

# CONTRACTUAL INCENTIVES

By George Stukhart,<sup>1</sup> M. ASCE

**ABSTRACT:** Contract incentives are the means by which an owner intends to secure certain project goals through the contracting process. Incentive contracting is designed primarily to reduce cost in negotiated contracts through profit sharing ratios, which should improve on the efficiency of cost reimbursable contracts. In the process, financial risk and control are shared by the owner and contractor, according to a ratio which is established in the early stages of project design. Contractual incentives are used frequently in construction to reduce overall project time. However, there is a lack of published research on the theory and consequences of the use of incentives in construction. Studies in government research and development contracts using incentives shows that contractors may not always behave in the fashion intended by owners designing such contracts. The apparent reason is that the risk a contractor assumes under conditions of limited scope and design information biases the setting of targets, so that overruns/underruns are more dependent on where targets are set, rather than on sharing ratios. In the construction industry this is apparently recognized, and targets are not fixed until design is approximately 40%–60% complete. Moreover, as the contractor and owner attain more knowledge of the project, both parties should attempt to reduce owner risk and control.

## INTRODUCTION

Incentives are used in construction contracting to reduce overall contract cost, to control time and to increase support of specific performance goals such as productivity, quality, safety, technological progress, innovation and management. Incentives should be designed to promote efficient contract management, achieve high performance standards, reward efficient contractors, and to achieve some or all of the owner's specific project objectives. The method of doing this is, in general, to assign some portion of the owner's risk to the contractor with a reward for accomplishing the objectives effectively. Incentives, along with commensurate penalties, are the means to an end and, unless the objectives are clearly understood by both parties to the contract and correlated with their expectations, they are not usually effective.

The owner of a construction project has three generally accepted goals; most economical cost, specified quality, and completion on schedule. These goals are not always fully attainable in any one contract, so compromise is necessary and specific objectives must be emphasized over others. The contractor has the obvious goal of making a "reasonable" profit, but other goals exist as well. Goals such as reducing the risk on any one project, satisfying long-term needs such as survival, growth, repetitive contracts with the same owner, and a greater share of the market. Generally by focusing on one contractor goal, job profit, and one or two owner goals such as controlling cost and schedule, the incentive mechanism becomes easier to manage and more understandable by both parties.

<sup>1</sup>Assoc. Prof., Civ. Engrg. Dept., Texas A&M Univ., College Station, Tex. 77843.

Note.—Discussion open until August 1, 1984. To extend the closing date one month, a written request must be filed with the ASCE Manager of Technical and Professional Publications. The manuscript for this paper was submitted for review and possible publication on August 20, 1982. This paper is part of the *Journal of Construction Engineering and Management*, Vol. 110, No. 1, March, 1984. ©ASCE, ISSN 0733-9364/84/0001-0034/\$01.00. Paper No. 18618.

Incentive type contracts are rather frequently used in the private sector of the construction industry. A recent survey of owners and contractors was conducted by the Cost Estimating Budgeting and Control Accounting Team of the Business Roundtable Construction Industry Cost Effectiveness Project. The responses, from 94 participants, half of them owners, show that incentives are used in approximately 12% of the contracts, and that the project size does not have a significant effect on this distribution (3). Incentives are not generally applied in public type construction. The regulations for formal advertising limit the choice to firm fixed price contracts. Nevertheless, incentive contracting, like so many other management tools, was developed in the 1960's and 1970's in the Defense Department, primarily in the weapons R&D procurement environment.

### RISK ALLOCATION

To be effective, contract incentives should conform to generally accepted principles of control and allocation of risk between the owner and contractor (7). In this paper, "risk" is the exposure to possible economic loss or gain.

1. Sufficient risk should be allocated to contracting parties to motivate them to perform in a professional manner.
2. Risk allocation should be based in part on the return or profit to be realized.
3. The degree of control over the risk must be considered. Responsibility for an end result must entail control over its occurrence.
4. The relative ability of the parties to protect themselves against the risk must be considered.

