

Delivery Methods (cont'd), Payment and Award Techniques

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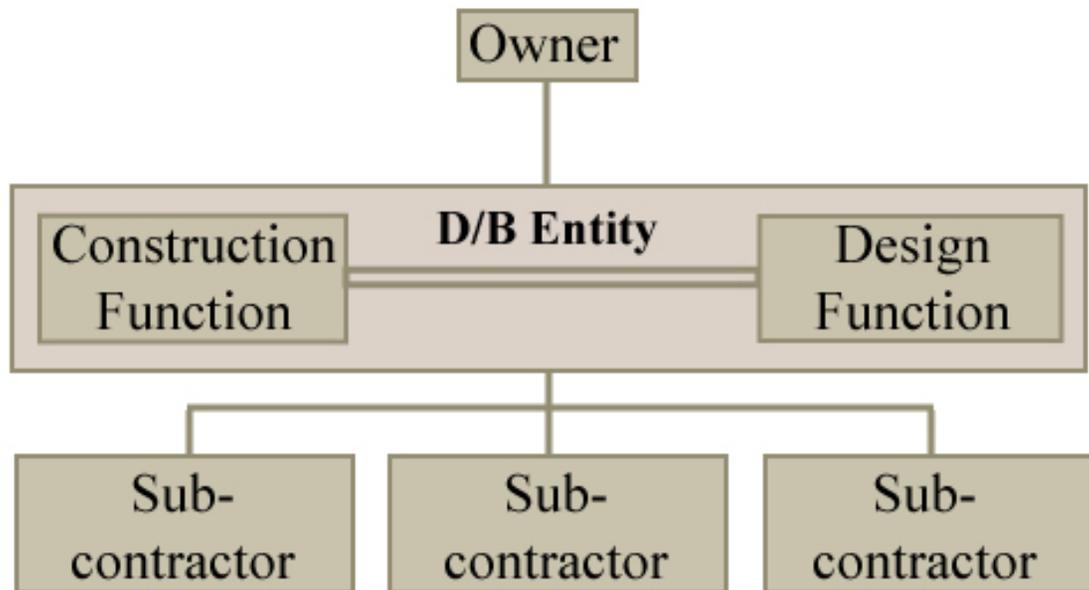
2/23/2004

Project Organization

- Project Delivery Systems (most common)
 - Design / Build
 - Others
 - Summary
- Payment Schemes
 - General points
 - Lumpsum
 - Cost plus fixed fee/% price
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 - Negotiation
 - Bidding

Design-Build

- Contractual Relationship
- Communicational Relationship
- ==== Internal Relationship



How To: Design / Build

- Owner
 - Develops early design (to communicate needs)
 - Hires a design/build firm that will complete both design and construction
- This firm can be a design/build firm but also a joint-venture firm for this specific project
- DB company may hire subcontractors
- Work solicited via RFP (honorarium, phased)
- Can be good for complex projects – but need phased design to shield parties from risk

Back to the Future...

- Dominant method early in US history
- Recent drivers
 - Time pressure (desire to fast track)
 - Shortcomings of tightly defined architect role
 - Constructability issues
 - Limited A/E oversight of construction
 - Downsizing of US corporations (outsourcing design)
 - Desire for single source of responsibility

Advantages DB

- Allows Fast Tracking
- May be good for some complex projects
 - Close coordination within team
 - Institutional knowledge build up
- Single source of accountability
- Owner need not mediate or be exposed to designer/contractor conflicts
- Easier incorporation of changes caused by field conditions

Disadvantages DB

- Lack of fiduciary relationship with designer
 - Risk of DB sacrificing *design* quality to protect profit
 - Owner must assume responsibility for quality assurance
- Pricing not possible at the beginning
- Demands sophisticated owner (construction, quality, oversight of submittals, negotiation,...)
 - Must stay on top of design so don't get surprise
- Can be bad for many complicated projects
 - Very important for owner to be closely involved to specify important and complex aspects of design
- Package: Can't pick or get rid of individual team members (e.g. individual subcontractors)

Design-Build Disadvantages II

- Need to make sure design goals stay foremost
 - Often contractor's interests within DB dominate
- Fewer checks and balances
 - Problems may be hidden until late (no A/E watch)
 - May take direction that owner does not really want
 - Design-build firm can give high quote for changes
 - Responsible for everything!
- If fast tracked, changes can lead to
 - Rework
 - Iteration
 - Delays

Public Use Challenges

- Regulatory hurdles
 - Federal use allowed
 - Federal Acquisition Reform Act of 1996 allowed
 - Many states still do not allow
 - Special permission may be granted for formal request
- Major opposition from
 - Architectural lobby
 - Unions

Bridge Designer/Engineer

- Serves as bridge between
 - Owner
 - Design-build team
- Performs preliminary design before DB team hired
 - E.g. up to 30% design
- Monitors development of design and construction
 - Fiduciary with owner

