



*Week 3*

# **Delivery and Contract Methods**

**457.307 Construction Planning and Management**  
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# 공공공사 계약절차

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## 1. 발주방법 결정

- 일괄입찰방법, 대안입찰방법, 일반공사 등

## 2. 설계서(기본 또는 실시) 작성

- 용역사업업체에 의뢰 건설교통부 제정 적산제도와 재정경제부 회계예규 원가계산에 의한 예정가격작성준칙에 의해 공사비 산정

## 3. 설계서 자문 및 심의

- 발주기관 내 설계자문위원회, 지방건설심의위원회

## 4. 발주기관 결정

- 조달청: 국가기관 발주 30억원 이상, 지자체 발주 100억원 이상
- 그 외는 자체발주

## 5. 계약방법 결정

- 일반경쟁, 제한경쟁, 지명경쟁, 수의계약 등

# 공공공사 계약절차

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## 6. 입찰공고

- 현장설명일 7일전 공고

## 7. 현장설명

- 입찰마감일 10-33일 전 실시
- 설계서, 물량내역서, 단가설명서 등 열람/교부

## 8. 입찰참가신청

## 9. 낙찰자 결정

- 최저가낙찰제, 적격심사낙찰제 등

## 10. 계약체결

- 낙찰 후 10일 이내

## 11. 계약이행, 완료, 준공검사, 사후관리

- 하자보수보증금: 계약금액의 2-5%, 지체상금: 지연일수\*계약금액/1000

# 계약목적물에 따른 분류

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- **일반건설업: 총 5종**

- 종합적인 관리 및 조정 하에 시설물을 시공하는 건설업
- (건설산업기본법령 제7조) 토목, 건축, 토목/건축, 산업설비, 조경

- **전문건설업: 총 29종**

- 시설물의 일부 또는 전 분야에 관한 공사를 시공하는 건설업
- (건설산업기본법령 제7조) 실내건축, 토공, 미장/방수, 석공, 도장, 조적, 비계/구조물해체, 창호, 지붕/판금, 철근/콘크리트, 철물, 기계설비, 상하수도설비, 보링/그라우팅, 철도/궤도, 포장, 수중, 조경식재, 조경시설물 설치, 건축물 조립, 강구조물, 온실설치, 철강재설치, 삭도설치, 준설, 승강기설치, 가스시설시공, 난방시공, 제시설물유지관리

# 공사실시방식에 따른 분류

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- **직영공사**

- 발주자 자신의 책임으로 공사 실시

- **도급공사**

- **일괄도급**: 전체공사에 대하여 한 시공자에게 도급계약을 발주 (소규모, 단순공종)
- **분할도급**: 공사를 수 개의 부분 공사로 분할하여 개별 시공자와 도급계약 (대형공사, 기술적 전문성이 다른 여러 공종의 복합공사)
- **공동도급**(컨소시엄): 2개 이상의 시공자가 임시로 결합, 조직, 공동출자하여 연대책임 하에 공사를 수급

