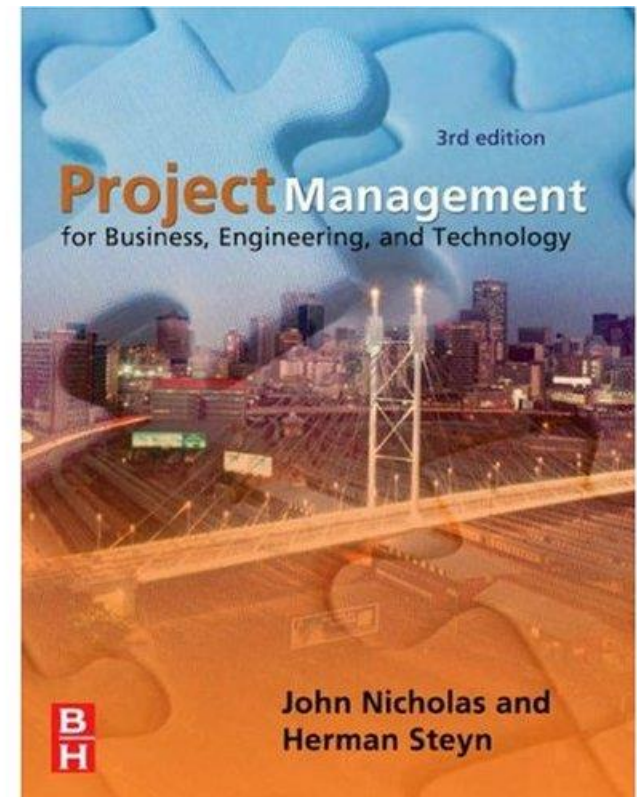


Appendix to Chapter 3

Kinds of Contracts

Project Management for Business,
Engineering, and Technology

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Contracting (cont'd)

- Contracts: this lecture only addresses aspects concerning price, schedule, and required end-results



Terminology

- Cost: all expenses incurred by contractor in performance of project
 - Fee: amount paid to contractor in excess of cost
 - Price: amount customer pays contractor
 - Profit (loss): difference between price and cost
-

Project Cost Estimate and Price Example

- To accurately estimate costs, project should be divided into work packages first



Project Cost Estimate and Price

I. Direct Costs	
Direct Labor (DL) Charges for labor working directly on project	50,000.00
Overhead on Labor (% of DL) Labor support: benefits, etc. E.g., 40%	20,000.00
Materials (M) Charges for materials necessary for project	10,000.00
Overhead on Materials (% of M) Shipping, insurance, security, etc. E.g., 33.33%	3,333.33
Direct Total	83,333.33
II. General & Administrative (% of Direct Total) Corporate overhead: proposals, publicity, president, etc. E.g., 20%	16,667.00
Cost Estimate	100,000.00
III. Fee (Determined in various ways, e.g., % of Cost Estimate) E.g., 20%	20,000.00
Project Price, Bid	120,000.00

Project Cost Estimate and Price

Example (cont'd)

- Therefore, price to be submitted in proposal or bid is \$120,000
 - Does this mean customer will actually pay \$120,000 and contractor profit \$20,000?
 - That depends on the kind of contract and the actual costs.
-

Firm Fixed Price Contract (FFP)

- Price stays the same, no matter what the cost. “Actual price” is fixed

Initial agreement:

original cost estimate = \$100,000

fee (say, 20%) = \$20,000

price = \$120,000

actual price = \$120,000

Firm Fixed Price Contract (FFP)

Initial agreement:

original cost estimate = \$100,000

fee (say, 20%) = \$20,000

price = \$120,000

actual price = \$120,000

- Hence, if actual cost is less than target cost of \$100,000, contractor stands to gain higher profit
- But if actual cost exceeds \$100,000, contractor earns less profit, or may even suffers loss

Firm Fixed Price Contract (FFP)

(cont'd)

- Customer is assured of price and is at no risk of having to pay more
 - Danger to customer: contractor will “cut corners” on work to keep costs down
 - The most common kind of contract, especially for projects that are somewhat routine and where costs can be estimated with confidence
-

Cost Plus Fixed Fee

- Actual price is not determined until end of project when actual costs are known