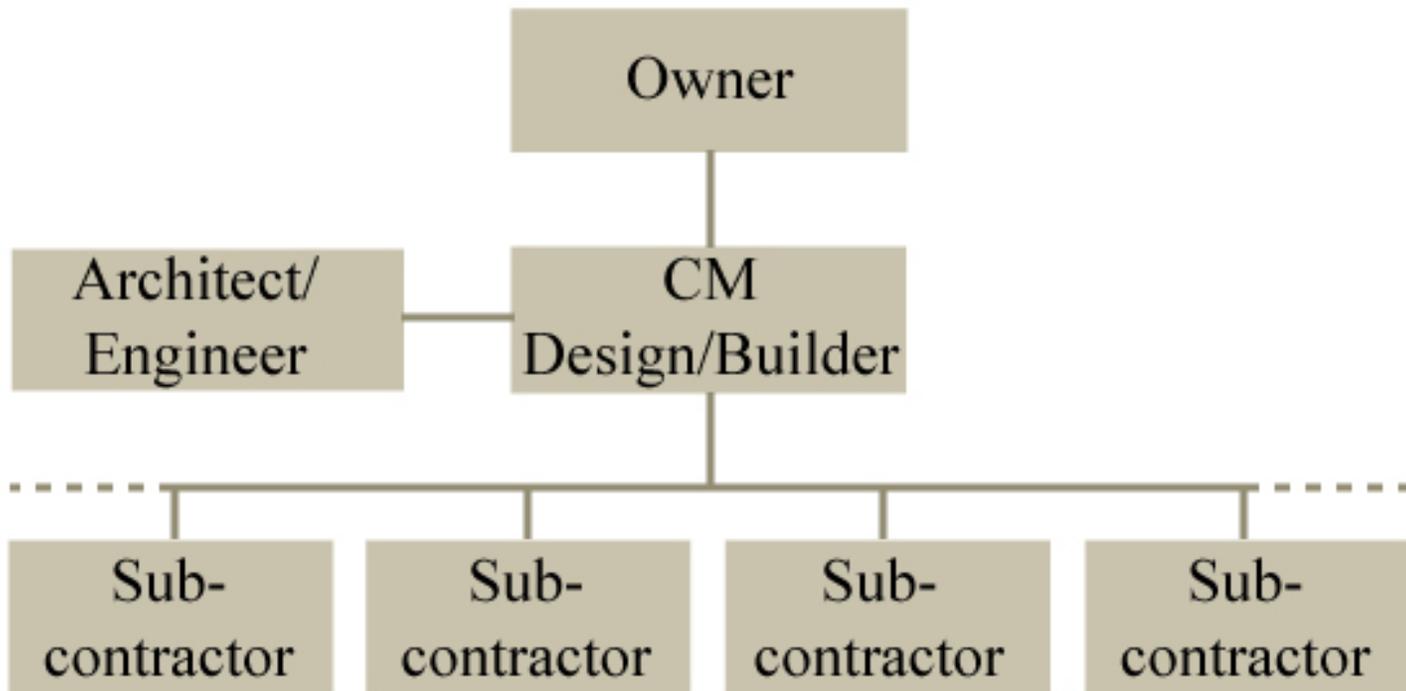
DB Selection Considerations

- Timing tension for when to recruit DB firm
 - Earlier recruitment:
 - Hard to judge – like beauty contest
 - Later recruit: Less benefit from DB
 - E.g. Lower ability to fast-track
 - Limit creativity (closer to GC)
- Often have segmented pricing (cost-plus design, fixed price or GMP construction)
- More comprehensive selection process typical
 - Design/Price/Schedule/Team
 - Design competitions undertaken

Example Design-Build: I15

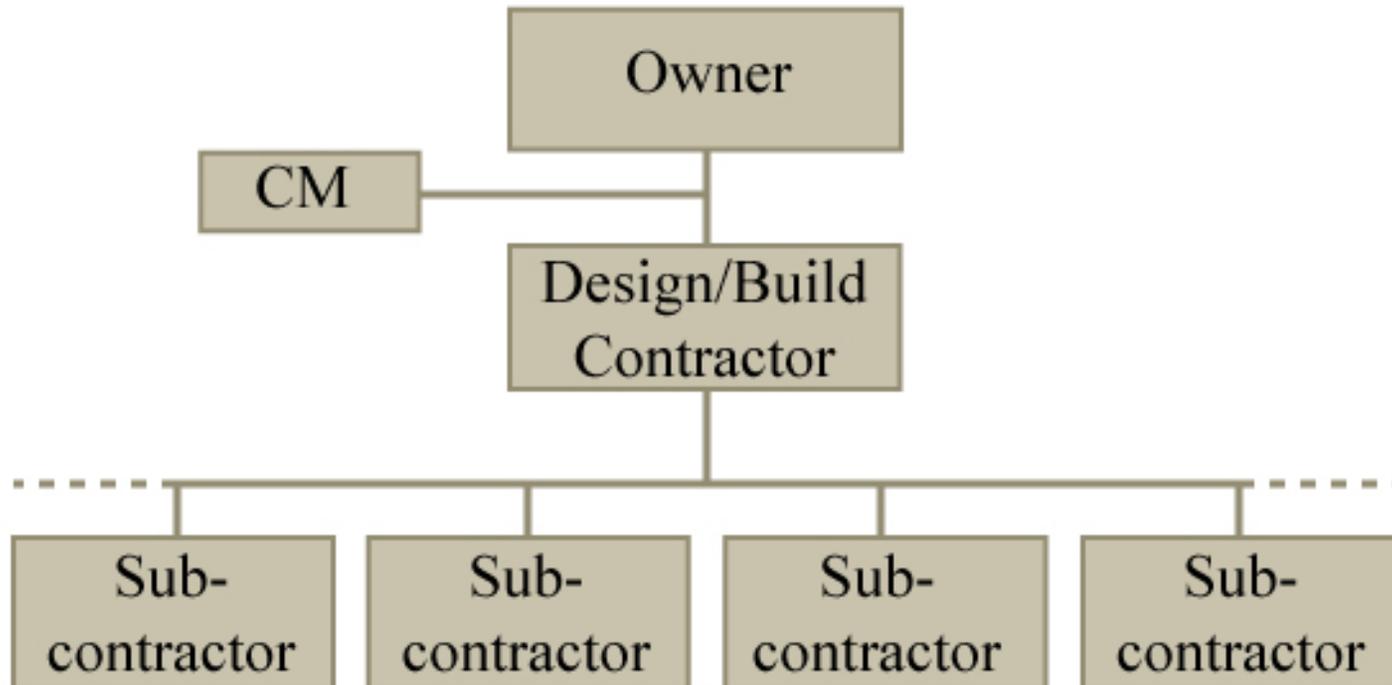
- Originally slated as DBB, but made DB to fast-track
 - Hard deadline due to 2002 SLC Olympic Games
- \$1.3B joint venture (Kiewit lead company)
- US DOT as owner agency
- Bidded project (with rights to use unsuccessful)
 - Unsuccessful bidders became subcontractors
- Reputation foremost
 - 200 Subcontractors
 - Few reviews
- Finished 5 months ahead of schedule

