

# Strategic Management and Project Selection

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- Maturity of Project Management
- Overview
- Criteria for PS Models
- Nature of PS Models
- Types of PS Models
- Uncertainty Analysis and Risk Management
- Information Base for PS Models
- Project Portfolio Process (PPP)
- Project Proposal

# Project Management Maturity Levels

- Ad-hoc (essentially disorganized)
- Abbreviated (some processes exist)
- Organized (standardized processes)
- Managed (measured processes)
- Adaptive (continuous improvement)

# Overview of PS Process

- Project Management Office (PMO)
- Project selection
- Dealing with uncertainty
- Strategically selecting best projects
- Locking up the deal

# PS Models

- Idealized view of reality
- Representing the STRUCTURE of the problem, not the detail
- Deterministic or stochastic

# Criteria for Project Selection Models

- **Realism** (technical-, resource-, market-risk)
- **Capability** (adequately sophisticated)
- **Flexibility** (valid results over large domain)
- **Ease of Use** (no expert needed to run model)
- **Cost** (much less than project benefit)
- **Easy Computerization** (use standard software)

# Nature of PS models:

## *Caveats*

- Project decisions are made by PM --  
- NOT by PS model!
- A PS model APPROXIMATES, but  
does NOT DUPLICATE reality!

# Nature of PS Models: Methodology

- **Start** with goals
- **Create** list of factors (PEF's)
- **Weigh** every element in list
- **Compute** an score for project
- **Select** project aligned with firm's goals

# Project Evaluation Factors (PEFs)

- Production Factors
- Marketing Factors
- Financial Factors
- Personnel Factors
- Administrative and Misc. Factors

# Types of PS Models: Nonnumeric

- Sacred Cow
- Operating Necessity
- Competitive Necessity
- Product Line Extension
- Comparative Benefit Model

See Q sort



# Numeric PS Models: Profit / Profitability

- Payback Period (PB)
- Discounted Cash Flow (NPV)
- Internal Rate of Return
- Profitability Index
- Other Profitability Models

# Numeric PS Models: Scoring

1. Unweighted 0-1 Factor Model
  - $S = \sum(x)$
2. Unweighted Factor Scoring Model
  - $S = \sum(s)$
3. Weighted Factor Scoring Model
  - $S = \sum(s \cdot w)$
4. Constrained Weighted Factor Scoring Model
  - $S = \sum(s \cdot w) \prod(c)$

# Choosing the PS Model

- Dependent on wishes and philosophy of management
- 80% of Fortune 500 firms choose "nonnumeric" PS models
- Firms with outside funding often choose scoring PS models
- Firms without outside funding often choose profit / profitability PS models

# Management of Risk: Terminology

- **Risk:** Decision based on complete information about the probability of each possible outcome.
- **Uncertainty:** Decision based on incomplete or insufficient data.
- **Game:** Decision based under conditions of conflict.

# Areas of Uncertainty

- Project timing & expected cash flow
- Direct outcome of project, i.e. what exactly will the project accomplish
- Side effects and unforeseen consequences of project
- Reward assess plan

