true even under MYP. Congress does not create a sinking fund at the beginning of a program to cover future-year outlays; each year is dealt with as it comes up. The NPV should be used as it is in industry—to rank alternatives and not to estimate savings. Remember, in the commercial world any NPV greater than zero adds value to the company. Thus, an NPV analysis that shows an MYP alternative having a smaller NPV than the standard method is good, no matter what the value of the NPV difference. The comparison most closely associated with the true savings is the comparison between current dollars if a realistic inflation rate is used. Therefore, NPV cannot be used by itself, but must be shown in combination with the current-dollar analysis. The current procedures also call for a separate analysis to estimate inflation savings (or cost avoidance). This is useful to a certain extent, but care must be taken in what inflation rates are used. The MYP requests should not (and cannot, by policy) be based on inflation savings alone.

One might also argue that if you inflate a constant-dollar estimate to get current dollars (as DOD does it), and then discount the current dollars to get a present value, you are back to something like constant dollars. However, the discount rate used is greater than the inflation rate, because the cost of capital includes premiums for inflation and the risk involved. Thus, constant dollars are not the same as discounted current dollars. In addition, the government does not estimate out-year expenses the same way industry does. The DOD method is to use a constant-dollar estimate and inflate that with a single set of indices mandated by the Office of Management and Budget. This usually leads to out-year estimates even more inaccurate than industry's.

It appears that the issue of actual savings is an example of the adversarial role between DOD and Congress and is a symptom of a larger issue—whether Congress wishes to give up the control it now has over weapon system acquisition, via the annual budget process, in return for out-year savings that do nothing to solve current-year budget and deficit problems.

Summary

The use of discounted cash flow analysis in the form of net present value is of use in pointing out the relative merits of an MYP program vice a standard procurement approach. Because of the nature of the budget process, the use of NPV to determine "savings" (or cost avoidance) and to quantify the savings is inappropriate. In addition, special care must be taken in estimating accurately the out-year expenses because of the sensitivity of changes in the out-year numbers to the present value number.

Recommmendations

I would recommend that program offices use an NPV analysis presented on the same page as the current-dollar estimates. I would also recommend a sensitivity analysis by the program office using pessimistic and optimistic out-year numbers (not to be included in the formal MYP request, but available as back-up data). The narrative accompanying the MYP request should point out the relative nature of the NPV analysis, and should caution against using the NPV numbers as an indicator of true cost avoidance. The T-bill rate should be used for the discount rate, but 10 percent is acceptable with the rate staying in the 8 percent to 12 percent range. Finally, the program office should attempt to get permission to use realistic inflation indices when conducting MYP and NPV analyses.

These recommendations would allow the use of NPV in a manner consistent with the commercial world, and would make a stronger case to Congress for the MYP approach. ■

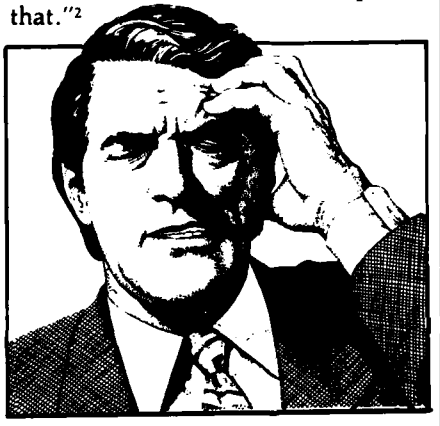
Communicating in a Noisy World

Patricia M. Gaynor

We are living in what has been called "The Information Age." New technologies are truly revolutionizing the way we communicate. Unfortunately, there is a risk that we will concentrate too much of our attention on the exciting things that are happening in the fields of computers and communications technology and not enough on those prosaic communications media that have served us so well in the past—and that continue to serve us today. The presentation of textual and graphic material is so common that we often fail to recognize the barriers we create—sometimes with the help of new technologies—that blunt our messages and confuse and discourage the recipients. This paper examines these more familiar information transfer modes in the light of the total communications process and points out some of our more common errors. Although I do not profess to describe all possible remedies here, I will attempt to shed some light on the problem areas. Perhaps it may prompt some communicators to devote more care and consideration to the design and presentation of the printed word and other graphic materials.

The Nature of Communication

The ability to communicate, to transfer ideas from mind to mind, is a fundamental aspect of humanity. Some would go so far as to say, "We are human because we can communicate."[1] Communication is certainly the essence of civilization. Without communication we could neither recognize nor share common interests, which means we could not easily cooperate in achieving mutual goals. The following words encapsulate this important fact: "With communication, we can have civilization; without it, we can't. It is as simple as that."[2]



Communication is a complex activity. It has many interconnected advances. The process of communication involves "four equally important parts: the communicator, the message, the medium, and the recipient."[3] Too often we attach importance only to the message, with perhaps a nod to the medium ("Shall we call or write?"). The communicator and the recipient are given scant notice.

The *communicator* enters the process in many ways. He is, first, the originator of the message. The way he conveys the message will demonstrate how confident he is of his command of the subject; how convinced he is of the validity and significance of his message; how urgently he wishes to inform, or persuade, or even control, his audience; and how sensitive he is to the capabilities, the prior knowledge, and perceptions of the intended recipients. This will be reflected not only in his actual phrasing, but also in his non-verbal communication.

The *message* we want to convey may consist of thoughts, feelings, or ideas. Regardless of its content, the message must be reduced to a code. It follows that the coding scheme used must be understood by both the sender and the receiver. A classic example of an effective, though meager, coding scheme that served its intended purpose well was the command language used by the Imperial Austrian Army prior to 1918. It consisted of not more than 200 action words, each with only one meaning. The language was devised to provide essential communication in a polyglot army whose officers and men spoke a variety of languages.[4]

The *medium*, that is, the vehicle or method used to convey the message, will also color the message and ultimately influence its effect. A memorandum written in tired prose will not create the same reaction as a tersely worded oral message presented at a hastily called meeting at the work site. A television speech replete with sophisticated visuals will have a different impact from the same message printed in the newspaper. On the other hand, it is not wise to attempt to convey *verbally* complex messages via television, because television viewers are accustomed to snatching meaning from visual images.[5]

The *recipient* is the player who "makes or breaks" the communications process. Until he accepts the message and makes its meaning "common" between himself and the sender, no communication occurs. "The communicator speaks or writes or sings—but he does not communicate. Indeed, he cannot communicate. He can only make it possible, or impossible, for a recipient—or rather, 'percipient'—to perceive."[6] If the purpose of communication for a manager

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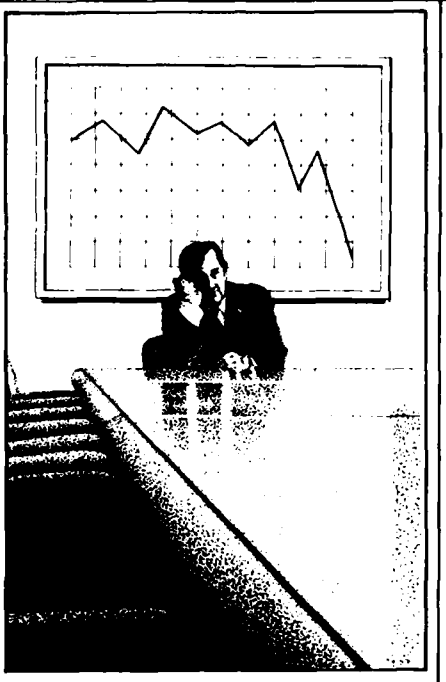
is influence, he must first solicit the cooperation of his intended audience.[7] Each recipient brings his own perceptions, or "filters" to the communications process and will respond in a unique way to the various modes of imagery. The verbal man will respond primarily to words, the visual man to pictorial or diagrammatic forms, and the kinesthetic man to mime or gesture.[8] A skillful communicator who believes in his message and truly cares about getting it across will neither demand nor expect each member of his audience to be "his kind of man." If possible, he will adapt himself and his message to accommodate them all.

The Place of Conventional Graphic Communications

The advancements in communications and information processing technology during the past three decades are impressive. People under the age of 35 cannot conceive of a world without radio or television. Many schools, including those at the elementary level, have installed computers both to enhance the instructional process in general and to provide students with a degree of computer literacy. It would be a mistake, however, to become so enamored of the new and so eager to dash into the future that we discount the significance of the communications media that now seem so commonplace. The printed word has been with us for 500 years and, despite doomsday prophets, there is abundant evidence that it will remain an important communications medium for a long time to come. Some examples of premature, and likely unfounded, predictions were cited in a book published in 1969:

> Newspapers will be a relic of the past in the world of 1984.
>
> Letters will be left to the eccentrics who will enjoy them for themselves.
>
> Libraries for books will have ceased to exist in the more advanced countries and most of the world's knowledge will be in machine-readable form. A few books will be preserved at museums.
>
> Paper work will cease to exist in twenty years.[9]



Some of these predictions are about to be overtaken by time. Toffler claimed in *Future Shock* that, at the time of that book's publication in 1970, adults in the United States spent an average of 52 minutes a day reading newspapers. Those same people also devoted time to other kinds of reading, such as books and magazines, advertising, and instructions. We are, says Toffler, "surrounded by print," and absorbing "between 10,000 and 20,000 edited words per day." That number is only a small portion of the edited words that each person is exposed to every day.[10]

None of the new communications have proved superior to printed words for the basic function of displaying information. Print is flexible because it allows great variety in style and format. There are approximately 2,000 typefaces available today. These typefaces, from the elegant, medieval-like flowing script to the square, clean, modern styles, are themselves an element of the true message, not just a means to display the words. A formal proclamation has a different message to convey than step-by-step instructions for assembling a child's toy. With a printed page, the reader sets his own pace and picks his own time and place. The printed page is a simple and convenient system for recording information. "It is small, light, cuttable, clippable, pastable, movable, disposable, and inexpensive."[11] Its permanence is not threatened by a power outage.

The printed page has limitations, of course. The newer technologies of electronics and micrographics exceed its capabilities in storage density, data manipulation, and speed of transmission. The printed word, however, does not depend on machinery or special training to make it accessible to any literate person. Most people, when ordering a document from a collection that is stored in microform, will request a paper copy even if it costs a little more. "Clearly, neither microfiche nor computer screen displays meet all the demands for convenience, light weight, low cost, and credibility that paper-based documents provide."[12]

Graphic communication is not limited to print on paper. It includes graphs, charts, and illustrations, often accompanied by text. It also encompasses the visual material displayed on a screen or flip-chart to accompany an oral presentation. In audio-visual presentations, the visuals should be an adjunct to the spoken words. They are intended to enhance the commentary, reinforcing or highlighting the important elements of the speech. Use of visuals is so commonplace in office briefings and large-group meetings that people have begun to expect them. "When relying on the spoken word alone to communicate, an estimated 90 percent of a message is misinterpreted or forgotten entirely. We retain only 10 percent of what we hear. Adding appropriate visual aids to the spoken word boosts retention to approximately 50 percent."[13]

Graphics are simplified representations of the intended message. The viewer's knowledge base will influence what information he takes from the graphic, and his attention will be drawn to the aspect of the graphic that is familiar and easiest to understand. He will scan the visual in a pattern accordingly. The designer of the graphic must, therefore, attract the viewer's attention to the important elements by highlighting them through skillful use of form, position, or color.[15]

There are a variety of techniques and equipment for displaying visual aids. They range from a simple chalk

board, to transparent slides projected on a screen, to motion pictures. Likewise, there are various ways to prepare the visuals, from a verbal outline handwritten on a transparent sheet, to artistic, multicolored slides prepared by a professional graphic arts shop. Whatever the method of preparation and presentation, the visuals must be consistent with the message and designed with both the audience and the meeting environment in mind.

Impediments to Message Transmission

For all the absolute essentiality of communication in our social, economic, and cultural lives, how often we fail to make it work! "Failures in . . . communication . . . are due mainly to the limited capacity of the receiver or to the injection of unwanted noise."[16] Noise in this sense is not limited to unintelligible sound or faulty electrical signals. We may describe noise as follows:

> Any undesired disturbance in a communication system such as random electrical currents. Noise is observed as hissing in a radio receiver and as white flecks (snow) on a television screen. In human communication any source of message distortion from unwanted sound to distracting emotions by the receiver may be thought of analogically as noise.[17]

It would not be improper to include in this definition the many quality failures we unwittingly or carelessly incorporate into the media we use to convey our messages.

