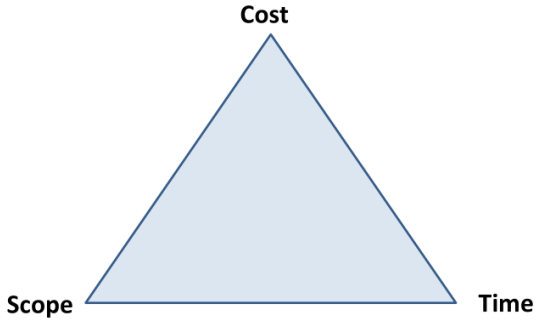
PM-1 Presentation

PMI – Project Management Institute

PMBOK – Project Management Body of Knowledge

- First edition published 1996
- 6th edition published 2017 (most recent)
- Outlines requirements for PMI exams
    - PMP (Project management professional)
    - CAPM (Certified associate in project management)
    - PgMP (Project management professional)
    - PMI-SP (Project management institute - Scheduling professional)

Project objectives (old):



Project objectives (new):

Projects

- Temporary
- Unique outcome
- Clear beginning and end
- Meet objective
- Differ from ongoing operations

Portfolio

- Sub Portfolios
    - Programs
    - Projects
- Programs
    - Sub programs
    - Projects
- Projects

PM-2 Presentation

PMO – Project management office
- Standardizes project-related processes
- Facilitate sharing resources, methods, and tools
- Supportive, controlling, and directive

PM – Project manager
- Leads the team responsible for achieving project objectives
- Satisfy task needs, and individual needs
- Competencies:
    - Technical project management
    - Leadership
    - Strategic and business management

Differences between PMO and Project Managers
- Level of focus, project vs. programs
- Resource allocation level
- Management level

Organization hierarchies
- Functional
- Projectized
- Matrix (somewhere between the other two)

Typical **project team**
- Project manager
- Project management staff
- Project staff
    - These first three exist in most projects
- Supporting experts
- User or customer representatives
- Sellers
- Business partner and their members

Project teams are
- Part-time (common in functional)
- Dedicated (common in projectized)

(Thus, matrix organizations use both)

Partnership-based projects
- Strategic alliance
- Joint venture
    - JV Project
    - JV Company
- Consortium

Strategic alliance

- Long-term
- Based on trust and mutual respect for each participant's business needs
- Further common interests of members
- Can be either horizontal (between contractors) or vertical (owner and contractor)
- Share resources, technologies, markets, profits, and supplement each others needs

Advantages

- Reduces investment risks
- Share technologies
- Enhance global mobility and competitiveness

Disadvantages

- Difficult to maintain
- Low efficiency

Joint venture project

- Two or more legally separate entities make a jointly-owned entity
    - Can be formed between contractors, contracts and design firm, contractor and owner
- Jointly-owned entity has two forms
    - Corporation
    - Partnership
- Can be further classified as majority, equal, or minority joint venture
- Either integrated or non-integrated
    - Integrated (take staff from each partner to form a project team)
    - Non-integrated (partner makes a team for their portion of the project, no team mixing)
- Set up by each partner contributing cash, facilities, equipment, materials, intellectual property rights, work force, and/or land use rights
- Pre-agreements set up to avoid competition between partners

Advantages

- Flexible (just for one project or projects)
- Mobile in the foreign market
- Cost saving by using partner's infrastructure

Disadvantages

- Difficult to find the right partner
- Power struggles
- Liability issues

Consortium

- Two or more individuals, companies, organizations
- Involved in a project or operation to achieve a common goal
- No independent entity

PM-3 Presentation

Project lifecycle

- Some typical project phases
  - Starting the project
  - Organizing and preparing
  - Execution
  - Closing the project
- Phases determined based on related activities which produce one or more deliverables
- Project phases are mostly sequential, but can overlap
- Risk magnitude decreases as time increases
- Cost of change increases as time increases
- Projects are most vulnerable near the end of their lifecycles
- Most risks occur near the beginning of their lifecycle

Types of project lifecycles

- Predictive
- Iterative
- Incremental
- Agile

Predictive lifecycle

- Scope, time, and cost determined in early stages
- Used in well-defined projects (residential construction)
- Fixed project requirements
- Phases are mostly sequential
- Project carried out in single pass
- Main goals are to manage cost and time

Iterative lifecycles

- Iteration in some project phases to enhance understanding
- Mostly used in high-tech and R&D projects
- Project requirements can change
- Some stages are repeated until everything is correct
- Main goal is the correctness
- Stakeholders might provide feedback on the prototypes

Incremental lifecycles

- Project speed is the main goal
- A portion of the overall solution is delivered first
- Smaller deliverables are delivered subsequently
- Project requirements can change
- Common in software industry

Agile lifecycles

- Common in modern software industry
- Uses aspects of iterative and incremental approaches
- Quick iteration and feedback loops for better understanding of requirements and faster delivery

