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Questioning the Cost/Effectiveness of the R&D Procurement Process

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The R&D procurement process should be subjected to the same intense "cost versus effectiveness" questioning that has been applied in recent years by the Department of Defense to the choice of alternative proposed weapon systems. Under this cost/effectiveness evaluation approach, alternative means of contracting for research and development should be examined in light of their relative benefits and costs of all forms. The present procurement process controls the awards of over $8 billion annually of government-sponsored research and development contracts to industry, universities, and non-profit organizations. A broad view of the process includes not only the legislation, policies, and procedures that underlie R&D procurement but also the organizations and people, their attitudes, and indirect as well as direct effects of the process.

In making this analysis, four questions will be asked:

1. Who are the winners of research and development contracts?
2. What are the key determinants of the awards to these winners?
3. Compared with possible alternatives, what are the benefits of the present R&D procurement process?
4. Compared with possible alternatives, what are the costs of the present R&D procurement process?

Answers to these questions will be based on the results of three years of research by the author on the research and development procurement process.

Who Wins R&D Awards?

To determine the characteristics of R&D award winners brief questionnaires were mailed to about 1100 companies solicited to bid on one of 45 formally-competitive R&D awards issued by a Department of Defense contract-

ing center. The awards were for unclassified work, each involving expenditures of between $100,000 and $2 million, the contracts issued between May, 1962 and June, 1964. Their selection for the sample study was designed to avoid bias by contract size, technology, or organization source within the DOD installation. Usable replies have been received on about forty per cent of the questionnaires, including approximately 55 per cent of the award winners.[1]

At this point in the cost/effectiveness evaluation, the questionnaire data will be examined to point out characteristics of the winning firms relative to their losing competitors. The data presentation will follow a time sequence starting with the environment preceeding the government's mailing of Requests for Proposals to industry and finishing with submission of the R&D proposals.

The first historical characteristic of the active competitors for the awards is their prior technical experience. The questionnaires asked: "Had your firm performed contract work for this technical initiator (or his group) prior to the issuance of the R.F.P.?" As shown in Table 1 61 per cent of the winners had this contractual background, while only 34 per cent of the losers qualified in this respect, a two to one difference in experience of the two groups of competitors. A number of the respondents had worked on more than one contract for the organization studied.

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[1]Some initial analyses of bidder-no bidder and winner-loser differences are included in a thesis performed by one of the author's graduate research assistants: Lewis G. Pringle, "An Investigation of R&D Marketing Strategy" (unpublished Master of Science thesis, M.I.T. Sloan School of Management, 1965).

Table 1. Prior Contractual Experience

	Prior Contract(s)	No Prior Contract	Total Responses
Winners	15	9	24
Losers	26	51	77

Of course, background contractual experience with other organizations or in-house independent research might also qualify the competing organizations. For this more general area of inquiry the questionnaires sought data on effort expended "in areas of immediate technical relevance to the subject procurement, prior to receipt of the R.F.P.". Here too the winners' experience outdistanced that of the losers, the average winner having had 18.0 technical man-years of prior effort in contrast with the 11.2 man-years average of the losers.

Winners have apparently been in much closer contact with the government technical group, exchanging ideas by formal and informal means. A two to one difference again shows up between winners and losers in their prior submittal of unsolicited proposals to the same customer in the same technical area, with 32 per cent of the winners and 15 per cent of the losers using this approach to technical communication and technical marketing.

Table 2. Unsolicited Proposals

	Prior Unsolicited Proposals	No Prior Unsolicited Proposals	Total Responses
Winners	8	17	25
Losers	12	67	79

Apparently R&D competitors learn of prospective contracts of interest by means other than the formal announcements. Even here, however, winners are more knowledgeable than losers, with 71 per cent anticipating the R.F.P. versus 53 per cent of the losers.

As soon as an R.F.P. is received it can be read and judgments made about the nature of the competitive situation. Three times as many losers as winners thought "the procurement appear[ed] to 'belong' to someone else", with 24 per cent or one of every four losers entering a competition he believed "wired" against him. The response figures are shown in Table 3.

Table 3. Procurement "Belonged" to Someone Else

	Procurement "Belonged"	Procurement Did Not "Belong"	Total Responses
Winners	2	23	25
Losers	19	59	78

On the other hand, four times as many winners as losers, 36 per cent compared with nine per cent, felt the procurement "belonged" to their own firm. It is interesting, if perhaps only coincidental, that eight per cent of the winners and nine per cent of the losers were "upset" in their predictions of "wired procurements. Other non-statistical evidences suggest that both groups may have been right, but that new factors arose during the competitions to reverse prior government preferences.