Most of the major litigation between owners and engineers or contractors has arisen because of deficiencies in the scope of work provisions or other articles in the contract. This has profound implications to incentives, which must be based on the degree of definition of the contract. Despite the efforts of owners to develop a "team" approach at the start of a contract, adversary relationships generally develop, and the intensity of this adversary relationship is heightened by imposition of excessive risks; that is, those not in accordance with the principles aforementioned. Incentive contracts are a means of sharing both risk and control, a "hybrid" approach which can provide benefits to both owner and contractor. If incentive contracts are properly negotiated and administered, both parties have an interest in reducing costs and claims.

### CONTRACTING STRATEGY

Although an owner can select a wide variety of single or multiple contracts, there really are two basic types, the firm fixed-price and the cost reimbursable. Variations and combinations of these two basic types are represented by the following equation:

$$F_c = F_t - k(C - C_t) \dots\dots\dots (1)$$

in which  $F_c$  = actual contractor's fee;  $F_t$  = the target fee;  $C$  = actual cost of a project;  $C_t$  = the target cost established in contract; and  $k$  = the sharing ratio (contractor's).

If  $k = 1$ , the equation represents a fixed price contract; the target cost may be negotiated, but is probably known only to the contractor. If  $k = 0$ , the equation represents a cost reimbursable contract having either a fixed fee ( $F_c$  constant) or percentage fee,  $F_c = \text{some percentage of } C$ . If  $k$  is some value between 0–1, the equation represents a cost sharing relationship which is frequently translated into a cost incentive contract.

**Fixed Price Contract.**—The fixed price contract is considered to be the best incentive for the contractor to control costs and enhance productivity. However, there are limitations on its use. In particular, a fixed price contract cannot be awarded unless the project scope, including detailed design, is "sufficiently" known. The owner has to provide a complete contract, including the overall schedule, the quality of the specifications and the adequacy of the site conditions before a rational contractor will bid a fixed price contract. One method of reducing this variability on large projects while retaining many of the advantages of fixed price contracts is by subdividing the work and awarding a series of fixed price contracts, each one to be issued when the scope and design for that contract is complete. However, multiple contracts require considerable coordination of contractors and have other limitations as well.

A major 'plus' for the contractor bidding a fixed price contract is that the owner must relinquish project management to the contractor, although the owner must still maintain some degree of control through contract administration, including quality assurance, monitoring progress, managing changes, paying the contractor and accepting finished work. The contractor achieves a major motivational factor, the desire to be in control of one's own fate, to be able to conduct affairs as one wishes and to be good at it.

**Cost Reimbursable Contract.**—At the other extreme, the cost reimbursable contract eliminates all the economic risks for the contractor and places them on the owner. As a consequence, the owner becomes the project manager. If the owner desires that the contractor be responsible for meeting a cost or schedule budget, the contractor must be given control over certain resources necessary to meet these objectives.

The major reason for adopting the cost reimbursable contract is the variability of the scope due to lack of knowledge in the early project stages and the need to start construction early.

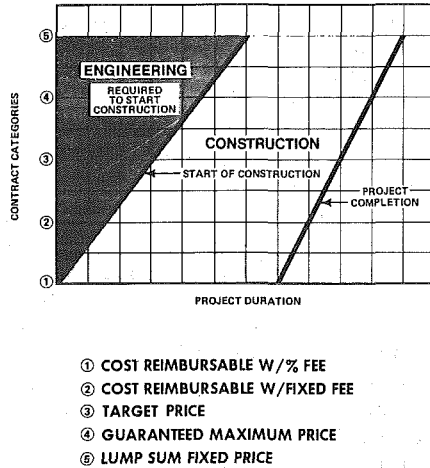
Fig. 1 is a schematic showing the time scale relationship between the various contract types. As more information becomes available, the degree of risk shifts to the contractor, resulting in a fixed price contract.

## TYPES OF INCENTIVE CONTRACTS

**Fixed Price Contract Incentives.**—Fixed price contracts can include two forms of incentives:

1. The guaranteed maximum. This is a fixed price contract in which the profit potential of the contractor is shared with the owner. The owner and contractor negotiate a target cost, profit, ceiling price, and sharing

**PROJECT SCHEDULE DURATION  
vs  
CATEGORY OF CONTRACT \***



**FIG. 1.—Project Schedule Duration versus Category of Contract**

formula. This type contract can, in certain instances, be quite disadvantageous to the contractor since the basis of the contract is to have the contractor share some of the cost risk with a 100% dilution of fee if overruns occur. If the standard profit is negotiated, the contractor will often attempt to negotiate a contingency amount to protect against overruns of the guaranteed maximum since the contractor may not have the same risk protection that the normal fixed price contract provides. The guaranteed maximum contract is most effective if the contractor has some control over design, such as a value engineering clause or in a design-build contract.