Project management processes

- Initiating
- Planning
    - Iterative w/ executing
- Executing
    - Iterative w/ planning
- Monitoring and controlling
- Closing

Initiating process group

- Define a project (or a new phase of a project)
- Assign project manager
- Develop and approve “Project charter”
- Align the stakeholders’ expectations with the project
- Create a shared understanding of the project among involved parties
- Sometimes initiating processes re-performed at higher levels than the project
- Part-time (common in functional)

Planning process group

- Determine the scope of the project
- Define objectives
- Develop course of action required to achieve objectives
- Develop project management plan
- Require comprehensive information gathering
- Iterative process to progressive elaboration
- Discover and plan for risks

Monitoring and controlling process group

- Monitor performance against baseline performance indicators
- Monitor changes
- Active and passive control
    - Identify influencing factors
- Take corrective or preventive changes

Closing process group

- Processes to complete a project, phase, or contractual obligations
- Premature closure of the project
- Important tasks include
    - Obtain completion certificates
    - Document lesson learned
    - Archive documents as historical data
    - Team assessments

PM-4-1 Presentation

Project integration management – aims to identify, define, combine, unify, and coordinate various project management processes

- Develop project charter
- Develop project management plan
- Direct and manage project work
- Monitor and control project work
- Perform integrated change control
- Close project or phase
- Develop a document that authorizes the existence of a project
- Authority of the project manager

Project charter

- Initiated by an entity external to the project
- Better to involve project manager (as soon as identified)
- Validates alignment of the project to the strategy of the organization
- Project charter is not a contract

Inputs to project charter

- Project statement of work (SOW)
- Business case
- Agreement
- Enterprise environmental factors
- Organizational process assets

Tools and techniques

- Expert judgement
- Facilitation techniques

Contents of project charter

- Purpose or justification
- Description and scope
- Project manager
- Measurable project objectives and related success criteria
- High-level requirements and resources
- High-level risks
- Assumptions and constraints
- Major milestones
- Summary budget
- Stakeholders
- Project sponsor(s) and other people who authorize the project charter

Project management plan

- Develop a document describing how the project is executed, monitored, and controlled

- Includes project baselines
    - Scope baseline
    - Schedule baseline
    - Cost baseline
- Also included subsidiary plans
    - Scope management plan
    - Schedule management plan
    - Cost management plan
    - Risk management plan
    - Quality management plan

Inputs to project management plan

- Project charter
- Output from other processes
- Enterprise environmental factors
- Organizational process assets

Tools and techniques

- Expert judgment
- Facilitation techniques

PM-4-2 Presentation

Project scope management – the process required to ensure that the project includes all the work required, and only the work required, to complete a project successfully

Includes these typical steps:
- Plan
- Collect requirements
- Define scope
- Create WBS
- Validate scope
- Control scope

WBS – work breakdown structure
- organizes and defines the total scope of the project
- Subdivides the major project deliverables and project work into smaller, more manageable components
- Should focus on physical deliverables in addition to other deliverables
    - Other deliverables such as permits, design, orders, tests, etc.
- Lowest-level WBS components, which are called work packages (some call it activity, some others task), can be scheduled, cost estimated, monitored, and controlled

Some more details regarding WBS
- Identifying the deliverables and related work
- Structuring and organizing the WBS
- Decomposing the upper WBS into lower level detailed components
- Developing and assignment identification codes to the WBS components
- Verifying that the degree of decomposition of the work is necessary and sufficient

Types of WBS
- Based on the product or outcome elements
- Based on the trades and skills involves
- Based on geographical location (if applicable)
- Combined approach (location and elements)

Work packages
- Some mega projects can have thousands of work packages
- Lowest level WBS component

Rules of thumb
- Each work package should be finished in a reporting period
- Should use engineering judgement and common sense
- 80 or 40 hour rules
- Don’t break it apart (too much)

PM-5-1 Presentation

Project time management – the processes required to manage the timely completion of the project

- Two main tasks
    - Scheduling
    - Controlling

Scheduling – Deciding when the planned activities will be performed and identifying those activities which require management attention and monitoring

Controlling – Reviewing the differences between the plan and the performance and taking corrective action

Project – A set of activities with a definite starting and ending point (in time management context)

Activity – A specific task, or job with a definite starting and ending point culminating in a tangible product

Event – The start or completion of an activity. It requires no time in itself

Why scheduling is used

- Studies the project
- Establishes a baseline for the project
- Determines a sequence of activities
- Assesses the implementation methods
- Communication tool
- Establishes realistic cost estimates & cash flow projections
- Manage parties involved in project

Bar charts

- Scheduled were primarily bar charts
- Time along the x-axis and activities listed along the y-axis
- Showed what activities should be underway, but no logic of activities
- Schedules were a mind exercise of very experienced project managers
- As projects became more complex, there became a need for a better planning tool
- Also known as a Gantt chart
    - Developed by Gantt in 1917

Advantages

- Easy and simple to understand
- Clearly represent the schedule of a project

Disadvantages

- Does not show the interrelationship and constraints between activities
- Does not show critical activities
- User should have detailed knowledge of the project