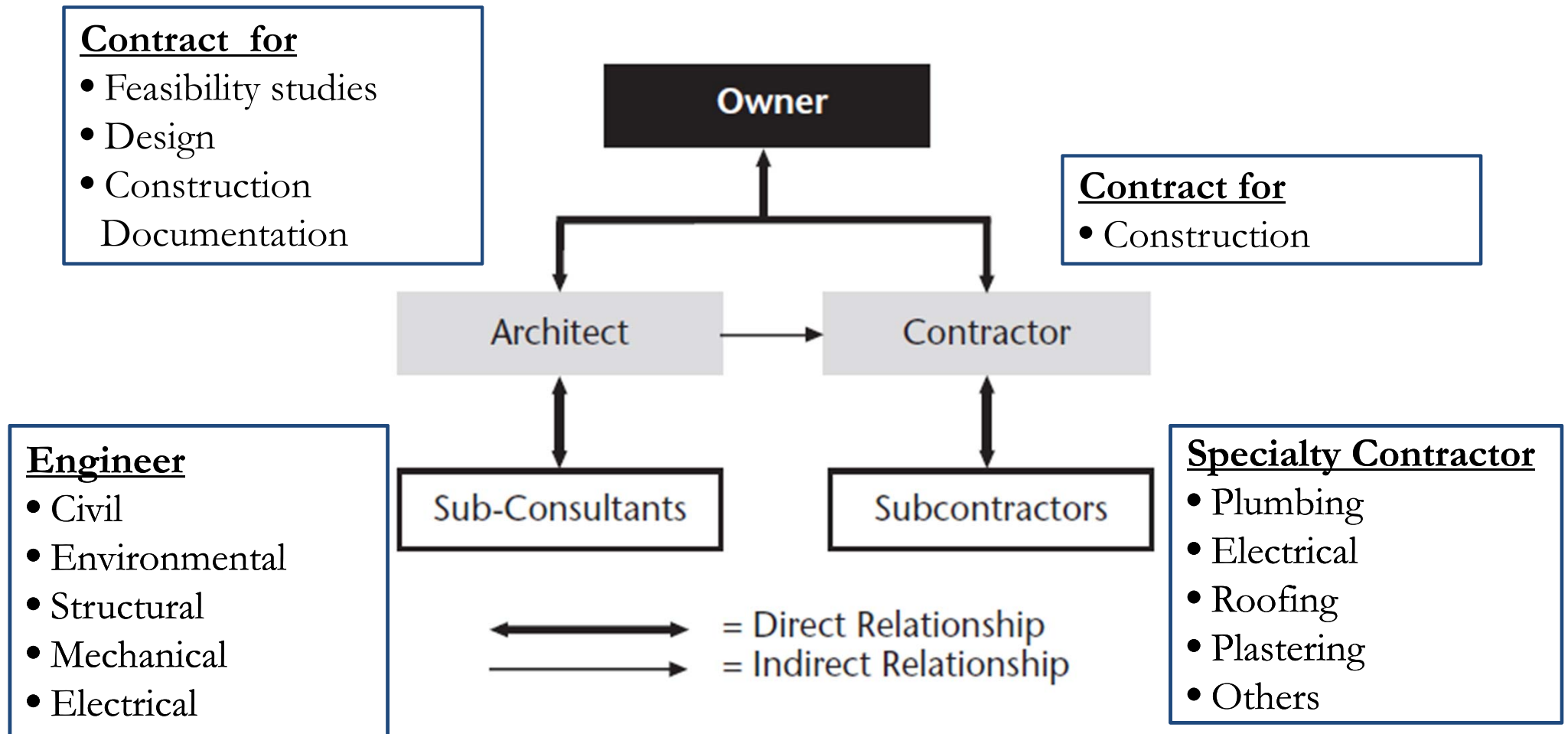
# 과업범위 발주형식에 따른 분류

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- How to organize roles of each participant and deliver the project (management model)
- Design-Bid-Build (시설도급발주, 설계시공분리발주)
- Design-Build (Turnkey, 설계시공일괄발주)
- 대안발주 | 기술제안발주
- Construction Management (건설사업관리발주)

*\*Construction Documentation: Final design phase, Finalizing all drawings and specifications for building systems, site utilities, and construction components*

# Design-Bid-Build (설계시공분리발주)



*No direct, formal relationship exists between the designer and the builder  
Communicate only through the owner*