Modified CM Design/Build: Design Subcontracted



CM Serves as Design/Builder and Subcontractors Design

CM Oversight Design/Build



CM Provides Agency Oversight on Owner's Behalf

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Other Delivery Methods

- Turnkey (Like DB but Contractor Financed)
 - Very common in residential housing
 - Gives owner time to raise money during construct.
- Design-Build-Operate-Transfer (BOT)
 - Long-term financing (vs. DBO)
 - Can compete on size, transfer time, etc.
 - Have different guarantees needed to entice
- Multiple Primes
 - Phase construct., hand-pick team, sophisticated owner
- Owner/Agent (owner does part of design)

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Type of Relationships Among Participants

	Owner- A/E	Owner- Contr.	A/E Contr.	Owner- CM	CM- A/E	CM- Contr.
DBB	K	K	C	—	—	—
PCM	K	K	—	K	C	C
CMR	K	—	—	K	C	K
D/B	K*		I	—	—	—

I - Internal Relationship

K - Contractual Relationship

C - Communicational Relationship

*** - Contractual Relationship between the Owner and the D/B Team**

Advantages of the 3 Most Common Delivery Methods

	Traditional Approach	Design Build	Construction Management
Type of contracts			
Advantages			
Legal and contractual precedent	X		
Cost determined before contract commitment	X		
Fast-tracked construction allowed		X	X
Minimum owner involvement	X	X	
Cost benefit from competition	X		X
Negotiation with quality contractor for unique expertise		X	X
Allow adjustment to new conditions without changing agreement		X	X
Single firm control of design/construct process		X	

Disadvantages of the 3 Most Common Delivery Methods

Type of contracts	Traditional Approach	Design Build	Construction Management
Disadvantages			
Design does not benefit from construction expertise	X		
Design construction time is the longest	X		
Adversarial relationship owner/designer vs contractor	X		~X
Contract agreement affected by changes	X		~X
Few checks and balances		X	
Cost control occurs late in project		X	
Contract amount may be complicated by continual contractor negotiations	X		~X
Contract agreement affected by unforeseen conditions	X		~X

Modified from Gould and Joyce, 2002

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Payment Schemes

■ Extremes

Payment method:

Reimbursable

Fixed Price



Product Type:

Service

Commodity

Award method

Solicit based on Reputation
and agree via Negotiation

Bidding

Key Idea Here: Risk Sharing

- Different parties have ability to manage or tolerate different types of risk
 - Owner (or big contractor) often better: Geotechnical risk, weather risk
 - Contractor better: Risk of slow teams, equipment quality, procurement, quality of supervision
- Divide risks within an agreement to
 - Save money on contract price
 - Provide incentive to contractors to finish early, in budget, good quality

Fundamental Ideas

- Contractors are often highly risk averse
 - Recall risk premiums: Contractor willing to “pay” owner (charge less for contract) if owner takes on risk – if have to
- For risks that contractor *can't* control, may be willing to pay a risk premium to owner to take over
 - Contractor here will lower costs if owner assumes certain risk (essentially, paying the owner a risk premium)
- For risks that contractors *can* control, cheaper for a contractor to *manage* risk than to pay a risk premium

Fundamental Ideas II

- Structure contract so that
 - Risks contractor can better handle are imposed on contractor (i.e. contractor will lose \$ if don't control)
 - To be competitive, will have to *manage* these
 - Risks owner can better handle are kept by owner
- “Risk can be better handled by A vs. B” here means that the risk premium that would be charged by the A for taking on this risk is smaller than would be charged by B

Fundamental Balance

- Impose *high* enough risk incentive to get contractor do job efficiently – within the specifications of the contract
 - E.g. Incentive to finish on time, incentive to stay within budget
 - E.g. better team assignment, equipment provision, mgmt
- Impose *low* enough risk to have reasonably low bid
- Impose according to contractor ability to tolerate

Derivative Results of Risks I: Accountability/Monitoring

- Consider parties A and B in an agreement
- The greater the risk on party A
 - The more incentive on party A to manage this risk
 - The less incentive on party B to manage this risk
 - More incentive on A to monitor the relevant factors so B can't claim the risk is responsible for a problem
 - More incentive on B to make sure that A's means of risk *management* falls within the agreement
 - E.g. that not "cutting corners" or otherwise cheating to shield from risk

Derivative Results of Risks II: Impact on Construction Timing

- Both parties must agree on cost to move forward
- In general, more risk on one party, less that party is willing to move forward
- More risk on contractor, the longer will delay construct.
 - Given uncertainty, contractor will charge more up front
 - Owner doesn't want to pay a huge amount up front
 - As uncertainty is lessened in design, prices converge
- Owner can expedite – by paying higher price (risk premium) to contractor or by shouldering risk
- Remember; delay can have major costs – but so can wrangling over change orders!