CPM – critical path method

Two main types

- ADM (Arrow diagramming method)
    - Round bubbles
    - activity is the arrow
- PDM (Precedence diagramming method)
    - Square bubbles
    - Activity is on the node

ADM

- Arrows represent activities and connect at nodes to show dependencies
- After A finishes, activity B will start
- Node shows an event (such as completion or start)
- Length of the arrow has no significance
- Event not achieved until all activities entering the node have been completed

- Two main applications
    - Maintains the logical sequence of an event
    - Maintains specific activity identification

Duration – Estimated time to complete an activity based on experience, historical data, assumptions, and/or available standards

$$Duration = \frac{Quantity\ of\ work}{Production\ rate}$$

Impact factors

- Method of execution
- Project time limit
- Work sequencing
- External factors (regulator, weather, etc.)
- Site condition (if applicable)
- Quality of supervision
- Labor training & motivation
- Complexity of task

Unit of time – Hour, day (work or calendar)

Dependencies – Finish to start, start to start, finish to finish, start to finish

PM-5-2 Presentation

PDM

Some definitions

Early start (ES) – The earliest an activity can start

Early finish (EF) – the earlier an activity can possibly finish

Late start (LS) – The latest that an activity can start and not impact project completion

Late finish (LF) – The latest that an activity can be completed without impacting the project completion

ES (Early Start)	ID#	EF (Early Finish)
	Description	
LS (Late Start)	Duration	LF (Late Finish)

Forward pass

- starting from the first activity in order to determine ES and EF
- ES of the first activity is 0
- EF = ES + Duration
- ES of the following activity = maximum EF's on predecessors

Backward pass

- Starting from the ending activity in order to determine LF and LS
- LF of the ending activity = EF of the ending activity
- LS = LF – duration
- LF of the previous activities = minimum of the LS of the successors

Lag – the time difference between two events

- Consider removing formwork immediately after concrete pouring
    - You can't the concrete has to harden, have to wait for 3 days before you can remove it
    - Lag = 3 days
- Lag can be positive or negative

Some more definitions

Total float (TF) – Amount of time by which start, or finish, of an activity may be delated without causing project to last longer

- Total float = LS – ES = LF – EF

Free float (FF) – Amount of time by which start, or finish, of an activity may be delated without delaying early start of succeeding activities

- Free float = min ES of the following activities – EF – Lag

Critical path – Longest path(s) in the network. Delay of any activities on the critical path will delay the project finish time (FF = TF = 0)

ES (Early Start)	ID#	EF (Early Finish)
TF (Total Float)	Description	FF (Free Float)
LS (Late Start)	Duration	LF (Late Finish)

Relationship between activities

FS (Finish to Start) – means that an activity start after completion of its predecessor

- The most common relationship

SS (Start to Start) – The initiation of the successor activity depends upon the initiation of the predecessor activity

- That is, two activities can be done concurrently (usually with some lag)

FF (Finish to Finish) – The finish of the successor activity depends upon the finish pf the predecessor activity

SF (Start to Finish) – Not useful in construction, mostly used in high-tech industries

PM-7 Presentation

PERT – program evaluation and review technique

- Based on statistical principles
- Uses beta or triangular distributions for task duration
- Developed by the United States Navy in the 1950s
- Used together with CPM

Optimistic time (T_o) – The minimum possible time to complete a task, assuming everything proceeds better than normally expected.

Pessimistic time (T_p) – The maximum possible time to complete a task, assuming everything goes wrong (but excluding major catastrophes)

Most likely time (T_M) – The most probable estimate of the time to complete a task, assuming everything proceeds as normal

Expected time (T_E) – The best estimate of the time to finish a task

For beta distributions:

$$T_E = \frac{T_o + 4(T_m) + T_p}{6}$$

For triangular distributions (not really used):

$$T_E = \frac{T_o + T_m + T_p}{3}$$

Variance:

$$var = \left(\frac{T_p - T_o}{6}\right)^2$$

- The mean duration for each path si the sum of the mean duration for each activity along the path
- The critical path is the one with the maximum duration
- The variance of the project duration is the sum of the variance for each activity along the critical path
- The mean value provides a 50% confidence that the project will be completed by that date or earlier

Duration of a path

$$(A + B + C) + var_B$$

Limitations of PERT

- Assumes all activities are independent (might not be true)
- More effort to obtain three values
- Path with the longest mean duration is the critical path, but a path with a lower mean and larger variance could be problematic.