# Design-Bid-Build

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- Advantages



# Design-Bid-Build

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- Disadvantages

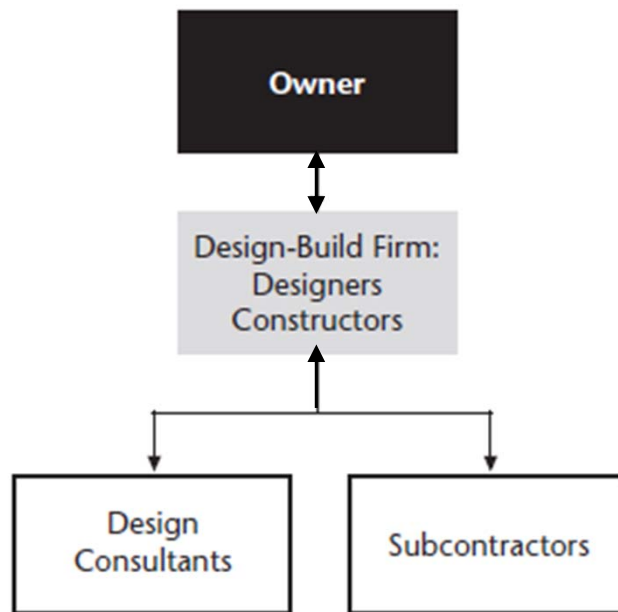
# Design-Build (Turnkey, 설계시공일괄발주)

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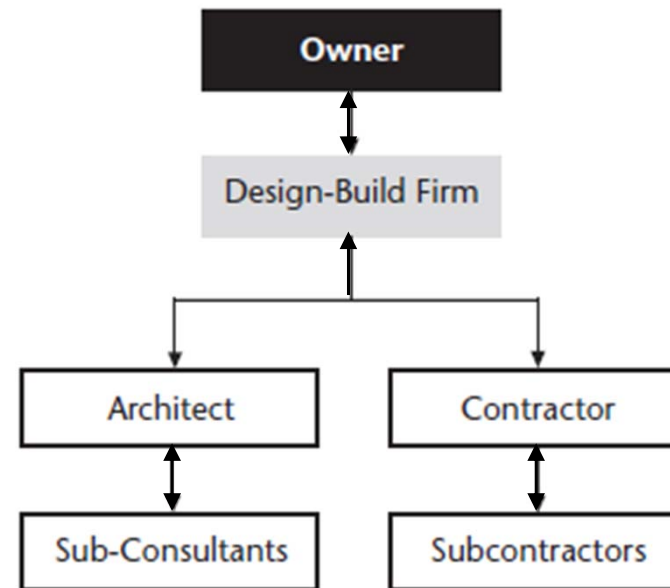
- Designer and contractor are either from the same firm or joint venture (consortium)
- 발주기관은 기본계획 또는 시설기준만 제시
- **Single-source procurement for the owner**
  - A design-build firm provides both design and construction
  - Creates a non-adversarial relationship between designers and constructors
  - Three major types of arrangements

# Design-Build

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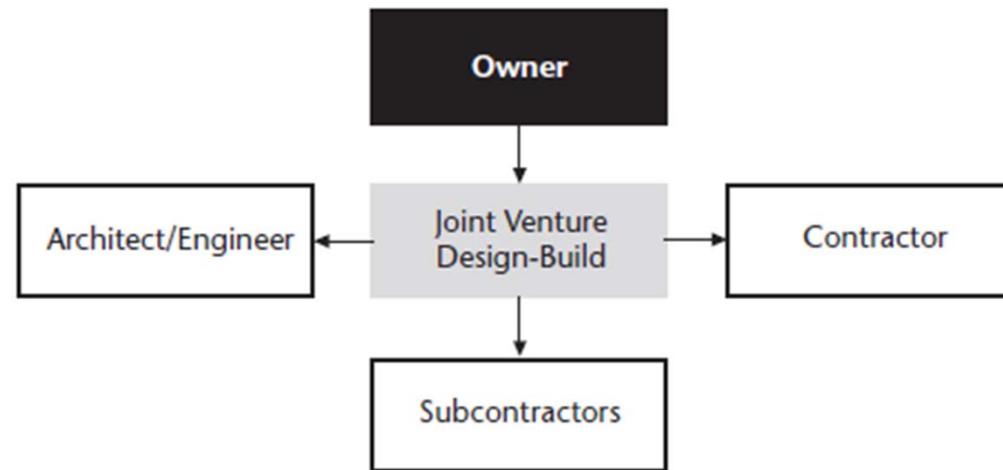
Includes and directly controls designers and constructors by Large design-build firm