Initial agreement:

original cost estimate = \$100,000, but all "allowable"
cost will be reimbursed

fee (say, 20%) = \$20,000

target price = \$120,000

actual price = \$120,000, plus any cost beyond the
\$100,000 estimate

Cost Plus Fixed Fee

Initial agreement:

original cost estimate = \$100,000, but all "allowable"
cost will be reimbursed
fee (say, 20%) = \$20,000
target price = \$120,000
actual price = \$120,000, plus any cost beyond the
\$100,000 estimate

- If, for example, costs end up at \$200,000, actual price will be \$220,000

Cost Plus Fixed Fee (cont'd)

- Profit remains at \$20,000, but contractor has no worry about cost overruns
 - CPFF is more common than CPPF—cost plus *percentage* fee—since latter is a *incentive* for contractor to exceed target cost
 - Customers prefer to avoid this kind of contract because they are at risk of having to absorb overruns
-

Cost Plus Fixed Fee (cont'd)

- To protect against waste, customer often has own PM to monitor contract work and costs
 - CPFF is used in situations where otherwise no contractors would bid, e.g., leading edge technology or other risky situations
-

Cost Plus Fixed Fee (cont'd)

- CPFF is used in
 - cutting-edge technology projects where costs are difficult to estimate
 - or high risk or dangerous projects where otherwise customer would not be able to attract contractors
-

Cost-Plus Contract Example

- Pratt & Whitney's development of hydrogen-fueled RL10 rocket engine for U.S. Air Force
 - Most successful rocket engine ever built in U.S. and still is use today after 40 years
 - Cost-plus contract
-

Cost-Plus Contract Example



Museum display of J-2 engine—
a rocket similar to the RL-10.

Cost-Plus Contract Example

- Original cost estimate for development of engine
 - \$9 million
 - but it was a guess!
 - Just to be safe, Pratt & Whitney doubled the estimate on the proposal to \$18 million
-

Cost Plus Contract Example (cont'd)

- Actual cost: around \$36 million!



Incentive-Type Contracts

- Provide incentives for contractor to meet or exceed specified cost, schedule, or performance targets



Cost Incentive Contracts

- What is the *target* cost? What is the incentive to hit the target?
 - Two popular incentive contracts aimed at hitting the target cost : CPIF and FPIF.
-

Cost Plus Incentive Fee (CPIF)

- CPIF is similar to CPFF, but
 - offers the incentive of larger profits if actual cost is *less* than target cost.
 - if actual cost exceeds target cost, customer agrees to pay a portion of overrun.
 - Customer and contractor “share” any savings or overruns according to the Cost Sharing Ratio, CSR
-

Cost Plus Incentive Fee (CPIF) (cont'd)

- Say, CSR = 60/40
 - This means: 60% of any savings (actual cost below target cost) go to contractor, but 60% of any overruns are paid by contractor (and 40% by customer)
-

CPIF example

Initial agreement:

original cost estimate = \$100,000, but all “allowable” costs will be reimbursed

fee (say, 20%) = \$20,000

target price = \$120,000

actual price = reimbursement + fee

cost-sharing ratio = 60/40 (60% contractor/40% client);

hence:

if cost \leq \$100,000, client will reimburse cost plus 60% of the amount below \$100,000

If cost $>$ \$100,000, client will reimburse \$100,000 plus 40% of the amount beyond \$100,000

Example

If cost is only \$80,000 (\$20,000 savings), client will reimburse \$80,000 plus \$12,000 (60% of savings), or \$92,000.

- Thus, price = reimbursement + fee = \$92,000 + \$20,000 = \$112,000
- Client “saves” \$8,000 from target price
- Contractor “earns” \$32,000 profit.

CPIF example (cont'd)

Initial agreement:

original cost estimate = \$100,000, but all “allowable” costs will be reimbursed

fee (say, 20%) = \$20,000

target price = \$120,000

actual price = reimbursement + fee

cost-sharing ratio = 60/40 (60% contractor/40% client);

hence:

if cost \leq \$100,000, client will reimburse cost plus 60% of the amount below \$100,000

If cost $>$ \$100,000, client will reimburse \$100,000 plus 40% of the amount beyond \$100,000

Example

If cost is \$200,000 (\$100,000 overrun), client will reimburse \$100,000 plus \$40,000 (40% of overrun), or \$140,000.