2. Bonus/penalty incentives for completion schedule. Such provisions normally provide for an amount per day of early or late completion and may reinforce the owner's need to complete the project on time. Delay penalties, however, can be very difficult to assess, because of conflicting claims on responsibilities. The liquidated damages clauses found in many standard contracts should not be confused with bonus/penalty clauses. The former serve to specify in advance damages for unexcused delays, and, as a consequence, provide incentives to the contractor to meet completion dates. Liquidated damages clauses provide no incentives to complete work earlier than contract completion dates and, if construed to be purely penalty clauses, could be nonenforceable (11).

**Cost Reimbursable Contracts with Incentive Provisions.**—Contractual incentive provisions can be combined with different types of cost plus contracts and have different effects by assignment of risk to the owner or the contractor. Such incentives are generally divided into two categories, cost and schedule or contractor performance.

1. **Cost and Schedule Incentives.** The typical provisions which fall into this category of incentives are: Sharing of target project construction cost underrun and overrun; sharing of target manhour cost underrun and overrun; bonus/penalty on average direct labor manhour cost; and bonus/penalty on schedule completion date. These provisions can be used with percent fee or fixed fee incentives. Examples: (1) Profit fee is measured by sharing the amount of overrun/underrun of the target cost or some measure of cost, such as direct labor manhours. As in the guaranteed maximum contract, the owner and contractor negotiate a target, profit fee, and sharing formula; however, there is no ceiling price. There may be a maximum and minimum fee. The bonus above the target profit can be a percentage of the underrun amount of the target and the penalty a percentage of the overrun amount; (2) bonus/penalty for completion of project ahead of or behind schedule. The bonus is generally a monetary amount per day and the penalty is either an amount per day or loss of fee on work done past schedule. Schedule incentives are generally easier to administer than cost incentives and place emphasis on an important owner objective. However, there is a potential danger to owners using reimbursable contracts with schedule incentives, that contractors will use excessive resources to achieve schedules; (3) combination of project cost and schedule incentives. A commonly used scheme involves setting one bonus/penalty sum for underrun/overrun of target labor hours and another for underrun/overrun of schedule dates. Such a scheme must be realistic, however, to control the excessive use of resources aforementioned. For example; in one situation a contractor severely underestimated the target manhours to complete the contract. Unable to come close to meeting the labor target, the contractor apparently decided to concentrate on the schedule incentive, at considerable increase in labor cost to the owner.

The advantage of the cost reimbursable contract with cost incentive provisions is that the owner and the contractor share the financial risk while retaining many of the desirable features of the cost reimbursable contract. The sharing feature is the incentive for both parties to work toward the common objective of cost effectiveness. Nevertheless, there are problems related to using cost incentives: (1) There is considerable difficulty in arriving at fair and equitable targets; (2) there are additional administration and negotiation costs; (3) negotiating contingency is difficult; (4) project engineering should be approximately 40% complete to set final cost and schedule, although this percentage can vary considerably with the type of work; (5) cost targets must be adjusted frequently for escalation and changes. For this reason, many incentive contracts use direct labor hours as the measure of overall efficiency; (6) changes must be negotiated as in a fixed price contract.

If incentive provisions are exercised after the project is underway (as is frequently done), the contract general and special provisions must be reviewed and negotiated to give the contractor necessary control of the work. Similarly, under these circumstances, a change in the owner's method of contract administration may be necessary.

To reduce the effort in setting and adjusting targets, a portion of the contract may be excluded from the target cost. This portion could include field project management, indirect labor materials and equipment,

construction equipment availability charges, small tools, expendables, home office costs, and contingency and profit on these items. In order to fix these prices, the contract scope must be defined, and design parameters established to the extent that a contractor can provide a reasonable cost basis. The nontargettable items are frequently in a fixed fee portion of the contract. Reimbursable items, subject to the target incentive measurement, would be direct labor; permanent plant direct labor; permanent plant equipment and materials; materials used in construction; construction equipment use charges; permits, bonds and taxes; and contingency on these items.