Contracts out design and construction works by Developer firms

# Design-Build

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Joint-venture for  
financing, resource, and  
risk management

# Design-Build

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- Advantages

# Design-Build

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- Disadvantages

# 한국의 턴키제도

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- **한국 턴키제도의 현안**

- 턴키공사 선정비율(설계점수 40%, PQ 점수 30%, 가격점수 30%)을 적용하기는 하나 공사의 특성에 따른 기술수준을 효율적으로 반영하지 못함
- 기본설계 및 입찰심의 후 선정자를 대상으로 실시설계 적격심의  
→ 실시설계 심의 전에는 계약체결과 공사착공을 할 수 없어 조기착공을 통한 공기단축이 곤란 (외국의 경우 실시설계와 공사착공을 동시에 허용하는 설계시공병행을 활용)
- 실시설계 기간 부족으로 부실설계 유발, 설계변경 사례가 빈발
- 여러 업체의 입찰에 따른 사회적 비용 증대

# 대안발주 | 기술제안발주

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- 대안발주

- 정부가 작성한 설계서 상의 공종 중에서 기본방침의 변동 없이 원안설계의 기능 및 효과를 가진 신공법/신기술/공기단축 등이 반영된 대안설계
- 발주자는 실시설계까지 제공
- 같은 가격이면 고품질의 개념

- 기술제안발주

- 대안발주와 개념은 비슷하지만 발주자가 기술제안을 받을 부분을 지정해줌. 즉, 기술제안을 할 수 있는 부분이 제한적임.
- 발주자는 대부분 기본설계만을 제시
- 같은 품질이면 저비용의 개념



# Construction Management (건설사업관리방식)

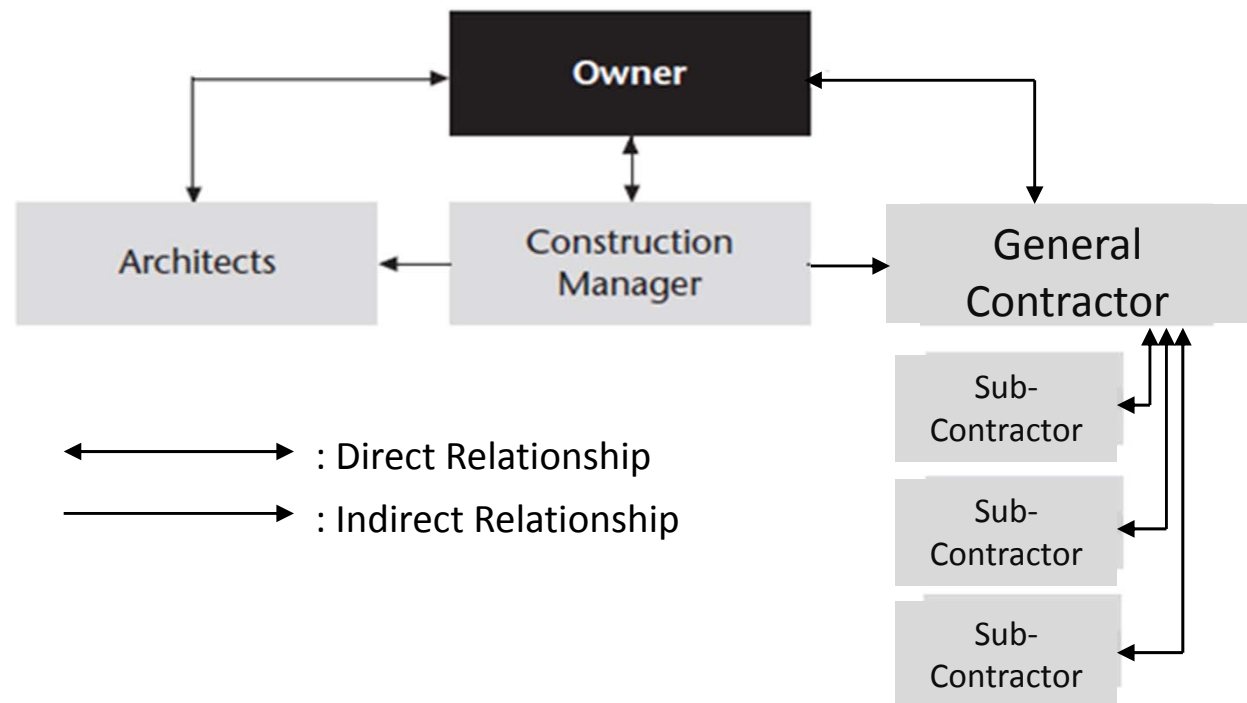
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- Applies contractor-based management systems early in the project
- CM delivery methods
  - Agency CM (CM for Fee, 용역형 CM)
  - CM at Risk (도급형 CM)