We have at our command in this age a vast array of equipment, techniques, and automated systems to assist us in coping with the immense volume of information being generated. These capabilities are invaluable in meeting our increasing needs to collect, retain, compact, extend, extract, and otherwise manipulate our growing store of information and to disseminate it far and wide. In the final analysis much of the output of this prodigious technology must be perceived by a person if it is to become useful to society. True, some of these systems speak to us audibly, and certainly we still speak to each other. In large measure, though, the perception of information comes through the mundane exercise of reading it. This applies not only to words, but to arrays, graphs, and diagrams, whether on paper, cathode ray tubes, projection screens, or painted signs.

Most people who are familiar with computer systems have encountered the term "user friendly." It should be the goal of every designer to make his system user-friendly, meaning convenient, comprehensible, and unintimidating even to the most casual of users. This philosophy should not be limited to computers, but should be extended to other communications media as well.

"Friendliness" in the medium of print on paper (including computer printouts) can be expressed in many ways. One of the most important, if most obvious, is to ensure that the print is legible. "Design, weight, style, size and length of line are the primary factors in readability of type."[18] If the recipient of your message can't read the print or must struggle to do so, there is a high risk that he will be prevented from decoding the message correctly and miss its meaning altogether.

There are a number of factors involved in the writing and designing of printed materials so that they can be understood and retained by their intended audience. There is a difference between "designing" a document and just "printing" it. Proper design includes clear and orderly arrangement of the information, ample white space for margins and separators, and avoidance of clutter such as too many different visual elements or typefaces. Using a single simple device for adding emphasis is more effective than combining boldface type, color, and underscoring. Combining all three devices would be counterproductive. While large blocks of type printed entirely in capital letters may give the illusion of emphasis, it is actually harder to read and more intimidating for the reader.[19]

The armed forces have conducted several studies to determine how best to prepare technical manuals and instructions for use by service members. A team experimented with university undergraduates to explore how people read and use directions presented in text and illustrations. They concluded that the presence of illustrations significantly improved performance. It appeared that any ambiguities in text or illustrations could be resolved by comparing the information in the two media. Their results also led the team to believe, however, that "specific types of information are presented more effectively in texts or in illustrations."[20]

Curran, another investigator, measured comprehensibility of manuals with respect to the reading levels of the intended recipients.[21] He considered the many factors involved in readability and comprehensibility of technical manuals, such as use of familiar words, short sentences, smooth style, and simple sentence structure. He discussed the distinction between the terms "readability" and "comprehensibility" and cited this definition of "readability": "used to indicate legibility of either handwriting or typography, ease of reading due to either the interest-value or the pleasantness of writing, and ease of understanding or comprehension due to the style of writing."[22]

In preparing technical manuals for use by military personnel, there are certainly a number of questions that must be addressed by the designer. Is the print large enough? Is the book small enough? If it is a "handbook," can it be held in one hand? It if will be used frequently, is the binding durable enough? Will the binding permit the book to lie flat while a technician's hands are busy with the equipment? To the degree that the manual fails these and similar tests, the resulting inconvenience, irritation, or distraction to the user could be considered "noise" in the communications process.

Far too often it seems that people in the information field are like the proverbial shoemaker's children. Some of the professional associations in the information and data processing fields are occasionally the sources of "good examples" of how *not* to communicate. They appear to employ our new technologies to produce publications, or parts thereof, that are virtually unreadable.

A local chapter of one of the international associations in the computer field publishes a monthly bulletin that is printed almost entirely in six-point type.* The 16-page booklet appears to be printed using the xerographic process, and, thanks to the reducing capabilities of modern copiers, several of the pages are reduced to smaller than six-point size.

In a recent quarterly research journal there is an article that discusses human communication in the future. The article has 10 pages of offensive print. It is printed in eight-point type that is strangely and poorly spaced. The letters within words sometimes touch one another and other times are so widely separated that the space could be mistaken for a word break. The lower case "i" is barely distinguishable from a lower case "l," and the lower case "w" is so lacking in sharpness that the blackness of each one stands out on the page. The article, indeed, the entire journal, is printed with what appears to be an extra line of space between each line of print. This may be a means of compensating for the small print, but it only provides another distraction for the reader.

A national information society has recently published the proceedings of its annual meeting, complete with author and subject indexes. These indexes are models of poor printing and could be labeled "noisy communications." They are computer-generated KWIC (key word-in-context) and KWOK (key word-out-of-context) indexes, which are difficult to read when printed approximately half the size of six-point type. There is no line spacing between entries, which results in two solid columns of miniature print; punctuated by partial lines of dots (or are they dashes?) to fill out incomplete lines. Scattered throughout the entries are special characters such as asterisks and plus signs to indicate where words and characters had been omitted for some reason. There is, of course, a key to these peculiar features provided at the front of the indexes. The print is all uppercase letters, and the quality of the original print, together with the degree of reduction, render the indexes unreadable.

*This is an example of six-point type.—Ed.

"Friendliness" is also often lacking in the visual aids we use with oral presentations. Sometimes a speaker forgets that "a picture worth a thousand words must first be a good picture."[23]

The language of graphic figures is "form" just as the language of text is "words." The form for a graphic presentation must be selected with the same care as the accompanying words. Visual communication can be impaired by using too much form, or not enough, or even the wrong kind.[24] Excessive and irrelevant detail in a visual can clutter the display and bury the key ideas that the visual is intended to convey.

A paramount consideration in designing and using visual aids is to ensure that they can be seen by everyone in the room. Far too often, visual aids are barely visible, and hence scarcely little aid to a segment of the audience. Several factors can contribute to this problem. The image, including textual material, may be too small for the size of the room. There may be inadequate contrast between image and background, or the focus may not be sharp enough. When members of the audience have to strain to see a visual, their attention is diverted from the speaker, and the message will be partially lost.

The wise use of color can increase the effect of a graphic. Any color used in a graphic must have a purpose; it must have a function other than decoration. True, color can attract the viewer's eye and lead him to look at the area highlighted, but if it does not aid him in understanding the graphic and the message, it may prove a distraction.[25]

Maps can present special problems when used as visual aids. Maps printed in books often use pastel colors to differentiate potential entities. Such distinction will be lost on a large screen. Strong, contrasting colors are more effective. The type of map displayed must be appropriate for its purpose. If the purpose is to give the audience an appreciation of the relative locations of several cities in a country, a map that is busy with topographical features or road nets will obscure the message and confuse the viewer.

Text on charts, graphs, or illustrations should read horizontally, and labels should be concise with their relationship to reference points clearly indicated.

If a communicator uses visual aids that are inappropriate, hard to see, or difficult to comprehend, he may destroy his message. If he fails to consider the capabilities, sensitivities, or even comfort of his audience, he may generate anxiety, irritation, or hostility. The message he conveys may be far different from what he intended. The audience may perceive that the speaker does not know his subject well or, worse, that he does not much care whether his audience learns what he does know. "Every audience is somewhat like a jury. It passes judgment based on its comprehension of the facts presented—seasoned with a measure of human emotion."[26]

Some Practical Conclusions

There is keen competition for attention in this noisy world. The sheer volume of information coming at us from every direction, and sometimes proffered with a mixture of motives, requires us to be selective in the communications we admit to our perception. We are almost forced to be less tolerant of faulty transmissions and to react in a way that is like switching off a radio station that has too much static. Many of the advertisements that come to us through the mail are left unread unless presented in an appealing way. In reading directives and instructions pertaining to our work, we often read only the sections that apply specifically to us and skip the rest. We can hardly expect poten-

tial recipients of our communications to treat us more kindly. They too have limits on their time, energy, and attention spans, and will be reluctant to spend too much time and effort to decode garbled or poorly presented messages.

As noted earlier, the recipient is the final determinant of whether the communications process succeeds. It therefore behooves the communicator to use every device and technique at his command to enable the recipient to accept and understand the message. The first consideration of the communicator should be to avoid creating barriers that will impede transmission.

In the case of the printed word, this means presenting the material in an eye-pleasing format with legible print, well-balanced with white space. The type sizes that provide optimum legibility are 10-point and 11-point.[27] [You are reading 10-point type—Ed.] These are the type sizes produced by standard typewriters. The writing style should be smooth and suited to both the subject and the audience.

Printed outputs from a computer deserve the same care as any other printed material. They should be designed so that they are easy to read and visually attractive. Headings should be concise, explanatory, and properly placed. Columns of figures should be aligned and spaced so that they are readily understandable.[28] Computer-printed reports should be stripped of any numbers and verbiage that are irrelevant to the user and that serve only to clutter the page.

If it is necessary to produce extra copies of documents on an office copier, make sure the copies are almost as clear and sharp as the originals. It contributes nothing to the communications process to demand that the recipient attempt to read faint or blurred copy.

If we use visuals with an oral presentation, we must design and display them so they can be seen and understood by the entire audience, including people in the last row. Eastman Kodak[29] proposes the following working table for determining the required size of an image on a screen in relation to the size of the room:

Viewing Distance	*Minimum Symbol*
128 feet	4 inches
64 feet	2 inches
32 feet	1 inch
16 feet	½ inch
8 feet	¼ inch

Some print styles are more legible than others. "Generally *sans serif* styles . . . tend to be most compatible to the character of visual form since their structure is formalized rather than elaborated."[30] Standard typewriters and computer printers generally do not produce print sizes that will be legible when projected on a screen. The material displayed on the screen should be simplified and exaggerated for best effect. Captions, labels, or titles should be laid out horizontally, since text displayed vertically or at an angle is not readily readable. Each illustration should depict one central idea and be expressed in familiar symbolism. When presenting narrative material, the number of words on each visual should be kept to a minimum. A speaker should not speak from an outline projected on a screen, much less speak to it. The visual should present a high contrast between image and background. Black on dark colors such as red or blue will not provide sufficient contrast.[31] The ambient lighting in the room is another important factor in audio-visual presentations.

Many business and government organizations employ printing and graphic arts specialists to assist communicators. It is wise to consult the experts and listen to their advice. To communicate effectively, a speaker should also find out as much as he can about the environment in which he will be speaking. This would include the make-up of the audience as well as the physical facilities, such as room size and availability of audio-visual equipment.

Finally, I reiterate that the communicator, in a sense, serves the intended recipient in any communications process. He must *always* keep the intended recipient in mind when preparing and transmitting his message.■

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Program Stability

Perspective for the Program Manager

Lieutenant Colonel William D. Smith, USAF

The Deputy Secretary of Defense memorandum of July 8, 1983, ("Guidance on the Acquisition Improvement Program") spotlights six of the original 32 Acquisition Improvement Program actions as areas offering "both the greatest management challenges and the highest potential payoff." All six are deemed critical to getting the most for our acquisition dollar, and all have the potential for impacting what many consider a defense industry gone out of control.

This paper concentrates on the first of the Thayer six—program stability. Whether listed first by design or not, program stability, in my mind, forms the basis for successfully executing the remaining five. Without stability, a program manager faces serious difficulties.

In addressing program stability, I will refrain from the usual practice of blaming Congress for our woes. As we have learned, Congress marches to a different drummer and can cause instability no matter how well thought out, managed, or executed our program may be. Instead, I will concentrate on what the program manager can do within his area of influence to make and keep his program stable. The "can do's" discussed are based on personal experience, observed success of other program managers, and "borrowed" thoughts lifted from readings and lectures whose principles stand out in my mind, if not the specific sources.

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Some of the areas I discuss may seem somewhat detached from the traditional concept of program stability, but in the total context of program management, they form a foundation upon which the program manager can build. They do not require that the program manager be there at program initiation, although that always helps. They can be applied at any time and, in fact, have been observed to bring a program from total chaos to total control.

First, a few basics.

The Environment

Systems theory stresses the concept of environment. We are not alone. Nothing save totality itself can be considered complete. As such, each environment operates within a larger environment, and each influences, to varying degrees, the other. The program manager lives in his own environment. It is made up of people, technology, requirements, contracts, politics, etc. It is complex and changing, and it affects other environments. The more a program costs, the higher its risk, or the more it is visible, the more complex is its enclosed environment and its affect on peripheral environments. These effects, within the program manager's own sphere and outside, basically increase by the square of the number of persons interested in the program. Thus, the program manager managing a high-cost, high-risk, high-visibility program can expect plenty of interest and "help."

The successful program manager recognizes the realities of environments and their interplay. And he realizes two basic facts—he can control much within some areas and absolutely nothing within others. How well he manages within the bounds of those facts can lead to success or failure of the program.

The acquisition environment is like a large lake. Each day, the program manager takes a swim. If he knows and understands his "lake mates"—who, how many, and what stroke they prefer—he can swim to the far side and be successful. If not, he's likely to sink and drown while everyone else watches.

Stability

Stability means different things to different people. A single level of stability can leave some feeling very uncomfortable, while others thrive. It depends on your perspective.