- Price = \$140,000 + \$20,000 = \$160,000
- Client pays \$40,000 more than target price
- Contractor takes a loss of \$200,000 - \$160,000 = \$40,000.

Fixed Price Incentive Fee Contract (FPIF)

- FPIF is similar to CPIF
 - But focus is on controlling *price*, not cost
 - This contract appeals to customer more than CPIF because it imposes a *cap* on amount customer will pay (max price)
 - Also, FPIF discourages contractor from cutting corners because it imposes a *cap* on allowable profit (max profit)
-

FPIF example

Initial agreement:

original cost estimate = \$100,000, but all “allowable” costs will be reimbursed
fee (say, 20%) = \$20,000

target price = \$120,000

actual price = reimbursement + fee, EXCEPT:

maximum allowable price = \$150,000 (client will pay no more than this)

maximum allowable profit = \$25,000 (contractor can profit no more than this)

cost-sharing ratio = 60/40 (60% contractor/40% client); hence:

If cost \leq \$100,000, client will reimburse cost plus 60% of the amount below
\$100,000, but the 40% amount cannot exceed \$5,000

If cost $>$ \$100,000, client will reimburse \$100,000 plus 40% of the amount beyond
\$100,000, but total price cannot exceed \$150,000

Example

Suppose cost is only \$80,000 (\$20,000 savings).

- Sixty percent of savings is \$12,000, but only \$5,000 savings can be given to contractor.
- Thus, price = reimbursement + fee = (\$80,000 + \$5,000) + \$20,000 = \$105,000.
- Client “saves” \$15,000 from target price
- Contractor “earns” \$25,000 profit.

FPIF example (cont'd)

Initial agreement:

original cost estimate = \$100,000, but all “allowable” costs will be reimbursed
fee (say, 20%) = \$20,000

target price = \$120,000

actual price = reimbursement + fee, EXCEPT:

maximum allowable price = \$150,000 (client will pay no more than this)

maximum allowable profit = \$25,000 (contractor can profit no more than this)

cost-sharing ratio = 60/40 (60% contractor/40% client); hence:

if cost \leq \$100,000, client will reimburse cost plus 60% of the amount below
\$100,000, but the 40% amount cannot exceed \$5,000

If cost $>$ \$100,000, client will reimburse \$100,000 plus 40% of the amount
beyond \$100,000, but total price cannot exceed \$150,000

Example

- If cost is \$200,000 (\$100,000 overrun),
- Client would reimburse \$100,000 plus \$40,000 (40% of overrun), except price would then be \$140,000 + \$20,000 = \$160,000, which exceeds contract maximum price as \$150,000.
- Hence, client pays \$150,000, or \$30,000 more than target price,
- Contractor takes a loss of \$200,000 - \$150,000 = \$50,000.

Incentive Contracts for *Schedule* or *Performance Requirements*

- Contractor stands to gain more or less profit, depending on time *when* project is completed or the *performance* of the end-item
-

Incentive Contracts Directed at *Schedule*

Example: Contract for tunnels for diverting the Colorado River for the Hoover Dam



