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Contractual Methods of Incentivizing Improved Space Flight Safety

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Abstract

The contractual methods NASA uses to assure safety for manned spaced flights are examined in this paper. It concludes that they do little to incentivize a contractor to improve safety and suggests that in areas as critical as manned space flight safety, NASA adopt a Safety Engineering Incentive Program. This program would be similar to the existing Value Engineering program except that financial incentives would be paid for improving safety. The paper also suggests that as an added incentive for improving safety, relief from liability under Public Law 85-804 on future projects be conditioned by limiting it to risks that the contractor disclosed to NASA or risks that he could not have known.

Manned space flight, because of its costs and concern for the safety of the crew, requires extraordinary measures to assure its success. Anything that can be done to increase the safety of the mission, and thereby its chances of success, must be considered. Ordinary contracting methods may not do enough to help achieve the objective of obtaining the highest obtainable safety for manned space flight. This paper suggests some extraordinary contracting methods that may incentivize contractors to become more involved in the quest for greater safety of manned space flight.

Contractor incentives can be divided into two types: positive incentives and negative incentives or the proverbial "carrot and the stick." The contractor's organizational structure is often determinant of which type of incentive he reacts to best. However, a combination of both positive and negative incentives should elicit the desired response from most contractors regardless of their organizational structure.

Existing Contracting Methods

NASA, as well as other government agencies, typically attempt to assure the safety of a system by specifying it either in the solicitation and/or as part of a Systems Safety Plan. NASA's Federal Acquisition Regulation (FAR), paragraph 18-23.7002 requires originators of procurement requests to ensure that procurement requests are processed through the appropriate installation safety officials for (1) determination if hazards are involved in the procurement, (2) formulating or selecting specific safety provisions applicable to the procurement, and determining to what extent a contractor safety or health plan will be involved. This approach normally results in the best Government and contractor safety experts being involved at the

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earliest stages of the program. The net results of their efforts is a system safety plan and/or specifications for the program.

The safety plan or requirements that evolve from this process may very well be the best available at the inception of the program. These safety plans may typically call for periodic safety reviews during the life of the program. However, once the safety plan has been agreed upon by the parties, these reviews tend to only measure performance against the plan. But as a contractor's design stabilizes, his interests are going to lean more toward justifying that his design meets the requirements of the safety plan or specifications and he will have little incentive to offer a design change that will improve the safety of the system.

Recognizing that contractors may be able to improve system safety during the life of a program, beyond what was initially specified, a special contract clause is used on Space Shuttle Contracts and sub-contracts. This clause, entitled "Manned Space Flight Requirements" requires the contractor to "advise the purchaser, notwithstanding cost, if he is able to supply the desired item with a quality which is higher than specified." While this clause is definitely a step in the right direction, it falls short of achieving the objective of assuring that the purchaser is informed of any potential ways to make the system safer. The clause has two shortcomings. First, it equates higher quality with improved safety. The two may not be that complementary, i.e. a change may improve the system safety but not the quality or vice-versa. The second, and major short fall, is that the clause does not give the contractor any incentive to find a way to improve the safety of his product. He could be fully compliant with the clause by merely advising the purchaser of any potential quality or safety improvement. He would not have to seek out such improvements and, if his design were reasonably secure, he would not have any incentive to be an advocate of any change that improves safety.

Value Engineering

One of the most effective ways the Department of Defense motivates contractors to seek ways to improve existing contract specification is through Value Engineering. Under the terms of a Value Engineering clause, a contractor is incentivized to look for more cost effective ways to make his product, or perform a service, without altering the critical performance characteristics of the product or service. If the contractor finds a better way of performing his task, and if it requires a change to the contract to implement it, he prepares a Value Engineering Change Proposal (VECP). If the contracting officer accepts the proposal, the contractor receives a significant share of the savings (on fixed price contracts it is 50 percent of the savings occurring over a three year period).

The Department of Defense has had remarkable success with Value Engineering. The contractor's interest in Value Engineering is one of the main reasons for this success. The Contractors were quick to recognize the potential for increased profits because of the generous sharing provisions in the Value Engineering clauses. The Government, in addition to recognizing its share of the saving, also realized that many contract specifications and other requirements could be improved upon. This is particularly true if one takes into consideration the new technologies that may have evolved since the inception of the original contract requirements. Furthermore, the Government recognized that the contractor is often in the best position for finding ways to improve contract specifications and requirements because he is closer to the work and has a financial incentive.

The same principles that motivate a contractor to propose changes to contract specifications in order to reduce cost can also be used to motivate
him to propose changes that will improve safety. There are two precepts of
the existing contractual Value Engineering program that makes it attractive
to the contractor. The first is the definitive and substantial financial
award that comes from an accepted VECP. The second is assurance that the
contractor is not going to be penalized for not already having his proposed
change as part of his current design or baseline.

