Research Program on the Management of
Science and Technology

THE ROLE OF FOLLOW-ON CONTRACTS IN GOVERNMENT-SPONSORED RESEARCH AND DEVELOPMENT

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July, 1967 #269-67

The research presented in this paper was supported in part by a grant from the National Aeronautics and Space Administration (NsG-235). However, the findings and views reported are those of the authors and do not necessarily reflect those of the supporting agency.

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by

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ABSTRACT

18 new business R&D contracts were investigated for the effects of considerations of follow-on potential on contract performance and for the impacts of these factors on further contract acquisition. The three dimensions of contract performance--schedule, cost, and technical--correlate significantly with each other, and problems in each area correlate with the growth in contract costs. These contract problems are greatest in those cases where greatest potential R&D and production follow-on was expected at the time of original proposal preparation. This suggests that companies that anticipated large follow-ons wrote into their initial R&D proposals promises of unrealistic time schedules, cost estimates and technical performance goals.

The general likelihood of R&D follow-ons is more accurately predictable at the time of original proposal preparation than is the likelihood of production follow-ons. However, except for the trivial cases in which it is clear that no follow-on potential exists, defense/space marketing men appear unable to predict effectively the dollar magnitude of the resulting follow-on contracts.

The greater the problems encountered during contract life, the less the original expectation of direct follow-on from the same government agency was realized. However, this was counterbalanced by a marked improvement in win ratio in technically related competitions conducted by other government agencies.

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Introduction

In the defense/aerospace contracting business, research and development (R&D) and production "follow-on" contracts to initial R&D contracts often comprise a large portion of the typical company's total government business. Consequently consideration of possible "follow-ons" plays a vital role in a company's R&D marketing decisions. In particular, many R&D contracts are of an investigatory or feasibility study nature, with the expected follow-on being the real reason for the initial bidding. In addition, to stay in business a defense/aerospace firm must keep up with new technologies and establish market positions in those technical areas likely to grow significantly. Yet the R&D contracting business is characterized by the high cost of breaking into a new technical area. To some extent this is caused by widespread competitive attempts to win new business contracts, even at high costs to the competing companies, when large follow-on is expected. The rewards for the high entry costs are often the expected follow-on. Knowledge and hardware gained through performing government sponsored research are salable commodities to other government agencies and, in the form of subcontracts, to industry. Thus the role of follow-on contracts should be of primary concern to those seeking to understand the performance of defense/space companies.

Summary of Original New Business Study

In 1965 a study was performed by staff members of the M.I.T. Research Program on the Management of Science and Technology to investigate successful marketing strategies in research and development con-

tracting.[1] During the research effort nine cooperating companies supplied data on a total of 121 of their most recent competitive situations that met the following sampling criteria:

1) R&D Research and/or development was the primary purpose of the contract.

2) New Business The procurement would not be included if it involved a direct follow-on or contract extension to contracts already held by the company.

3) $100,000 or Greater in Bid Price The actual bids ranged from $100,000 up to $10,500,000.

4) Prime Contract from a Federal Government Agency Subcontracts were excluded from the sample.

5) Competitive Procurement A procurement was included if the RFP was sent to at least two companies, regardless of the number submitting bids.

6) Contract Awarded Pending and cancelled procurements were excluded.

It was the intent to collect information on about twenty-five contracts from each company. Unfortunately, far fewer suitable contracts were

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[1]For a full description of the procurements and companies involved, see Kneissler, Norman W., An Investigation of Marketing Strategies in the Government R&D Industry, and Ramsaier, L. Mark, Performance Measures and Marketing Strategies in Research and Development, unpublished S.M. theses, M.I.T., February, 1966. Copies of either may be purchased from the M.I.T. Microreproduction Service in Microfilm or Xerox form. A brief summary of the above studies was presented by Edward B. Roberts at the Boston College Conference on Marketing in the Defense Industry, May 19, 1966, and later published as M.I.T. Working Paper #235-66, The Measurement and Improvement of R&D Marketing Effectiveness, January, 1967.

available in the companies studied. Table 1 shows the actual number of competitive situations that met the criteria.

