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1.040 Project Management  
Spring 2009

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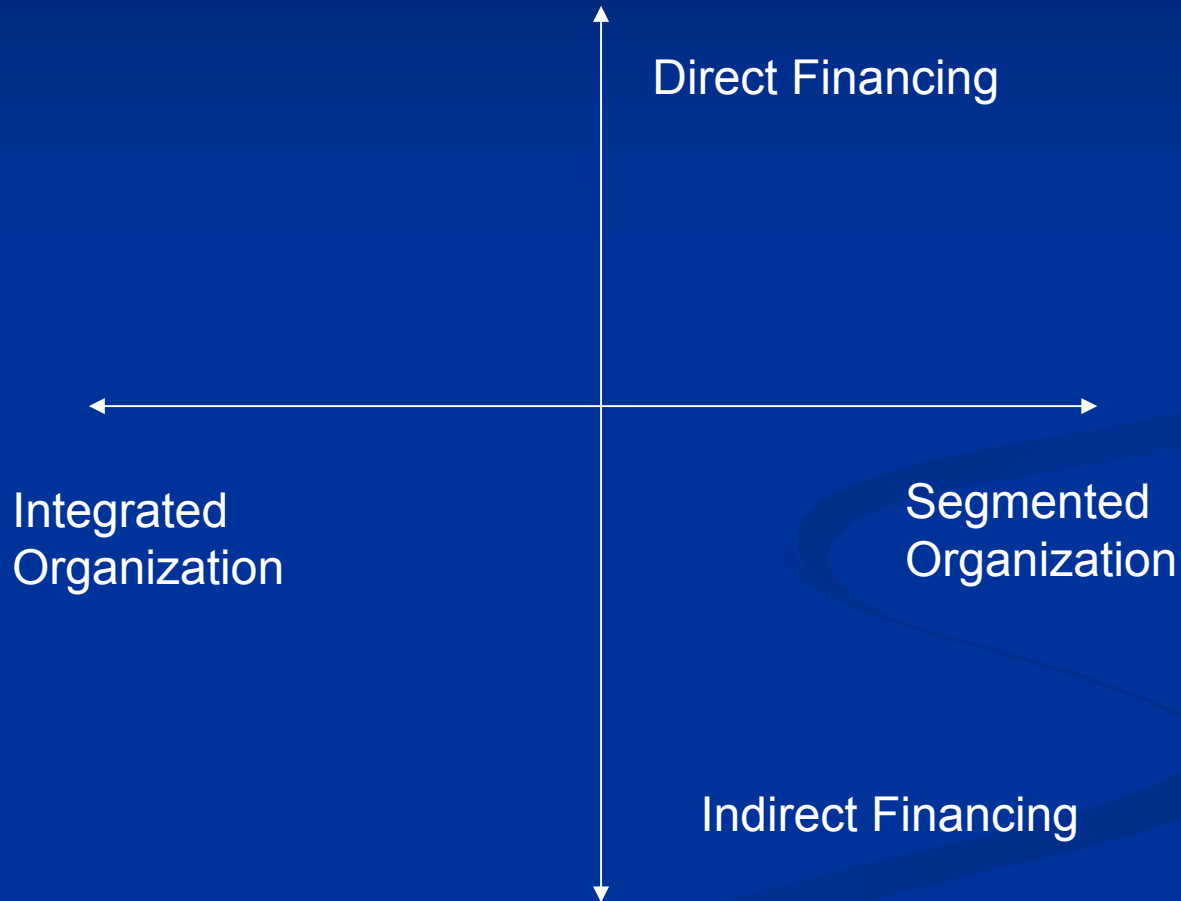
# Project Organization