Incentive Contracts Directed at Schedule

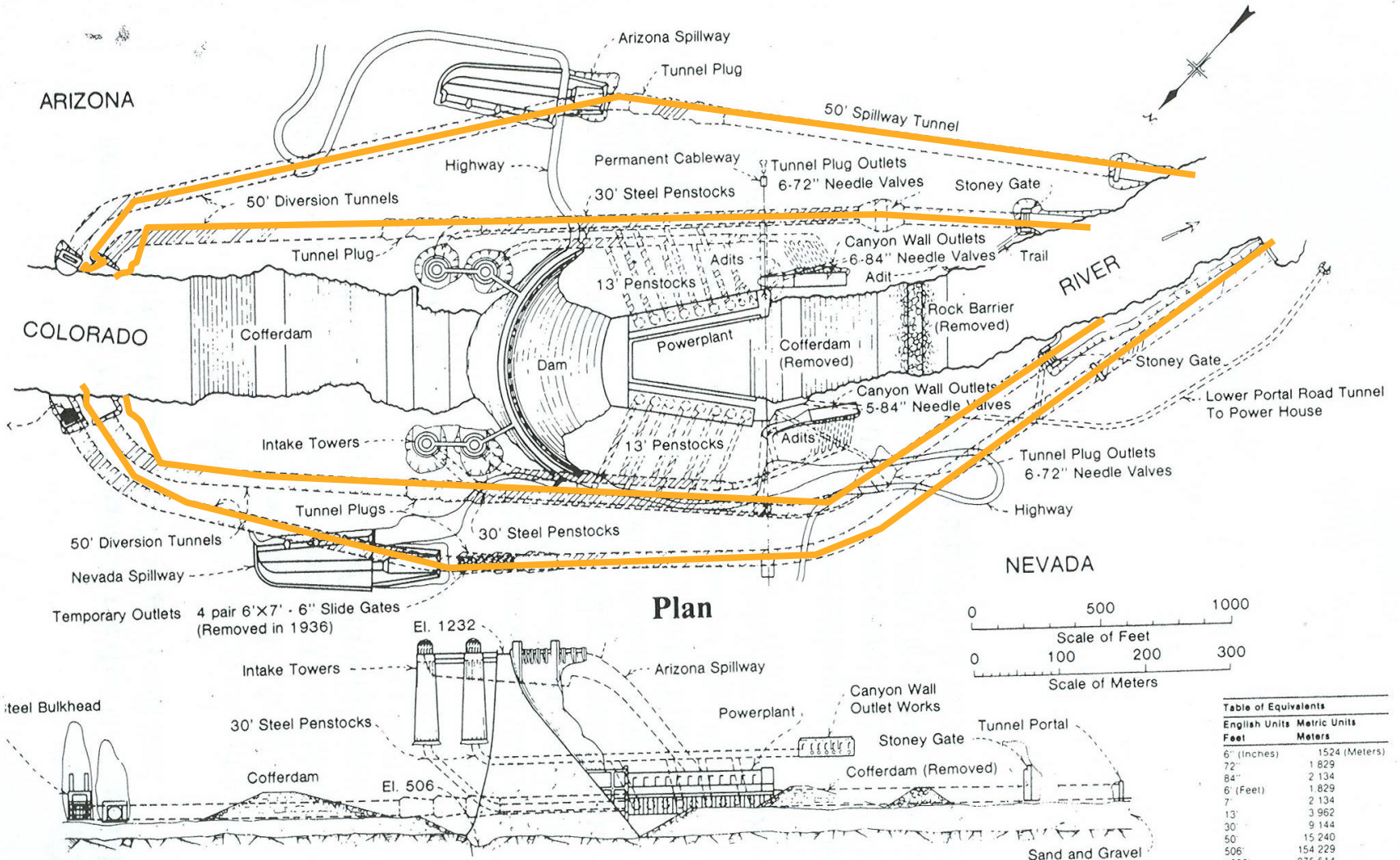
■ Requirements

- Four concrete tunnels
- Each $\frac{3}{4}$ mile length and 50 ft. inside diameter

■ Contract

- Target completion date: October 31, 1933
 - Penalty: \$3000 per day beyond target date
-

Incentive Contracts Directed at Schedule



**Longitudinal Section
Hoover Dam and Appurtenant Works**

Table of Equivalents	
English Units	Metric Units
Feet	Meters
6" (Inches)	1524 (Meters)
72"	1 829
84"	2 134
6' (Feet)	1 829
7'	2 134
13'	3 962
30'	9 144
50'	15 240
506'	154 229
1232'	375 514
55,000 H P	55 765 Metric H P
70,000	70 973
115,000	116 598

Incentive Contracts Directed at Schedule

- Work started on tunnels, May 1931
 - Results
 - All tunnels were completed and Colorado River diverted by Nov. 12, 1933
 - 19 months after start, 11 months ahead of target
 - Earning the contractor an additional estimated $30 \times 11 \times \$3000 = \$990,000$
-

Incentive Contracts Directed at Schedule

- Results (cont'd)
 - 11.5 million cubic yards of rock removed
 - Several fatalities from heat prostration, carbon monoxide poisoning, electrocution, etc.
-