Winners of research and development contracts apparently had better personal relationships with government technical initiators than did losers, or at least they were more conscientious of the importance of personal contacts. Slightly more of them knew the identity of the technical initiator

Table 4. Procurement "Belonged" to Own Firm

	Procurement "Belonged"	Procurement Did Not "Belong"	Total Responses
Winners	9	16	25
Losers	7	70	77

of the procurement, and relatively more of the winners established contact with government technical personnel after receipt of the R.F.P. but before proposal submittal.

Table 5. Knowledge of and Contact with Technical Initiator

	Knew Initiator	Did Not Know Initiator	Contacted Initiator	No Contact with Initiator
Winners	20	5	12	13
Losers	56	23	27	51

Given these indications it is not surprising that winners had more confidence in themselves as having an "advantage over a hypothetical company of equal technical competence whose knowledge of customer requirements was limited solely to information contained in the R.F.P." The answers to this question suggest that winners not only knew information not contained in the R.F.P. but also that they regarded their incremental knowledge as important.

The R&D winners also thought the prospective jobs were important to their government customers and that contracts would in fact be awarded (rather than be lost in the red tape) and result in significant follow-on. When asked to estimate the priority that the customer attached to the pro-

Table 6. Advantaged over Competition

	Advantaged	Not Advantaged	Total Response
Winners	16	7	23
Losers	34	41	75

curement, the winners relative to the losers regarded the procurements as higher in priority, the difference in their answers being highly significant (i.e., at the 2 per cent level of probable occurrance). Furthermore, the average winner's estimate at the time of bidding of the follow-on to the procurement was 20 per cent higher than the average loser's estimate. Getting closer to a technical area of work changes a winner's views of its importance, the winner's current average estimate of follow-on being double his initial estimate, while the average loser's estimate has been unchanged.

During the proposal preparation phase the winners of research and development contracts also showed themselves to be significantly different from losers. 68 per cent of the winners versus only 33 per cent of the losers stated they designed the technical approach of their proposals to satisfy known technical preferences of the customer. Furthermore, 28 per cent of the winners versus 14 per cent of the losers directed the content of their proposals toward particular individuals in the government agency.

Table 7. Proposal Reflected Preferences of and Directed to Customer

	Reflected Customer Preferences	Did Not Reflect Customer Preferences	Directed at Particular Individuals	Not Directed at Particular Individuals
Winners	17	8	7	18
Losers	26	52	11	68

These data support the notion that his more extensive prior contacts are crucial to differentiation of the winner from the loser.

The final distinguishing characteristic of the R&D winner is that he does not pay as much attention as do losers to the formal aspects of proposal preparation. A recent study by Thomas J. Allen of the M.I.T. Sloan School of Management revealed that in 22 R&D proposal competitions, the company that received the highest technical evaluation (and usually won the contract) had invested on the average less technical man-hours in the formal proposal than did the next four highest ranking contenders for the award. Furthermore, his study showed that higher ranking companies used less outside technical consulting than did lower firms.[2] Among respondents to the author's questionnaires only 16 per cent of the winners used technical writers to improve their proposals whereas 36 per cent of the losers resorted to this form of superficial competition.

Table 8. Use of Technical Writers

	Technical Writers	No Technical Writers	Total Responses
Winners	4	21	25
Losers	29	51	80

Thus, the data indicate that companies that win research and development contracts possess more prior contract and other relevant technical

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[2] Thomas J. Allen, "The R&D Proposal Preparation Process: Factors Influencing Technical Quality (unpublished manuscript, M.I.T. Sloan School of Management, July, 1964), p.8.

experience than their competitors, have prepared more related unsolicited proposals, understand and more strongly appreciate the government's proposed programs and technical preferences, et cetera, et cetera, et cetera!

What Determines R&D Awards?