# Risk Analysis

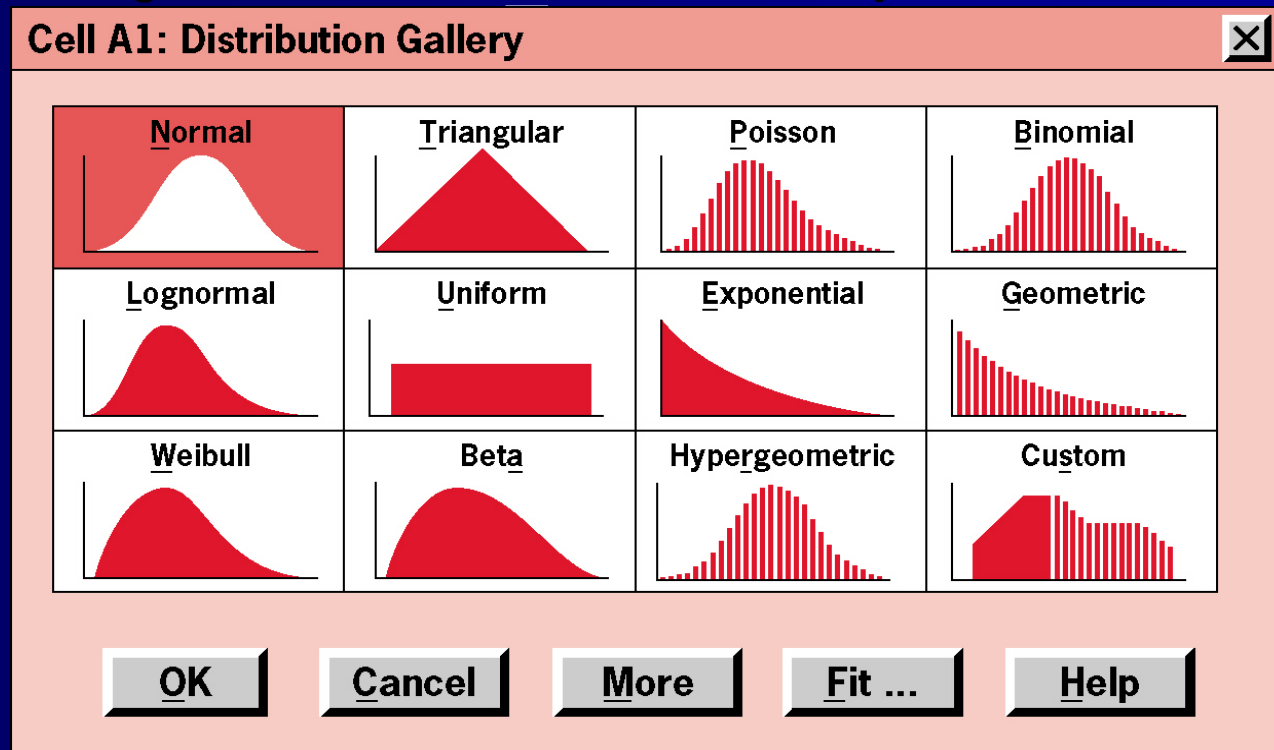
## Crystal Ball® 2000

### Software

- 1) Start with estimated risk profile for all key parameters of project
- 2) Use Crystal Ball®, an EXCEL® plug in, to represent decision by statistical model
- 3) Repeat many times to get a statistical distribution of all possible outcomes

# Risk Analysis: Crystal Ball® 2000 Software

- 1) Input of Cash Flow parameter from Psycho Ceramic example

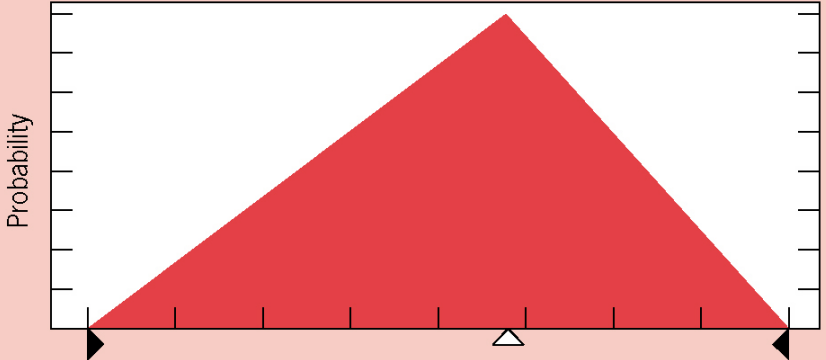


# Risk Analysis: Crystal Ball® 2000 Software

- 2) Select distribution parameter  
(Triangular for this example)

Cell B7: Triangular Distribution

Assumption Name:

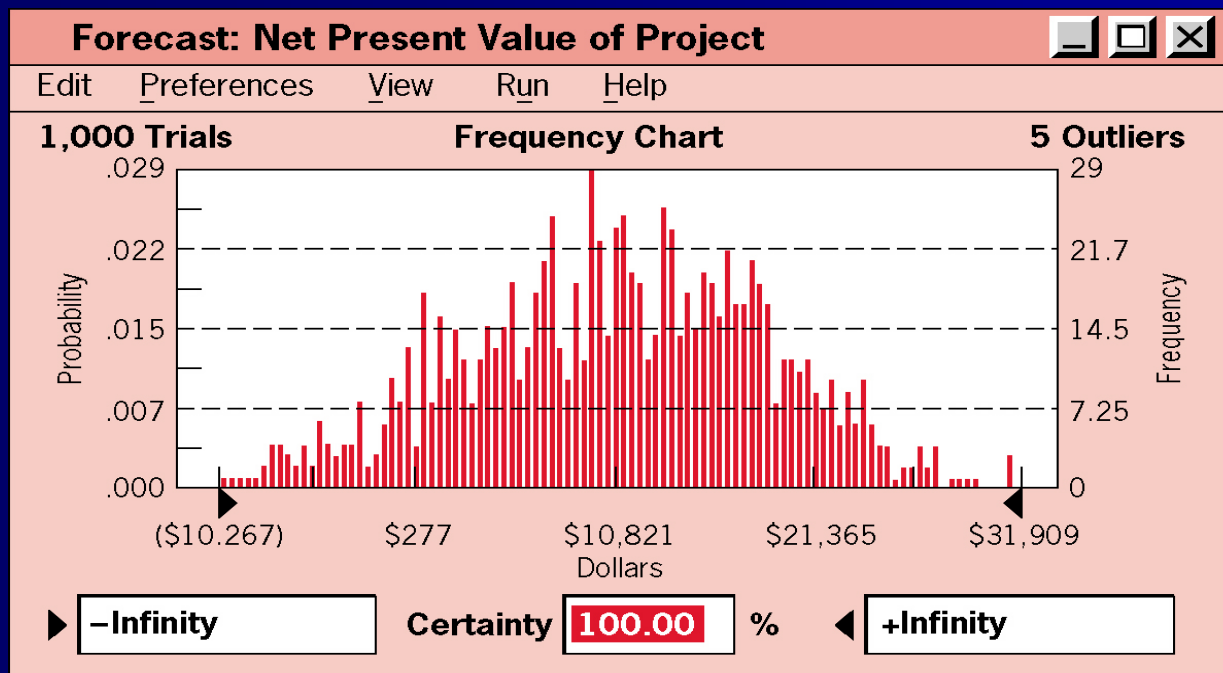


35,000 41,250 47,500 53,750 60,000

Min  Likeliest  Max

# Risk Analysis: Crystal Ball® 2000 Software

- 3) Output, 1000 Monte Carlo Runs  
(example: Average Project NPV \$10,821)



# Window-of-Opportunity Analysis

- **Estimate** *in advance* economic impact of innovation before R&D is undertaken
- **Set up** a baseline of current process as the sum of all current sub-processes
- **Compute** cost/performance of new innovation as a multiple of each sub-process in the baseline system

# Problems Affecting Data Used in PS Models

- **Accounting:** arbitrary assignment of overhead costs, linear cost and revenue forecasts

# Problems Affecting Data Used in PS Models

- **Measurements:** subjective vs. objective, quantitative vs. qualitative
- **Technology shock:** New technology has to overcome initial resistance threshold.

# Project Portfolio Process (PPP)

- Step 1: Establish a Project Council
- Step 2: Identify project categories & criteria
- Step 3: Collect project data
- Step 4: Assess resource availability
- Step 5: Reduce project and criteria Set
- Step 6: Prioritize projects within categories
- Step 7: Prioritize the projects within categories
- Step 8: Implement the Process

# Step 1: Establish a Project Council

Includes:

- Senior Management
- Project Managers of major projects
- Relevant general managers
- Those who identify **key risks**
- Those who could **derail PPP later**

# Step 2: Identify Project Categories and Criteria

- Derivative Projects
- Platform Projects
- Breakthrough Projects
- R & D Projects

# Step 3: Collect Project Data

- **Use** “activity based costs”
- **Verify** all data
- **Include** timing for benefits and resource needs
- **Document** assumptions for future checking

# Step 4: Access Resource Availability

Access availability of Internal and External Resources by:

- **Type**
- **Department**
- **Timing**: can vary 100% over project life cycle

# Step 5: Reduce the Project and Criteria Set

## Narrow down existing projects

- required competence exists in organization
- Market for offering
- Profitability
- Risk
- Potential partner to assist with project
- Right resources available at the right times
- Good technological fit with organization
- Uses organization's strengths
- Synergetic with other important projects
- Slipped in desirability