# Agency CM

- **Agency CM (CM for Fee)**

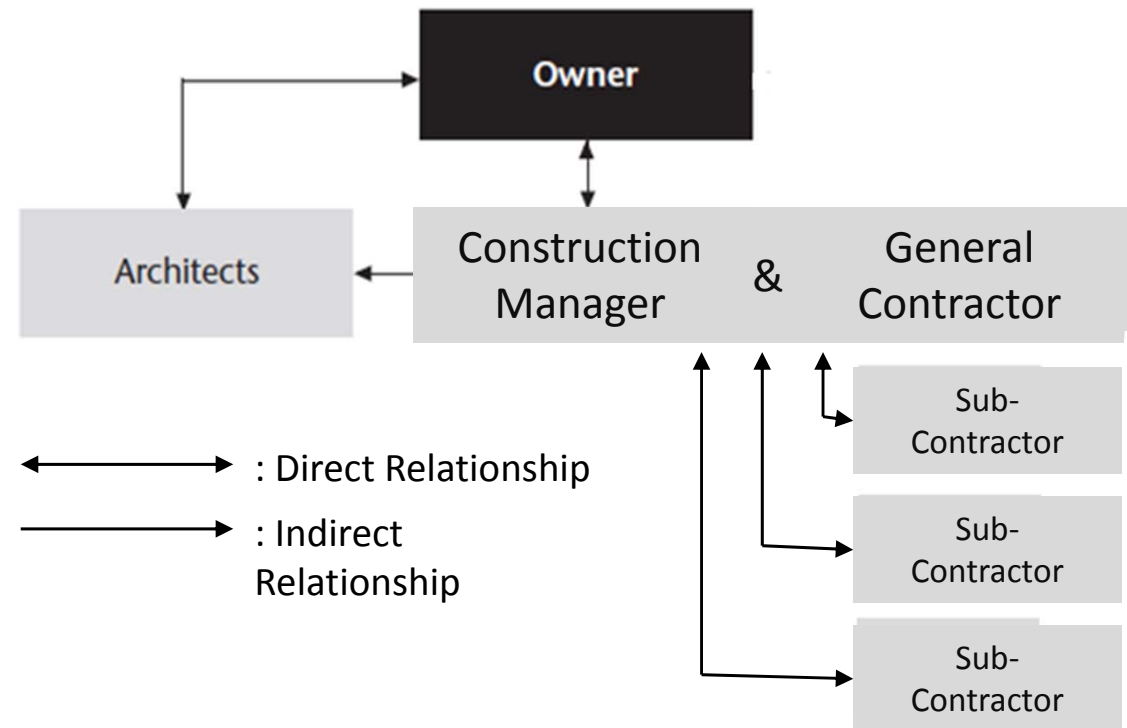
- CM as an owner's agent managing both A/E & GC
- CM brings management tools
- Best for an owner who has little or no CM expertise
- e.g., 5%



# CM at Risk

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- **CM at Risk**
  - CM is involved in project planning, design, and construction of the project
  - CM provides the owner a maximum price for the project, considering the project's initial scope.



# CM Project Delivery

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- **Advantages**

- Input of construction processes during design by CM
- Good communication is established early among the owner, designer, and construction professional and continues through the completion of the project.
- The implementation of changes is not as difficult as in the traditional method because of close communication.
- Reduce the project duration

# CM Project Delivery

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- **Disadvantages**

- If any of the players become inflexible, uncooperative or uncommunicative, the advantages can quickly become disadvantages.
- This arrangement requires high owner involvement and more sophisticated owner.