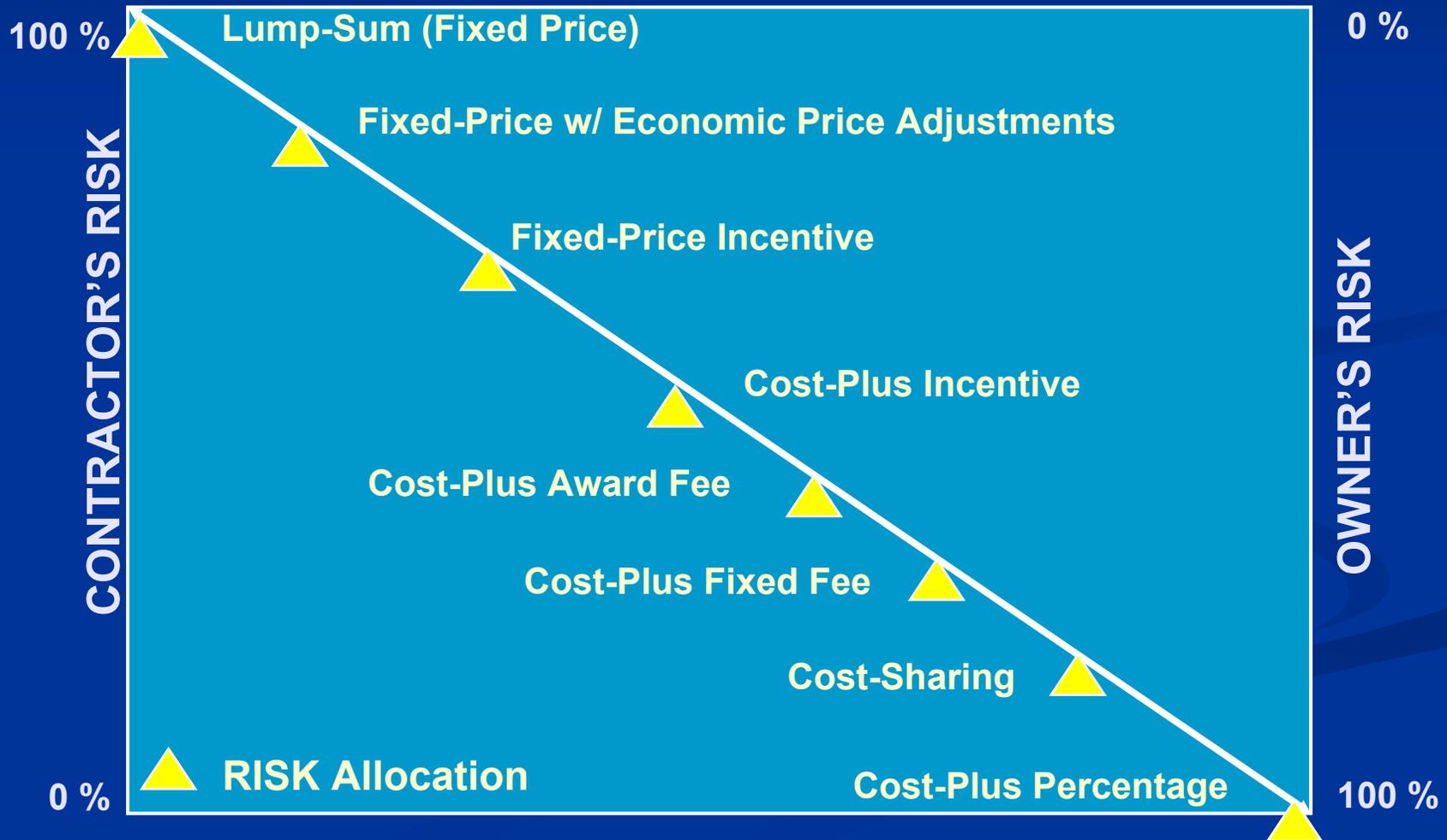
Note on Change Orders

- Changes contract (cost/schedule/scope/etc.)
- Can lead to costs beyond contract specification
- Anticipated costs incorporated in “contingency”
 - Often 1-3% on top of agreed upon price
- Often only paid for additional direct costs
 - Big problem if disruption in work
- Source of very large risk