PM-8 Presentation

Cost estimation
- Bidding
- Payments
- Project control

Time schedule
- CPM and bar chart
- Resource allocation
- Project control

Expenses
- Can be shown as regular costs (weekly) or cumulative

EVA (earned value analysis) – objective method to measure project progress
- Developed in the 1960s and used by the United States government
- Integrates cost, time, and scope to assess the performance of a project
- Widely used in construction
- More objective than estimate percent complete

Four main measures for EVA
- Budget at completion (BAC)
- Planned value (PV)
- Earned value (EV)
- Actual cost (AC)

Budget at Completion (BAC)
- Cost estimation of an activity
- CPM (critical path method) of the project

Planed value (PV) – also called budgeted cost of work scheduled (BCWS)
- The budget of the task that is planned to be carried out
- This is based on the baseline of the project

$$PV = scheduled\ progress\ (SP)\ x\ BAC$$

$$SP = \frac{(time\ to\ date)}{(total\ required\ time)}$$

Earned value (EV) – also called budgeted cost of work performed (BCWP)
- Budgeted cost of work that has actually been performed in carrying out a scheduled task during a specific time period

$$EV = \left(\frac{work\ performed}{total\ work}\right) \cdot BAC$$

Actual cost (AC) – also called actual cost of work performed (ACWP)

- Total costs actually incurred and recorded in accomplishing work performed during a given time period for a scheduled activity or work breakdown structure component

Equations:

$$Cost\ Variance\ (CV) = EV - AC$$

$$Schedule\ Variance\ (SV) = EV - PV$$

$$Cost\ Performance\ Index\ (CPI) = \frac{EV}{AC}$$

$$Schedule\ Performance\ Index\ (SPI) = \frac{EV}{PV}$$

EVA shortcomings

- Problem in some iterative projects
- Sometimes difficult to obtain information
- Information could be available too late
- Could be better ways to obtain information
- Assuming that everything behaves in linear manner, which is obviously not correct

PM-9 Presentation

Project risk – an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least on project objective, such as time, cost, or quality. A risk may have one or more causes and, if it occurs, one of more impacts. (PMBOK)

- Can result in loss or profit
    - Risks present threat and opportunity
- Taking greater risks can result in a larger profit
    - If you can manage risk, you can make more profit
    - If you can't, you have more loss

Risk vs. uncertainty

- Risk (aleatory variability) is a probable event in a project event which is known and can be measured (e.g. weather)
- Uncertainty (epistemic uncertainties) is due to limited data and knowledge about an event or its probability of occurrence (e.g. subsurface conditions)

Project risk management

- Risk management planning
- Risk identification
- Qualitative risk analysis
- Quantitative risk analysis
    - The 4 above are the most common methods
- Risk response planning
- Risk monitoring and control
- Methodology
- Roles and responsibilities
- Budgeting
- Timing
- Risk categories
- Definitions of risk probability and impact
- Probability and impact matrix
- Revised stakeholder's tolerances
- Reporting formats
- Tracking

Tools and techniques

- Documentation review
- Information gathering; brainstorming, Delphi technique, interviewing, root cause analysis
- Checklist analysis
- Assumption analysis
- Diagramming techniques
- SWOT analysis
- Expert judgement

Methods for creation and gathering ideas from a group used for problem solving and decision making

- Brainstorming
- Delphi method
- Fishbone diagram
- SWOT analysis

Brainstorming

- Quantity matters
- Encourage wild idea (out of the box)
- No criticism
- Combine and improve ideas through association

Methods of brainstorming

- Nominal group technique
- Group passing technique
- Team idea mapping method
- Directed brainstorming

Delphi Technique

- Method to collect ideas from a panel of experts
- Unlike brainstorming, it does not depend on a large number of participants, rather the experience and expertise of the participants matter
- Experts on the panel should remain anonymous to each other
- Repeating process until the answers converse

Fishbone diagram

- Material
- Manpower (Mind)
- Machine
- Environment
- Methods
- Measurement
    - All of which lead to the Defect (or quality risk)

SWOT analysis

- Internal factors
    - Strengths
    - Weaknesses
- External factors
    - Opportunities
    - Threats

Qualitative risk analysis

- Tools and techniques
    - Risk probability and impact assessment

    - Probability and impact matrix
    - Risk data quality assessment
    - Risk categorization
    - Risk urgency assessment
    - Expert judgement
- Data gathering and representation techniques
    - Interviewing
    - Probability distributions
- Qualitative risk analysis and modeling techniques
    - Sensitivity analysis
    - Expected monetary value analysis
    - Modeling and simulation
- Expert judgement

Project risk

- Risk avoidance
- Risk mitigation
- Risk transfer
- Risk acceptance

Risk avoidance

- Direct approach to eliminate risk sources such as the risk of lack of knowledge
    - Get information, effective communication, simulation, gain knowledge acquisition
- Indirect approach, mostly to avoid risk impact
    - Change project scope to eliminate the risk, use proven technology, safety factors

Risk mitigation

- Reduce the size of the risk exposure to the threshold of risk acceptability

Risk transfer

- Use financial tools, such as insurance, warranties, etc.
- Contracting and subcontracting, risk becomes contractor's responsibility

Risk acceptance

- Active acceptance
    - Contingency plan
    - reserve resources
- Passive acceptance
    - Risk management procedure in processes
    - Risk management training

PM-10 Presentation

Project roles
- Owner/client
- Designer
- Contractors/subcontractors
- Suppliers
- Construction management (CM) – maybe