Table 1. Disposition of the Awards by Company

Company	1	2	3	4	5	6	7	8	9	Total
Number Won	7	2	3	1	6	1	0	0	1	21
Number Lost	15	10	12	9	4	17	13	17	3	100
Total	22	12	15	10	10	18	13	17	4	121

In the original study only one question was asked of the companies that directly treated expectations of follow-on contracts. It sought information on the possible impact of follow-on considerations on the proposal as well as estimates of possible R&D and production follow-on. The questionnaire inquired:

> At the time the decision was made to bid, did you particularly concern yourself with potential follow-on which might result from this procurement? Yes_____ No_____
>
> If yes, what was the total dollar volume of R and D follow-on expected from this procurement in the five years following receipt of the RFP?
>
> (a) From this customer: $_____?
> (b) From other government agencies: $_____?
>
> What was the total dollar volume of production follow-on expected from this procurement in the five years following receipt of the RFP?
>
> (a) From this customer: $_____?
> (b) From other government agencies: $_____?

Ramsaier[2] found no significant relationship between follow-on seekers and contract winners (Table 2).

Table 2. Effect of Expected Follow-on on Initial Awards

Concerned with Follow-on	Percent Won	N	Significance Level
Yes	17.6	68	.45
No	17.5	51	

This table is interpreted as indicating that 17.6% of the 68 proposal teams who were concerned with potential follow-on won contracts. A similar percent (17.5%) of the 51 "No" answers also won contracts.

In further analyzing the original data, Dyer has found a number of conclusions concerning follow-ons:

(1) The mean of the R&D follow-on expected by winners is statistically higher than the mean of the losers

Mean expected R&D follow-on, winners = $23,440
Mean expected R&D follow-on, losers = $ 3,372
(T-test, 1-tail probability = .003)[3]

This fact should be tempered by the knowledge that the data were collected after the contracts were awarded and the winners would know more about the agency's plans than the losers.

(2) Companies place a higher priority on contracts with expected follow-ons in that they are more likely in those cases to establish technical contact with the customer prior to RFP receipt (p = .07).

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[2]Ramsaier, op. cit., p. 28.

[3]Rather than be repetitive from this point on, all reported probabilities will be for one-tail tests. Thus a T-test which determined a one-tail probability of .003 will be shown as (T-test, p = .003).

(3) Those proposal teams without previous experience with the customer's technical initiator or his group were more likely to bid on contracts if there was expected follow-on (R&D, T-test, $p = .08$; Production, T-test, $p = .14$). It would appear that companies who receive an RFP without knowing the technical initiator feel they are at a disadvantage. In these situations they mainly go after those contracts that will give them entry to new technical areas that have good potential for later government R&D and production follow-on business.

These conclusions initiated our interest in examining follow-ons, specifically with the twenty-one winning contract situations in our original study.

The Follow-on Study

In August, 1966, a questionnaire was sent to each of the 21 respondents of the original winning proposals with the purpose of learning how the original expectations relate to the actual project history and follow-on (so far and now expected), and how the bid-no-bid decisions and results within the same technical area have proceeded in the year and one-half since the awards. Eighteen questionnaires were returned fully completed with two incomplete returns and one non-response (the latter from Company 9 which only bid on four procurements meeting the criteria during the original test period). For the most part the remainder of this paper treats the analyses of the eighteen completed questionnaires from six different companies.

The questionnaire contains two broad divisions: the first is concerned with the performance achieved on the original R&D contract and the second asks questions about contract follow-ons received up to the date of questionnaire distribution (August, 1966) and follow-ons now expected from the original contract.

Performance on the Original Contracts

Fourteen of the contracts were completed as of questionnaire response, with the other four estimated at more than 90% complete. One-half of the eighteen contract situations resulted in dollar growth ranging from $1000 to $694,000 while the remaining nine received only the award price (Table 3).