Contractual Risk Allocation

RISK SHARING METER

Modified from Kerzner, 2000

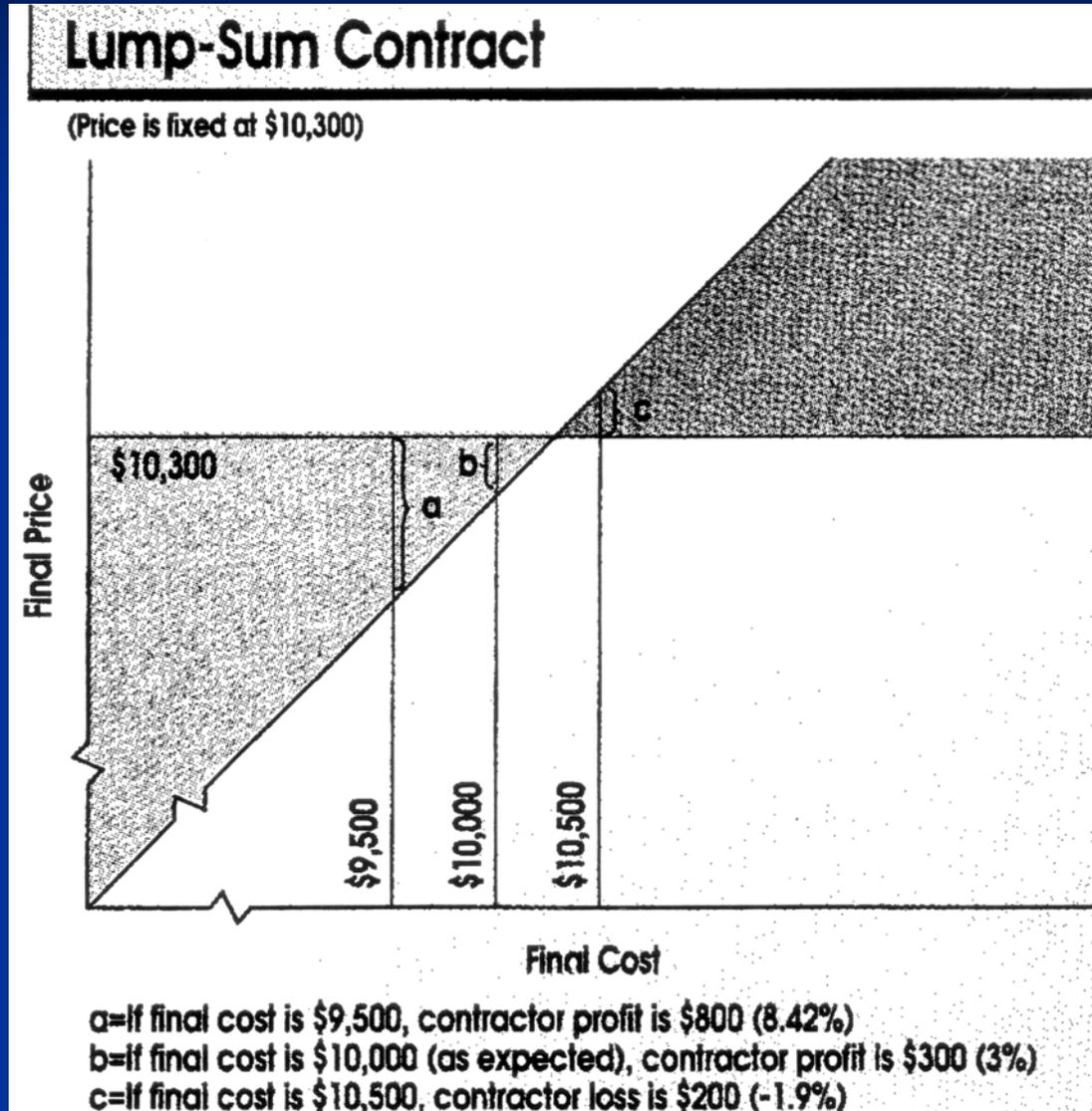


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(Courtesy of John Macomber. Used with permission.)

Cost Versus Price for Lump Sum



Lump Sum (“Fixed Price”)

- Contractor required to achieve the project at the negotiated contract value
- All risk of cost, schedule fall on contractor
- The owner knows the actual cost of the project before it begins
- Minimizes risk for the owner if the project is well estimated, contractual documents accurate and project clearly defined
- High incentive for contractor to finish
 - Early (so can move on to other jobs)
 - Low cost (so can make a profit)

Lump Sum

- Required for many public projects
- Good for some well-defined projects
 - Good price competition in commodity metric
- Bad for ill-defined projects
 - Adversarial relationship over responsibility and payment for of changes
- High contractor risk means typically start late
- *Very different from typical meaning of “Fixed fee”!*

Ways to Save Money: Effect on Owners

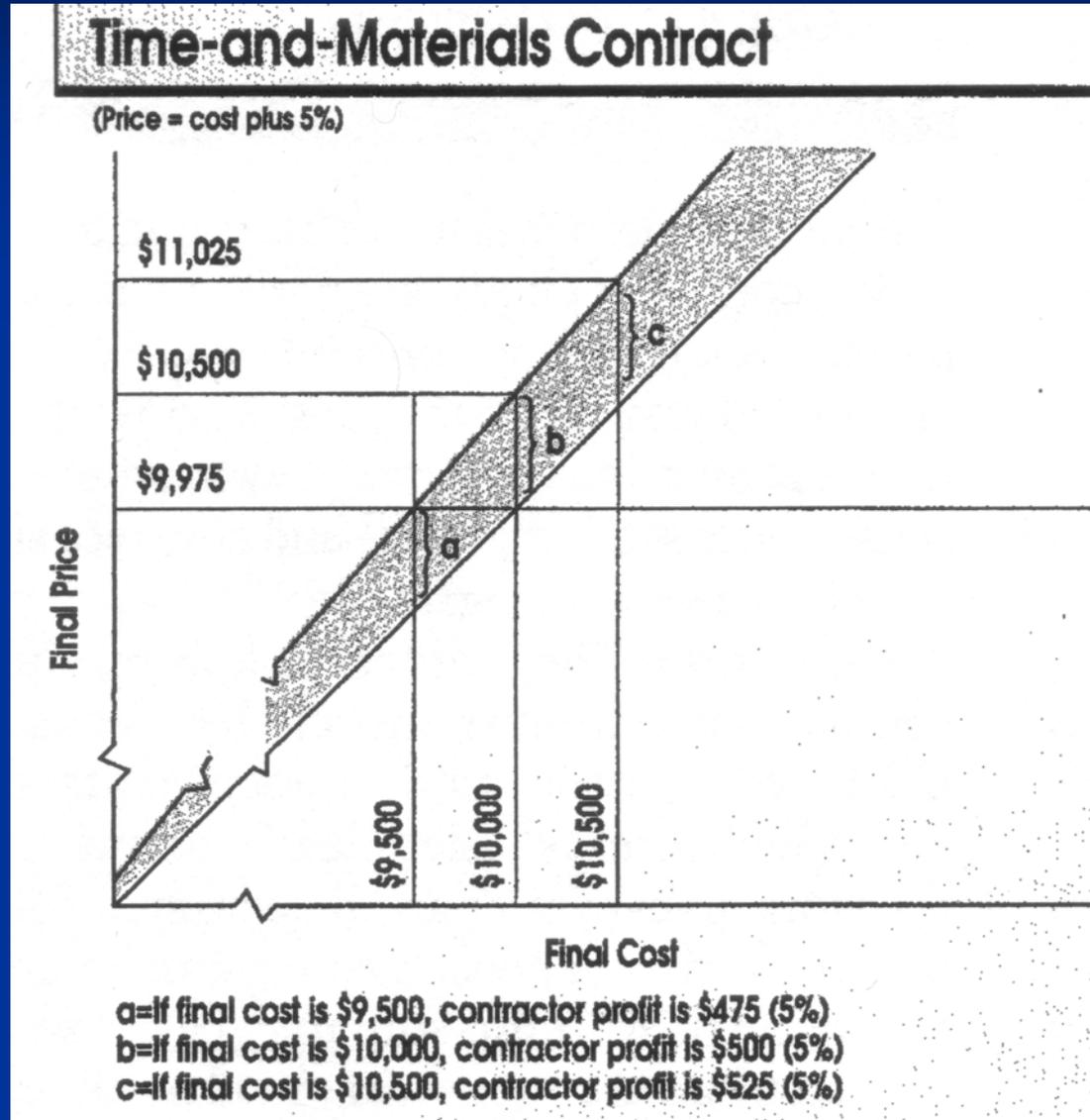
- Helps: Efficiency within construction
 - Best teams
 - Appropriate equipment
 - Careful management
 - Quality workmanship (to avoid risk of rework)
- Hurts: Cutting corners, distortion, charge orders
 - Substitution of materials
 - Distortion of quantities used
 - Distortion of progress