# Step 6: Prioritize Projects within Categories

- **Rank** projects within each category
- **Measure** by
  - Risk
  - Development of new knowledge
- **Consider** benefits first
- **Consider** cost second

# Step 7: Select the projects to be Funded and Held in Reserve

- **Determine** the mix of projects across various categories and time periods
- **Leave** 10-15 % of organization's resources free
- **Focus** on committing to FEWER projects

# Step 8: Implement the Process

- Make results of the PPP widely known
- Senior management must fully fund
- Process will be repeated on a regular basis

# Project Proposal: Content

- Cover letter
- Executive summary
- Description and past experience of project team
- Nature of technical problem to be solved
- How to approach solution of technical problem
- Plan for implementation of project
- Plan for logistic support and administration

# Project Proposal: Cover Letter & Executive Summary

- **Compose** a cover letter
- **Explain** nature and benefits
- **Minimize** technical language

# Project Proposal: Past Experience of Project Team

- **List** key personnel
- **Include** resume of principals
- **Provide** references

# Project Proposal: Technical Approach

- **General description** of project
- **Major subsystems**
- **Methodology**
- **Special** requirements
- **Test** procedures

# Project Proposal: Implementation Plan

- **Estimates**
- **Establish** milestones
- **List** costs
- **Develop** contingency plans

# Project Proposal: Plan for Administration and Logistic Support

- **Control** subs
- **Nature and Timing** of all reports
- **Change** management
- **Termination** Procedures
- **“Touch of class”** capabilities

**End**

**DESIGN-BID-BUILD**

**DESIGN-BUILD**

**CONSTRUCTION MANAGEMENT AT RISK (CM @ RISK)**

**JOB ORDER CONTRACTING**



# In the Beginning.....

- Project delivery systems evolved over time.
- In centuries past the *master builder* was hired by a facility owner to design, engineer and construct an entire facility.
- The master builder had complete control of the design and construction of a facility.

# Project Delivery System Evolution.....

- This master builder system was common until the industrial revolution and, in some cases, into the early 20<sup>th</sup> century.
- Frank Lloyd Wright was one such example.
- Subsequently, changes in technology and the increasing sophistication in buildings required specialization of design and construction services.
- Designers and constructors began to separately specialize in the design, fabrication and/or construction of particular building systems.

# Project Delivery System Evolution.....

- Specialists became separate companies
- Hired to provide their specific service or install products.
- Led to the traditional *design-bid-build* system
- Separation of design and build services in the public sector was also a response to perceived corruption in the public sector.
- Sealed bidding was seen as the only way to select teams objectively.

# Project Delivery System Evolution.....

- Separation and specialization of services increased, design and construction entities shared information only at the end of design and during the construction process.
- Interaction was extremely low.
- Results? Inefficient designs, increased errors, disputes, higher costs and, ultimately, longer schedules.
- In the 1970s and 1980s, facility owners brought in *third parties* to assist them in managing design and construction entities.

# Project Delivery System Evolution.....

- Third parties, often called agency construction managers, did not hold the trade contracts nor contractually guarantee the cost or schedule to the owner.
- Projects were still awarded to a low bid general contractor. agency construction managers act as an agent of/or advisor to the owner.
- Late 1980s and 1990s, the concept of the contractor in a similar role as the agency construction manager, but contractually taking responsibility for the work, and guaranteeing both the cost and schedule.

# Project Delivery System Evolution.....

- As general contractors developed capabilities, the construction manager/general contractor (CM/GC) or *construction manager at risk* (CM at-risk) evolved.
- Under this approach the construction manager, could also self perform some or all portions of the work in order to meet a contract guarantee.
- In CM @ Risk, the contractor has significant input in the design process and guarantees the maximum construction price. (GMP)

# Project Delivery System Evolution.....

- A desire for unified responsibility in the project delivery process and a faster, more seamless, delivery led many owners toward single source *design build* contracting.
- Widespread efforts to downsize in-house project management staff and costly disputes between design and construction parties also made design-build contracting popular
- In the 1990s the design-build project delivery system saw increased use. This project delivery system is characterized by a single contract between the design-build entity and the owner.