For the purposes of this paper, I will define stability as the ability to execute a program according to plan. This implies stability over those areas wherein the program manager can exercise a degree of control. Change is a fact in this business, but you cannot worry yourself into oblivion over changes you cannot control. So, we will concentrate on internal issues and hope that a degree of internal stability may affect outside influences. But that is not a guarantee.

The Key Player

The program manager.

Things You Can Do

First: Run your program with integrity. Now, it may sound a bit flaky to put integrity first, but realize that all human interchanges are based on trust. Program management is no different and is, in fact, human interchange at a very high level. You and your people must be dedicated to getting the job done *and* to getting it done with integrity. You cannot operate successfully for long unless you, and those who represent you,

are persons whose actions and words are considered bond. This means being up-front—up, down, and across the line. It means gaining respect through knowing what you're doing and admitting it when you don't. It means not promising what you cannot deliver. It means taking hits at times, but it means you can run your program with self-respect and the trust of others. You may lose a few in the short run, but you'll win in the end. If not, we are in much deeper trouble in this business that I believe. If it's not worth doing with integrity, it's not worth doing.

Second: Take care of your people. Programs are run by people, and the better people you can attract the better the program will be managed. The most successful program manager I ever saw in action *attracted* good people, provided the guidelines (including program discipline, i.e., stability), and let them act. And he rewarded them, not only in terms of the normal rewards, i.e., efficiency reports, decorations, certificates, etc., but also in a personal sense. It was the only office I've ever seen where everyone was *totally* dedicated to the job because the boss represented the job in its totality. That program was highly successful and stable. Everyone knew where we were going and did the utmost to get us there, knowing that success of the total program meant personal success. It was a group of hard-working mavericks all pointed in the same direction—and it worked magic.

Third: Understand the concept of goals. What is it you and your team are trying to do? Many lose sight of the fact that single entities do not exist in a vacuum. Cost, schedule, performance, support, requirements, etc., do not exist by themselves; they form a system. Thus, a key goal within the program office is to make smart trade-offs between all the competing priorities so that the result is a system that fights well, is supportable, gets there when it's needed, and doesn't break the bank.

It is easy to say that all acquisition parameters are equal. But is that true? If it were, we'd have an impossible task. What is important to understand is that in the aggregate they are equal, but trade-offs must be made, and there are usually no "best ways" of making these trade-off decisions. If the aggregate-goal viewpoint is used, however, the trades will be made with a long-term view. That leads to stability and, in my opinion, ties back directly to integrity of the program office.

With the realities of today's acquisition environment, a program manager ought to consider that the next generation will probably fight with what he/she is building. Build it with that in mind.

A more specific aspect of understanding goals is *planning*. Plan to meet your goals. We all know that early planning is a black art, so admit that and take advantage of it. Don't lock yourself in with descriptions down to the last nut and bolt, and cost estimates to three decimal places. It may look good, but who are you trying to kid? The key is to not lock yourself in but to concentrate on those areas that will enhance your chances for program stability. Flexibility early means stability later.

Cost growth is not natural. A program that is properly planned, baselined, and estimated will not experience cost growth. Unfortunately, few programs have the luxury of perfect planning, baselining, and estimating. Understand that and apply risk resources where necessary. You or your successor will have to live with your estimates, so do them justice and don't try to squeeze the estimate to fit the budget. Remember integrity? Pay now or pay later. Perhaps if we'd be honest in what we put forward on cost we'd have few problems with cost growth. Yes, systems would be expensive, but we now have the worst of two worlds—expensive systems and no credibility.

Fourth: Know, understand, and communicate with the players. Your environment includes many people, who have their own goals, ideas, and specific reasons for being a part of your environment. You must understand that and take advantage of it. You have to understand the detractors as well as the supporters. Detractors present as interesting a case as supporters. Their views, while seeming to lessen your chances, may prove beneficial both in understanding your goals and in achieving them. At the least, know where the detractor is coming from so that appropriate counters can be established. Better yet, find out what you have in common and strengthen those bonds. A little integrity here helps, too.

The user connection is all important, as is your link to the supporting agencies. They form a large percentage of your "pot of goals" and must be understood. Do not, however, forget that they represent separate interest groups, and that their interests may not, in total, be the same as yours. Take advantage of the fact and use it to everyone's mutual benefit.

Keep the lines of communication open to all players. Actively work at it and work especially hard at those that seem distasteful. If you don't, your chances of being blindsided increase substantially. It is better to work issues out at a lower level than to get a lot of help.

Fifth. Run your own program. Everyone wants to join in when you're a hero, but you stand alone when the program fails. Knowing that, make your own decisions based on the four ideas discussed earlier.

Along that same line, have the courage to say no—no to bells and whistles, to changes in the baseline, to fiddling with your budget, to arbitrary changes in personnel, and to everything else that could cause instability. But say no with thought and class.

Say *yes* when the change will enhance your goals and is manageable within the context of the program environment. Likewise, say yes with thought and class.

The five ideas discussed are broad in thought, but specific to each and every program we manage. While I admit that there is no magic formula for success, the areas addressed will go a long way toward smoothing out program difficulties and enhancing stability. It is hard to believe that a program with integrity; that is run by good people who understand themselves, their programm, and their goals; that works at communication with all the players in the environment; and that is run with discipline will suffer from internally caused instability. And its ability to react to external forces will be enhanced because of the lack of internal chaos.

What better world can a program manager ask for? ■

Down with "Head in the Clouds" Testing

A. N. Hafner

There is a misconception in many Department of Defense test and evaluation circles that automatic data processing (ADP) system testing is a sterile, one-time scientific experiment designed to prove conclusively the value of the new system. This misconception is a primary cause of the program disruption and guarded skepticism that often pervade the environment of defense systems acquisition. It is certainly the prime reason for the creation of inviolate schedules and absolute testing benchmarks which, once set "in concrete," give rise to testing that is more opportunistic and improvisational than rigorous.

The spectrum of appropriate test techniques for military systems extends from rigorously controlled sci-

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entific experimentation through simulation and opinion sampling. More often than not, however, the operational nature of the developing system requires testing in the center of that spectrum. This is to say that while there is a place for rigorously controlled variables and scientific experimentation, the unstable and unpredictable nature of operational (i.e., combat) conditions often defeats efforts to control critical variables.

This means that those charged with planning for, designing, and conducting tests must be pragmatists rather than idealists. They must carry out testing in a way that accommodates not only the vagaries of the system's operational environment, but the vagaries of the test environment as well.

I present the following in an effort to assist the idealist in becoming a realist. In my view, more pragmatism is needed in the test environment if the test results are to be anything other than just so much paper. Our testing, from the planning stage through to completion, must reflect the real world in which we live and in which our systems must operate.

Test Planning

The foremost thought that the pragmatic test planner must keep in mind is the certain knowledge that his test budget will be reduced at some time during the system test cycle. Accordingly, the astute test planner creates a test plan that anticipates either a reduction in funds, personnel, or operational force availability, or an increase in the tempo of development/testing and the foreshortening of the test period. Bear in mind, too, that for certain types of tests (e.g., prototype development testing) the testable/operable elements of the test system that are actually available for testing will only approximate those that were envisioned when the schedule was formulated.

Beyond this philosophical observation, the next most valuable concept the test planner can incorporate into his repertoire of skills is the appreciation of the test planning/design/application process as an iterative "art."

The creation of a test for an evolving operational system requires the use of flexible methods and adaptable sequences. It mandates that the planner expect to use personal direction as frequently as schedules, that the designer use instinct with as much facility as logic, and that the applications personnel rely as much upon initiative and observation as upon written procedures and data traps. If one is to test an existing operational system, all of whose elements are in place and whose operating parameters are known, the test plan and design can be created with as much detail and confidence as one is willing to fund. However, the very process of developing a new system that in some way advances the state of the information-processing art is one that guarantees a measure of uncertainty and an exploration of uncharted areas. It is only through the introduction of initiative and flexibility that the test plan can keep pace with the ebb and flow of the state of the evolving system.

The test plan is, above all, dependent on the early availability of appropriate personnel. The inclusion of a test-design analyst into early program development, i.e., at the preparation of the Justification of Major System New Starts (JMSNS), allows the formulation of alternative plans and schedules as the various elements of the development program coalesce. Admittedly, the creation of a variety of hypothetical test plans and schedules is not cost-effective in the early stages of systems development. However, during the intensely active period immediately preceding system delivery, a knowledge (program memory) of the rationale behind the selection and/or rejection of various test plans is invaluable to ensuring that the inevitable "adjustments" to the test program do not violate or neglect a basic premise of the system authorization process. Further, the creation of the elements of system evaluation (measures of effectiveness) need not necessarily wait for the test-design phase. The early stages of system development (e.g., the system definition and design review meetings, the early planning and status briefings) are the most imaginative environments in which to collect the thoughts that will eventually create system measurements.

Finally, the astute test planner should be mindful of the iterative nature of test planning. In planning tests for an evolving system, the planner must always anticipate the need to redesign and upgrade tests to accommodate successive versions of the developing system. It goes without saying that test planners must first project the state of development the system will have attained at the time of each scheduled test. Test directors regularly rely on the prescience shown by their planners when they begin to apply the procedures, built weeks before, to systems whose developmental state was estimated by the planner months (or years) in the past.

Test Design

Perhaps the *sine qua non* of effective testing is the participation in the testing of the analysts who designed and specified the test. It is not absolutely necessary that the test-design analyst be present for the entire duration of testing, or that he necessarily be a data collector. Nevertheless, the intellect that created the test must experience a sufficient sample of the operational circumstances of its application to ensure that the environment he originally envisioned is, in actuality, the envelope within which testing occurs.

Once the practitioner of pragmatic test design is resigned to the certainty that he will apply the procedures he is to create, he will then acknowledge that those procedures (and therefore the test design) can be only as sophisticated as the budget and the system technology warrant. A common, if unfortunate, psychological phenomenon often observed in inexperienced test designers is the disillusionment that occurs when a sophisticated test design (an "experiment," really) is gradually eroded and watered down by the pragmatics of development scheduling, financial management, and the imprecision of ADP development. It is far more efficient and productive (if less ego-enhancing) to recognize early the limits of the testing resources and to design one's test to be effective within these limits. On the other hand, while testing resources, and therefore sophistication, are always limited by outside forces, the rigor and pertinency of the test

design are limited only by the creativity and expertise of the test designer. One should expect the sophistication of the test design to be a measure of such factors as the designer's insight into the system, its operations, and its environment, rather than to be an announcement of the affluence of the program.

Test design and planning must encompass the physical aspects and limitations of test locations. This is to say that the designer must be realistic in the scope of his test and its support requirements. At remote-site testing, test plans must anticipate such limitations as the physical stamina of data collectors, the facilities' limitations caused by dislocation from utilities and, of course, the constraints caused by travel and accessability. An ever-increasing problem for remote-site testing is the diminishing availability of secure, interference-free, data communications links. Error-free transmission of raw data to central analysis and processing facilities is becoming increasingly more expensive *vis-a-vis* the cost of creating an on-site analysis capability. The advent of high capability, low-cost personal computers may bring some relief in this area.

Finally, the practical test design is one that creates tests that are nondestructive. Naturally, one would expect test procedures to provide for the safety of the equipment being tested. However, all too frequently, (and particularly in the case of on-site testing) the inexperienced test designer creates a series of tests that, while they save the system hardware and software, sacrifice the program by undermining the confidence of the future user and thus destroy the system's reputation before the system is even completed and installed.

Efficient tests should seek to minimize their impact on ongoing systems development. The test team and test sequences can have a potentially devastating effect on the reputations of the system developers. Test designers must be intensely sensitive to the motivation and egocentric needs of the developing team. This is not to say that practical tests must not be rigorous and accurate or that they need to take into account the "feelings" of the developer. Truly credible tests must have an inherent integrity that transcends the emotions of all concerned. However, it is equally true that, without question, the good of any program demands that its tests must avoid, at all costs, the aura of a "witch hunt." Accordingly, the truly effective test designer is experienced and thorough in his design activities even to the extent that he creates test plans that anticipate and circumvent any potential for psychological or physical damage to the system and program development activity.

Test Application

The test planning and design phase culminates in the production of a detailed set of test procedures. These procedures specify, to the finest detail possible, all aspects of the forthcoming tests, including the system configuration, data inputs, data output, and actions of the test personnel. They should specify what information is to be collected, when it is to be taken, and where (at what place in the system) it is to be extracted. These procedures must be validated.