Project delivery
- In-house
- Out-sourcing

Stone age
- Mostly in-house, I guess

Mesopotamia to medieval ages
- Outsourcing
- Design and building by one entity (master builders)
- No standard textbook
    - Based on rules of thumb
- Knowledge transfer through apprenticeships and from father to son
- Technology transfer though migration or war

Renaissance (after medieval)
- Separation of design (architectural) and construction
- Architects were often an artist, with little knowledge of building technology
- Provide detail drawings for craftsmen
- Classic architecture (Filippo Brunelleschi)

Modern construction
- Each method carries a different level of risk for the owner
- Level of control retained by the owner correlates with the level of risk
- None of these delivery methods is right for every project
- Depends on project requirements, goals, and potential challenges
- Construction management agent could be involved in each of the methods

Project delivery method (or project procurement method) – system designed to achieve the satisfactory completion of a construction project from conception to occupancy. A project delivery method may employ any one or more contracting formats to achieve the delivery

Out-sourcing (types of project delivery methods)
- Design-bid-build (DBB or traditional method)
- Design-build
- Construction management at risk (CM at risk)
- Integrated project delivery

Construction management (CM) – professional management practice applied to construction projects from project inception to completion for the purpose of controlling time, cost, scope and quality

- Not a delivery method
- Could be involved in each of the methods
- In-house staff or third party
- Should be engaged in early stages of project
- Advise on or manage the process over the life of the project, or during specific phases
- 'CM at risk' is the delivery method, not this one!

Owner's considerations

- Cost
- Schedule
- Design
- Expertise
- Risks

Compensation methods

- Lump sum / fixed price
- Guaranteed maximum price (GMP)
- Reimbursable
    - **Unit price –** based on actual quantities at set unit prices
    - **Cost plus fixed fee –** payment is based on actual cost plus a fixed fee
    - **Cost plus incentive fee –** payment is based on actual cost plus an incentive-based fee
    - **Cost plus award fee –** payment is based on actual cost plus performance-based fee
    - **Time spent –** payment based on actual hours spent at set billing rates
    - **Time and materials –** payment based on actual costs with fixed markup on costs

Project Delivery Method	Design-Bid-Build (DBB)	Construction Management at Risk (CMAR)	Design Build (DB)	Integrated Project Delivery (IPD)
Contracting Methods				
Lump Sum	Common	Common	Common	Rare
Guaranteed Maximum Price	Rare	Common	Common	Rare
Reimbursable	Rare	Rare - Common	Rare	Common

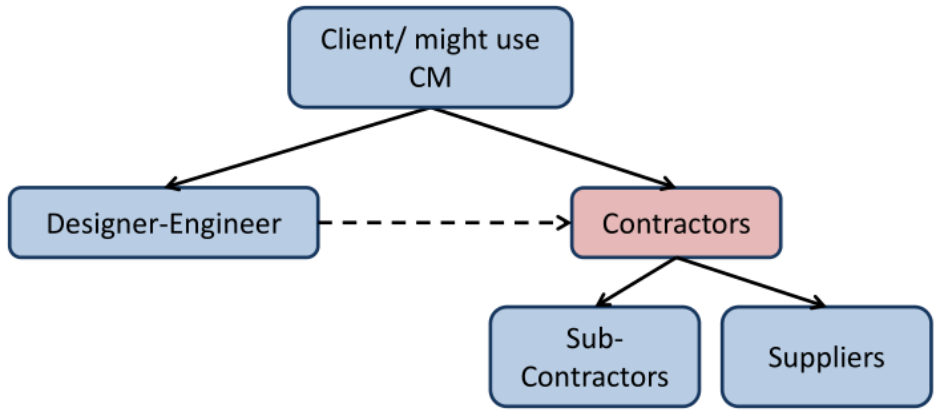
CMAA Owner's Guide to Project Delivery Methods

Selection Criteria / Project Delivery Method	Low Bidder	Best Value	Best Qualifications
	Selection is based solely on Price	Selection is based on a weighted combination of Price and Qualifications	Selection is based solely on Qualifications
Design-Bid-Build	Most Common	Common; Price evaluation based on Construction Cost	Rare
Construction Management at Risk	Rare	Most Common; Price evaluation based on CMAR Fees and General Conditions	Common
Design/Build	Common	Most Common; Price evaluation based on fees and GCs; may or may not include Construction Cost	Common
Integrated Project Delivery	Rare	Common	Most Common