# 대가지불방식에 따른 분류

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- Specify how to compensate/pay the contractor for work completed
- Contract type
  - Lump sum (총액계약)
  - Unit price (내역계약)
  - Cost plus fee (실비정산계약)
  - Guaranteed maximum price (최대비용 보증계약)

# Lump-Sum (Single Fixed Price, 총액계약)

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- 당해 계약 목적물 전체에 대하여 총액으로 체결하는 계약
- 공사기간 중 공사내용의 변경이나 노임과 자재단가 등의 물가변동이 예상되지 않을 경우나 소규모 공사
- **분할지급방식:** 공사기간이 장기간인 공사에서 공종별로 금액을 배분한 내역서를 미리 작성하고 기성율을 공종별 금액에 적용하여 계산된 금액을 정기적(월별)으로 지급
- **일정지불방식:** 기기류의 주문제작과 같이 주문시, 완성시, 납품시, 설치완료시 등 기준시점별로 지급





# Cost Plus a Fee (실비정산계약)

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- **Characteristics**

- Contractors work on the project and get reimbursed by the owner for costs, plus additional agreed-upon fees
- Usually used when the scope of work is difficult to define
- No fixed price
- Working well with both CM and D-B

- **Cost and Fee**

- Cost: Labor, material, equipment, subcontracts, and on-site overhead
- Fee: Indirect overhead and profit (benefit/cost sharing) (e.g., Cost plus 5%)

# GMP (최대비용 보증계약)

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- **Guaranteed maximum price (GMP)**
  - Hybrid of the lump-sum and cost plus
  - A guaranteed maximum price by the contractor
    - Contractor is reimbursed at cost with an agreed-upon fee up to the GMP (e.g., \$100M)
    - Beyond the GMP, contractor is responsible for covering any additional costs (e.g., if actual = \$110M, 100% cost)
    - Incentive clause specifies that contractor will receive additional profit for bringing the project under the GMP. (e.g., if actual = \$90M, 60% incentive)

# 입찰참가 요건에 따른 분류

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- **일반경쟁입찰**

- 건설업면허를 받고 사업자등록이 되어있으면 누구나 참가 가능
- 입찰업무관리에 어려움, 경쟁과열, 부실공사 우려

- **제한경쟁입찰**

- 시공능력 공시액(도급한도액), 실적, 기술보유상황, 지역, PQ에 의한 제한 등
- **지역제한**: 30억 미만공사, 3억미만 전문공사는 당해 시공지역에 본사가 있는 업체로 제한
- **시공능력공시액 제한**: 예) 발주공사금액의 2배 이상 (공사실적평가액, 경영평가액 등)
- **실적제한**: 동종공사 실적 경험
- **특수기술 보유상황제한**
- **입찰참가자격 사전심사(PQ)**: 시공경험, 기술능력, 경영상태 등

# 입찰참가 요건에 따른 분류

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- **지명경쟁입찰**

- 특수한 설비, 기술, 자재/물품 또는 실적이 있는 자가 아니면 계약목적을 달성하기 곤란한 경우나 소규모 공사 등의 경우에 발주기관이 입찰참가자를 미리 지명

- **수의입찰**

- 계약상대자가 한정되어 경쟁이 불가능한 경우
- 공사현장 여건상 특정업체와 수의계약하는 것이 유리한 경우
- 비밀공사, 접적지역 등 특수지역공사, 특허공법공사, 신기술 공사 등
- 이미 시공중인 또는 완료된 공사와 공간적, 시간적 중복이 많아 하자책임구분 및 작업상 혼잡을 고려해야 하는 경우