In spite of the potential for program mis-scheduling and the instability of system configuration, it is imperative that the application phase of any test and evaluation effort begin with a thorough, all-inclusive dry run of the test procedures. A basic tenet of successful testing is that all data collection personnel must be thoroughly familiar with the test procedures and that their methods of data collection and reporting be standardized. Additionally, the thorough rehearsal of each test procedure serves to acquaint test observers with the anticipated activity and response of the system to be tested. This familiarization equips the observers to better recognize system abnormalities and to identify and record spontaneous reactions and unanticipated responses. Quite often, in testing operational ADP systems, the major insights into system performance and behavior are gained through analyses of the spontaneous events, outlaying data points, and operational "workarounds" created by the users.

Additionally, and equally as important to credible testing, is the opportunity created by dry-run testing to iterate another step in the test design. The testing of evolving systems is an art that depends on instinct and judgment just as surely as it does on the statistical and behavioral sciences. Thus, the iterative process of "design—dry run—redesign" enhances the fidelity with which test procedures replicate the working environment of the evolving system.

Another rationale for the inclusion of a rehearsal stage in the applications phase of testing is the need to avoid contamination of the test environment. The presence of even a minimal number of test observers in an operational environment introduces an element of unreality that must be overcome. The potential for the observers to influence the outcome of testing is lessened by a thorough familiarization with the anticipated operating conditions. The pre-test rehearsal is an excellent forum to emphasize the need to establish appropriate public relations with the user community

Lastly, while it is preferable that the test application phase be conducted in an environment that allows the test team to have exclusive, uninterrupted use of the system, this happy circumstance is more often than not impossible in the test and evaluation of large, expensive systems. Failing this luxury, the next most appropriate solution is a thorough indoctrination of test-team personnel in the importance and considerations of their interactions with other system users.

The final set of precepts that are generally applicable to all test application efforts are the requirement for rigorous, accurate recording of all data; validation of the data analysis procedures; a scrupulous attention to detail; and an alertness for extraneous and spontaneous events. The test team must be rested and professional so as to be able to record exactly what they observe without *a priori* analysis or judgment. They must be fully familiar with both the system technology and its operational environment so that they are capable of interpreting the unfolding test scenario and projecting future events in order to anticipate and record unexpected events. Lastly, a thoroughly rehearsed test applications team must be personally committed to the quality of the test and to its task of observation and interpretation of system behavior.■

Risk Funding for Realistic Budgets

Major George D. Schneickert, USA

In the *Second Year-End Report of the Acquisition Improvement Program Steering Committee*, the status of technological risk funding is reported to have ". . . been implemented by the services, and this initiative is now considered completed."[1] However, problems encountered in maintaining risk dollars through the Office of the Secretary of Defense (OSD) and the congressional budget process were recognized, and two specific actions were recommended.

The first was keeping risk funding as part of "Realistic Budgeting," one of then Deputy Secretary of Defense Paul Thayer's six major areas of emphasis. The second was that "OSD and the services should work with the Congressional authorization and appropriation committees to improve Congressional acceptance of risk budget requests."[2]

My purpose in this paper is to examine how OSD can demonstrate to Congress the value of the risk-funding approach. But first, I will present the concept and history of risk funding.

Concept

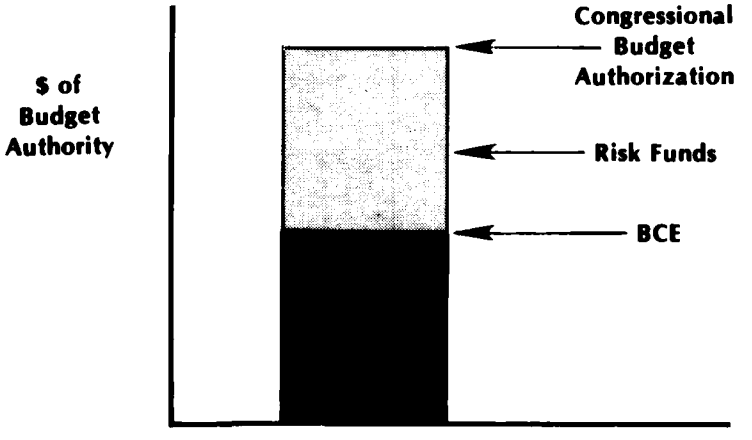
One of the few constants in the weapon systems acquisition process over time has been cost growth. This has been true in all phases of the life cycle. In research and development (R&D), cost growth manifests itself for a variety of reasons. Among these are the difficulty in predicting what events will occur or what activities will be required in R&D. A program manager (PM) makes the best estimates of these events and activities and generates a baseline cost estimate (BCE). Then, as the program proceeds through R&D, the "unknown" events and activities become "known," and there may, or may not, be adequate funding to address them. The concept of risk funding is to provide money for these problems above the level of BCE funding. Graphically, this concept is portrayed in Figure 1. The cost of specific program events and activities is shown by the level of the BCE. An additional amount, called "risk funds" is provided in the congressional budget authorization for the resolution of problems that may occur in R&D. Generally, the risk-funds estimate is calculated to provide a 50/50 chance of a cost underrun or overrun.

History

This process of providing risk funds as a part of the budget for a program's R&D was initiated by the Army in 1975. In the Army this process is called Total Risk Assessing Cost Estimate (TRACE). As the TRACE concept matured, four methodologies for determining an appropriate level of risk funding developed. The risk-percentage method is the simplest for generating the TRACE. In applying this method, the BCE for research and development is simply increased by a percentage factor. This factor is most typically a subjective estimate based on program experience. A second method, the risk-factor method, is an enhancement of the first method. Program elements are defined by using the project summary work breakdown structure (WBS). Subjective percentage factors are then developed and applied to the program elements. The factors can vary depending on anticipated problems in these program elements and the program history. The individual program elements are then summed to arrive at the TRACE.

Probabilistic event analysis continues to build on the work breakdown structure. But using this method requires estimates both of problems within program elements and of the effects individual problems in program elements will have on other program ele-

Figure 1. Relationship of Risk Funds to BCE



■*Major Schneickert is a student at the Armed Forces Staff College, Norfolk, Va. He is a graduate of PMC 83-2, and this "think piece" was written in partial fulfillment of the requirements of that course.*■

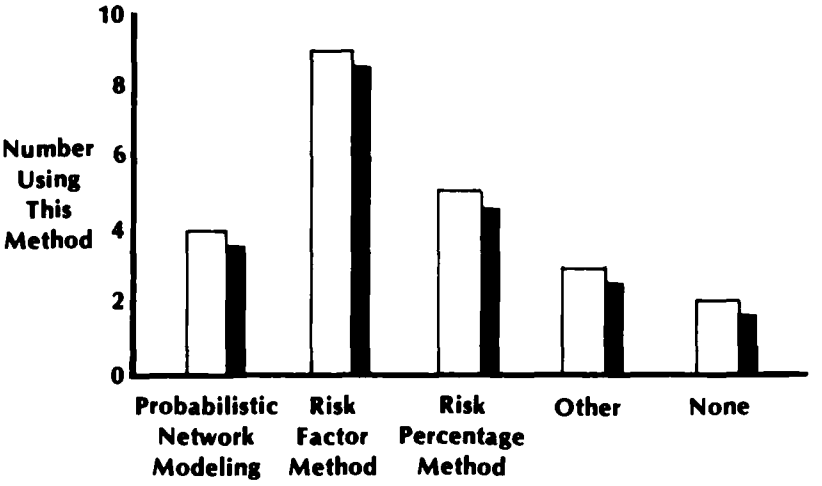
ments. In other words, this method considers interactions of program elements. This method also requires more extensive estimating efforts than the first two. Probabilistic network modeling is the most demanding approach to generating a TRACE. It combines program evaluation and review technique (PERT)-type network analysis with "monte-carlo" simulation to give cost and schedule probability distributions, which can be used for a variety of additional program management functions besides a TRACE.

In 1980, Paul Grover and I, as analysts with the U.S. Army Logistics Management Center, conducted a survey of Army PMs to determine, among other things, the methodologies that had been used in producing the TRACE.[3] Their answers are shown graphically in Figure 2. Our study showed that PMs favored the simpler estimating techniques. This was due primarily to lack of in-house analysts, with time contraints being a second consideration.

In 1981, the new Deputy Secretary of Defense, Frank C. Carlucci, included an action on incorporating risk funding in the budget process in his memorandum on "Improving the Acquisition Process."[4] This was the first attempt at institutionalizing a risk-funding concept at the DOD level. He directed the Navy and Air Force to develop, within 60 days, programs similar to the Army's TRACE. This was done. Another outgrowth of his memorandum was a 1982 Army study that examined expanding the TRACE concept to include procurement budgeting.[5] This has also been accomplished. Within the Army, "the FY 84 budget contains a request for TRACE-P [TRACE-procurement] funds for the XM-833."[6]

Discussion

"Major weapon system cost estimates are not accurate and do not provide Congress with the information needed to effectively evaluate DOD budget requests."[7] This finding of the House Committee on Government Operations in 1979 reflected a level of frustration over cost growth in weapon system programs and brought the entire cost estimating process under scrutiny. The TRACE concept is unique in its attempt to make cost estimates more accurate by providing funds for the risks inherent in R&D. But, it has had mixed reviews from Congress. Although the Army has been successful with its TRACE program, other attempts to budget for risk have not been as successful. "Program managers who explicitly requested funds to cover program uncertainties have usually found those funds deleted by the services or DOD in the planning, programming, and budgeting system (PPBS), by the Office of Management and Budget (OMB), or by the Congress."[8] What, then, is the problem?



John Cockerham, founder and president of John M. Cockerham and Associates, Huntsville, Ala., has stated that, "the problem begins at the Congressional level in that there are no requirements for uncertainty or risk information to support the Congressional responsibility of deciding which programs are funded and how much."[9] But this is not all. In the same article, he identifies what I believe to be the major problem: "There is no coordinated ; ish from DOD, nor has Congress expressed any approval, disapproval or even knowledge of the efforts to budget and plan for risk."[10]

Recommendations

Clearly, the time has come for some action on realistic budgeting that reflects accurate cost estimating. I believe that the thrust must come from OSD, and I specifically recommend five actions.

First, one organization at OSD level should be assigned the responsibility for promulgating a risk funding methodology for all the services. Instead of separate Army, Navy, and Air Force techniques and policies there should be just one set of techniques and just one policy. This would clearly establish for Congress the structure by which risk-fund estimates could be developed. Furthermore, Congress could be assured that risk-fund estimating was uniformly generated and that risk funds were being properly used by the services.

The second action is to apply more rigor in developing risk-fund estimates. The study I participated in identified the simpler risk estimating techniques as the most prevalent, even though the more demanding techniques provided the added benefit of a very detailed network model of the program's research and development. Program managers simply did not have the resources to use the probabilistic network modeling techniques. Notwithstanding all the demands upon the PM's resources, more rigor must be applied in estimating risk funds. I don't believe it surprising that Congress has failed to give a resounding vote of confidence to an estimating technique that increases a baseline cost estimate by some subjective percentage to generate an estimate that incorporates risk. The Office of the Secretary of Defense must recognize the requirement for rigor and communicate this requirement to

the services. It should ensure adequate staffing of program offices and service materiel commands with qualified analysts. Resources should also be provided to fund more detailed analysis of risk. The use of probabilistic network models should be encouraged, not only for the TRACE application, but also as a program management tool.

The third action is directly related to staffing. Education and training of personnel in using TRACE must be increased. This type training is now a supplementary part of several courses conducted at the U.S. Army Logistics Management Center, Fort Lee, Va. This training should be expanded, either within this Army facility, other services' facilities, or at the DOD level. A separate educational consideration would be an informational program directed at the Congress. This program would document OSD's resolve and rigor in pursuing more accurate cost estimates.

The fourth action is to consider the use of contractor support to provide probabilistic network models and risk-funds estimates. This would provide an alternative to increased staffing and increased training. It would also potentially meet requirements under OMB Circular A-109. The expertise developed within many analytical contractors, can be a valuable asset for the DOD community.

The fifth action is not so much a specific action as it is a result of the previous four. DOD should give Congress an example of a program which budgeted for risk and that did not use all the risk funds provided. Credibility would be given the principal risk-funds concept—that the risk-funds estimate provides a 50/50 chance of an underrun or an overrun. This would, of course, require OSD attention. Risk funds could easily become a source of funds for problems other than those for which they were provided.