2. Performance Incentives (Award Fee). In this type of cost plus incentive contracting the contractor either earns a bonus or a penalty that adds to or subtracts from his earned fee, or earns an award fee which is added to a minimum or base fee. In either case, the contractor's minimum profit fee is never eliminated.

Performance is measured against the parameters that have the most significant impact on the construction cost and schedule. Some of the most widely used are: (1) Safety; (2) quality of construction work; (3) responsiveness; (4) technical management; (5) business management; and (6) utilization of resources, including craft labor productivity.

The contractor's incentive or award fee is based on performance by the contractor, as evaluated and determined by the owner. Fee determinations are made monthly, quarterly, or semiannually in accordance with performance criteria established in the contract. The contractor generally reports accomplishments against performance norms, and the owner assigns a score based on the relative achievement of the performance standards.

The performance norms are generally difficult to measure since they involve subjective judgments as to what constitutes "timely, efficient, and economical" or other descriptors. As a result the actual norms can vary with the contract or contractor and they may change as the project develops. Such norms are more difficult to establish when the owner and contractor have not worked together than when they have such experience.

## **INCENTIVE MODELS AND ADJUSTMENTS**

There is a noticeable lack of published research on the theory and consequences of the use of contractual incentives in construction. To understand the underlying contracting theory, one can research the extensive number of articles on the subject during the period 1960–1970, when the Defense Department and NASA resorted to incentives to gain efficiencies in F&D contracts.

The conclusion of this research is very revealing: Cost-based incentives are not necessarily the means of inducing cost efficiency (measured as the degree of underrun/overrun between actual and target cost) (4).

The reason for such a conclusion appears to be that the perceived degree of risk at the time of contract negotiation may be several orders of magnitude greater than the cost efficiencies achievable. In Government procurement contracts there is evidence that efficiency in controlling costs using various types of contracts could not be tested unless the type of

product procured were held constant (6). The size of the overrun/underrun was more a function of the type of work (production or R&D) than the type of contract or sharing ratio. Government research and development contracts had larger "going-in" profits than production contracts, but lower "coming-out" profits (4).

The analogy between government R&D contracts and construction is quite obvious. In construction, the uncontrollable cost components may dominate those that are controllable. At the time of contract negotiation there may be much greater variations in cost than the contractor can influence by achieving efficiencies. The uncontrollable costs include economic factors, unknown site conditions, design variables, and many other factors subject to change during contract execution. Nevertheless, a contractor who has limited knowledge of the contract scope and design features can and should be able to negotiate a reasonable target cost and sharing ratio, provided the principles of risk sharing are followed by the owner and contractor; that is, the greater the underlying risk, measured as cost variability, the greater must be the commensurate gain, measured as expected fee.

Cost sharing under uncertainty implies that a rational contractor attempting to minimize potential losses either reduces the sharing ratio, or seeks to negotiate a higher fee and/or contingency in the target. Theoretically, as a contractor attains more knowledge, the contractor should attempt to eliminate the owner's share of the risk and control; simultaneously the owner should be reducing its share of the risk (and control), and attempting to reduce the fee and the target cost. Once owners are able to define completely the contract scope it appears logical that

**TABLE 1.—Typical Incentive Chronology**

Design stage (1)	Incentive Contract Provisions Negotiated	
	Percentage fee (2)	Fixed fee (3)
0–10%	Maximum/minimum fee Sharing ratio Target cost range  Contingency range Schedule dates	Fee  Bonus/penalty Target labor hour range Contingency range Average hourly cost Range of schedule dates
Greater than 40% (several adjustments possible)	Target cost Contingency General and special provisions	Target labor hours Revisions to schedule dates Contingency General and special provisions
Changes	Revisions to target cost & schedules	Revisions to target labor hours & schedules

they attempt to negotiate a fixed price contract and contractors should have the same objective, to regain complete control of the project.