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Cost Versus Price for Cost Plus



Cost Plus Fixed %

- Owner is paying the actual cost plus a fixed percentage
- Contractor agrees to do his best efforts to achieve the work
- Contractor shoulders very little risk
- Typically select contractors based on reputation and comfort (*service* rather than commodity)

Cost Plus + Fixed %: Advantages

- Maximum flexibility to the Owner
 - No fighting over change orders – contractor gets paid for any extra work required
- Permits to collaborate at the early stages of the project
 - Minimal negotiation time
 - Minimal fear of commitment by contractor
- Only have to pay for what actually costs
 - If manage closely, can *save money* vs. fixed-price

Cost Plus + Fixed %: Disadvantages

- Owner shoulders all risk
 - Little incentive to reduce costs and overtime salaries can even increase costs
 - Cost unknown until contract completes
- Owner needs to oversee construction closely
 - Speed up slow crews
 - Identify management problems
- Contractors have incentive to grow scope, price
- Terrible with turnkey delivery type!

Applicability

- *Requires sophisticated owner to manage*
- Uses if the pricing could not be performed in any other way and if it is urgent
 - Emergencies (civil, military)
- Ill-defined, risky scope
 - e.g. historic building renovation with unknown cond.
 - Unknown technologies
- Either scope or construction method unknown
- Confidential projects (limit public knowledge)

Cost Plus Fixed Fee (“Fixed Fee”)

- Cost may vary but the fee remains firm
- The fee is independent of the duration of the project
- Like Cost + fixed % except some shared risk
 - Less time risk: High incentive to finish early
 - Less risk of contractor growing size of project

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Unit Price Contract

- Agreement on the price charged *per unit* between the contractor and the owner
- Interesting example of risk sharing
 - Owner: risk for uncertainty in quantity
 - Contractor: risk for unit price (efficiency, procur)
- Contractor overhead must be integrated in the units price
- Necessity of an owner presence on site to measure the actual quantities
- Typically renegotiate if quantity 20% off
 - Quantity influences price b/c economies of scale

Unit Price Contract

- Highly dependent on the accuracy of the estimation of the quantities given by the Owner/Designer
 - Risk of unbalanced bidding
 - If contractor believes actual quantity will differ, case increase and/or decrease the unit price
 - Contractor can make profit because payment is based on actual quantities but he can also lose money in the same way
 - A contractor can be excluded if its bid is very unbalanced
 - The total cost for the owner can be greater than planned