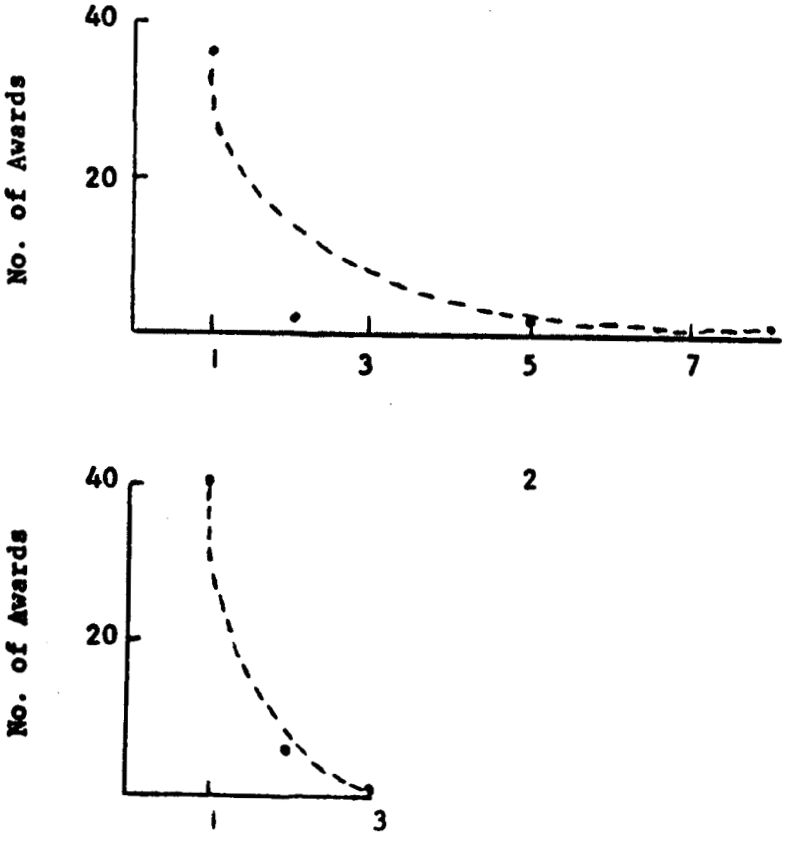
The second question listed at the outset of this paper inquired about the key determinants of contract awards in research and development. As sources of data pertaining to this question the author has studied 100 research and development awards made by one NASA and two Department of Defense installations. The NASA center was studied in 1962 at which time ten large awards (ranging from $1 million to $40 million in initial size) were studied by file search and open-ended interviews with technical, administrative, and procurement personnel. These large contracts were interesting to follow and furnished an informative but inconclusive picture of what happens in the award of R&D contracts. Three faults were apparent in the study approach: (1) the size of the awards examined necessitated a small yet complex sample; (2) the newness of the agency produced uniqueness of procurement techniques and/or policy in almost every case; (3) the emphasis on open-ended interviews led to rich background material and anecdotal evidences but gave only sparse persuasive quantitative results.

With this background it was decided to solicit cooperation from various Department of Defense organizations, working with contracts of $100,000 and more, devoting much attention to the gathering of quantitative evidences on the award process. The first two DOD organizations contacted agreed to participate in the research and made available their procurement files for study and their technical and procurement personnel for interviews. Without the complete cooperation of these organizations, the research re-

ported in this paper would not have been possible. Their assistance is deeply appreciated although for obvious reasons their anonymity must be preserved.

In the first of these installations forty-one competitions were studied that resulted in awards of research and development contracts ranging from $100,000, the minimum award size included in the study, up to eight million dollars in size. In this first installation, the awards were made during the period from January, 1960, to June of 1963. The second study in another DOD field center covered forty-nine contract awards, ranging from $100,000 to in this case $2,000,000 in initial size; and these contracts were issued in the time period from May, 1962, to June, 1964, the time that data gathering was initiated on this last study. Thus the data are drawn from fairly current cases, the latter study reflecting whatever influences the McNamara regime has had on the R&D award process.

The next five figures describe some of the results of these studies. Four of them show data from both Defense Department contracting organizations, the evidences from the first installation at the top of the page, and organization two down below. The award structures in the two installations studied are compared on the basis of several different dimensions. Figure 1 shows the measure that is generally regarded as the most important determinant of R&D awards, i.e., the evaluated technical rank of the competing companies. The curves are frequency distributions of the number of contracts awarded as a function of the evaluated technical rank of the individual award-winning companies. In the first organization, the graph indicates that 36 contracts out of the 41 went to the highest technically-ranked company. Two awards went to organizations ranked #two technically, and so forth. In organization #2 where 49 awards were studied,



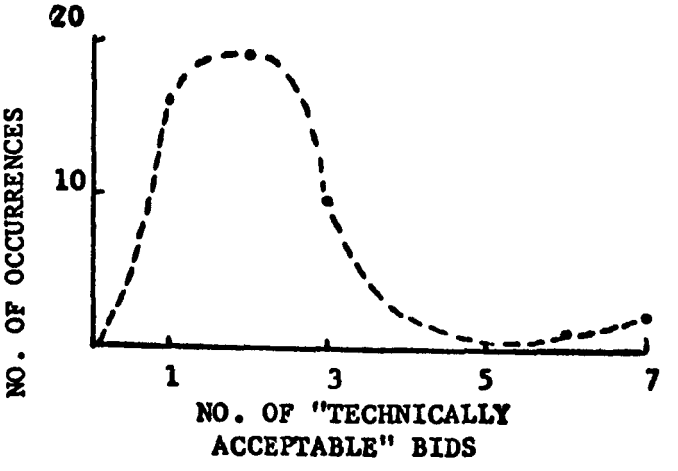
AWARDS AS FUNCTION OF TECHNICAL RANK

Figure 1

41 of the awards went to the highest technically-ranked organization, half a dozen went to the second highest ranked, one went to the third highest ranked. The technical rank data appear to support the generally accepted notion that in research and development the technical evaluation is the key influence on contract awards. With more empirical evidence yet to be presented, however, it may be wise to reserve final judgment.