Summary

The concept of budgeting for risk is a mature concept and an integral part of realistic budgeting. In order to win congressional acceptance of the concept, OSD should take specific actions to demonstrate the rigor that has gone into generating risk-funds estimates and the value the enhanced estimates will have in controlling cost growth. The actions should be promulgated and coordinated at OSD so that management and policy as it relates to risk funds is uniform throughout the services. Finally, the success of the risk-runds budgeting should be illustrated by example. ■

Notes

1. Paul Thayer, Memorandum for the Secretaries of the Military Departments, and others, Subject: "Guidance on the Acquisition Improvement Program," June 8, 1983.
2. *Ibid.*
3. Paul Grover and George Schneickert, *Total Risk Assessing Cost Estimate (TRACE): A Field Survey*, March 1981.
4. Frank C. Carlucci, Memorandum for the Secretaries of the Military Departments, and others, Subject: "Improving the Acquisition Process," April 30, 1981.
5. Monte Norton; Richard Abeyta, and Paul Grover, *"Production Risk Assessing Methodology,"* report, Army Procurement Research Office, May 1982.
6. Richard Baker, "Budgeting for Technological Risk in Procurement," September 1983.
7. *Inaccuracy of Department of Defense Weapons Acquisition Cost Estimates*, Ninth Report by the Committee on Government Operations, November 16, 1979.
8. Colonel John D. Edgar, USAF, "Controlling Murphy: How to Budget for Program Risk," *Concepts*, Summer 1982.
9. John M. Cockerham, "Implementation of Risk Information Into The DOD Decision Making Structure," paper presented at Risk and Uncertainty Conference, Defense Systems Management College, 1983.
10. *Ibid.*

Sea Cobra Fires Hellfire

Lila Edwards

A unique joint-service test program aimed at qualifying Marine Corps AH1-J Sea Cobra Attack Helicopters to fire the new Hellfire anti-tank missile has begun at Yuma Proving Ground, Ariz.

The testing, now in its final phase, began in 1982 to determine if the twin-engine gun ship could accommodate the new missile along with its current armament which includes the family of 2.75 inch air-to-ground rockets, and a 20-millimeter Gatling gun.

According to Chuck Ramsdell, the YPG chief project engineer in the program, six Hellfire missiles will be fired to test the operation of the missile system, and structural load capabilities of the aircraft. Other items of interest in the program are control of the aircraft before, during, and after firing, as well as integration of a night-sight vision system.

Three of the firings will be ballistic tests, while the other three test telemetry missiles, similar to the production missile, will be fired to test the aircraft's fire control and launch systems, Ramsdell said. Unlike Army attack helicopters, the AH1-J has no on-board laser designator system.

Among the tests scheduled for the six-week program is a jettison test, aimed at making sure emergency actions with the missile won't hamper control and safety of the airplane.

The AH1-J has been in the Marine Corps inventory since the late 1960s and is the main attack helicopter used by the Marine Fleet Air Wing.

The addition of the Hellfire system will give the aging gun ship vastly increased firepower, and allow the use of fire-and-forget ordnance, which will reduce battlefield vulnerability, according to program proponents.

Also, unlike Army land-based attack helicopters, the Sea Cobra does not have an integrated night vision system. Ramsdell said the Marine Corps is attempting to compensate by performing collateral tests of the AN/AVS-6 Pilot's Night Vision Goggle System.

The tests will include flying over the Sonora Desert to verify modifications in the instrument cluster made to accommodate the night vision system.

With the addition of a night vision system and Hellfire, the Sea Cobra becomes a day-night, all weather fighter capable of attacking targets from stand-off range. ■

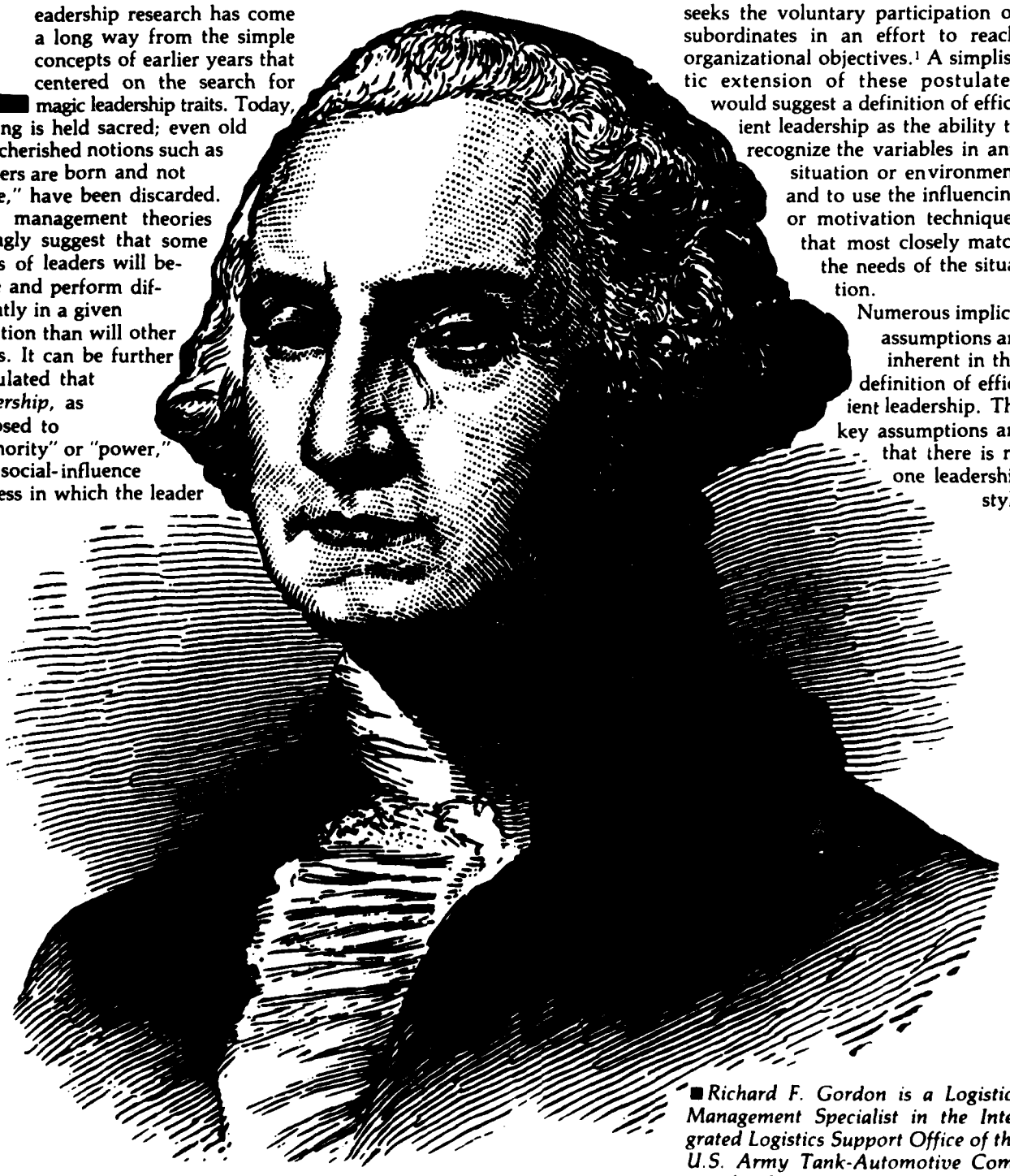
■ *Ms. Edwards is Editor of the Yuma Proving Ground* Outpost. ■

Beyond the "Born Leader" Concept

Richard F. Gordon

Leadership research has come a long way from the simple concepts of earlier years that centered on the search for magic leadership traits. Today, nothing is held sacred; even old and cherished notions such as "leaders are born and not made," have been discarded. New management theories strongly suggest that some types of leaders will behave and perform differently in a given situation than will other types. It can be further postulated that *leadership*, as opposed to "authority" or "power," is a social-influence process in which the leader seeks the voluntary participation of subordinates in an effort to reach organizational objectives.[1] A simplistic extension of these postulates would suggest a definition of efficient leadership as the ability to recognize the variables in any situation or environment and to use the influencing or motivation techniques that most closely match the needs of the situation.

Numerous implicit assumptions are inherent in this definition of efficient leadership. The key assumptions are that there is no one leadership style



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with universal application; that successful leadership occurs when the leader's style matches the situation; and that efficient leaders use situation or environment variables for formulating leadership strategy.

Universal Application

During most of recorded history, the prevailing leadership assumption has been that leaders are born and not made. Famous leaders like Alexander the Great, Napoleon Bonaparte, and George Washington were said to have been blessed with an inborn ability to lead. This so-called "great-man" approach to leadership eventually gave way to the trait theory, which mushroomed in popularity during the second quarter of the Twentieth Century. Literally hundreds of physical, mental, and personality traits were said to be the key determinants of successful leadership. Unfortunately, there was little agreement over what were the most important traits of a good leader. It was not until 1948 that a comprehensive review of competing trait theories was conducted.[2] This review culminated in moderate agreement on only five traits in which the leader exceeds the average member of the group: intelligence, scholarship, dependability in exercising responsibilities, activity and social participation, and socio-economic status.

Since the beginning of World War II, the study of leadership has experienced a change in conceptual approach. Rather than concentrating on the personal traits of successful leaders—the universal approach—researchers turned their attention to patterns of leadership behavior styles.

In 1939, Kurt Lewin developed the triple definition of management styles.[3] These three "classic" styles of leadership—authoritarian, democratic, and laissez faire—still have a useful niche in management thought. The authoritarian leadership style is appropriate in a centralized decision-making environment for unskilled workers performing routine activities. The democratic leadership style is appropriate in a decentralized decision-making environment composed of skilled workers engaged in creative activities. Laissez faire, or "hands-off" management could be viewed as the most appropriate leadership style for managing brain surgeons and symphony conductors.

The major shortcoming in this leadership-stereotype approach is that none of these styles allow for open-system environmental and situational changes. In effect, they make no allowance for the job and psychological maturity of the subordinates, nor flexibility in the leadership style in order to adjust to changing situations.

Great-man, trait, authoritarian, and laissez-faire styles prevailed because of their acceptance by a powerless and uneducated work force. During the capital-formation phase of our industrial society, the laborer work force was composed mainly of people with little or no formal education. This work force was augmented by a large influx of immigrants. The aspiration and expectation levels of both groups were keyed to the necessities of life.

Soon after World War II, our economy transitioned from an industrial to a post-industrial society. New forces came into play, forcing both managers and leadership educators to reorient their thinking. Some of these forces were the continuing growth of labor unions, the downstream impact of the New Deal legislation passed in the 1930s, liberal politicians at the state and national levels, and last, but not least, the rapid elevation of the educational level of the workers, who had higher expectations than their predecessors.[4]

Leader's Style Matches Situation

The continuing focus on leadership behavior led to the concept of situational leadership in the 1950s. Situational leadership is based on the assumption that a leader does not operate in isolation, but is influenced by a number of interdependent variables to include: the goals, objectives, and norms of the organization; the demands inherent in the leader's job; and the expectations of superiors, subordinates, and peers. One of the more popular situational leadership models was developed by Paul Hersey and Kenneth Blanchard in the late 1960s and early 1970s.[5] Their three-dimension model is based upon the interplay among the amount of direction (task behavior) a leader gives, the amount of socio-emotional support (relationship behavior) a leader provides, and the maturity level of the followers. The key determinant of leadership style is the maturity level of the followers in relationship to a specific task. The leader's style can vary within the task and relationship dimensions from authoritarian to quasi laissez faire, based on the job and psychological maturity continuum of the followers.

One of the negative aspects of the situational leadership model is that it offers little help in the formal study of leadership.[6] There is such a variety of situational contexts that training institutions cannot determine what kind of experience will be most valuable to prospective managers. Experience in one situation, or even in a variety of situations, may not be representative of those in which the trainee will ultimately work.

A more widely accepted situational model is Fred E. Fiedler's Contingency Leadership Model, which is based on a situation continuum that extends from highly unfavorable to highly favorable.[7] The three major dimensions of this continuum are the leader's position power (the formal power to reward and punish followers); leader-follower relations (how much do the followers respect the leader as a person); and task structure (how narrowly can the task be defined for issuing directions). Based on 30 years of research, Fiedler concludes that task-motivated leaders seem to be effective in extreme situations when they have either very little control or a great deal of control over situational variables. But in moderately favorable situations, relationship-motivated leaders tend to be more effective. Consequently, Fiedler and one of his colleagues have summed up their findings by noting that "everything points to the conclusion that there is no such thing as an ideal leader."[8] There are leaders, and there are situations. The challenge, according to Fiedler, is to analyze a leader and his basic motivation and then match them with a suitable situation to form a productive combination. Fiedler believes that it is more efficient to move leaders to a suitable situation than to tamper with their

personalities by trying to get task-motivated leaders to become relationship-motivated, or vice versa.