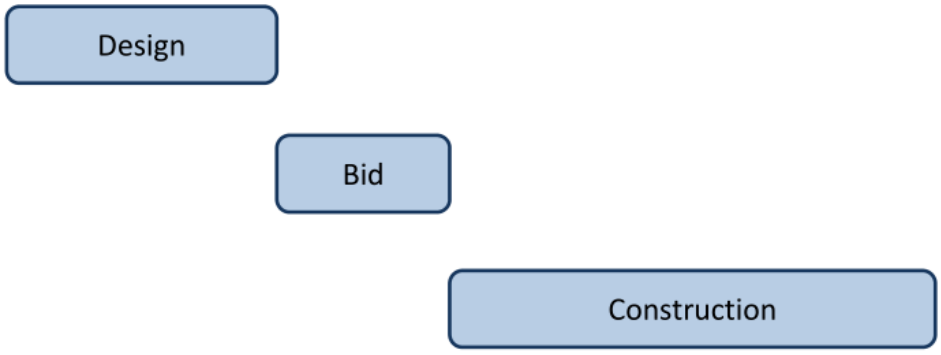
Fast-track – overlapping of design and construction

Design-Bid-Build Method (DBB or traditional method)

- Single prime uses one contractor
- Multiple prime uses several contractors



Timeline



Selection

- Usually based on lowest price first
- Most shortlist contractors based on pre-qualification

Compensation

- Fixed priced in most projects where the scope and underground conditions are known (residential and ICI, whatever that means)
- Unit price for projects that the scope might change and subsurface uncertainty exists (e.g. heavy construction such as dams, tunneling and highway)

Advantages

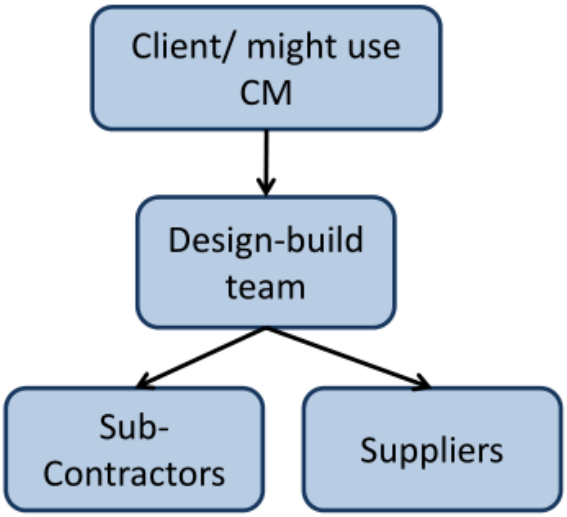
- Well-established and clear documents
- Known price before starting construction
- Comply with local, provincial or federal regulations
- Control over the projects

Disadvantages

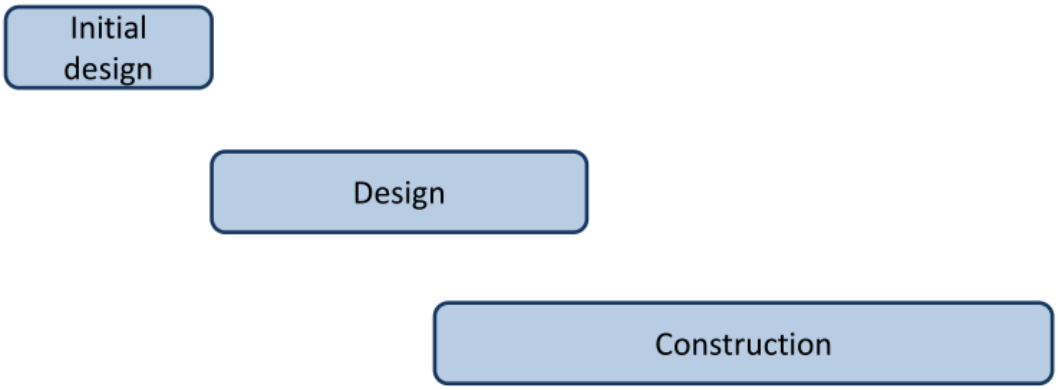
- Sequential (no overlap)
- Design are not always cost-effectives
- Change order and claims from contractors to compensate their lowest price bid
- Adversarial relationships rather than cooperation or coordination among parties
- Lack of constructability analysis during design
- Least-cost approach by contractor
- Responsibility of defects

Design-Build Method

- Could be joint venture
- Could be a contractor with a designer as a sub-consultant
- Could be designer-led team with a contractor as a subcontracted entity
- Could be a single firm capable of performing both design and construction



Timeline



Selection

- Two steps
  - **Request for Qualification (RFQ)** – establish a short list
  - **Request for Proposals (RFP)** – contact shortlisted firms, requesting cost information and a technical proposal which defines the project scope along with the firms' innovations, schedule and details that define the quality of the delivered project

Compensation

- Fixed-fee contract for design and pre-construction costs and an agreed General Conditions costs and construction fee given as a percentage of total construction costs
- **Guaranteed Maximum Price (GMP)** after progress in design

Advantages

- Single point of accountability for design and construction
- Fast-track
- Better constructability
- Cost effective
- Change orders from owner side