It is clear from Figure 1 that not all awards go to the highest technically-ranked company. Some of the awards apparently are based upon other factors, and cost considerations are suggested immediately. However, before cost or other influences can affect an award, competing companies must be qualified as technically acceptable. Strict adherence to the use of technical acceptance evaluations varies from one government organization to another. The second DOD center examined is committed to the practice of first qualifying proposals for technical acceptability and then examining the cost proposals of only those firms that are technically acceptable. The same people who do the technical evaluation determine technical acceptability, of course. The chart of Figure 2 demonstrates that in 16 cases of the 49 awards investigated only one company was regarded as technically acceptable. After each such determination, the award was evident--it either went to that "acceptable" company or the job might be cancelled by the Procurement Office. Contract award, however, was a precondition for inclusion in the sample. Therefore, Figure 2 is indicating that in 16 out of 49 cases, the only influence on the award was the technical assessment. Going further, there are 19 cases in which two companies survived the technical assessment and were regarded as technically acceptable. This now gives 35 awards out of 49, about 70 per cent of the awards, in which the procurement officer might have considered no more than one or two companies. The next

point on the curve represents an additional ten cases in which three companies were listed as technically acceptable. Thus, after the technical

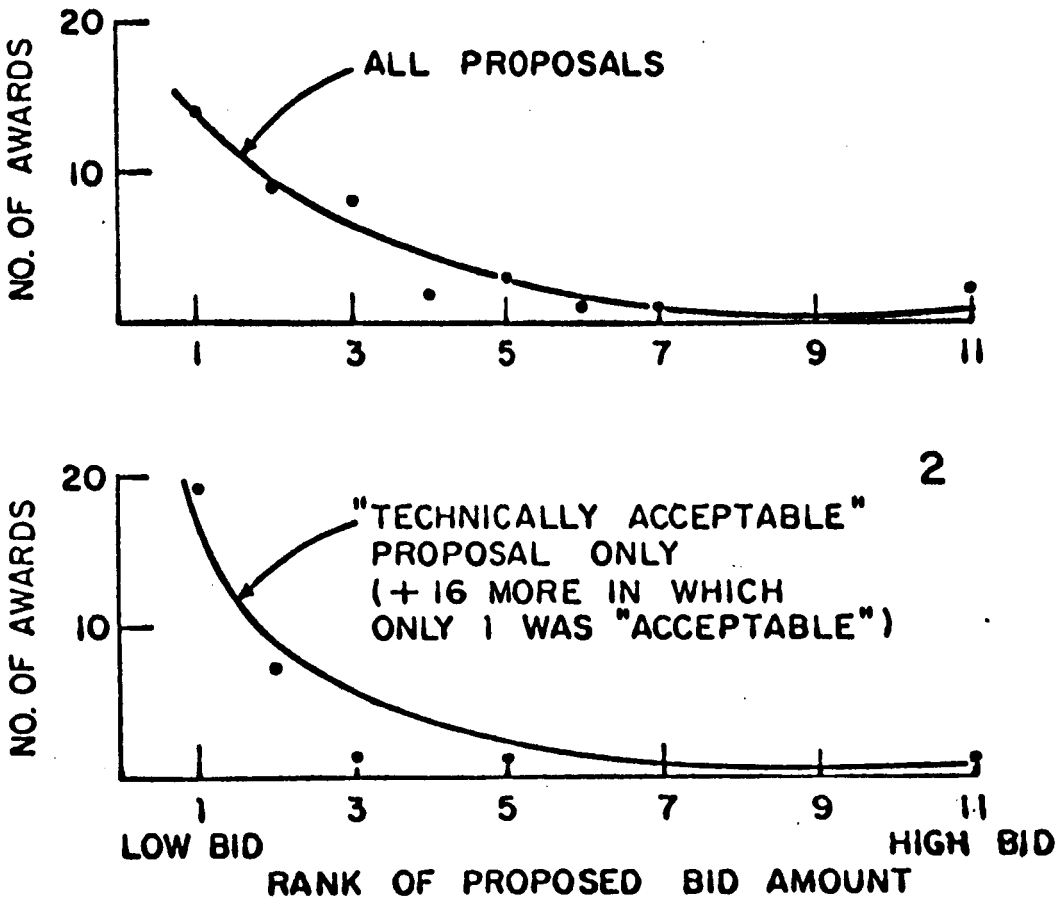


FREQUENCY DISTRIBUTION OF NUMBER OF "TECHNICALLY ACCEPTABLE" BIDS

Figure 2

evaluation in 45 out of 49 award cases, better than 90 percent, no more than three companies were still in the running for the award of the R&D contract. These data demonstrate the power of the technical phase of evaluation and of the technical evaluators in determining the award recipient.