Project Management  
1.040/1.401J  
*Spring 2009*

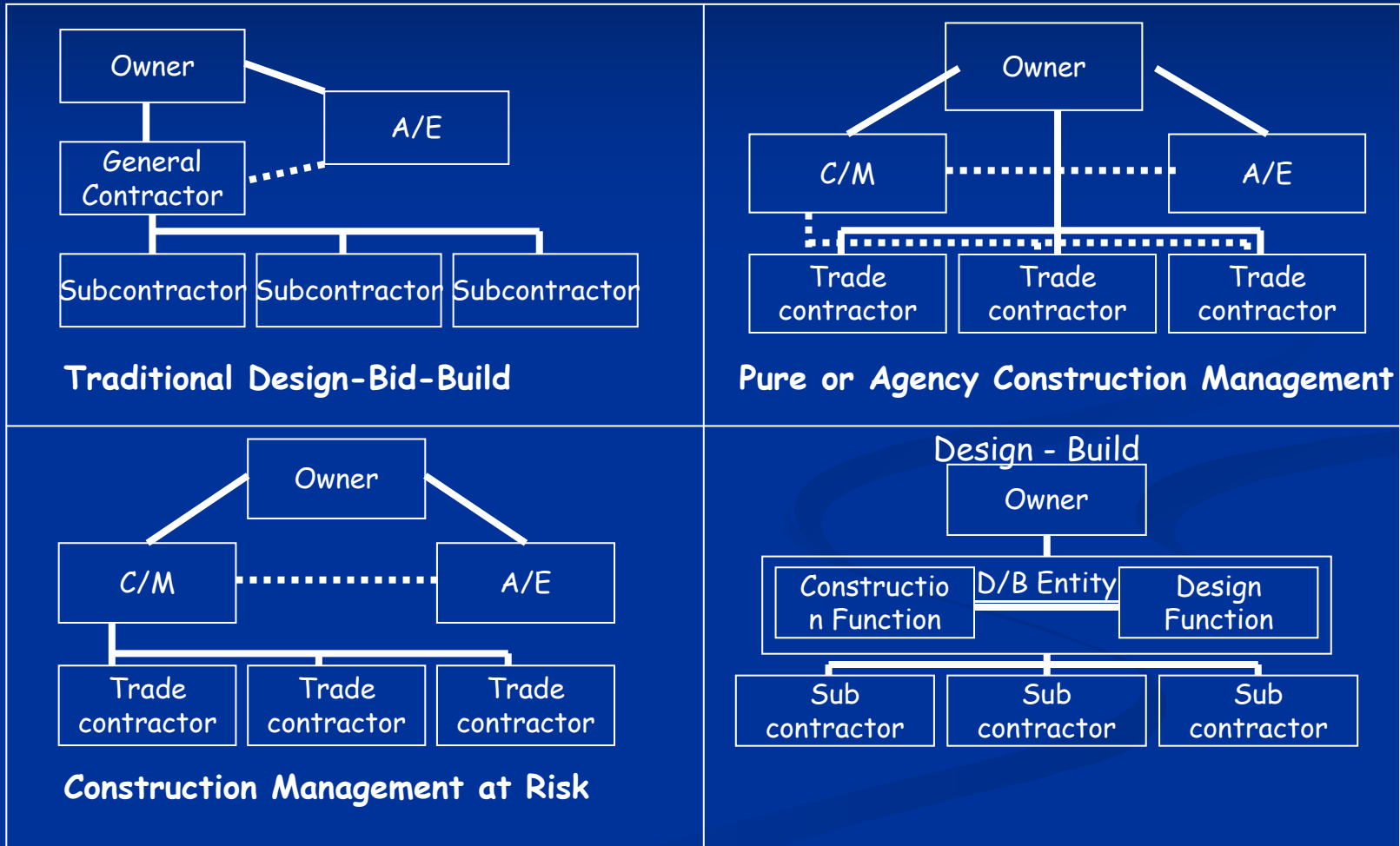
*Fred Moavenzadeh*

*Department of Civil and Environmental Engineering  
Massachusetts Institute of Technology*