The growth tended to be found in the larger dollar volume contracts (contracts for over $300,000). The growth slightly correlated with the difference between the original bid and the negotiated award price, although surprisingly this relationship was not significant ($p = .34$). Growth was not a function of contract type as the average growth per contract was about equal for the eight fixed price and 10 cost-plus contracts in the sample. Many of the non-responses in the profit columns are attributable to fixed price contracts. This problem and the fact that four contracts were not complete suggested that no statistical tests be performed on the profit data. But these data are presented in Table 3 for the reader to draw his own conclusions.

The managers of the projects had had prior orientation to their jobs, serving in all but one case as head of the proposal team. Even the manager of the single exception had been a contributor to the pro-

Table 3. Dollars Received, Growth, Profit, and Contract Extensions

Contract	Co.#	Bid Price ($000)	Award Price ($000)	Total Amount Received ($000)	Growth In Scope ($000)	Growth Beyond Scope ($000)	Original Negotiated Profit ($000)	Negotiated Profit ($000)	Contract Extensions (months)
A	1	265	353	353	0	0	N.R.	N.R.	0
B	1	800	800	1350	250	300	52	45	3
C	1	348	300	416	N.R.	N.R.	N.R.	38	3*
D	1	141	132	132	0	0	N.R.	N.R.	0
E	1	460	500	821	0	321	N.R.	56	3*
F	1	2200	2200	2894	151	529	201	263	0*
G	2	184	149	149	0	0	N.R.	N.R.	4
H	2	129	150	150	0	0	19	19	7
I	3	1200	550	640	90	0	N.R.	N.R.	0
J	3	263	263	264	1	0	24	24	0
K	4	249	245	245	0	0	21	24	1
L	5	170	161	165	0	4	13	13	12
M	5	142	142	161	0	19	N.R.	N.R.	2
N	5	264	261	261	0	0	16	16	0
O	5	260	241	241	0	0	15	15	0
P	5	100	97	97	0	0	7	7	2
Q	5	197	193	197	4	0	13	13	7
R	6	425	408	408	0	0	27	27	6*

N.R. - No Response * - Not yet completed

posal effort. This background of the manager agrees with the results found by Rubin and Marquis in a study of forty-eight government sponsored R&D projects.[4] Despite the project managers' experiences, many changes occurred during the projects.

In one-third of the contracts technical specifications were significantly altered during the life of the contract, two requiring no time extension. In one case significant changes in the program direction were informally agreed upon to resolve differences of opinion between the two-government technical monitors. In other cases increased work and new knowledge gained external to the contract were cited as change agents.

Only two contract situations indicated technical problems as the reason for time extensions, while the rest gave the customer's expansion of contract objectives as the cause.

In order to help us assess the nature of difficulties encountered during the project the respondents were asked to rate on a five-point scale the extent of problems encountered in the three areas of schedule, cost and technical performance. The resulting data are displayed in Table 4.

The three contract performance measures listed in Table 4 correlate highly with each other. A non-parametric (Kendall Tau) intercorrelation statistic was calculated for each of the three possible pairs. These relationship indices are shown in Table 5 with the corresponding probability that such a value of Tau could occur randomly.

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[4]Rubin, Irwin M. and Donald G. Marquis, Critical Decisions in the Initiation of Development Projects, M.I.T. Working Paper #192-66, June, 1966, p. 13.

Table 4. Contract Performance Ratings+

Contract	Schedule Problems	Cost Problems	Technical Problems
A	1	1	3
B	4	2	2
C	1	4	2
D	3	3	1
E	4	4	5
F	5	5	4
G	4	3	3
H	4	4	5
I	4	5	4
J	1	1	2
K	2	1	1
L	3	3	1
M	1	3	1
N	2	2	2
O	2	2	1
P	2	1	1
Q	2	3	1
R	2	1	3

+ The higher the rating, the more serious the problem (e.g., 1 = problems not significant; 5 = problems were crucial)