# 공공공사 낙찰자 결정방법

설계·시공 분리	적격심사제	<ul style="list-style-type: none"> <li>● 300억원 미만 공사 ⇒ 최저가 입찰자부터 “수행능력+가격” 을 심사하여 일정점수 이상인 자를 선정</li> </ul>
	최저가 낙찰제	<ul style="list-style-type: none"> <li>● 300억원 이상 공사 ⇒ 최저가 입찰자 순으로 입찰금액이 저가심의를 통과할 경우에 낙찰자로 선정</li> </ul>
설계·시공 일괄	턴키 입찰	<ul style="list-style-type: none"> <li>● 300억원 이상 고난도 공사 등 ⇒ 설계와 시공을 일괄하여 입찰하고, 최고점수 획득자를 선정</li> </ul>
	대안 입찰	<ul style="list-style-type: none"> <li>● 300억원 이상 고난도 공사 등 ⇒ 원안설계입찰과 대안설계입찰을 병행 입찰하되, 발주기관에게 최고 이익이 되는 자를 선정</li> </ul>
	기술제안 입찰	<ul style="list-style-type: none"> <li>● 상징성, 예술성 등이 필요한 고난도 공사 ⇒ 입찰자가 기술제안을 하고, 최고점수 획득자를 선정</li> </ul>

# 낙찰자 결정방법에 따른 분류

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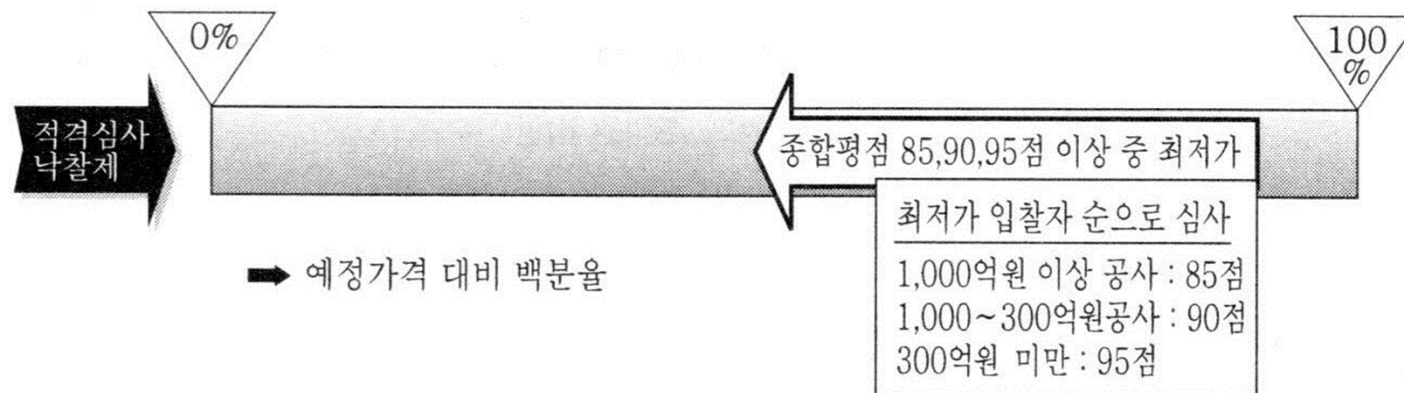
- **최저가낙찰제**

- 예정가격 범위 내에서 최저가격으로 입찰한 자를 선정
- **덤핑**: 공사원가 이하로 도급을 받는 것 → 품질저하, 부실시공
- **담합**: 입찰참가자들끼리 낙찰자 및 낙찰금액을 미리 협정하고 입찰에 참가하여 최대한 100% 예정가격과 가깝게 도급
- 발주자는 현장설명 시 약 30여개 공종으로 구분하여 예정가격을 발표
- $\text{공종기준금액} = \text{해당공종 설계금액} \times 70\% + \text{입찰자평균금액} \times 30\%$
- 입찰자평균금액은 예가보다 높은 금액, 하위 10%, 상위 30% 제외
- 이러한 공종기준금액을 기준으로 부적정공종(낮게 투찰된 공종)에 벌점 부과

# 낙찰자 결정방법에 따른 분류

## • 적격심사 낙찰제

- 시공경험, 기술능력, 경영상태 등을 포함하는 공사수행능력 (40%), 입찰가격 (30%), 자재 및 인력조달가격의 적정성 (16%), 하도급관리 계획의 적정성 (14%)을 종합적으로 심사하여 공사금액별 일정점수를 획득한 자를 대상으로 예정가격보다 가장 근소한 차이로 높게 쓴 업체를 선정
- 기초금액  $\pm 2 - 3\%$  범위 내 15개 금액 중 4개를 무작위로 선정하여 평균 낸 금액을 예정가격으로 함.