# Broad Delivery Method Space



# Most Common Delivery Methods

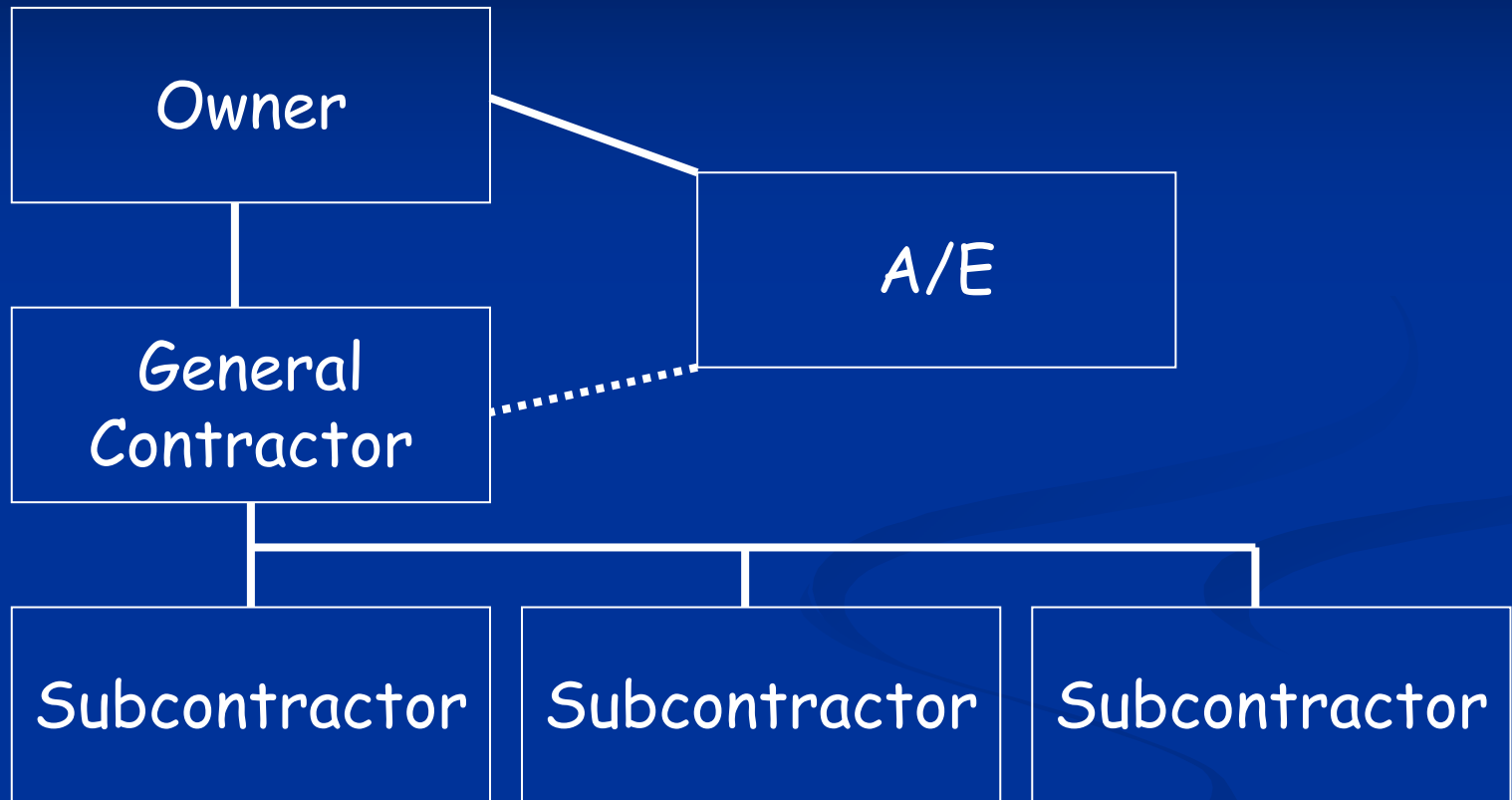


————— Contractual Relationship  
 ..... Communicational Relationship

# A Bit of History (Western World)

- Antiquity, Middle Ages: Design build
- 15<sup>th</sup> century
  - Greater Distinction between architect & trades
  - Greater attention to design
- 18<sup>th</sup> century: Century of engineering
  - General contractor in charge of trades, little subcontractors
- Before 1930s: mixture of methods
  - Most design-build, some with alternative financing (94%)
- Post WWII: Emergence of more specialized needs, subcontracting
- 1960s, 1970s: More complicated structures, emergence of CM, constructability needs