Table 5. Relationships among Contract Problems and Contract Cost Growth

	Tau	Probability	Tau, partial correlations
Schedule-Cost	.510	.009	
Schedule-Technical	.364	.044	
Cost-Technical	.300	.088	
Schedule-Growth	.228	.165	-.047
Cost-Growth	.496	.010	.445
Technical-Growth	.186	.195	.055

The three measures were also correlated with the total growth in the dollars received from the contract (from Table 3). As expected, contract growth correlated most highly with cost problems. In fact, because of the interdependences among the various performance measures, they were

each correlated with contract growth with the other measures partialed out (i.e., the effects of variation by the third and fourth variables upon the relation between the two variables are eliminated). The Tau values for the partial correlations, as listed in Table 5, indicate that contract growth correlates truly only with cost problems.

When asked to explain the nature of those problems rated as above average in seriousness, respondents indicated that cost and schedule problems seemed to occur most frequently when the technical specifications were altered without adequate changes in the delivery date or money awarded. One respondent for a contract that achieved low technical performance indicated that the contract was essential to help his organization capture a much larger development follow-on contract which the company subsequently lost.

The Predictability of Direct Follow-on

In Table 6 the direct follow-on dollars received and expected are compared to the amounts expected approximately at the time the original R&D contract was awarded.

Table 6. Direct Follow-on to R&D Contracts

($000)

R&D Follow-on			Production Follow-on		
Originally Expected	Received So far	Now Expected	Originally Expected	Received So Far	Now Expected
0	0	0	0	0	0
5000	1500	3000	0	0	0
0	0	20000	0	0	0
0	0	0	0	0	0
200000	30	0	0	0	0
50000	0	0	50000	0	0
0	0	0	500	150	150
0	0	0	350	0	150
200000	360	23500	50000	0	0
0	26116	0	0	0	0
1500	373	1000	0	0	0
1000	49	100	0	30	100
800	320	0	0	0	0
0	0	0	0	0	0
0	395	500	0	0	0
0	520	500	0	0	500
500	100	500	0	0	0

If the magnitude of the dollar volume is neglected and follow-on is momentarily considered as a something-or-nothing variable, the following four contingency tables can be set up.

Table 7. R&D Follow-on, Originally Expected vs. Received*

	Received No Follow-on	Received Some Follow-on	Totals
Expected No Follow-on	7	3	10
Expected Some Follow-on	1	7	8
Totals	8	10	18

*Fisher Exact, p = .02

Table 8. R&D Follow-on, Originally Expected vs. Present Expectations+

	Now Expect No Follow-on	Now Expect Some Follow-on	Totals
Initially Expected No Follow-on	7	3	10
Initially Expected Some Follow-on	3	5	8
Totals	10	8	18

+Fisher Exact, p = .14

Table 9. Production Follow-on, Originally Expected vs. Received‡

	Received No Follow-on	Received Some Follow-on	Totals
Expected No Follow-on	13	1	14
Expected Some Follow-on	3	1	4
Totals	16	2	18

‡ Fisher Exact, p = .37

Table 10. Production Follow-on, Originally Expected vs. Present Expectations**

	Now Expect No Follow-on	Now Expect Some Follow-on	Totals
Initially Expected No Follow-on	12	2	14
Initially Expected Some Follow-on	2	2	4
Totals	14	4	18

**Fisher Exact, p = .16

The high statistical significance of the contrasting data arrayed in Table 7 indicates that R&D marketing men are fairly good at predicting whether any R&D follow-on (without regard to amount) will result within two years. Their ability at longer range prediction, however, is not as good, as can be seen in Table 8. The results suggest that the original predictors of follow-on are still generally optimistic about their future prospects (neglecting dollar volume considerations), and they are reasonably consistent with their earlier forecasts. Tables 9 and 10 and their corresponding less significant probability levels indicate low predictability by R&D competitors of possible production outcomes of their work. Thus we can say with a reasonable degree of confidence that the marketing men cannot predict production follow-ons at the time of R&D proposal submission. This finding suggests that possible production follow-ons should not be weighted heavily when fixing a bid price in an R&D competition.