### ADJUSTING CONTRACT INCENTIVES

Incentives are frequently incorporated into projects at an early stage of scope and design definition, then adjusted as more information becomes known. In practice, incentive contracts are frequently awarded at the 10% design stage and finalized when 40%–60% of the design is complete, subject to changes in scope. A typical chronology is illustrated in Table 1.

If the target parameters and share ratio are set in the early design stage, so necessarily is the expected fee value. The expected overrun/underrun is theoretically not dependent on scope definition, but since there is much greater risk in early stages of contract design, there is much greater variability in the cost. Consequently, if the range of target cost or target hours is very uncertain, the contractor will seek a sizeable target contingency to protect the expected fee; this amount will be difficult to negotiate but the owner must realize that the contingency is a function of the known information and seek to reduce this contingency in subsequent negotiations.

### CONCLUSIONS AND RECOMMENDATIONS

Contract cost and schedule incentives are used in construction and offer a very attractive alternative to the cost reimbursable contract with percentage or fixed fee. Since incentives can be negotiated at an early stage of the process and be refined as scope and design information is improved, construction can start early in the project.

Most major contractors are now experienced in how cost incentives work and able to provide owners with proposals from their experience on similar projects. Owners must be prepared to negotiate these contract provisions in detail, which implies that owners have their own cost estimates available. In the negotiations, both owners and contractors must realize that risk sharing principles apply, meaning that contractors must be able to control the resources necessary to achieve the incentives, and to assume risks commensurate with potential gains.

To insure that incentive contracts achieve the efficiencies that owners want, it is essential that targets be realistic estimates of actual costs, labor hours or schedules. This implies that owners must emphasize negotiation of the most reliable targets rather than elaborate sharing schemes and complex incentives. Owners should seek competitive proposals, if they are not already doing so, at the earliest stages of the project, with mechanisms for modifying the targets and the contract provisions at a later day. These revisions should continue to follow accepted principles of control and allocation of risk.

### APPENDIX I.—REFERENCES

1. Bradley, C. E., and McCuston, C., "The Rationale for Incentive Contracting," *Decision Sciences*, Vol. 3, Jan., 1972, pp. 15–29.



2. The Business Roundtable, "Contractual Arrangements," A Construction Industry Cost Effectiveness Project Report, Report A-7, Oct., 1982.
3. The Business Roundtable, "Cost Estimating, Budgeting and Control Accounting," A Construction Industry Cost Effectiveness Project Draft Report, Report A-6.2, to be published.
4. De Mong, R. F., "The Effectiveness of Incentive Contracts: What Research Tell Us," *National Contract Management Quarterly Journal*, Dec., 1978, pp. 12-22.
5. Finchum, J. A., "Expectation of Contract Incentives," *Naval Research Logistics Quarterly*, Vol. 19, No. 2, June, 1972, pp. 389-397.
6. Fisher, I. N., "An Evaluation of Incentive Contracting Experience," *Naval Research Logistics Quarterly* 16, Mar., 1969, pp. 63-83.
7. Johnson, M. G., "Engineering/Construction Liability from The Contractor's Viewpoint," *Engineering-Construction Contracting Proceedings*, American Institute of Chemical Engineers, 1977, pp. 58-64.
8. Marshall, C. W., "Quantification of Contractor Risk," *Naval Research Logistics Quarterly*, Dec. 16, 1969, pp. 531-541.
9. Merrow, E. W., Chapel, S. W., and Worthing, C., "A Review of Cost Estimation in New Technologies: Implications for Energy Process Plants," R-2481-DOE, Rand Corporation, Santa Monica, Calif., July, 1979.
10. Parker, J. M., "An Examination of Recent Defense Contract Outcomes in the Incentive Environment," Air Force Institute of Technology, 1971, AD 731-764.
11. Sweet, J., "Legal Aspects of Architecture, Engineering and the Construction Process," West Publishing Company, St. Paul, Minn., 1973, pp. 401-405.

## APPENDIX II.—NOTATION

*The following symbols are used in this paper:*

- $C$  = the actual cost of a project or the cost of a measured target such as direct labor;  
 $C_t$  = the target cost established in the contract negotiation;  
 $F_c$  = the actual fee paid the contractor for completing the contract requirements;  
 $F_t$  = the target fee established in the contract negotiation; and  
 $k$  = the contractor's share of the variation in the cost target.