Turning now to other possible influences upon R&D awards, Figure 3 illustrates what happens when the award winners are ranked on the basis of their cost positions, looking at how much each winner bid relative to his competitors for the award. It is important to note that all the awards were either CPFF, CPIF, cost reimbursable or cost sharing in some sense. Therefore, in no case was there a formal incentive for a low bid, there being no fixed price competitions in all of the 90 awards studied. It is

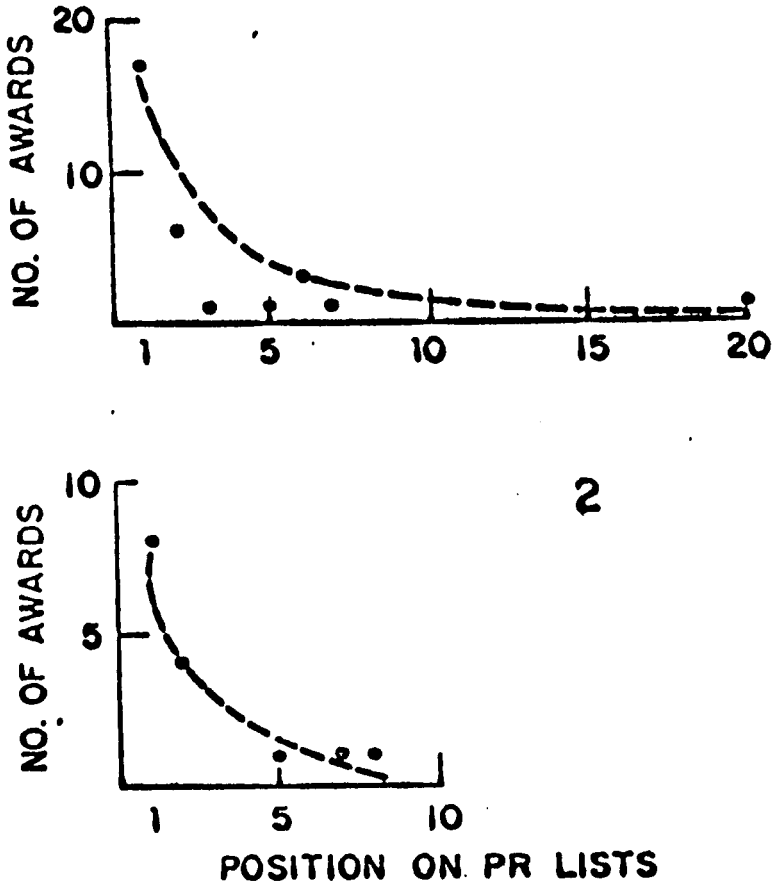


AWARDS AS FUNCTION OF BID AMOUNT

Figure 3

well known that the typical cost growth that occurs in cost-plus contracting is sufficient wholly to distort any initial bids that are presented. Yet, looking at all the proposals in organization #1 (even those that were not technically qualified) and at the technically acceptable proposals in organization #2 (cost data were not kept on file for those not regarded as technically acceptable), the possibly surprising result is that the low bidder received more awards than any other bidder. This shows up even though for the second group studied the sixteen cases were omitted in which only one company was ranked acceptable. (It was not known whether to treat that one company as high bidder or low bidder.)

These results still do not fully explain the R&D award process. First it has been shown that technical evaluation appears to determine many of the awards; secondly, cost evaluation apparently explains other awards. But there is one catch! All of these formal evaluations, of course, occur after proposals have been solicited, after proposals have been prepared, after proposals have been received by the government agency. But some things do happen even before these phases. And one of the events that precedes proposal solicitation, preparation, receipt, and evaluation is that the technical initiator in the government agency prepares a procurement request (PR). On this PR he indicates, among other things, a list of suggested companies that he has in mind for doing the job. In the research conducted at both DOD organizations the procurement request forms in the government files were surveyed and led to the results shown in the next figure. For both agencies the plots show the frequency of awards as a function of the position of the winning company's name in the list of suggested companies on the procurement request form. It should be noted that these lists were