Incentive Contracts Directed at *Performance*

- Example: Contract between U.S. War Department and Wright Brothers for flying machine
March 1908
-

Incentive Contracts Directed at Performance

- Base purchase price of flying machine: \$25,000
- Target Speed : 40 mph



Incentive Contracts Directed at Performance Requirement

- Incentives
 - *Add* 10 percent bonus for each mph flying machine exceeds 40 mph
 - *Deduct* 10 percent of purchase price for each mph machine falls short of 40 mph goal
 - Deductions or additions to payments will be based upon rounding *down* to nearest whole mph
 - So, e.g., a speed of 40.99 mph would be paid for 40; a speed of 39.99 mph would be paid for speed of 39
 - Results to be determined by trial flight of 10 miles
-

Incentive Contracts Directed at Performance Requirement

- Trial results
 - 10 miles traversed in 14 minutes, or just *under* 43 mph.
- Bonus received
 - 10 percent for each whole mile above 40, or \$5,000.
- Hence, Wright brothers paid \$30,000 for their flying machine.



<http://invention.psychology.msstate.edu/gallery/movies/SignalCorpsTakeoff.html>

Multiple Incentive Contracts

(cost, schedule, and performance)

- Simple example
 - $\text{Price} = f(\text{target cost}) + g(\text{target date}) + h(\text{target performance})$
 - Where f , g , and h are functions as specified in contract
 - Such contracts are difficult to negotiate because details about f , g , and h must be agreed upon
-

Time and Material (T&M)

- Simplest of all! Initial estimated price is provided, but actual price is based upon actual labor and material cost:

Price = labor cost (time-based) + material cost

- Common for small projects where costs can be somewhat-accurately estimated
-

On the web: http://www.defenselink.mil/contracts/2002/c12272002_ct655-02.html
Public contact: <http://www.dod.mil/faq/comment.html> or +1 (703) 428-0711

CONTRACTS

Rolls-Royce Corp., Indianapolis, Ind., is being awarded a \$21,500,000 ceiling-priced modification to a previously awarded **firm-fixed-price**, multi-year contract (N00019-98-C-0122) for the **procurement of 10 spare T56-A-427 turboprop engines** for the E-2C aircraft. Work will be performed in Indianapolis, Ind., and is to be completed in December 2003. Contract funds will not expire at the end of the current fiscal year. The Naval Air Systems Command, Patuxent River, Md., is the contracting activity.

Advatech Pacific, Redlands, Calif., is being awarded an \$8,000,000 **cost-plus-fixed-fee** contract to provide for **research and development** under Broad Agency Announcement Technical Area 12 entitled System Simulation Toolkit Enhancement and Support for the Advanced Computational Engineering Simulator – Integrated Space Analysis Tool Program. At this time, \$2,044,512 has been obligated. This work will be complete by September 2008. Solicitations began in December 2003 and one proposal was received. Negotiations were complete September 2005. The Air Force Research Laboratory, Kirtland Air Force Base, N.M. is the contracting activity.

Textron Marine and Land Systems, New Orleans, La., is being awarded a \$63,118,800 **fixed-price-incentive** contract for the **Landing Craft Air Cushion** Service Life Extension Program of five craft. The contract also provides for **installation of craft alterations, repair/refurbishment** of government-furnished property, engineering services and spare parts. This contract includes options which, if exercised, would bring the total cumulative value of this contract to \$111,426,772. Work will be performed in New Orleans, and is to be completed by July 2006. Contract funds will not expire at the end of the current fiscal year. This contract was not competitively procured. The Naval Sea Systems Command, Washington, D.C., is the contracting activity.

ITT Systems, Pacific Missile Range Facility (PMRF) Barking Sands Project, Kekaha, Hawaii, is being awarded a \$40,577,735 **cost-plus-incentive-award-fee, fixed-price-incentive-award-fee** option under previously awarded contract to exercise an option for **base operation services and range operation services support** PMRF Barking Sands, Kekaha, Hawaii. Work will be performed in Kekaha, Hawaii, and is expected to be completed by September 2006. Contract funds will not expire at the end of the current fiscal year. This contract was competitively procured, with 83 proposals solicited and four offers received. The Fleet and Industrial Supply Center, Pearl Harbor, Hawaii, is the contracting activity.