# Traditional Delivery Method



- Contractual Relationship
- ..... Communicational Relationship

# How To: Traditional

- Hire a design professional in charge of the preparation of the design and contract documents
- Competitive bid or negotiation with contractors *after* design complete
- Contractor in charge of the delivery of the completed project (may decide to subcontract)
- The contractor is the only one responsible of the execution of the work

# Traditional Delivery Method

- Sequential Construction Process
- Collaborative Relationship between A/E (Chosen on Qualification Basis) and Owner
- Different Participants' Interests:
  - Owner: Quality and Value Product, Delivery Schedule
  - Contractor: Profit, Construction Time, Site Safety, Relationships, Reputation
  - A/E: Profit, Aesthetics, Relationships, Quality, Recognition
- Lump Bids Commonly Adopted, Resulting in Adversarial Relationship between the Owner and the Contractor



# General Contractor Responsibilities

- Still responsible for a large fraction of jobs
  - Particularly public jobs with bidding
- For larger job, GC doesn't do much of work (sometimes <10%)
  - Sometimes verge up against CMs
- Division of responsibility for problems (Different teams)
  - Owner must mediate fights between contractor, designer
- Contractor designs temporary structures
  - Engineer needs to stamp (often *not designer* architect)

# Subcontractors

- GC manages most subcontractors
  - Overhead at each level
  - Handles submittals
  - Get bids from subcontractors (bid shopping a danger; no formal guarantee of award of contract)
  - Can be large number of subcontractors
  - Responsible for failure
  - Shop drawings typically produced by subcontractors
    - E.g. engineer consultants
    - Signed off on by architect to say that meets design needs
  - Problem: Things can fall through the cracks

# Subcontractors 2

- Motivations
  - No In-house ability
  - GC overstretched
  - GC lacks familiarity with local conditions
  - Need to get warrantees
  - Laws and regulations (assign subs to contractor)
  - Due to specialization, more efficient, cheaper
- Sometimes GC provides equipment to subs
- Tensions (e.g. how quickly, many subs on site)
- Subcontractor management very important for productivity
- Sometime owners or GC put umbrella insurance over
- Required to have bonding by owner

# Role of Architect/Engineer

- Typically negotiated contract
  - Recruited on service rather than commodity basis
  - Financial stability, other factors critical
  - Sometimes have design competition
  - Don't want to push too low:
    - Poor design
    - Poor personnel
    - No time for double-check
- Contrast
  - Price of design has small impact on overall price
  - Quality of design has big impact on overall price

# Role of Architect/Engineer II

- If estimates off, may be required to redo design at own expense
- Carry errors and omissions experience
- Limited participation in construction process
  - Typically “observes” constructions
    - Avoid official assumption of inspection guarantees
  - Review shop drawings – with disclaimers
- Avoids close communication with GC
- Do not want to direct construction methods
  - May put suggestion in contract documents

# Advantages

- Well known method (courts, companies)
- Flexibility during design (vs. design-build)
- Cost defined early (when bidding)
- Good contractual protection for the owner
- Open bidding procedure very easy
- Owner not too involved in the construction process
- Fiduciary relationship between A/E & owner
- Good if uncertainty primarily in design

# Disadvantages

- Design not reviewed before construction
  - Miss opportunities for major time/cost savings
  - May yield changes due to constructability probs
- Sequential and linear process preventing from overlapping of tasks and money saving
- Few interactions among the participants
- Too rushed to consider multiple alternatives
- Construction can't start until design is complete

# Disadvantages II

- Innovative financing difficulty
- Leads to very conservative design strategies
- Difficult for complex projects



# How To: Construction Management

- The Owner hires both a design firm and a construction management firm *before* the beginning of the construction of the project
- Typically CM selected based on quality
- Many variations are possible in the delivery method depending mostly on when the management team is hired and its skills

# General Characteristics

- Started in late 1960s
  - World trade center
  - Madison Square Garden
- May recommend A/E
- Check billings
- Specific CM firms tend to be quite sophisticated
  - Warning: Many GCs claim CMs
  - “design CM”, “construction CM” “owner CM”