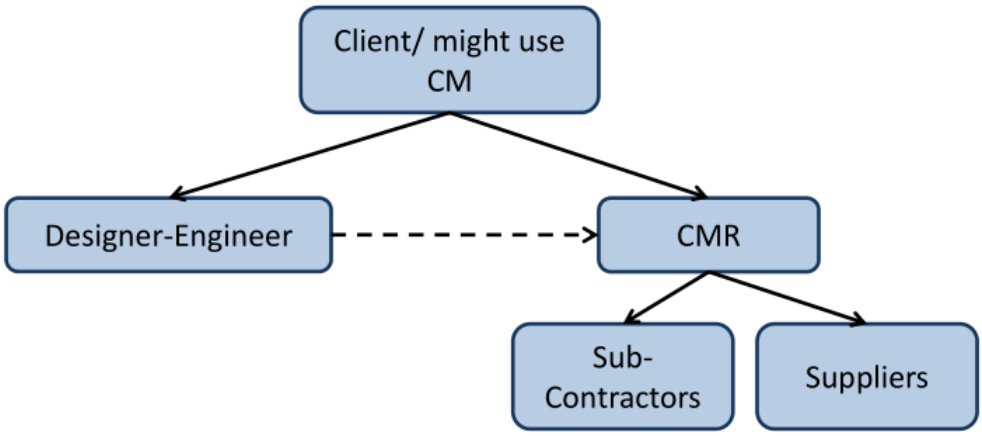
Disadvantages

- Less design control and involvement by the owner
- Owner must be highly responsive in its decision making
- May be problematic when there is a requirement for multiple agency design approvals
- Not suitable for complicated projects

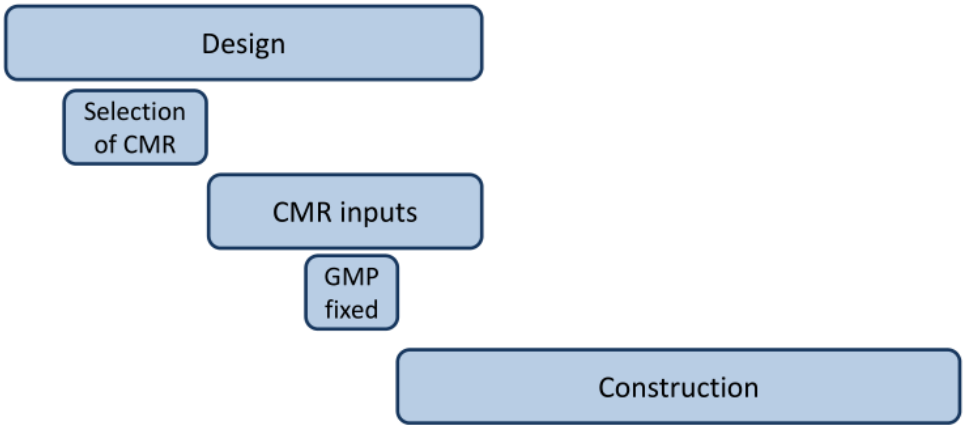
Design-build vs. Turnkey

- In some design-build instances, the contractor may also agree to be responsible for acquiring land, financing the project, and commencing projects operation
- More comprehensive arrangement is usually referred to as 'turnkey'
- Turnkey is most applied for industrial projects
- Usually not bound by traditional public sector procurement regulations
- Turnkey typically has more responsibility than design-build

Construction management at risk (CMAR)



Timeline



Selection

- One step
  - Request for proposals (RFP) for qualifications of the team, along with price proposals for pre-construction costs, general conditions costs, and construction fee as a percentage
- Two step
  - Request for Qualifications (RFQ) to establish shortlist
  - Request for Proposals (RFP) among shortlist for cost information

Compensation

- Fixed-fee contract for pre-construction and general conditions costs, along with an agreed contractor's markup fee as a percentage of construction costs
- Guaranteed Maximum Price (GMP) after design professed enough

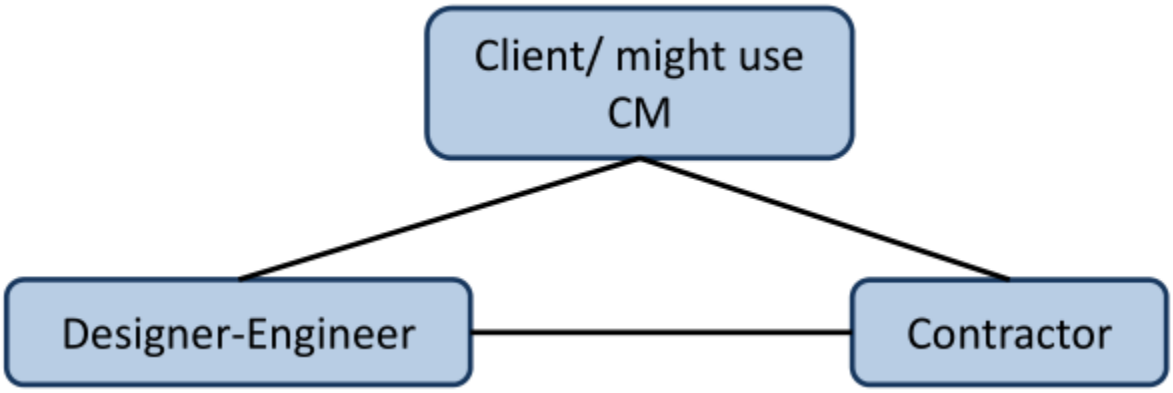
Advantages

- Inputs of contractor into design and planning
- Fast-track

Disadvantages

- Dispute and adversarial relationships after GMP is fixed
- Construction quality, the completeness of the design after GMP (guaranteed maximum price)
- Premium is placed on the proper selection of the CMR (construction manager at risk)