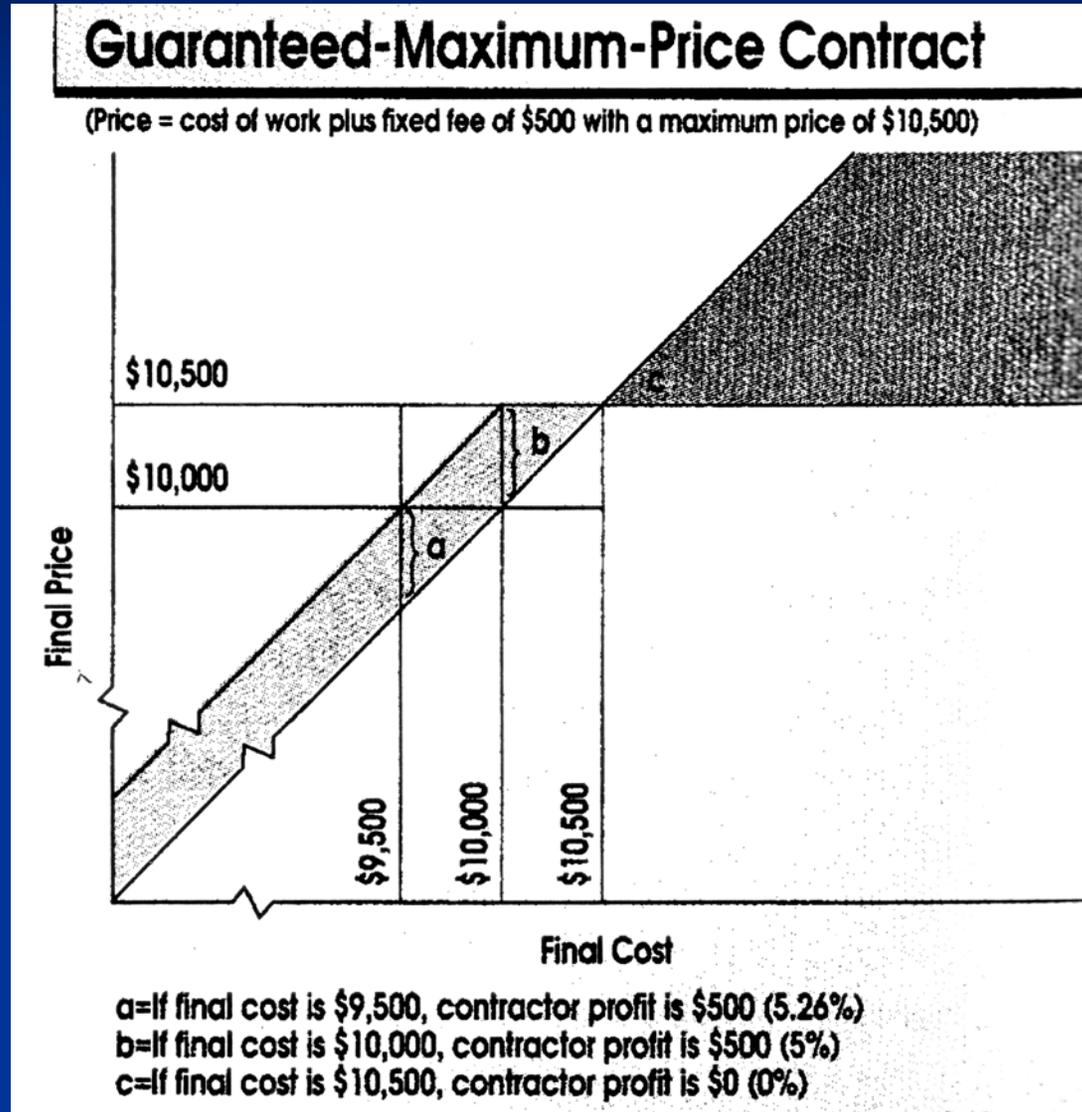
Example: Pile Driving

- Too risky to just charge fixed price
 - Geotechnical uncertainties make length of piles uncertain
 - Piles can be highly expensive
- Risk allocation
 - Price risk more under contractor control (efficiency, crew and equipment selection): to contractor
 - Length out of contractor control: to owner
- Owner must precisely monitor length used

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Cost Versus Price for GMP



Guaranteed Maximum Price or GMP

- Variation of the Cost Plus a Fee but GMP can be a cap on *direct costs*
- After a certain point, the “floor” or “ceiling”, the contractor assumes any additional costs
- Often *start* in cost plus fixed fee and then impose GMP at e.g. 90% design
- Best: GM Shared Savings: Below Guaranteed Maximum, savings shared (60-40% or sliding)
- Very good for turnkey, well-defined scope

GMP: Advantages

- Permits easier financing
- Can fast-track
- Owner keeps savings below GMP
- Often can get started quickly on construction
 - Particularly if contractor already involved w/design
- Contract may be higher than for fixed price b/c design often not complete when contract set

GMP: Disadvantages

- Contractors may still spend lots
- Owner must monitor contractor spending
- Can be fights over what is direct vs. indirect cost
 - i.e. what must fall below GMP
- Bad if unclear scope after GMP agreed to (must renegotiate)
- Just as for CPFF, quality may be sacrificed whereas without GMP, cost and/or schedule would have increased

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Relative Costs of Construction Contracts

- E = contractor's original estimate of the direct job cost at the time of contract award
- M = amount of markup by the contractor in the contract
- B = estimated construction price at the time of signing contract
- A = contractor's actual cost for the original scope of work in the contract
- U = underestimate of the cost of work in the original estimate (with negative value of U denoting an overestimate)
- C = additional cost of work due to change orders
- P = actual payment to contractor by the owner
- F = contractor's gross profit
- R = basic percentage markup above the original estimate for fixed fee contract
- R_i = premium percentage markup for contract type i such that the total percentage markup is $(R + R_i)$, e.g. $(R + R_1)$ for a lump sum contract, $(R + R_2)$ for a unit price contract, and $(R + R_3)$ for a guaranteed maximum cost contract
- N = a factor in the target estimate for sharing the savings in cost as agreed upon by the owner and the contractor, with $0 \leq N \leq 1$.

Original Estimated Contract Prices

Type of Contract	Markup	Contract Price
Lump sum	$M = (R + R1)E$	$B = (1 + R + R1)E$
Unit price	$M = (R + R2)E$	$B = (1 + R + R2)E$
Cost plus fixed %	$M = RA = RE$	$B = (1 + R)E$
Cost plus fixed fee	$M = RE$	$B = (1 + R)E$
Guaranteed max cost	$M = (R + R3)E$	$B = (1 + R + R3)E$

Owner's Actual Payment with Different Contract Provisions

Type of Contract	Change Order Payment	Owner's Payment
Lump sum	$C(1 + R + R1)$	$P = B + C(1 + R + R1)$
Unit price	$C(1 + R + R2)$	$P = (1 + R + R2)A + C$
Cost plus fixed %	$C(1 + R)$	$P = (1 + R)(A + C)$
Cost plus fixed fee	C	$P = RE + A + C$
Guaranteed max cost	0	$P = B$

Contractor's Gross Profit with Different Contract Provisions

Type of Contract	Profit from Change Order	Contractor's Gross Profit
Lump sum	$C(R + R1)$	$F = E - A + (R + R1)(E + C)$
Unit price	$C(R + R2)$	$F = (R + R2)(A + C)$
Cost plus fixed %	CR	$F = R(A + C)$
Cost plus fixed fee	0	$F = RE$
Guaranteed max cost	$-C$	$F = (1 + R + R3)E - A - C$