# Tasks

- Preconstruction
  - Constructability, value eng, estimation, alternatives, schedule, financing, manage designer, early procurement
- Field supervision
  - QA, Targets met, invoice checking, coordinate work of contractors, M&E, change orders, payments, claims, inspections for design requirements, sometimes safety

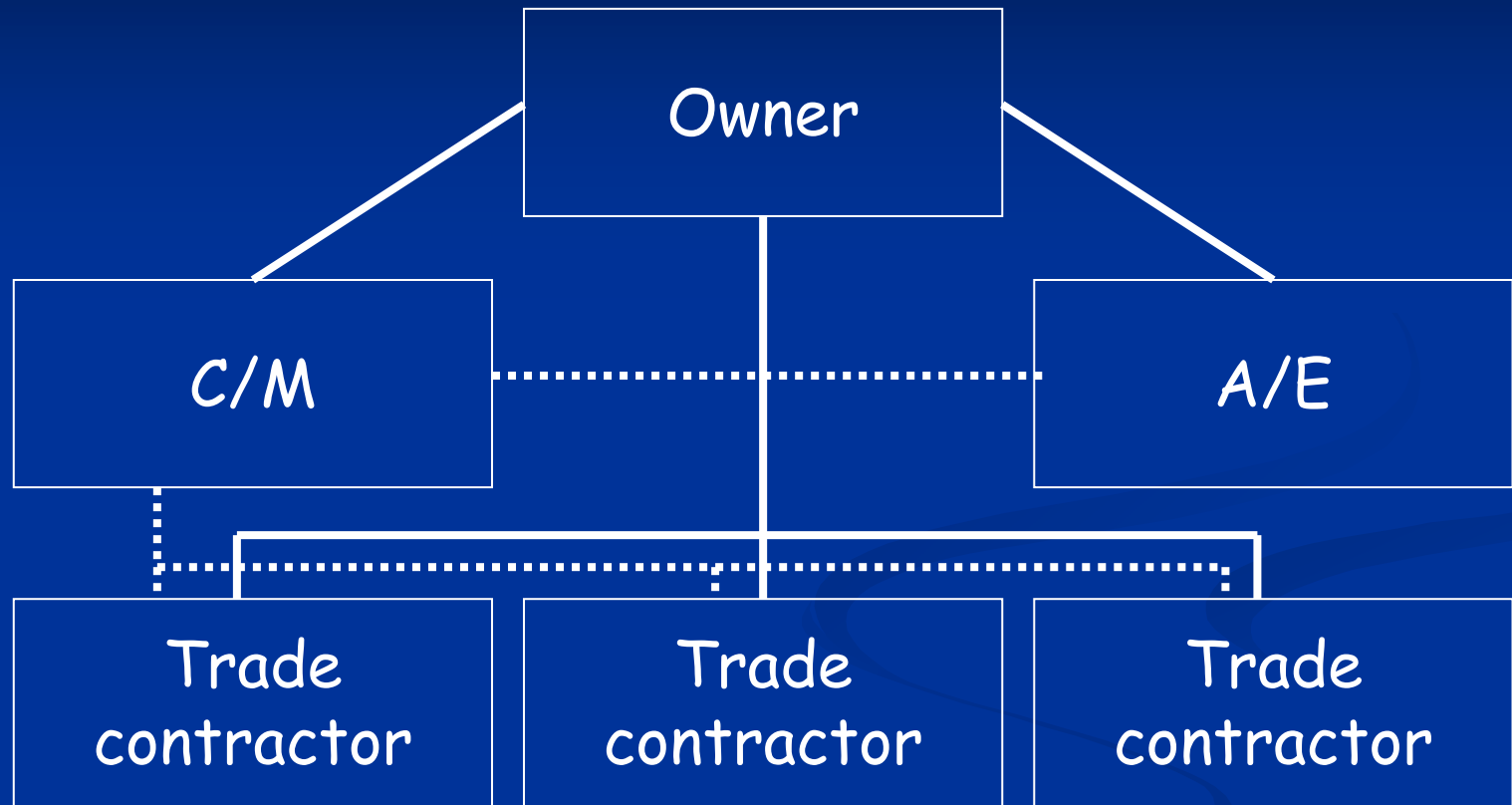
# CM General Advantages

- Involvement in design allows better
  - Knowledge of price early on
  - Eliminates risks in design before bids
  - Constructability, value engineer. reasoning from start
  - Working construction constraints into design plans
- Allows flexibility in the Schedule (Fast tracking )
- Can select CM based on quality
- Really familiar with plans before price/get bids