# Project Delivery System Evolution.....

- By 1996, design-build was recognized for use in public agency procurement in over half of the 50 U.S. states and accounted for over 24 percent of the \$286 billion of non-residential construction put in place (Forest, 1997).
- Congress also enacted specific authorization that enabled federal contracting officers to use the design-build project delivery system in the public sector.
- Also, civil and infrastructure industries developed new applications of design-build to procure highway and bridge projects (Powers, 1997).

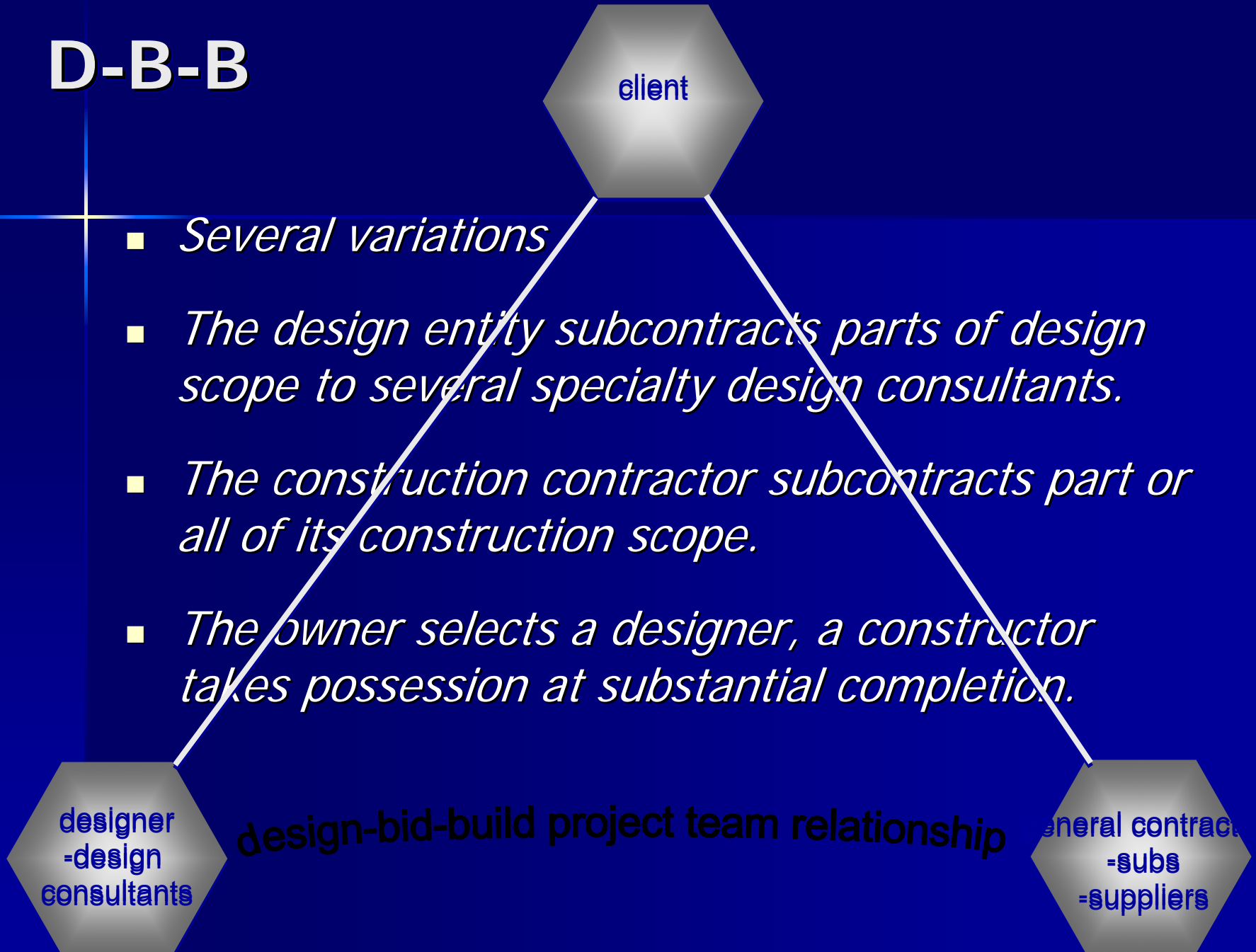
# Project Delivery System Definitions...

- A project delivery system defines the relationships, roles, and responsibilities of parties and the sequence of activities required to provide a facility.
- More commonly stated, delivery methods “describe the roles of participants, the relationships between them, both formal and informal, the timing of events and the practices and techniques of management that are used” (Ireland, 1982).