The authors feel that the dollar magnitude estimates provided in the questionnaire responses for expected follow-ons merely represent orders of magnitude and should not be regarded as exact interval numbers (i.e., parametric tests are not justified). Therefore, rank-order correlations have been performed on the original expectations against the follow-on money received so far and that now expected. (The non-parametric Kendall Tau test was employed in these analyses.)

If all the data of Table 6 are used (i.e., all eighteen contract situations), the original R&D follow-on expectations are discovered to be strongly correlated with that received so far (Tau = .34, p = .07). In addition original expectations are closely matched by current expecta-

tions of R&D follow-ons (Tau = .33, p = .09). However, it was felt that even the least experienced marketing man could tell from the nature of certain contracts that they would not involve follow-ons. On this basis six contract situations were eliminated in which: (1) follow-on expectations were $0 originally, (2) $0 has been received so far, and (3) $0 is now expected to be received in the future (see Table 6 for these data).

The remaining contract situations are concerned in some way with follow-ons. Here the analysis indicates that in nontrivial cases the marketing people know little about the magnitude of expected follow-ons. When the original R&D follow-on expectations are correlated with the follow-on amount received so far, the resultant statistic (Tau = -.250, p = .33) indicates that the original expectations in these twelve contract situations were grossly wrong, even as to the order of magnitude of the expected research and development follow-ons. If we consider the sum of the present expectation of future R&D follow-on (remembering that the original contracts are for the most part completed) plus the money received so far as our best estimate of total R&D follow-ons, we find that the original estimates correlate even more negatively (Tau = -.272, p = .118).

It is of note that R&D marketing people do not seem to base present expectations on money received so far (intercorrelation coefficient of Tau = .051). Yet each correlates highly (and to the same extent) with the sum of the two, i.e., present actual plus future expected follow-on (Tau = .504 and Tau = .469, respectively).

The correlation of original expectation of production follow-ons with the corresponding actual and now expected is even more negative. Although only six contract situations were affected by nontrivial production follow-

on considerations, the company that originally expected a $500,000,000 production contract must have made bid decisions different from what it would have done if it had expected $0.00, which it does now!

Follow-on Expectations vs. Project Performance

It is likely that expectations of large follow-on contracts may have led the companies into making far too optimistic performance promises in the original R&D contract proposals. Such promises would then augur problems in the resulting projects. We shall now look at the relationships of the various measures of performance on the original R&D contract to the original expectations of follow-on.

In the questionnaire the companies rated on a five point scale the extent of problems encountered in the original R&D contract in the three areas of schedule, cost, and technical performance (Table 4). A rating of one indicated that the problems were not significant while a five meant the problems were crucial to the project.

We first looked at the rank-order correlation of the three performance measures and the original expectations for R&D and production follow-ons.

Table 11. Follow-on Expectations and Performance Problems

Problem Measure vs. Original Follow-on Expectations	Tau	Probability
Schedule Problems vs. R&D Follow-on Expected	.422	.032
Cost Problems vs. R&D Follow-on Expected	.276	.108
Technical Problems vs. R&D Follow-on Expected	.255	.147
Schedule Problems vs. Production Follow-on Expected	.589	.029
Cost Problems vs. Production Follow-on Expected	.554	.034
Technical Problems vs. Production Follow-on Expected	.531	.037

Examining the correlation of the paired variables with the others partialled out reveals that all the above relations are indeed correlated significantly. Based on these statistical evidences we can conclude that those companies that expect large follow-ons submit initial proposals with unrealistic time schedules, cost estimates, and technical performance goals in order to capture the initial R&D award. These overoptimistic promises then induce serious problems during the actual project duration.