Principles of Incentive

Contracts

Additional profits are possible by lowering cost

Customer and contractor share cost savings

EXAMPLE

TARGET COST: \$20,000

TARGET FEE: \$1500

SHARING RATIO: 80/20 %

- 
- OWNER PAYS 80 % OF OVERRUN
 - CONTRACTOR PAY 20 % OF OVERRUN
 - PROFIT IS \$1500 LESS CONTRACTOR'S 20 %

- 
- OWNER KEEPS 80 % OF OVERRUN
 - CONTRACTOR KEEPS 20 % OF OVERRUN
 - PROFIT IS \$1500 PLUS CONTRACTOR'S 20 %

Note: limitations may be imposed on price or profit

Conclusion

- When market is not very good, clients insists on fixed price bids whereas when the project offers are numerous, it is more difficult to obtain those conditions
- The contract type choice must depend on:
 - The accuracy of the estimation
 - The ultimate cost know since the beginning or at least the maximum
 - The desired risk
 - If quick completion of work is wanted

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Award Methods: Contractor Selection

■ Extremes

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Fixed Price



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Bidding

- Variants
 - Low bid
 - Multi-parameter bidding
 - Low bid plus arithmetic combination of other factors
 - Low bid divided by ranking of other factors
- Fixed price low bid is win-lose
- Typically associated with lump-sum contract
- Prequalifications critical

Bidding Tradeoffs

- Time provided to bidders to review documents
 - Too long: Construction delayed
 - Too short:
 - Bids low-quality because too little time to review contract docs(incorporate high risk premium or unrealistically low)
 - Few bidders willing to participate
- Bid count
 - Too many bidders: Scare away best contractors
 - Too few bidders: Bid not competitive

Bidding Tradeoffs

- Advantages
 - Can get good price
 - Transparency
- Disadvantages
 - Can set up win-lose situation
 - Competitive pressures can eliminate profit from bid
 - Try to make up with change orders, cutting corners
 - Can lead to combatative relationships
 - Insufficient consideration of design before pricing

Bidding Metrics

- Most common: Price alone
- Bidding “cap”: Bid on how far can go with set amount of money
- Multi-parameter bidding (increasingly popular)
 - Consider non-price items (time, quality, qualification)
 - A+B Additive measures
 - Price+(\$/day)*days (common for retail),
Price+qualification+design rank, price+design rank,...
 - A/B (e.g. B scoring along some metric: Design, etc.)

Issues with Bids

- Low bidders can be unreliable
 - Prequalify aggressively!
- To allow for fast-tracking may bid early (30%)
- Don't try to force delivery from low bid
- Growing Frequency: innovative bidding method
- Pressure for lowest bid can create
 - Cutting corners
 - Low-quality personnel
 - Bad feelings

Bidding Process

- A/E oversight typical
- Publicity (specifies qualification requirements)
- Provide bid documents
 - Typically include fair cost estimate, sample contract
- Answer RFIs
- Pre-bid conference
 - Explain scope, working conditions, answer questions, documented in writing)

Public vs. Private Bidding

■ Public Bidding

- Must be publicly advertised (posting in newspapers, public building, etc.)
- Qualification occurs after submission of bids
- Typically 60 day period in which can submit bids

■ Private Bidding

- May be by invitation only
- Qualification occurs before submission of bids

Dealing with Way-Out Low Bids

- Forcing collection from unrealistically low bids is dangerous
 - Construction highly contentious, poor morale
 - Risk of extreme corner cutting
 - Default is possible
 - Disruption
 - Insurance companies fulfilling performance bonds very difficult to work with

Subcontracting Bids

- GCs push subs for lowest possible price before GC bids
 - GC not obligated to use sub who gave bid
- Can lead to serious predatory behavior
 - Bid shopping (before *and* after GC wins bid)
 - Bid peddling (unsolicited calls from subs to GCs after GC wins bid)
- Some owners/states require listing of chosen subs at bid time or assign based on sub-bidding

Qualifications

- Common items for qualifications
 - Bonds/Insurance (bid, performance, payment)
 - Safety record
 - Reputation
 - Financial strength
 - Total/Spare capacity
 - Licensing
 - Background in type of work
 - Experience in local area/labor market
 - Management system (QA, planning, estimation, control)
 - Interest, adaptability shown

Negotiation

- Typically selected based on reputation, qualifications
- Typically used for two cases
 - Very simple
 - Use trusted, familiar party
 - Very complex/big
 - Get contractor involved in design, start work early
- Requires relatively savvy owner
 - Evaluate proposals, monitor performance
- Important even for DBB for post-bid changes

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Negotiation Considerations

- Can get win-win because of differences in
 - Risk preferences
 - Relative preferences for different attributes
- Goal is to find a pareto optimal agreement
- Key skill in negotiation: Ability to find win-win options

Negotiation Tips

- Try to maintain clear sense of reservation price
 - Price or conditions under which will accept offer
- Want to adopt some objective basis for position
 - Without this impersonal criteria, other party can take disagreements personally as arbitrarily demands
- Discuss multiple issues at once
 - Permits trading off issues flexibly
- Formal exposure good—but experience gives edge

Negotiation Tips 2: Major Sins of Negotiation (Thomson, 2001)

- Leaving money on the table: Failing to identify and use win-win opportunities
- Settling for too little: Unnecessarily large concessions
- Walking away from the table: Rejecting terms that are favorable, often due to pride
- Settling for terms worse than existing alternative: Pressure to reach some deal leads to opportunity less attractive than opportunity cost