# Design-Bid-Build...

- Traditional project delivery system in the U.S. construction industry under which the owner contracts separately with a designer and a constructor.
- The owner normally contracts with a design entity to provide "complete" design documents.
- The owner subsequently solicits fixed price bids from construction contractors to perform the work.
- A general contractor is selected and enters into an agreement with the owner to construct the facility in accordance with the plans and specifications.

# D-B-B



# Design-Bid-Build...

Project start

Substantial completion



Select designer

design

Select constructor

construction

Design-bid build project timeline



# Design-bid-build advantages...

- Established way of doing things
- Suitable for competitive bidding
- A/E directly works for owner
- Extensive litigation has resulted in well established legal precedents.
- No legal barriers in procurement and licensing
- Insurance and bonding are well defined

# Design-bid-build disadvantages...

- Two contracts for owner to manage
- Disagreements go through owner, owner bears design adequacy risk
- All parties have different agendas/objectives
- Initial low bid doesn't result in final best value
- Bids over budget presents most difficulties in reducing costs/creates significant delay
- No constructor involvement in design
- Slowest project delivery system
- Most litigious delivery process

# Design-build...

- ***Design-build*** represents the most recent evolution of project delivery systems. It is a project delivery system where the owner contracts with a single entity to perform both design and construction under a single design build contract.
- Contractually, design-build offers the owner a single point of responsibility for design and construction services and often guarantees the performance of the facility.
- Portions or all of the design and construction may be performed by a single integrated design-build entity.

# Design-build...

client

- Selected specialty work, or in some cases all work, may be subcontracted to other design, construction or design-build specialty companies.
- The owner selects a design-build entity to design and build the facility. The constructor portion of the entity provides constructability input to design and then constructs the facility as portions of the design become available.
- The owner takes possession of the facility at substantial completion

Design-build  
entity

# Design-build...

Project start

Substantial completion



Select design-builder

design

Pre- construction

construction

Design-build project timeline



# Design-build Advantages...

- Single point of responsibility for owner
- One RFQ and or RFP required vs. two for other systems
- More professional relationship with contractor
- A/E and constructor on the same team providing unified recommendations to owner
- Fastest most cost-effective delivery system
- Design submission and pricing project at proposal stage possible
- Earliest knowledge of firm costs

# Design-Build Advantages...

- Allows most innovations/options for owner to select
- Delivers equal or higher quality
- Allows clearest definition of risks
- Fewer changes
- Fewer claims and less litigation

# Design-Build Disadvantages...

- Owners pushed for earlier and timely decisions
- New learning curve for owners
- Different process in front end of project
- Barriers in some states with procurement and licensing
- Use of new insurance bonding products
- Resistance among those not familiar with approach

# Construction Management at Risk.....

- ***Construction Management at Risk*** evolved from the traditional project delivery system as a method to somewhat overlap the design and construction phases and to obtain significant constructability input during the design phase of a project.
- Construction Management at Risk is a project delivery system where the owner contracts separately but somewhat simultaneously with a designer and a contractor.
- The owner contracts with a design entity to provide a facility design. As with the design-bid-build methodology, the designer may subcontract part of its design scope to specialty sub consultants.

# CM @Risk

- The owner selects contractor to perform construction management services and construction work in accordance with the plans and specifications, for a fee and reimbursable costs.
- Construction manager has significant input during the design phase.
- The construction manager (CM) generally will subcontract part or all of its construction scope to specialty contractors as soon as that specific part of the design is completed.
- When the design is sufficiently complete, the CM usually guarantees the maximum price of the project and a project schedule to the owner.

# CM @Risk

- Any savings in actual costs under the guaranteed maximum price can be shared by the owner and contractor, or retained in full by the owner.
- The owner selects a designer to design the facility. The owner can simultaneously select a CM/GC to provide constructability input to design and then to build the facility. The CM/GC then constructs the facility and the owner takes possession at substantial completion.