In order to capitalize on the potential contractor initiate to improve
system safety, NASA should consider developing a new contract provision for
inclusion in its contracts involving manned space flight. The clause could
be entitled "Safety Engineering Incentive Program". Its goal would be to
offer contractors financial incentives to improve the safety of the product
or service being delivered. Determining the amount of financial reward to
provide a contractor under a Safety Engineering program will be difficult
because changes to increase system safety will rarely result in any costs
saving to be shared as is the case in Value Engineering. However, in
keeping with the goals of making the reward definitive and substantial
enough to be motivating, various options are available.

The typical contract change involves deleting some effort and adding new
effort. On a change under the Changes Clause (FAR 52.243-1) when effort is
reduced, profit is reduced proportionately. When a change is accomplished
under the Value Engineering clause, profit is not changed. It is suggested
that for safety enhancing changes submitted under the Safety Engineering
Clause, the contractor be allowed to keep his originally negotiated profit
regardless of the fact that some work will be deleted. On work added, the
NASA Structure Approach for Profit Fee Objective (NASA Form 634) could be
adjusted to add an additional five (5) percent profit under the existing
"special situations" factor (Block 2). This profit would be in addition to
the profit the contractor would normally be entitled to under the Structured
Approach. The following is an example of how this procedure would work.

<table>
<thead>
<tr>
<th>SAFETY ENGINEERING CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Contract Price</td>
</tr>
<tr>
<td>Cost</td>
</tr>
<tr>
<td>Profit 10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Changed Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Deleted</td>
</tr>
<tr>
<td>Cost</td>
</tr>
<tr>
<td>Profit</td>
</tr>
<tr>
<td>(100,000)</td>
</tr>
</tbody>
</table>

Total increase in contract price ($230K-100K) = 130,000

Actual profit on $200,000 of new effort = 30,000 new profit + 10,000 profit
on work deleted = 40,000 or 20%

New contract price = 1,230,000
1,100,000 - 100,000 + 230,000
Normal Change Clause Change

<table>
<thead>
<tr>
<th>Work Deleted</th>
<th>Work Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>$100,000</td>
</tr>
<tr>
<td>Profit</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>($110,000)</td>
</tr>
</tbody>
</table>

New Contract Price $1,210,000
(1,100,000 - 110,000 + 220,000)

From the above example one can see that while the difference in total contract price is not that much different between a typical Change Clause change and a change under the Safety Engineering Clause, the difference in profit is great. In this example it is 20 percent or twice his normal profit. This profit would even be greater if the costs of the work deleted was equal to or greater than the cost of the work added.

The reader may have some concern that the profits that a contractor may make under this approach exceed the limits of 10 USC 2306(d) which limits fixed fee payments on cost contracts to 10 percent of the estimated cost for production contracts and 15 percent for research and development contracts. However, the proposed additional financial incentives, although treated as profit by the contractor, are probably more in the nature of incentive payments. The Armed Services Board of Contracts appeals has held, and the FAR (FAR 48.102 (d)) has recognized that Value Engineering incentive payments do not constitute profit or fee within the limitations imposed by 10 USC 2306(d) and 41 USC 254(b). The same should be true for incentive payments under a Safety Engineering incentive program.

Contractors In Loss Position

Notwithstanding the financial rewards for an accepted Safety Engineering proposal, there may be some reluctance for a contractor to submit a Safety Engineering proposal if he is in a loss position on the work he would propose changing. He may not want to recognize the loss immediately or he may be concerned with the loss adjustment rules which require you to delete effort at the current cost of performance even if it is greater than the contract amount. On significant changes that could involve a major safety concern, the Administrator of NASA may waive the loss adjustment rule under the authority of Public Law 85-804. Such relief would be at the discretion of the Government and would be granted only under unusual circumstances where there is a serious safety concern and/or significant opportunity to improve system safety. The Government's willingness to consider such relief, in the event the circumstances warrant it, could be conveyed to the contractor in a brief clause similar to (or perhaps as an addition to) the Manned Space Flight Requirements clause. In this clause the Government would reiterate its concern for manned space flight safety and that, notwithstanding cost, if a major change were required or possible to significantly improve flight safety it should be proposed and, if necessary, the Government will consider restructuring the contract to incorporate the change regardless of financial consideration, under the authority of Public Law 85-804.
Safety Engineering Program Requirements Clause

The Safety Engineering Incentive Program described above relies on the contractor's initiative for submission of safety enhancing change proposals. There is no requirement that he submit them. Where the government believes there are areas in a system or design which have the potential for improving safety or are so critical that they need further examination, the Government could include a Safety Engineering Program Requirements Clause. This clause would be similar to the Value Engineering program requirements clause (DAR 7-104.44 Alternative I). Under this clause, the contractor would be required to conduct studies and analysis into certain pre-designed areas of his design or services and to provide proposals (if possible) for improving the safety in these designated areas. He would be paid for this effort under a separate line item of his contract and would submit the required proposals and/or reports under a separate item involved on the Contract Data Requirement (CDRL). Since the Government is paying the contractor for this effort, the rewards for his submitting a successful Safety Engineering Proposal need not be as great as under the Safety Engineering Incentive Programs. The incentive rewards for submissions under the Value Engineering Program Clause are approximately half those provided for under the Value Engineering Incentive Clause. (Dar 7-104.44(f)(1)) The same proportion should be appropriate with Safety Engineering incentives.