A relatively new leadership theory is the Robert J. House and Terence R. Mitchell path-goal theory.[9] This theory is a derivative of the expectancy motivation theory and gets its name from the assumptions that effective leaders can enhance subordinate motivation by clarifying the subordinate's perception of work goals; linking meaningful rewards with goal attainment; and explaining how goals and desired rewards can be achieved. In effect, the leader can motivate the followers by providing clear goals and meaningful incentives for reaching them. This theory also recognizes that the personal characteristics of subordinates, environmental pressures, and the demands placed on subordinates may all vary from situation to situation. Thus, path-goal proponents believe that leaders need to rely contingently on four different leadership styles: directive, supportive, participative, and achievement-oriented. This assumption that leaders can and do shift situationally from style to style clearly sets path-goal theory apart from Fiedler's Contingency Model. Path-goal leadership theory has a promising future because it effectively weaves together two important influence processes—motivation and flexible leadership.

Situation or Environment Variables

One important leadership variable that is not adequately addressed in the situation, contingency, and path-goal models is follower involvement. When an individual joins an organization, he or she must decide how hard to work and whether or not to stay with the organization. These decisions are affected by many factors. One very important factor is the degree to which one's psychological contract is fulfilled. Too many unrealized expectations will lead to second thoughts about working hard and staying with the organization. Amitai Etzioni defines involvement as the degree to which the individual personally indentifies with the objectives of the organization. This definition served as the bedrock for his Types of Individual Involvement Model.[10] His model has two dimensions. First, one's involvement may be positive or negative, for or against the organization. Secondly, the intensity of involvement may be high or low. A combination of these two dimensions yields four basic types of involvement:

—*Rebellion*: High negative involvement. This individual not only stops identifying with the organization's purpose, but resorts to open rebellion against the organization.

—*Alienation*: Low negative involvement. This individual does not identify with what the organization is trying to accomplish. Apathy runs high among alienated employees, who feel powerless and view their work as meaningless.

—*Commitment*: High positive involvement. This individual is committed to the organization's purpose and is characterized by initiative and a willingness to identify and solve problems.

—*Unrealized Potential*: Low positive involvement. Even though this individual identifies with the organization's purpose, his or her involvement lacks intensity. This zone of unrealized potential represents a challenge for leaders.

All four types of involvement may be evident in any work group with four or more employees. If there are more "positives" than "negatives," then the organization has a good chance of meeting its objectives. Without positive involvement there can be no commitment; without commitment there can be little, if any, organizational success.

Edward L. Thorndike identified another important situational variable with his classic law of effect, which states: Favorable consequences encourage behavior, whereas unfavorable consequences discourage behavior. This classic law served as one of the pillars for B. F. Skinner's theory of operant conditioning.[11] Behavior modification (B. Mod.) is the practical application of Skinner's operant conditioning. The three components of B. Mod. are antecedent (the prior event cue that prompts an individual to behave in a given manner); behavior (specific observable behavior); and consequences (subsequent events that either encourage or discourage behavior). B. Mod. occurs when the antecedent and consequence portions of the Antecedent → Behavior → Consequence model relationship are rearranged to strengthen desirable behavior and weaken undesirable behavior. Proponents of B. Mod. prefer to shape behavior positively through positive reinforcement in lieu of negative reinforcement, such as extinction or punishment. Continuous reinforcement is recommended for new behavior, and intermittent reinforcement for established behavior.

Conclusion

Efficient leaders must recognize the complexities involved in managing the diversity of knowledge-workers in the mid-1980s. There are many reasons why people work, many rewards they derive from working, and many sources of discontent. Each individual has a unique combination of work values, attitudes, needs, and desires. Theoretical models such as situational leadership, path-goal leadership, and B. Mod. provide the leader with a conceptual framework for formulating a flexible leadership strategy to cope with the ever increasing complexities of the emerging work force.

The bottom line for efficient leaders in the mid-1980s is the realization that they can and should adapt their leadership style to the situation.

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FORRESTAL AWARD
Goes to the Late Senator Henry M. (Scoop) Jackson; Nunn Speaks

The late Henry M. Jackson, United States Senator from Washington, was honored on March 14 for his significant contributions to the national security and was awarded, posthumously, the 1983 James Forrestal Memorial Award from the National Security Industrial Association (NSIA). Mrs. Jackson accepted the award on behalf of her husband, who died last September. Senator Sam Nunn of Georgia addressed some 1,400 members and guests at the 30th annual Forrestal Dinner held in Washington, D.C.

Robert L. Wendt, President of Sperry Electronic Systems, Sperry Corporation, and Chairman of the NSIA award committee, praised Senator Jackson as "a great patriot, legislator, and statesman. . . ." Nunn said that during 43 years as a U.S. Congressman and Senator, Henry M. Jackson was an imaginative and dynamic legislator and a dedicated and unswerving proponent of a strong national security.

The Forrestal Memorial Award has been presented annually since 1954 when President Dwight D. Eisenhower was the recipient. The person selected for the award is an American whose leadership has prompted significant understanding and cooperation between industry and government, in the interest of national security.

After eulogizing the late Senator Jackson, Senator Nunn addressed the group about the development of a more effective strategy for the protection of U.S. interests worldwide. The following remarks are excerpted from that address.

It has been said that for every complex and complicated problem, there is an answer that is simple, easy, and wrong.

The late Senator Henry M. Jackson

The Forrestal Memorial Award has been presented annually since 1954 when President Dwight D. Eisenhower was the recipient.

During the course of the 1984 political campaign the candidates for President and for Congress will be asked many times: How much money should we spend for defense? Which weapon systems would you cut?

These questions cannot really be logically answered without first addressing the underlying questions facing our nation in defense and foreign policy:

—How do we in America begin to distinguish carefully between important interests worthy of our diplomatic efforts, and vital interests worthy of our blood?

—What military strategy can secure these vital interests, and what is the appropriate role of America's allies?

Since 1979, the announced purposes of U.S. military strategy have been substantially increased, reversing the trend of the post-Vietnam era. Starting with President Carter's commitment to protect U.S. and allied interests in the Persian Gulf, a commitment reiterated by President Reagan, we have asked our military forces to take on several new and demanding tasks—in Lebanon, the Caribbean, and Central America—in addition to traditional U.S. military obligations in Europe and the Far East. The military is also faced with a rising global terrorist threat.

This expanded set of commitments and responsibilities, viewed against the background of the increasing Soviet threat, clearly demands substantially improved capabilities.

When we look at what the United States has done over the past few years, it is evident that most of our improvements have been qualitative. We have under way a robust program of modernization, both of strategic and conventional weapons. We have significantly increased personnel readiness, while unit and equipment readiness is a mixed bag with some indicators up, and some down.

In terms of force structure, we have marginal increases in the number of Navy ships and Air Force fighter attack squadrons. We have the same number of Army and Marine divisions, but fewer maneuver battalions.

Have we improved? The answer is clearly "yes!" Have we and our allies appreciably increased our forces to meet growing commitments and growing threats? The answer is clearly "no."

The bottom line is sobering: The large increases in defense spending over the past few years have not been enough to close the gap between our military strategy and the military capability available to execute it. If anything, that gap has widened further due to the additional commitments we have taken on. General David Jones, former Chairman of the Joint Chiefs of Staff, recently stated: "The mismatch between strategy and forces to carry it out is greater now than it was before, because we are trying to do everything."

This obviously poses a serious dilemma.

A sound military strategy must be predicated on a calculated relationship between ends and means. Based on this definition, there would appear to be three alternatives:

(1) Alter our global national security objectives, or
(2) Increase the resources for defense, or
(3) Make significant changes in our military strategy.

Are we prepared as a nation to redefine our vital interests, and, therefore, our military objectives? Do we write off Europe or the Persian Gulf, or Northeast Asia?

If we are not so inclined—and I submit that we are not—are the Congress and the American people prepared to increase substantially the military budget over the current Reagan plan—with $200 billion deficits staring us in the face and sending shudders through Wall Street and international financial markets? The answer to this, obviously, is "no." We will be fortunate in current economic circumstances to maintain real annual growth in defense spending of between 3 and 6 percent over the next few years.

If we cannot afford to give up our national security objectives, and if we are not willing to spend huge additional funds for defense, then we must begin to consider seriously the third alternative—making substantial changes in our military strategy.

Our principal challenge is the development of a military strategy that would seek to build on Western strengths and to exploit Soviet weakness.

Senator Sam Nunn

Significant changes in military strategy require careful consideration of our foreign policy objectives, input from our best military minds, and close consultation with our allies. This is a formidable undertaking, and I do not pretend to have all the answers. But, permit me to make a few suggestions in the hope they will stimulate discussion and debate.

First, any new strategy must be convincing to the American people and clearly related to what this nation wants to protect.

Second, any new U.S. strategy must be based on a strengthened partnership with our allies.

Third, the advent of nuclear parity means that we must prepare our conventional forces to deter and defeat conventional aggression. While maintaining our nuclear deterrent, we must reduce the reliance of the Western World on the early use of nuclear weapons for its defense.

With these points in mind, I believe that our principal challenge is the development of a military strategy that would seek to build on Western strengths and to exploit Soviet weaknesses.

In wartime, Soviet force planners would confront a number of inherent weaknesses, including the following:

—The tenuous land lines of communication connecting European Russia with Soviet forces in the Far East;
—The unreliability of their Warsaw Pact allies;
—The lack of easy Soviet naval access to the high seas;
—The relative weakness of the Soviet industrial base in any prolonged war; and
—The relative rigidity of the Soviet command structure.

We should establish a new set of military goals that would exploit these weaknesses.

We have historically looked at the huge Soviet land mass as an asset to the Soviets. I submit that it can be converted into a serious liability. Across this huge land area, the Soviets have tenuous lines of communication and limited access to the sea. They have potential adversaries on most of their borders.

We should let the Soviets know that if they invade Europe or the Persian Gulf, we would tie down their forces in the Far East and in other areas of the Soviet Union. We would not necessarily seek to accomplish this through direct assault on their forces, but, rather, through destruction of their lines of communication.

While I do not believe that the West should count on China's opening a second front if the Soviet's invade Western Europe, I submit that the Soviets would think long and hard if they believe their Far East forces could be isolated and left to the tender mercies of their Chinese comrades.

Eastern Europe is also a potential Achilles' heel for the Soviets. To wage war against the North Atlantic Treaty Organization (NATO), the Soviet Union must move massive forces and supplies from Western Russia across Eastern Europe, including Poland and Czechoslovakia, countries whose people have long resented—and occasionally resisted—membership in the Soviet empire.

The Soviets must be convinced by NATO capability that, in the event they invade the West, violence will not be confined to Western Europe, and that Soviet forces in, or passing through, Eastern Europe would be subject to attacks ranging from deep aerial strikes to commando and partisan raids.

Another critically important element of national strategy must depend on our Navy. I do not believe we should take on Soviet naval power through massive employment of our carrier-based air power directly against heavily defended ports and naval installations in the Soviet homeland.

In wartime, the primary goals of our naval forces should be to deny Soviet use of the sea.

By sinking and blocking the Soviet fleet, we would gain sea control, protect the lines of communication and, also, at war's end, leave no viable opposing navy to threaten us, whatever the outcome on land. This task is no longer a matter of battle force against battle force in a World War II manner, but is primarily a matter of our submarines and long-range aircraft with new stand-off munitions operating against enemy submarines, land-based air, and surface ships.

As part of this task, our naval forces, assisted by land-based air, should have the mission of controlling the choke points that limit Russian access to the sea. The best way to keep the Soviet navy in its proper place in a war is to keep it bottled up in the Norwegian, Baltic, and Black Seas and in the Sea of Japan.

Even if we have to repaint some Air Force planes navy blue and gold, we must insist that our naval strategy be based on the full utilization of land-based air.

In addition to exploiting Soviet weaknesses, we must take better advantage of our own military strengths. The United States and its allies possess marked advantages over the Soviet Union, not the least of which is that we are free peoples, freely allied in the defense of our homelands and liberty. We have a number of military advantages that we should build on including the following:

—Superior access to the ocean;
—Superior tactical airpower;
—Superior anti-submarine warfare capabilities;
—Superior training for our military forces;
—Superior capability to project power to points far removed from our respective borders;
—Superior advanced technology such as precision guided munitions, submarine detection, stealth technology, microelectronics, and cruise missiles; and
—A superior network of allies whose combined present economic power, and potential military power exceed our own.

We should press these advantages to the fullest. In particular, I would like to see us aim for greatly enhanced air superiority at points of vital interest. This will require, among other things, top priority funding of the munitions used in tactical air combat.

When implemented, these new capabilities would greatly enhance NATO's ability to carry out its long-standing doctrine of forward defense.