*construction management at risk project team relationship*

client

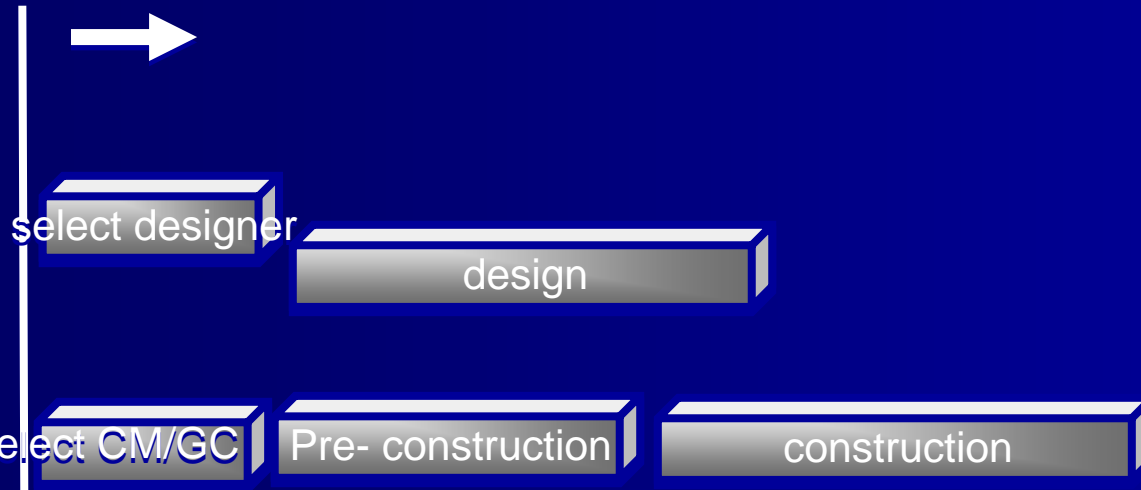
designer

Construction  
Manager/  
General  
contractor

# Construction Management at Risk...

Project start

Substantial completion



Construction management at risk project timeline

# Construction Management at Risk Advantages.....

- More professional relationship with contractor
- Earlier knowledge of costs
- Earlier involvement of constructor possible
- Two contract system is less change for owner
- Project delivery faster than traditional

# Construction Management at Risk Disadvantages.....

- Two contracts for owner to manage
  - Disagreements go through owner
  - Owner bears design adequacy risk
- Parties may still have different agendas/objectives
- Cannot firmly price project as part of proposal
- Constructor input may not be included by designer
- Project delivery slower than Design-build
- Agency CM places ever more risk on owner

# United States Project Delivery System Study.....

- The objective was to empirically compare cost, schedule and quality performance of projects delivered using design-build, design-bid-build, and cm @ risk.
- Data from 351 general building projects recently completed in the United States.
- Statistical analysis of cost, time data and quality results quantified the differences among the project delivery systems studied.

# United States Project Delivery System Study.....

- In 1997, the top 400 contractors in the U.S. construction market generated \$62.6 billion in revenues from the general building sector.
- This represented 45% of their total volume (Tulacz, 1998).
- The data was divided into six sectors of the U.S. general building market.
- The six general building sectors studied were: light industrial, multi-story dwelling, simple office, complex office, heavy industrial and high technology.

# Summarizes the primary results of the study.....

Metric	Design-build Vs. Design-bid-build	CM@R vs. Design-bid-build	Design-build vs. CM@R	Level of Certainty
Unit Cost	6.1% lower	1.6% lower	4.5% lower	99%
Construction Speed	12% faster	5.8% faster	7% faster	89%
Delivery Speed	33.5% faster	13.3% faster	23.5% faster	88%

*\* The level of certainty is a statistical measure used to express the ability of a particular regression model to explain differences in each performance metric. The higher the Level of certainty the more confident one can be about the results shown.*

*(Sanvido & Konchar 1999)*

# Illustrates the average differences among the project delivery systems.....

Metric	Design-build Vs. Design-bid-build	CM@R vs. Design-bid-build	Design-build vs. CM@R	Level of Certainty
Cost Growth	5.2% less	7.8% more	12.6% less	24%
Schedule Growth	11.4% less	9.2% less	2.2% less	24%

*\* The level of certainty is a statistical measure used to express the ability of a particular regression model to explain differences in each performance metric. The higher the Level of certainty the more confident one can be about the results shown.  
(Sanvido & Konchar 1999)*

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- [www.dbia.org](http://www.dbia.org)