Because both R&D follow-on amounts received so far and the R&D money now expected correlate so well with the sum of these two follow-on figures, it was decided to use this sum (i.e., money received so far plus dollars now expected) as a proxy for actual eventual total follow-on. The companies were divided into those identifying a serious performance problem (rating of four or more) and those with less serious problems (i.e., three or less). To remove the scope of the contract as a major influencing parameter, we used the algebraic difference (i.e., + or -) of the original expected follow-on less the sum calculated above. The results split on the seriousness of scheduling problems are shown in Table 12.

Table 12. Schedule Problems and Changes in Expected R&D Follow-On
(Changes shown in thousands of dollars)

Problems rated 4 or more	Problems rated 3 or less	
+500	-20,000	+500
+199,970	0	0
+50,000	-26,116	-900
0	+100	0
0	+850	-1000
+176,000	0	-100

A +500 indicates that one company which rated schedule problems as high as 4 on the scale originally expected $500,000 more follow-on than it now expects (including that already received).

Again we treat the numeric follow-on sums as indicative only of order of magnitude and therefore use a nonparametric test to avoid the assumption of interval data. To test whether the two independent groups have been drawn from the same population, we apply the Mann-Whitney U test.[5] For schedule problems and R&D follow-on the calculated U is 11 with $p = .009$. With this small amount left to chance, the researchers conclude that serious schedule problems statistically result in the loss of expected R&D dollars. A similar analysis of the schedule problems' effect on loss of originally expected production follow-on resulted in a $U = 10$, $p = .007$. (The direction of effect is obtained from inspection of the data.) Again we conclude that schedule problems deleteriously affect production contract follow-ons.

In like manner both cost problems and technical performance difficulties were used to split the contract situations into comparative groups. For both measures of performance, problems result in lowered contract follow-ons. The detailed results will be summarized in Table 16.

Contracts in the Same Technical Area

It was necessary to protect against double counting of follow-ons or contracts won in the given technical areas. The possibility existed that two or more original contract awards to one company dealt with similar technology and that the follow-on awards attributed to both would lead to double counting. In order to insure against such an

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[5]Siegel, Sidney, Nonparametric Statistics for the Behavioral Sciences New York: McGraw-Hill Book Company, 1956), p. 116.

occurrence, the technical areas of the contracts were examined as well as the follow-ons and contracts to other agencies. Only for company 2 were the technical areas the same for two contracts and the company expected and received nothing in both cases.

In the two years since the original awards were made, there have been fifty-two procurements conducted in the remaining sixteen technical areas represented.

Table 13. Contract Opportunities in the Same Technical Area

Number of follow-on procurements conducted?		R&D	51
		Production	1
		Total	52
Number of sole-source awards to you?	18		
Number of competitive proposals?	30	Won?	22
Number unsolicited proposals submitted?	9	Won?	4

In some cases awards are still pending. Taking all companies together, the technical experience gained through the initial contract certainly has been utilized by other agencies (or industry). Forty-four follow-on or related contracts were awarded to the six companies for a total value exceeding $28,000,000.

The companies were asked to breakdown their bidding in the technical area by agency. Agency 1 (in Table 14) represents an aggregation of the ones each company considered most important in utilizing the technology. Agencies 2 and 3 are aggregates of the companies' second and third most cited government organizations. Twelve original contract situations led to bidding activity in the same technical area, six led to bids submitted to two or more agencies, and two led to bidding to more than three agencies. On the average each of the original 18 contracts studied has led

to company bids in about three follow-on procurements. An alternate view is that the 12 original probable nominees for follow-on have each produced about four follow-on opportunities.