If U.S. forces are to undertake these new tasks and continue to provide an effective nuclear deterrent, what should be the role of our allies? First, we should insist on a greater contribution from the Japanese to their own security within 1,000 miles of their homeland. We should also insist that Japan participate, at least financially, in defending the Persian Gulf oil resources on which it depends.

Second, we clearly must rethink NATO's present doctrine of forward defense. The political desirability of conceding as little European territory as possible to an invader is not at issue.

A large gap, however, exists in NATO's ability to implement the sacred principle of forward defense. NATO is thus confronted with a choice: either drop the concept of forward defense as part of its doctrine, or convert forward defense from a politically comforting slogan into a reality.

The U.S. ground forces are and must remain a vital part of the defense of Europe. To implement the new doctrine of Airland Battle properly, our forces must emphasize maneuverability and flexibility, lighter reinforcements, special operations forces, communications, and second-echelon attack.

The allies, however, must increasingly provide the basic ingredients for Europe's initial forward defense, including heavy ground forces and more effective utilization of their vast pools of trained reserves. In short, if U.S. forces in Europe are to assume the primary responsibility for disrupting and destroying Soviet second-echelon forces, European units must assume the primary responsibility for holding the first echelon in check. The U.S. reinforcing ground units could then provide a badly needed source of mobile reserves.

Another element of a new national strategy should be greater use of our reserve and guard components. If we truly want to increase U.S. defense capabilities within reasonable budget constraints, the time has come to make the total-force concept a reality.

We now face the need to reshape our military strategy. In so doing, we must engage our minds as well as our pocketbooks. A sound military strategy encompasses far more than an adding machine. More money for defense is a necessity; but spending more money without a clear sense of ultimate purpose or priority will not result in a sound strategy or an adequate security.

In an era of nuclear parity, defense and deterrence are inseparable. The ability, actual or perceived, to wage war successfully is the best means of avoiding the necessity to wage it at all. This should be the driving force behind our objectives, our goals, and our strategy. As the late General George C. Marshall observed, "If man does find the solution for world peace, it will be the most revolutionary reversal of his record we have ever known."■

DTIC May Have Just What You Need

Linda McGinnis
Office of User Services
Defense Technical Information Center

The Defense Technical Information Center (DTIC) and its predecessors have saved the Department of Defense (DOD) money, manpower, and minutes for nearly 40 years. Today, DTIC provides centralized information services to DOD, defense contractors, and other U.S. government agencies and contractors. Technological advances in information processing and telecommunications have permitted these services to become increasingly sophisticated and responsive in supporting the important role defense information plays in research, development, test, and evaluation (RDT&E)—and in defense readiness.

A primary-level field activity of the Defense Logistics Agency (DLA), DTIC is colocated with DLA headquarters at Cameron Station, Alexandria, Va. Predecessor organizations can be traced back to 1945. Since 1951, the Center has been known as the Armed Services Technical Information Agency (ASTIA) (1951-63); the Defense Documentation Center (1963-79); and DTIC (1979-present). These changes mirror an expanding mission for the Center, coinciding with an awareness of the prominence of defense information.

As the hub of a revitalized DOD scientific and technical information program, DTIC applies latest state-of-the-art concepts to acquire and disseminate defense information via document and data base systems. This information results from, or is related to, DOD research and development (R&D) efforts in subject areas ranging from aeronautics to zoology. An extensive technical-reports collection (1.5 million) and four major data bases address defense R&D past, present, and future.

What does this mean to you? If you are part of a DOD organization, a DOD contractor, work for another U.S. government agency or a contractor, you may register to receive DTIC information products and services. You may be eligible to use DTIC under one of the potential contractor programs sponsored by each of the military services and the Defense Advanced Research Projects Agency (DARPA). Under these programs, industrial companies, educational institutions, non-profit technical organizations, and separate individuals with adequate R&D capabilities are given access to DTIC technical reports and data bases.

DTIC users can search their field(s) of interest in one, or all, of the data bases maintained at the Center: a technical reports (TR) data base that consists of formally documented scientific and technical results of DOD-sponsored RDT&E; a work unit information system data base that contains the what, where, when, how, at what costs, by whom, and under whose sponsorship ongoing efforts are being performed; and a program planning data base that is being studied to make it more responsive to user needs. Search results are in the form of a bibliography of descriptive citations, in the TR data base, or a collection of summaries meeting the search criteria in either the work unit or the program planning data bases. The work unit and program planning data bases are known as management data bases as is a fourth major DTIC data base, the Independent Research and Development (IR&D) data base that contains descriptions of research projects currently in progress in industry and is available only to DOD organizations.

Data base searches are made on demand or on a recurring basis, with the searcher establishing a subject profile with DTIC. Reports may be ordered from the technical reports collection.

Many DTIC users have joined the Defense RDT&E On-Line System (DROLS) that links terminals located across the United States with the DTIC central computer at Cameron Station. Via DROLS, users query DTIC data bases from terminals at their work sites and are able to order bibliographies, management data reports, and technical reports on the spot. Classified users are required to use hard-wired (dedicated phone lines) cathode ray tubes. Various printers and tape cassette systems are available. A dial-up, unclassified capability was added to the system several years ago and permits access to DROLS through a variety of terminals; dial-up users pay a connect-hour charge.

Other DTIC services include the following:

—Announcement services for the technical reports collection. This publication, the Technical Abstract Bulletin (TAB), is classified confidential and is available only to users with facility clearances.

—Reference services to identify and locate technical reports.

—Referral services to other sources of information and assistance.

—Customized searches of DTIC data bases that allow the requester to visit remote service facilities in Boston, Los Angeles, or Alexandria, and to interact with a subject retrieval analyst as the on-line search is taking place.

—Automatic distribution, every 2 weeks, of newly accessioned scientific and technical reports on microfiche in accordance with user subject interest profiles.

A search of DTIC data bases, before project work begins, can prevent duplicating work, or may provide a foundation of completed efforts or of ongoing, related efforts with contact points on which the new project can build. In either case, there are savings of money, manpower, and time. Any or all of these factors may be critical to the successful completion of your project.

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☑ YES!
☑ NO!
Will Competition Reduce Cost?

The Need for Common Business Sense in Decisions on Competition

William M. Brueggemann

Will competition reduce cost? Acquisition Improvement Program (AIP) Action 32 on competition "is designed to enhance competition in the acquisition process in order to reduce costs." The initiative begs the question and presumes an obvious "yes" answer. But is the answer so obvious? My thesis is that careful planning, dollar investments, and sensitivity to the risks of competition are needed to ensure a positive "yes" answer. Each case for competition needs to be analyzed to determine if the investment in competition will really pay off.

Free-Market Competition vs. Competition for DOD Procurements

Competition is the essence of the free-market system. The promise of financial profit motivates entrepreneurs to compete their products in the marketplace. Competition motivates them to make and sell their products inexpensively in order to obtain as large a share of the market as possible. Strategies to accomplish this objective include investments in modern plants and equipment to reduce variable costs, and selling with narrow profit margins. It is this "market force" that DOD would like to have working for it to reduce weapon systems costs.

However, as Dr. Jacques Gansler points out in his book *The Defense Industry*, the free-enterprise system is not necessarily at work for DOD.[1] There are several reasons for this:

—The market for a major weapon system has only one buyer—the United States Government;

—Market demand is largely driven by technological performance to meet perceived military threats rather than by purchase price;

—The product is very expensive and takes 7–10 years to develop. Sellers can only afford to provide the product for a guaranteed sale (i.e., defense contract). During the development, DOD specifies the product, serves as the bank for funds, is the judge of claims, and regulates everything the developer does from parts selection to how the program is managed; and

—Profit during development is gained as a percentage of costs rather than driven by free-market forces.

These and other factors make it clear that defense industry does not operate in a normal free market. Gansler concudes that:

> . . . given the structure of the defense industry and its non-free-market operation, it is proper to question policies that attempt to impose optimal free-market conditions piecemeal in individual cases or individual sectors unless it can be demonstrated that their overall effect (in combination) will result in improvements. Yet through its various regulations and micro policies, the Department of Defense has been applying small adjustments here and there in an attempt to create conditions closer to optimal free-market conditions, with neither an overall policy coordination effort nor a recognition that these actions might be making things worse.[2]

The Acquisition Improvement Program action on competition may be an example of policies and regulations that will make things worse if not accompanied by planning for competition and application of good business payback principles.

One defense industry official made this point to the students of DSMC's Program Management Course when he said that "sensitivity on when to open up a competition and when to leave it alone because you've already gotten the benefits of competition is an important role for the program manager."

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The following concerns were documented by the AIP Steering Group's second year-end report to then Deputy Secretary of Defense Paul Thayer:

> There remains the perception in some segments of industry and the DOD technical community that this initiative [#32 on competition] may result in our competing contracts without properly weighing the risk to successful program completion.[3]

Planning and Payback Analysis Needed Before DOD Competitions

It should be clear that the objective of enhancing competition will be met only by careful planning and investment. The forces that drive costs down in a true free-market economy are not operative for DOD procurements. Further disruption and inefficiency in DOD procurements may result if DOD tries to force competition without such planning and investment considerations. In the paragraphs that follow, I will discuss three procurement scenarios and the factors needed in each for competition to succeed in reducing cost.

Scenario 1: New procurements where competition is relatively easy to stimulate without significant DOD investment.

Scenario 2: New procurements where competition will be stimulated only after careful acquisition planning accompanied by significant DOD investment.

Scenario 3: Procurement of systems that have been developed without prior planning for competition and which are currently sole source.

Scenario 1

There are situations where DOD can satisfy its needs by purchasing commercially available, off-the-shelf items. For these items, the free-market system is operative. Choice between several systems is generally available for prices driven downward by competition. No investment is needed by DOD to enhance the competition; it is there for the taking. The constraint is that DOD must be willing to accept off-the-shelf performance. Directed changes will make the item unique, and DOD becomes the sole customer, which removes the competition incentive to keep the cost low. Examples of systems in this category are computers, office equipment, some test equipment, and the plethora of "catalog" items from hand tools to eating utensils.

Another situation where a little planning and a small investment can enhance competition is during the concept exploration (CE) phase of the system acquisition cycle. During this phase, the primary product is ideas. Some critical pieces of the system may be built and tested, but large expenditures are unusual. A little advertising, some personal encouragement, and a small amount of money for the CE contracts will encourage potential sellers to participate. Multiple participants in the CE phase gives DOD a selection from alternatives, provides opportunity for synergy between ideas, and allows risks to be assessed by looking at the maturity of solutions proposed. These factors will help ensure the selection of an affordable systems approach, while obtaining the benefits of competition for development of the system.

Scenario 2

As the system acquisition cycle moves out of CE and into demonstration/validation (DEM/VAL) or full-scale development (FSD), significant dollars for development are generally required. The traditional approach used by DOD has been to conduct a selection process for the development. The winner usually became the sole-source supplier for that system. When changes were directed by DOD and when new contracts for production were awarded, DOD had no competition to help drive the costs down, and no alternative but to pay whatever price the seller could get past an audit.

The alternative to this approach requires investment in competition during the development. Several techniques have been documented and include the following:

—Multiple awards to develop competing systems;
—Teaming, with members of the team competing for production when the development is complete;
—Leader-follower, where a prime contractor brings a "follower" contractor up-to-speed so that competition between them is possible;
—Subsystem competition by the prime contractor or component breakout by DOD; and
—Purchase of reprocurement data package, including licenses for restricted or proprietary data, so that systems or subsystems can be recompeted.

All of these techniques require significant added funds compared to the traditional approach of awarding to a single contractor. These funds are the investment DOD must make in competition in order to fund more than one source, fund a team or leader-follower arrangement, buy data needed for second sources, or pay the prime to conduct competitions for subcontracts. Whether the investment will pay a suitable return must be decided on a case-by-case basis; however, business investment principles should apply. Each case should be analyzed to determine the payback to DOD from the investment. It makes no sense to spend $100 million in added program costs if the savings from competition will be $100 million or less. In addition to the actual dollar outlay required for the investment, the impact on staffing in the program management office, the potential inefficiency from added workload, the time value of money used in the competition investment, and the risk that the desired result will not be realized must be evaluated. Unfortunately, when initiatives such as "increase competition" exist, smart business sense could be cast aside in the drive to show progress toward meeting the initiative.

Scenario 3

In the face of the competition initiative and recent public criticism over the price of spares, there will be a strong temptation to force competition on systems where no planning for competition exists. As Dr. Gansler pointed out, forcing competition might be making things worse.[4] Let's examine some of the potential impacts of forcing competition without adequate planning.