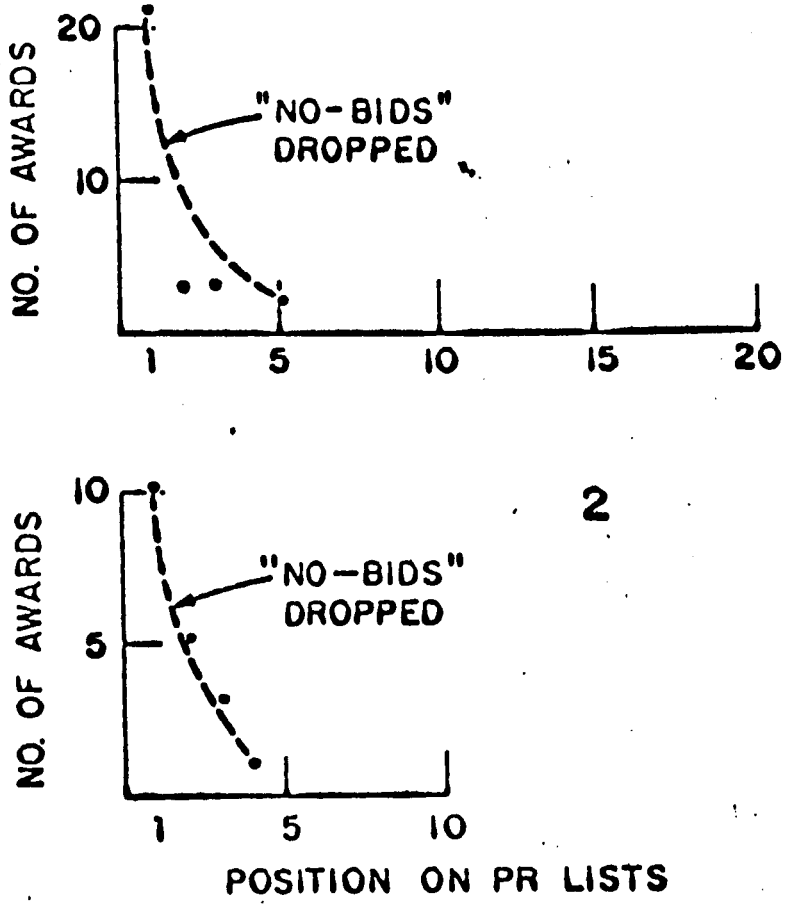
AWARDS AS FUNCTION OF PREFERENCE INDICATOR ON PR LISTS

Figure 4

prepared by the technical initiator of the procurement six months to a year prior to the evaluation of proposals. Alphabetical lists were necessarily excluded from this analysis. (There is little reason to believe that a company name beginning with "A" is more favorable than one starting with "Z" for getting government business.) Looking at these non-alphabetical cases, a very simple hypothesis is proposed; i.e., where a firm's name appears on the original suggested source list prepared by the technical initiator is a good indicator of the initiator's preferences. When one plots, as is done in Figure 4, the award of R&D contracts as a function of listed position on the PR form, it appears that indeed the data support this hypothesis in both DOD organizations.

One more step can be taken with this PR listings data. If a company preferred by the technical initiator (and so listed) did not bid (there appear to be numerous slips of this sort), it is obvious that this preferred company could not win. Amending the lists by dropping these no-bidders, the frequency of awards as a function of the revised positions of those who were listed and did bid produces the sharper curves of Figure 5.

It seems obvious that the award indicators shown in Figures 4 and 5 are important. The data presented are drawn from procurement request forms that precede by six months to a year the technical evaluation measures shown in Figure 1. It is almost always the government engineer or scientist who prepares the lists incorporated in Figures 4 and 5 who also prepares the technical evaluations. Whatever produces the technical prejudice, the feelings of confidence and trust in one particular organization rather than in another, that is built into the initiator at the time that he prepares the procurement request, seems to stick with him throughout the entire for-



AWARDS AS FUNCTION OF PREFERENCE INDICATOR ON PR LISTS

Figure 5

mal competitive process. It is apparent that the determinants of awards of research and development contracts are influences on the initiator-evaluator prior to the preparation of the procurement requests, not during the period of time of formal proposal solicitation, proposal preparation, and proposal evaluation. The proposal solicitation, preparation, and evaluation are responses to a decision by the technical initiator to undertake a set of technical acts under contract, It is clear that he generally enters into that set of acts already committed, at least in his own mind, to one or two companies. Other evidences exist, primarily from interviews with the government technical and procurement staffs, that support this conclusion.

What are the Benefits of the Present System?

Given the conclusions now reached on the characteristics of award winners and of the award process, it is appropriate to pose more direct questions of cost/benefits comparison. The present R&D procurement system features the formal solicitation and evaluation of formal proposals from industry. Four possible benefits of this approach have been proposed: (1) better technical ideas are obtained by competitive solicitation; (2) lower costs are secured for the government; (3) in general, "objectivity", regarded as "good" for its own sake, prevails; and (4) the system is "democratic", open to all new comers. Each of these presumed benefits is questionable.

1. It is true that some better technical ideas are obtained by competitive solicitation. This is shown by the fact that seven of the 41 awards in the first DOD installation went to companies not originally recommended by the government technical initiator. Only two awards of organization #2 went to non-recommended firms, and one of these happened in

response to the strong personal preferences of a newly-assigned technical evaluator who replaced the original initiator. Certainly some of these awards were made because of unique technical ideas proposed by these winners. However, most of the award winners were preferred on technical grounds long in advance of the formal phases of the process. Thus, the obtaining of their ideas is not a resultant of the formally competitive aspect of procurement. Furthermore, the differences between Figure 4 and 5 reflect a number of no-bid decisions by companies initially preferred by the technical initiators of the procurements. There is good likelihood that a number of the better technical ideas were lost to the government because the better firms were not responsive to large-scale open solicitation.