Table 14. Breakdown of Bids in Same Technical Area by Government Agency

No. of Procurements	Agency 1	Agency 2	Agency 3	All other	Total
Bid	27	16	6	3	52
No bid	2	1	3	0	6
Won	22	11	5	3	41
Lost	4	2	0	0	6
Not yet awarded	1	3	1	0	5
Procurement Dollars (in $000)					
Won	27,000	410	156	4	28,170
Bid but lost	3,360	110	0	0	3,470
Bid but no award	65	?	?	0	65+

The fact that only one production contract has been let within two years after the 18 new business R&D contract awards may suggest how few R&D jobs result in production opportunities. It also may indicate the time delays between initial funding of R&D projects and the use of the technology gained for production items. (Perhaps another study is justified in a few more years to examine production follow-on obtained by then.) The dollars won and lost, as shown in the bottom half of Table 14, may be somewhat misleading in that one contract win of $26,000,000 and one loss of $3,000,000 dominate the totals. The response data on the question about dollars won, lost, and bid but not awarded were poor in some cases so that the numeric capture ratio (number of contracts won/number of contracts awarded) is for this study a more accurate measure of competitive success than a win/loss dollar ratio.

The numeric capture ratio of 41/47 = 87% of related "follow-on" competitions demonstrates the value of winning an initial contract to gain work experience and possibly a reputation in a given technical area. Even assuming eventual loss of the five awards still not announced produces a win ratio of 41/52 = 79%. The numeric capture ratio of the original study was 21/121 = 17%. Even eliminating from the original study data the three companies that were not included in this follow-on analysis gives a ratio in the initial study of only 20/87 = 23%. The six companies in the present sample have the following capture ratios:

Table 15. Numeric Capture Ratios*
(number of contracts won/number of contracts awarded)

	1	2	3	4	5	6	Mean
Original capture ratio (%)	32	16	20	10	60	5	23
Follow-on capture ratio (%)	89	0	80	78	91	100	87

*Mann-Whitney U = 16, p = .05

Thus only company 2 has not yet gained in overall competitive effectiveness from the government-sponsored research performed during its original contract. In that case the reason is that no new contract yet has been awarded in the technical areas involved. These data are biased somewhat by including sole-source awards in the follow-on comparisons, even though they were excluded in the initial study. However, even in the competitive follow-ons the win record was 22 out of 30 awards for an overall capture ratio of 73%.

Summarizing the Effect of Performance Problems on Follow-on

We are now ready to examine the effect of poor performance on the loss of R&D and production follow-on to the original government contracting agency and to all other government agencies (and industry). The Mann-Whitney U statistical test was used with the following results:

Table 16. Impact of Project Performance on Follow-ons

Schedule Problems

1. Serious problems cause loss of expected direct R&D follow-on ($U = 11$, $p = .009$).
2. Serious problems cause loss of expected direct production follow-on ($U = 10$, $p = .007$).
3. Serious problems cause no statistically significant effect on win-loss ratio or number of contracts won in similar technical areas for different government agencies.

Cost Problems

1. Serious problems cause loss of expected direct R&D follow-on ($U = 18$, $p = .087$).
2. Serious problems cause loss of expected direct production follow-on ($U = 12$, $p = .023$).
3. Serious problems cause no statistically significant effect on win-loss ratio or number of contracts won in similar technical areas for different government agencies.

Technical Performance Problems

1. Serious problems cause loss of expected direct R&D follow-on ($U = 13$, $p = .063$).
2. Serious problems cause loss of expected direct production follow-on ($U = 8$, $p = .012$).
3. Serious problems cause no statistically significant effect on win-loss ratio or number of contracts won in similar technical areas for different government agencies.

In addition, the analysis did indicate (though not statistically significant at the .10 level) that the lack of serious problems tended to correlate with a larger win-loss ratio for contracts awarded by other government agencies.

Conclusions

An investigation was made using questionnaire data on proposal preparation decisions, contract performance, and follow-on procurements in 18 cases of original R&D new business awards. It was found that marketing men are able to predict the general likelihood of later R&D follow-on contracts more accurately than they can predict production follow-ons. However, except for the trivial cases in which it is clear that no follow-on potential exists, the dollar magnitude of the resulting follow-on contracts cannot be predicted effectively. Despite the uncertainty of these predictions consideration of the potential follow-on appears to strongly affect aspects of the original R&D proposals, and the resulting contracts.