# CM General Disadvantages

- Don't know total cost when start construction
- Potential conflicts with other parties
  - Designer
  - Subcontractors
  - (Where applicable) GC

# Pure (“Agency”) Construction Management



————— Contractual Relationship  
..... Communicational Relationship

# Pure Construction Management

- Great Flexibility in the Schedule and for Changes
- Market Competition for subcontracts
- Fiduciary Relationship with the Contractor
- Small Financial Risks of PCM and High Risk of Loss of Reputation
- PCM Generally Paid a Fixed Fee (professional)
- Take over work of designer, GC, owner
- PCM as Facilitator/Mediator in Conflicts

# Advantages Pure CM

- Great Flexibility for Changes
- CM more objective, less partial
- Less conflict between owner and CM
- Small Financial Risks of PCM
- Have both
  - Cost competition (for subcontractors)
    - Often 5-8% savings for dealing directly with subs
  - Fiduciary relationship with GC
- One common reference point: The CM
- Owner can get rid of particular subcontractor
- Lessens owner's responsibilities



# Disadvantages Pure CM

- Lower incentive for CM to reduce price, time
- Owner alone takes risk on cost of project
  - No guarantee from CM!
- Participants must all be cooperative and well communicating
- High Risk of Loss of Reputation
- All parties must be committed from the beginning

# Lessens Owner's Responsibility

- E.g.
  - Project control
  - Job meetings
  - Management meetings
  - Reports (operational and annual)
  - Administrative tasks
  - Budgets
  - Drawing approval
  - Oversight
  - Quality assurance

# Central Artery / Big Dig



<http://www.masspike.com/bigdig/index.html>

# Central Artery / Big Dig

- Most complex highway project in American history
- The project consist in building 161 lane miles of urban highway - about half underground in a 7.5-mile corridor
- Planning for the Central Artery/Tunnel Project began in 1982
- Congress approved funding and the project's basic scope in April 1987

# Central Artery / Big Dig

For the Fort point channel:

- Notice to proceed was granted to Modern Continental on March 7 1997
- Expected date of completion: March 13 2002
- Estimated cost: 301,377,284.10 \$
- Modified estimated cost: 403,929,276\$
- Modified date to completion: December 2004
- Engineers + consultants = 100
- Workers on the site = 800
- Priorities = schedule- cost- technical

# Project Organization

- ✓ Project Delivery Systems (most common)