2. There is no way of evaluating whether or not lower bids are secured by competitive solicitation. In contrast with procurement of off-the-shelf hardware, specifications for R&D projects are constantly changing and no two procurements (except for parallel studies) are alike. Therefore, it is impossible to compare contract amounts obtained by different procurement methods. Furthermore, with the large cost growth that typically occurs in research and development reliance upon initial bids (or on cost growth) is not a convincing measure.

Two results of the studies shed some insight into the question of contract cost. First, the evaluation reports and the interviews in DOD organization #1 showed conclusively that at least four awards were made because of cost differences in proposals, not because of better technical approaches. In two of these four cases, the assumed cost benefits turned out to have been grossly misleading, and the government project monitors regretted the awards to these lower bidders. Thus, it is possible that lower bid costs are obtained occasionally through competitive solicitation, but that higher final costs often result.

Secondly, an important observation is that the originally preferred companies, that later become the higher technically evaluated companies, also are most often the lower bidders, as shown by the earlier figures presented. It has been suggested by both government and industry officials that this phenomenon is due to the "insider's" better understanding of what is really wanted by the government, resulting in a lack of attempt to cover all possibilities in his proposed solution approach. Whether or not this explanation is valid, it is true that the lower bidders (after the fact of solicitation) are the same firms that would have received awards had initial government initiator preferences been followed by a more direct form of contract award.

3. A major presumption is that "objectivity", viewed by many as good for its own sake, results from the widespread solicitation, formal evaluation, multi-level review process used currently for R&D procurement. That this argument is patently false was demonstrated in an earlier article by the author.[3] Most evaluation teams are dominated by one or two individuals, their evaluations are dominated by experiences that precede the readings of the proposals, and the committees appointed to review their work usually rubber stamp the earlier reports.

4. The final benefit often claimed for the present procurement system is that it is "democratic", permitting new companies to break into the R&D contracting business. It appears from the evidences already presented that new companies can win awards, but not primarily because of the formal

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3 Edward B. Roberts, "How the U.S. Buys Research", International Science and Technology, no. 33, September, 1964, pp. 70-77.

aspects of the competitions. Figures 4 and 5 show that the award winners are generally known before the formal phases get underway. The answers to the first question posed in this paper indicate that award winners have done extensive prior contact work with the government initiators. It is this personal contact route, not the responses to formal solicitations, that leads to R&D awards for old companies as well as new.

What does the System Cost?

Four types of costs result from the present R&D procurement system that might be avoided under an alternative method. They include: (1) absolute dollar outlay for proposal preparation and evaluation; (2) misallocation of government and industry technical skills; (3) added time delays in the achievement of desired R&D results; (4) lowering of the ethical standards of participants in the industry. Complete analyses of the cost aspects of the government and industry data presented earlier are not yet available. Thus, the comments here will be limited to first-order effects.

1. Companies expend and the government reimburses through overhead allowances large amounts for the direct costs of preparing R&D proposals. The total costs depend upon the number of firms bidding on a contract and the number of bidders is dependent in turn on the number solicited to participate. This dependency is shown by Figure 6 as well as by the results of correlation analysis.[4] In this regard it should be noted that in both DOD organizations studied, double the number of firms were solicited than were

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[4] The Pearson Product Moment Correlation Coefficient relating number of bidders to number solicited in DOD organization #2 is 0.53, with a confidence level of 1 percent.

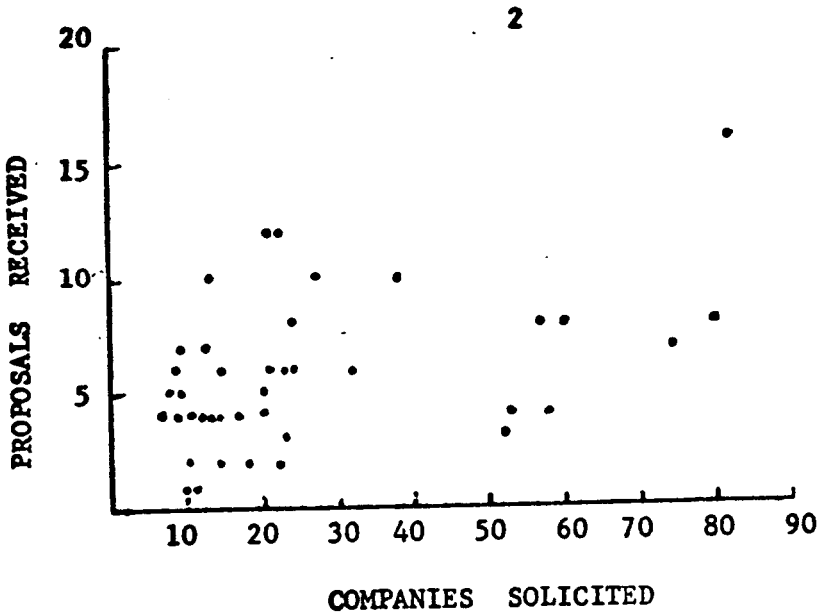
2
20
15
10
5
PROPOSALS RECEIVED
10
20
30
40
50
60
70
80
90
COMPANIES SOLICITED
COMPANY RESPONSES TO RFPs