In the R&D projects studied the three performance measures of schedule, cost, and technical performance are highly intercorrelated. The greatest performance problems in all three areas arose in those contract situations in which the original expectations for direct follow-ons were highest. The companies that anticipated large follow-ons thus appear to have written initial R&D proposals with unrealistic time schedules, cost estimates, and technical performance goals. The problems that were created by not meeting these three-dimensional goals have caused loss of expected direct follow-on contracts in both R&D and production areas.

Yet it seems that other government agencies either do not check too closely into the past performance of the company or are not adversely affected by performance problems in contracts performed for other agencies. The other agencies appear to be interested only in the fact that the company has experience in the technical area. This is suggested by the far higher win ratio generally achieved by the companies in follow-on areas than in the areas of original competition studied earlier. Thus in deciding whether or not to "promise the moon" in a new business proposal, R&D contractors need to balance the potential loss of some of the expected direct follow-on from the government agency awarding the initial contract against the increased business potential that becomes available from other government organizations once the initial contract work is performed. This situation appears to be unfortunate to the interests of both government and effective industrial contractors. It would be desirable that good R&D performance be more consistently rewarded and poor performance more consistently penalized by the follow-on process.

Appendix--Questionnaire

FORM A (WON) FOLLOW-UP ON SOLICITED COMPETITIVE PROCUREMENTS

Company_____

Respondent_____ Title_____

RFP No._____ Company Internal Proj. No._____

RFP Title_____

_____ Technical Area_____

Contracting Agency_____

Bid Price $_____ Award Price $_____

Original Contract Form_____

Form of Final Contract (Please check if renegotiated)_____CPFF;

_____CPIF; _____Fixed Price; _____Fixed Price

(Incentive); _____Cost Sharing; _____Other (please explain)

I. Project History (If project is not completed, estimate answers where applicable. Also please indicate here your current estimate of the percent of job now completed._____)

1. What is the total amount received from this contract? $_____
How much growth does this figure include?

In Scope $_____ Beyond Scope $_____

Original Negotiated Profit $_____

Final Negotiated Profit $_____

2. What was the originally contracted completion date?_____

What was the actual completion date?_____ If different, what reasons for contract extensions?

_____ 1. continuation of effort
_____ 2. expansion
_____ 3. technical problems
_____ 4. other (specify please)

3. Were the technical specifications of the contract altered significantly during the life of the contract? Yes____ No____

   How, in general?

4. Was the head of the proposal team made project manager? Yes____ No____

   If not, who was made project manager?

   _____ _____
   name title

   Was he on the proposal team? Yes____ No____

5. On a scale from 1 to 5, indicate your problems in the following areas.

   Schedule

   1 2 3 4 5
   problems not significant — problems were crucial

   Cost

   1 2 3 4 5
   problems not significant — problems were crucial

   Technical performance

   1 2 3 4 5
   problems not significant — problems were crucial

6. Explain the nature of the problem in the areas for which you circled 4 or 5 for the previous question.

II. In order to learn more about the effect of winning this contract on your subsequent bidding, we should like to know first the immediate follow-ons coming directly from this contract and second your bidding activity within the same general technical area as covered by this contract.

1. What has been the total dollar volume of direct R&D follow-on from this procurement to the same agency:

   so far $_____ expected in next four years $_____

2. What has been the total dollar volume of direct production follow-on from this procurement to the same agency:

   so far $_____ expected in next four years $_____

3. Taking all the agencies together, please answer the following questions about all the contract opportunities that you feel to be follow-ons to this procurement.

   a. How many follow-on procurements were conducted? R&D_____, Production_____.

   b. Number of sole-source awards to you_____.

   c. Number competitive solicited proposals_____ Number Won_____.

   d. Number unsolicited proposals submitted_____ Number Won_____.

4. Break down your bidding in the area by agency (e.g., NASA-LRC, USAF-ESD, USA-Edgewood Ars.)

No. Procurements	Agency 1.	Agency 2.	Agency 3.	All Other
Bid				
No Bid				
Won				
Lost				
$ Won				
$ Bid but Lost				
$ Bid but no Award				