- ✓ Traditional

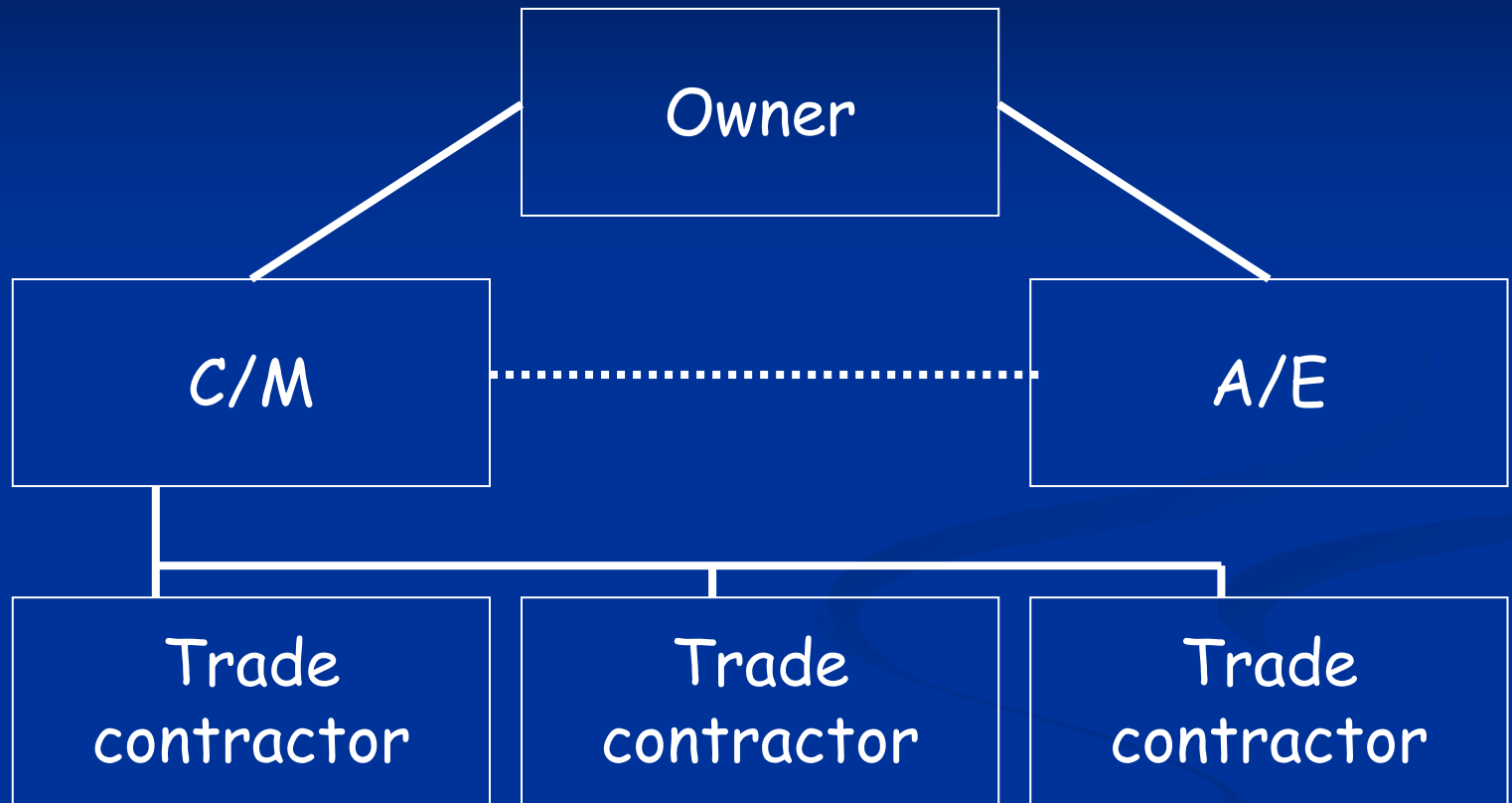
- ✓ Pure Construction Management

- Construction Management at risk

- Design / Build

- Summary

# Construction Management at Risk



———— Contractual Relationship

..... Communicational Relationship

# Construction Management at Risk

- CM *usually* Guaranteeing Maximum Price: GMP to give the owner security that the project will be built within budget
  - Often set at 95% of design
  - This is a big difference from pure CM
  - Fee typically 10-15%
- Reduced Owner Risk
- Risk-wise,  $\frac{1}{2}$  between the DBB and the PCM System (VERY similar to GC hired early)
- Contractual Relationships betw. CM&subs
- Performance bonds typical



# Advantages CM at Risk

- Reduced Owner's Risk
- CM at risk usually goes with Guaranteed Maximum Price (GMP)
- Contractual Relationships between CM and Trade Contractors

# Disadvantages CM at Risk

- The GMP is a defined price for an undefined product
- Bad during design: Design pressure
- Tension
  - CM hired early: more price risk
  - CM hired late: less value during design
- CM is no longer impartial (may argue against changes b/c of own interest)
- Risk of adversarial relationship
- The contract can be hard to enforce

# Albert and Barrie Zesiger Sports and Fitness Center

- Groundbreaking : October 2000
- Occupancy : 2002
- Designed by the architectural firms of Roche & Dinkeloo and Sasaki Associates
- Construction: Turner Construction Co.
- Cost : \$45 million
- Olympic-class 50-meter pool
- An 11,000-square-foot fitness center