Figure 6

originally suggested by the technical initiator. This high percentage of "add-ons" for the sake of competition seems an integral part of the present system. It need be remembered that hardly any of these "add-ons" win the contract, but they do help increase the total procurement cost.

2. The present system ties up the best industry people in proposal preparation efforts, denying their skills from the contracts already in-house in the competing firm. The most competent government technical personnel are similarly engaged in proposal evaluation formalities, instead of in in-house government research.

3. On the average six to eight months pass from preparation of the initial procurement request form until contract award. The life of the typical R&D contract is only one to two years. Thus, the present procurement process adds from one-fourth to one-half the scheduled duration to the life cycle of R&D contracts in the size range studied, i.e., up to about $1 million. With the award usually going to a company identifiable at the time of procurement request, serious doubts arise as to the justification of the added delay.

4. The ethical standards of both industrial and government participants in the R&D procurement are lowered by the pressures of the present system. Industrial people are pushed to intentionally low bid, even when they know that costs will rise orders of magnitude during contract life. Industrial people see and respond to competitive solicitations that they know were prepared by their own staff as unsolicited proposals months before. Industry often responds to requests for proposals only to help out a friend in government who is seeking to keep the procurement office happy about the "competitiveness" of the procurement. Government people, on the other hand, are led to devious practices to ensure awards to com-

panies they believe competent to carry out the R&D tasks. None of these practices are designed to encourage the best technical people to stay in the R&D contracting business, on either the industry or government side.

What Alternatives Exist?

The questions and answers presented in this paper are difficult to evaluate conclusively. Whether or not the present system provides any real benefits is unresolved. How expensive these benefits should be is also a value-laden question. In the opinion of the author the present R&D procurement system unnecessarily stresses formalities of competition, when intense person-to-person informal competition seems to be having the greatest real effects. Why should so much time, cost, and technical skills be wasted in improper emphasis on formal proposal preparation and evaluation? In this final section are presented some changes in attitudes and policies that should strengthen the effectiveness of R&D procurement.[5] These changes appear to be most suitable for R&D projects involving less than $1 million of contract funding.

1. Government technical initiators should be given greater flexibility in the form of information-seeking that they may use prior to R&D awards. Alternate schemes should be encouraged, as appropriate to each individual procurement, including wider use of limited-source solicitations of the top two or three technically preferred companies, the use of oral proposals, laboratory visits by government initiators to assess both facilities and technical staff, question-answer proposals and any other approach that reduces the red tape and gives the government evaluator the information needed for an award decision.

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[5]The changes were originally documented in the author's article, "Improving R&D Procurement", The Scanner, Fall, 1965.

2. Needless practices of a few government agencies should be weeded out. In an apparent attempt to keep industry on the "outs", some installations go to great effort to keep procurement details secret. Occasionally one government installation sends out the RFPs and then tricks industry by forwarding the proposals to a second center for evaluation. These practices reflect a mood of warfare between government and industry, instead of the cooperative partnership that is needed in pioneering technical achievements.

3. Changes in cost-allowances should be considered that will encourage contractors to shift much of the present relatively unproductive proposal budgets into more advanced in-house R&D, and into support of extended technical publication and communication programs on the companies' progress in research studies. In line with such a shift, it is probably advisable to discourage sometimes irresponsible "blind"-bidding practices by companies that only add to the government evaluators' burdens. Cost allowances for proposals might be restricted to "acceptable" bidders or to the top few companies, or a sliding scale of cost reimbursements might be based on the technical evaluators' rankings.

4. To further improve the communication between government and industry of technical requirements and technical progress, some of the time released by reduction of proposal preparation and evaluation workloads should be invested in more frequent symposia sponsored cooperatively by the several agencies working in each technical field for exchanges with interested contractors. Such stress upon idea and progress communication will not succeed, however, unless companies feel confident that significant ideas might readily be recognized by unhesitant awards of sole-source contracts.

5. Finally, the accomplishment of this more open, more responsible approach to research and development contracting demands that government technical initiators and evaluators include more of the best people in each technical field. In order to accomplish this, programs of job enlargement need be undertaken in government to attract and hold the most competent scientists, engineers, and technical administrators. More explicit recognition of status, combined with higher salaries, particularly for the R&D program managers in both civilian and military categories, is urgently needed.