—Reprocurement data packages will be expensive to procure from sole-source contractors.
—If the original developer is replaced in production, there will be loss of integration expertise. Integration problems are almost certain to repeat, or

new ones arise, without the design expertise to solve them.

—Incentive for contractors to invest in production tools and equipment will be reduced if the sales base is in constant jeopardy to competition. If DOD wants to stimulate industrial investment in modern equipment, contractors need a stable sales base. Initiatives like multiyear procurements and economic-order quantities, are needed to provide such a stable base. The threat of competition for each new fiscal year order has the opposite impact.

—The R&D contracts generally require investment by contractors, e.g., independent research and development, bid and proposal funds, and profit. If new competitions for production are conducted after each development, there may be a tendency for contractors to wait until development investments are complete before entering the market. DOD may lose some of its technology braintrust if contractors "sit out" the R&D phases and become production specialists. Some assurance that contractors' R&D investments will "pay off," if they do a good job, is needed to avoid this potential problem.

—As a minimum, schedules will be slipped while competition alternatives for existing sole-souce systems are evaluated.

Many of these potential impacts could be dismissed as obviously dumb, at least for major weapons systems. However, for smaller procurements like spares, support equipment, and support services, the battle lines are being drawn. Public Law 98:72 sections that took effect in October 1983, require that, before negotiating for any sole-source contract of over $1 million in FY 1984, $500,000 in FY 1985, and $300,000 in FY 1986, the head of the procuring activity, or his deputy, must approve. The authority cannot be delegated.[5] With this kind of bureaucracy in place by public law, coupled with competition advocates in each service whose sole objective is to maximize competition, the stage is set for doing what seems to many program managers to be "obviously dumb."

Notes

1. Dr. Jacques S. Gansler, *The Defense Industry*, (Cambridge, Mass.: MIT Press, 1980) pp. 1-8 72-96.
2. *Ibid.* p. 31.
3. DEPSECDEF Memorandum, "Acquisition Improvement Program (AIP) Second Year-End Report," May 18, 1983.
4. Gansler.
5. *Aviation Week and Space Technology*, editorial, October 3, 1983.

Handbooks, Guides, and Studies Available

The publications listed below are still available from DSMC and may be obtained by writing (no phone calls, please) Publications Directorate (DRI-P), Defense Systems Management College, Fort Belvoir, Va. 22060.

Lessons Learned: M-1 Abrams Tank System
Lessons Learned: Advanced Attack Helicopter
Strategies for Dealing with the Defense Budget
JLC Guide for the Management of Multinational Programs
JLC Guide for the Management of Joint Service Programs
DSMC 1984 Catalog
Systems Engineering Management Guide
Skill in Communication
Risk Assessment Techniques—A Handbook for Program Management Personnel

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While we recognize that people involved in acquisition management are extremely busy, we would greatly appreciate your taking a few moments to complete the survey should you receive one in the mail. Your *candid* responses will help us to better serve you and other members of the acquisition community.

We appreciate your interest in the DSMC publications program.

The Editors

Rear Admiral Roger D. Johnson, USN Is New Commandant of DSMC

Rear Admiral Roger D. Johnson, USN, has become the eighth commandant of the Defense Systems Management College. He succeeds Colonel Thomas V. Forburger, USA, who had served as commandant since the January 1984 retirement of Brigadier General Benjamin J. Pellegrini, USA. Admiral Johnson, who officially assumed command on April 13, comes to DSMC from the Naval Air Systems Command, where he had been Deputy Commander for Plans and Programs since July 1982.

Admiral Johnson was born March 23, 1932, near Montpelier, N.D., and attended school in Willmar, Minn. He enlisted in the Navy and served as an electronics technician until he received an appointment to the U.S. Naval Academy. Admiral Johnson graduated with distinction from the Academy in June 1955 and entered flight training, where he earned designation as a naval aviator in October 1956. He then reported to VFP-63, where he served as a team pilot and detachment maintenance officer, flying F9F-8 Cougar and F8U Crusader reconnaissance aircraft.

From February 1959 until June 1960, Admiral Johnson served in the

Rear Admiral Johnson

Power Plants Division, Fleet Air Service Squadron NINE, during the developmental demonstration of the Jet Engine Complete Repair Concept. He then attended the Naval Postgraduate School, where he carried out specialized studies in plasma physics and controlled thermonuclear reactions. He earned an M.S. degree in physics in June 1963. He then served for 3 years on the staff, Commander Fleet Air Western Pacific, in various assignments including Attack Class Desk and Airframes Officer. In August 1966, Admiral Johnson reported to the Power Plants Division of the newly formed Naval Air Systems Command where he was a member of the TF-34/S-3 development team and the early VFX/F-14 study and specifications effort.

Assigned to Commander Naval Air Force Pacific Fleet in April 1969 as the F-4 Fighter Class Desk Officer, Admiral Johnson coordinated fleet participation in the development of the F-4B to F-4N Service Life Extension Program. In August 1971, he reported as Executive Officer of Naval Air Rework Facility, North Island.

After attending National Defense University and the Industrial College of the Armed Forces, Admiral Johnson reported to the Naval Air Systems Command, first as the F-14/PHOENIX Deputy Project Manager, and then, in September 1977, as the F-14/PHOENIX Project Manager. In August 1980, he was named Assistant Commander for Systems and Engineering, Naval Air Systems Command.

Admiral Johnson is married to the former Jean Ann Bernard of Omaha, Neb. They have three children. ■

DSMC Breaks Ground for New Academic Facility

Colonel Paul J. Higgins, left, Fort Belvoir Chief of Staff, Mr. William M. Schlosser, building contractor, and Colonel Thomas V. Forburger, then DSMC Commandant, break ground at the construction site of a secure academic facility for the College. If construction is on schedule, 18 months from now DSMC will have the newest and most modern building on Fort Belvoir. The 37,000-square-foot building will incorporate the latest energy conservation features including active solar energy for domestic water heating, set-back double-pane windows of a smaller, more energy-efficient size, and instrumentation for monitoring and controlling heating and cooling. The new facility will house a 400-seat auditorium, 10 student study rooms, 5 seminar rooms, and the DSMC Library. The William M. Schlosser Company of Hyattsville, Md., will constuct the new facility at an estimated cost of $3,615,323. ■

DSMC Professor Makes Presentation

Gantt Medal Goes to Mobil Corporation Chief Executive

David D. Acker, a Professor of Engineering Management at DSMC, has presented the Gantt Medal and a citation to Rawleigh Warner, Jr., Chairman and Chief Executive Officer of Mobil Corporation. As Chairman of the Gantt Board of Award, Professor Acker made the presentation March 19 in Boston during the American Management Associations' 55th Annual Human Resources Conference, which was attended by almost 1,000 people. A biography and personal comments about Mr. Warner were given by James H. Evans, Chairman of the Board, Union Pacific Corporation. Thomas R. Horton, President and Chief Executive Officer, American Management Associations, presided.

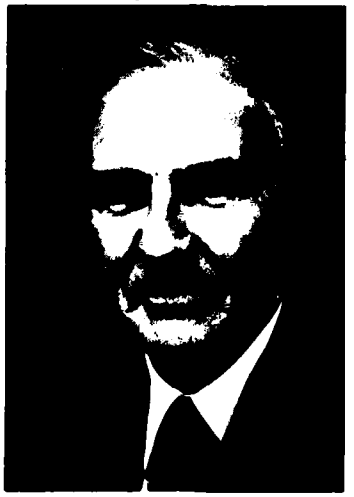
The Henry Laurence Gantt Medal, established in 1929, honors those from any field whose personal endeavors and managerial leadership have rendered conspicuous service to the community at large. The award has been made each year, except when no nominee was deemed fully deserving. There have been 49 recipents.

The Gantt Citation, presented to Mr. Warner, reads as follows:

> In recognition of his commitment to bringing the voice of management into national decisions and public issues; his high personal standards of management and principles of conduct; his emphasis on the training and development of others; his introduction and sponsorship of culturally-enriching programs and his significant support of higher education; his keen interest in creating opportunities for minorities; his expansion of philanthropic programs for the disadvantaged; his deft blend of capitalism and social consciousness.

. . . Honors those from any field whose personal endeavors and managerial leadership have rendered conspicuous service to the community at large.

Rawleigh Warner, Jr.



The Gantt concept was the result of over 30 years of his working as a mechanical engineer and management consultant when he sought to turn the potential of industry into a broad contribution of service that would revolutionize the future of our civilization. Gantt (1861-1919) conceived management in simple terms that were, nonetheless, startlingly new for his times, as evidenced by the following:

> Managers must view their activities from the vantage point of the larger communities that business serves, thus dedicating themselves to the doctrine of service;
>
> Management is universal in business, on the farm, in government, or in education;
>
> As an activity progresses, management experiences continuing interplay between planning and control;
>
> Each manager has the specific responsibility to develop other managers and to help their subordinates increase their abilities and their knowledge; and
>
> The business system must accept its social responsibility and devote itself primarily to service, or the community will ultimately make the attempt to take it over in order to operate it in its own interest.

The Medal that bears Gantt's name acknowledges those who have followed his philosophy and built on his achievement. They are stamped with the hallmark of the superior manager—the will to teach, to lead, and to assure that a sound economy is directed to the achievement of social goals. ■

Including 9 DSMC Grads

Army Names 19 for Project Manager Slots

The Army has named 19 colonels and promotable lieutenant colonels for assignment to project manager positions that will become vacant later this year. Two of the 19 are currently project managers who will be changing jobs.

Thirteen of the selectees are graduates of the senior service colleges, and nine have graduated from Defense Systems Management College courses.

The seven-member selection board, headed by Lieutenant General Robert L. Moore, Deputy Commanding General for Research, Development and Acquisition, U.S. Army Materiel Development and Readiness Command, recommended two officers for aviation PM positions; one for armament/munitions; seven for communications/electronics/data processing; five for missile/air defense; and four for tank/automotive.

To be considered for a project management assignment, an officer must be a member of the Materiel Acquisition Management (MAM) Program, an outgrowth of the old PM Development Program; hold specialty 51 (Research and Development); or be currently serving as a project manager.

Officers with more than 26 years of service and those officers serving, or waiting to serve, as brigade-level commanders or district engineers were ineligible for consideration.

Names and assignments of the selectees are as follows:

Aviation

Colonel Robert S. Fairweather, Jr., Tactical Airborne Remotely Piloted Vehicle/Drone System/(RPV)

Colonel David L. Funk, Target Acquisition Designation System/Pilot Night Vision System (PNVS)

To be considered for a project management assignment, an officer must be a member of the Materiel Acquisition Management (MAM) Program, an out growth of the old PM Development Program; hold specialty 51 Research and Development); or be currently serving as a project manager.

Armament/Munitions

Colonel Paul L. Greenberg, Ammunition Support System (AMSS)

Communications/Electronics/ADP

Colonel Martin G. Olson (PMC 76-2), Airborne Optical Adjunct Demonstration (AOA)

Lieutenant Colonel Gilbert J. Beglitz (PMC 76-2), Ballistic Missile Defense Radar/Data Processor (BMD/RDP)

Colonel Ronald C. Baldwin, Pathfinder/Remotely Monitored Battlefield Sensor System (PATHFINDER/REMBASS)

Colonel Fletcher H. Maffett, Mobile Subscriber Equipment (MSE)

Colonel Gene A. Venzke, Satellite Communications (SATCOM)

Lieutenant Colonel Jay Richards Hern (PMC 73-2), Single Channel Ground and Airborne Radio Subsystem (SINCGARS)

Colonel Douglas H. Barclay (PMC 74-1), Test, Measurement and Diagnostic Equipment (TMDE)

Missile/Air Defense

Colonel Samuel Liberatore, Hawk Missile System

Lieutenant Colonel William Schumacher, Hellfire Missile System/Ground Laser Designators

Colonel William J. Fiorentino (ERC 79-3, CPMC 81-1), Joint Tactical Missile Systems (JTACMS)

Colonel Robert A. Browning (PMC 79-2), Pershing Guided Missile System

Colonel James B. Lincoln (PMC 77-1), TOW Weapon Systems

Tank/Automotive

Colonel William Rittenhouse, M1 Abrams Tank

Colonel Howard W. Roth, Heavy Tactical Vehicles (HTV)

Lieutenant Colonel Joseph A. Petrolino (PMC 75-2), Light Tactical Vehicles (LTV)

Colonel James A. Logan (PMC 76-2), Medium Tactical Vehicles (MTV)

Colonels Fiorentino and Lincoln are currently project managers. Colonel Fiorentino has served as Pershing project manager for more than 5 years. Colonel Lincoln was serving as acting project manager, JTACMS, when the board named him for the TOW job. ■

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