In some situations the Government might want to include both Incentive Clauses and Program Requirements clauses. A typical example would be where the Government wants to incentivize the contract or in general to look for ways of improving flight safety and also has some specific areas that it wants the contractor to look into in depth. These clauses are complementary. However, on proposals submitted on items or areas identified under the Program Requirements Clause, the lower incentive reward percentages would apply. Value Engineering allows for both types of clauses being available on the same contract under Alternative II of DAR 7-104.44.

Contents Of Safety Engineering Proposal

The Safety Engineering Incentive and Program Clauses should set forth the required contents of a Safety Engineering Change Proposal. As a minimum the proposal should include the information the Government needs to evaluate the desirability of the changes. This should include the following requirements:

A. A statement identifying the change as a safety change being submitted under the Safety Engineering Clause.

B. A cost computation including the cost to be added and deleted. (Because of the urgency of safety issues, preliminary cost estimates or not-to-exceed pricing may be acceptable.)

C. The impact the change will have on the contract schedule.

D. The recommended time to implement the change (when the change could be implemented most efficiently).

E. Some quantitative estimate of the improved safety resulting from the change. The method of quantification such as reduced probability of failure should be flexible, but the method of quantification should be explained.

The exact language of a Safety Engineering Incentive Clause, including the appropriate profit percentage or other incentives will probably develop over time through trial and error. The clause should be modified as more is
learned about contractors' reaction to incentives and to account for problems in the administration of the program. This should be expected. From the time of the first DOD Value Engineering clause in 1959 until 1974, when the Value Engineering program evolved to essentially what it is today, the Value Engineering Clause has gone through some twenty changes. Hopefully, Safety Engineering can learn from the experience of Value Engineering and not need as many changes.

It is recommended that NASA consider using a Safety Engineering Incentive Program on a trial basis on any future contracts involving manned space flight where this is above normal concern for safety. The results of it could be carefully monitored with the objective of using it on all contracts involving manned space flight if it proves satisfactory.

One thing that should be considered in administering a Safety Engineering Incentive program is providing the contractor assurance that he will not be penalized for submitting a Safety Engineering Change Proposal. If the Contracting Officer unjustifiable takes the position that a contractor's proposed change is within the scope of his current contract or should be part of his baseline design, the contractor will have no incentive to submit a Safety Engineering Proposal. This has been a major problem with Value Engineering proposals at some procurement offices. Contractors soon learn when a procurement office is not receptive to Value Engineering and soon stop submitting proposals. When this happens both parties lose.

Failure to accept a Safety Engineering Change Proposal because it is within the scope of the contract could be an even greater problem for NASA because many safety improving changes could be accomplished without a change in the contract. (In contrast Value Engineering Change Proposals, by definition, require a change in the contract.) NASA can overcome this potential problem by careful administration of the Safety Engineering program and establishing a policy of encouraging Safety Engineering and rewarding contractors for submittal of Safety Engineering proposals. If a Safety Engineering program is administered by NASA with the same commitment that it has shown to its New Technology Program, it is sure to be a success.

Public Law 85-804

The aforementioned incentives were all positive, i.e. they reward a contractor for proposing ways to improve safety. Not every contractor or every part of his organization will be motivated by these incentives. Some contractors may need a stick to get them to advise NASA of any potential safety hazards. NASA has this stick in the relief from liability under Public Law 85-804.

In 1983 NASA announced that due to the dangerous nature of space flights it would, within certain limitations, identify contractors (and subcontractors) for liability on products or services they performed in support of the Space Transportation System... This indemnity was formalized in NASA FAR Supplement 18-52.250-70 (October 1984) and 18-52.250-71 (October 1984). As the Administrator of NASA determined when he granted this relief, manned space flight is dangerous and accordingly the risks involved cannot be insured against at reasonable prices. What is surprising is that this decision was not made until ten years after the contract for the design of the shuttle was awarded. Consequently, this relief could do little to help improve the safety of shuttle design (it did help enable several contractors to begin or continue working on shuttle repair or maintenance contracts who could or would not be able to perform due to the cost or unavailability of liability insurance).

The indemnification protection available under Public Law 85-804 could be
used to incentivize contractors if not to improve, to at least disclose potential safety problems with their product or service. This could be accomplished by conditioning relief from liability to only those potential risks which the contractor disclosed in writing to the Government unless the risk could not be discovered by the contractor with due diligence. If this was made clear at the inception of a program, contractors would have the incentive to report at the outset of the contract and throughout the life of the contract in order to be assured they would be relieved from any potential liability. The interesting thing about this incentive is that it will get the attention of the contractor's lawyers and accountants, who may not be involved in a Safety Engineering Incentive Program. They would be interested in assuring compliance with this disclosure requirement because they would want to protect their firm from potential liabilities.

Conclusion

As stated in this paper, there are contractual means to incentivize a contractor to improve safety. However, there are extraordinary means that should only, at least for the present, be employed in the pursuit of something as important as improving the safety of manned space flight.