Integrated project delivery (IPD)



Traditional communication – all over the place, everyone talks to everyone

Integrated communication – everyone communicated to a central system

Advantages
- Input from contractors and suppliers into design
- Fast-track
- Better constructability
- Cost effective
- Entire teams interests are aligned with the project goals making the chance of success high

Disadvantages
- Lack of industry experience in such collaboration
- Lack of law and regulations
- Objective selection of the team is very difficult
- Actual agreement on the criteria and the final IPD contract can be very difficult
- Cost vs. objective

What methods are used in the 'vertical construction market'
- 60% - Design-Bid-Build (DBB)
- 25% - CM at Risk (CMAR)
- 15% - Design-Build (DB)
- <1% - Integrated Project Delivery (IPD)

What methods are used in the 'horizontal infrastructure market'
- Major method – Design-Bid-Build (DBB)
- Mostly PPP Projects – Design-Build (DB)
- Rare – CM at Risk (CMAR)

Final notes about project delivery methods

- No single solution for every project
- Considerations
    - Project type and size
    - Project uncertainties
    - Risk transfer
    - Level of owner's control and involvement
    - Time constraints
    - Owner's resources and capabilities
    - Local market knowledge
    - Legislative and regulatory requirements
- Transfer the risk to an entity who can handle it

PM-11 Presentation

Financing projects

- Owner's resources
- Sponsor's and lenders
    - Their investment is recovered from project's revenue

Public-Private-Partnership (PPP also known as P3) – agreement between a public agency (federal, state or local) and a private sector entity. Through this agreement, the skills and assets of each sector (public and private) are shared in delivering a service or facility for the use of the general public. In addition to the sharing of resources, each party shares in the risks and rewards potential in the delivery of the service and/or facility.

- Private parties' partner with a public entity in the development of infrastructure projects
- Financial risks are very critical and should be addressed at very early stages
- Canada is one of the most successful countries in adopting PPP
    - Successful Canadian case is the 407 highway

Benefits (for governments and public entities)

- Overcome budgetary constraints
- Deliver complicated projects
- Innovation to the project
- Exploit managerial skills
- Timely decisions
- Operate the infrastructure more efficiently

Benefits (for private companies)

- Long term investment opportunities
- Deliver complicated projects
- Make more profit
- Expand it's in-house P3 expertise and establish a reputation
- International market

There are 18 forms of P3 such as:

- **BOT (build operate transfer)**
- **BOO (build-own-operate)**
- **O&M (operation and maintenance)**
- **OMM(operations, maintenance & management)**

Build-Operate-Transfer

1. Formation of the Project Company under the government granted concession
2. Lender involvement in BOT
3. Revenue distribution during the operational period

- Contracts are between the project company and stakeholders
    - Stakeholders can include government, project sponsors, lenders, and users

Risks

- During construction
  - Completion risks
  - Cost overrun risk
  - Performance risk
  - Environmental risk
- During operation
  - Political risk
  - Macro-economic risk
  - Revenue risk

More about risks

- Construction risks (private party support)
  - Sponsor will not receive a guarantee for these risks
- Operation risks (host government supports)
  - Cash subsidy
  - In-kind grants
  - Favorable tax treatment and capital contributions
  - guarantees

PM-12 Presentation

Quality – the degree to which a set of inherent characteristics fulfill requirements

Grade – as a design intent, is a category assigned to deliverables having the same functional use but different technical characteristics

Main aspects of Project Quality Management

- Customer satisfaction
- Continual improvement
- Management responsibility
- Partnership with suppliers

Cost of conformance (cost of quality)

Prevention costs

- Training
- Document processes
- High quality equipment
- Time to do it right

Assessment costs

- Testing
- Destructive tests
- Inspections

Cost of non-conformance (cost of quality)

Internal failure costs

- Rework
- Scrap

External failure costs

- Liabilities
- Warranty work
- Lost business

Manage quality

- Incorporate quality management plan and organization quality policies into the project

Quality assurance

- Make sure that the quality policies, processes, and procedures are complied in project activities

Quality control

- Assess and document the results of execution of quality management in activities and ensure that the results comply with required standards and customer expectations

Seven Basic Tools of Quality

- Check sheet, checklists, and statistical sampling
- Root cause analysis (“fishbone diagram” or Ishikawa diagram)
- Flow chart
- Pareto chart
- Histogram
- Scatter diagram
- Control chart