- **종합심사제**  
- 시범운영 중

현 행		개 선(안)	
300억원 미만	적격심사제	100억 원 미만	적격심사제
		100억 원 ~ 300억 원	최저가낙찰제 적용 유예(2년)
300억원 이상	최저가낙찰제	종합심사제 시범사업 실시 [가격 + 공사수행능력 + 사회적 책임]	
고난이도 공사 등	설계·시공 일괄, 기술제안입찰	설계·시공 일괄, 기술제안입찰	

심사 분야	평가 항목		가중치 범위
공사수행능력 (40~50점)	전문성	동일공사 시공실적	20~30%
		매출액 비중	0~20%
		배치 기술자	20~30%
	역량	공공공사 시공평가 점수	30~50%
		규모별 시공역량	0~20%
	소 계		100%
입찰가격 (50~60점)	가 격		100%
	가격 산출의 적정성		감점
사회적 책임 (가점 1점)	건설인력 고용		20~40%
	공정거래		30~40%
	건설 안전		20~40%
	소 계		100%



# PPP

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- **PPP (Public Private Partnership, 민간투자사업, 민자사업)**

- SOC financed, constructed and operated by private consortium called SPC (Special Purpose Company)
- **BOT (Build-Operate-Transfer)**: 준공 후 일정기간 동안 사업 시행자가 이를 소유 및 운영하고 그 기간이 만료되면 소유권을 정부에 이전 (자체 운영 수입 창출이 가능한 고속도로, 다리, 터널 등 – 리스크는 사업자가 감수)
- **BTO**: 준공과 동시에 소유권이 정부에 이전되며 사업 시행자가 일정 기간 운영권을 갖는 방식 (BOT와 동일, 정부가 일정 수익률을 보장)

*\*MRG(Minimum Revenue Guarantee, 최소운영수입보장)*

- **BTL**: BOT와 같이 소유권을 정부에 넘기나 일정기간 시설의 사용/수익권만을 가짐. 건설사는 정부에 그 시설을 임대해 주는 형식으로 운영비와 건설비 등을 매년 임대료 명목으로 받음 (수익률 정부 보장, 자체 운영 창출이 어려운 학교나 공익시설 등)

# 해외 입찰 제도

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- Best Value의 개념
  - 가격외 품질 등 여러 복합적인 요소에 가중치를 부여
  - 시공비와 같은 초기 투입비용의 최소화가 유지관리 비용을 포함한 총 생애주기비용의 절감이 아니라는 사실 인식
  - 적정한 공사비를 바탕으로 공기를 단축하는 것이 투입비용의 최소화
  - 단기적/적대적 관계 → 장기적/협력적 관계: 파트너링, 프라임계약 등 사업특성에 맞는 여러 계약방식의 활성화
  - 미국의 경우 20% 정도만 최저가 낙찰제, 그 외 협상에 의한 계약, 인센티브 계약 등을 활용
  - 최종 결정은 반드시 기술적 판단에 기반
- 엄격한 Screening 제도를 바탕으로 입찰 참여자수 최소화
  - 한국의 적격심사/최저가의 경우 심할 경우 300개 기업 이상, 미국/유럽 등은 3-5개가 적정



# *Week 3*

## **Pre-Project Planning (1)**

**457.307 Construction Planning and Management**  
Department of Civil and Environmental Engineering  
Seoul National University

**Prof. Seokho Chi**

[shchi@snu.ac.kr](mailto:shchi@snu.ac.kr)

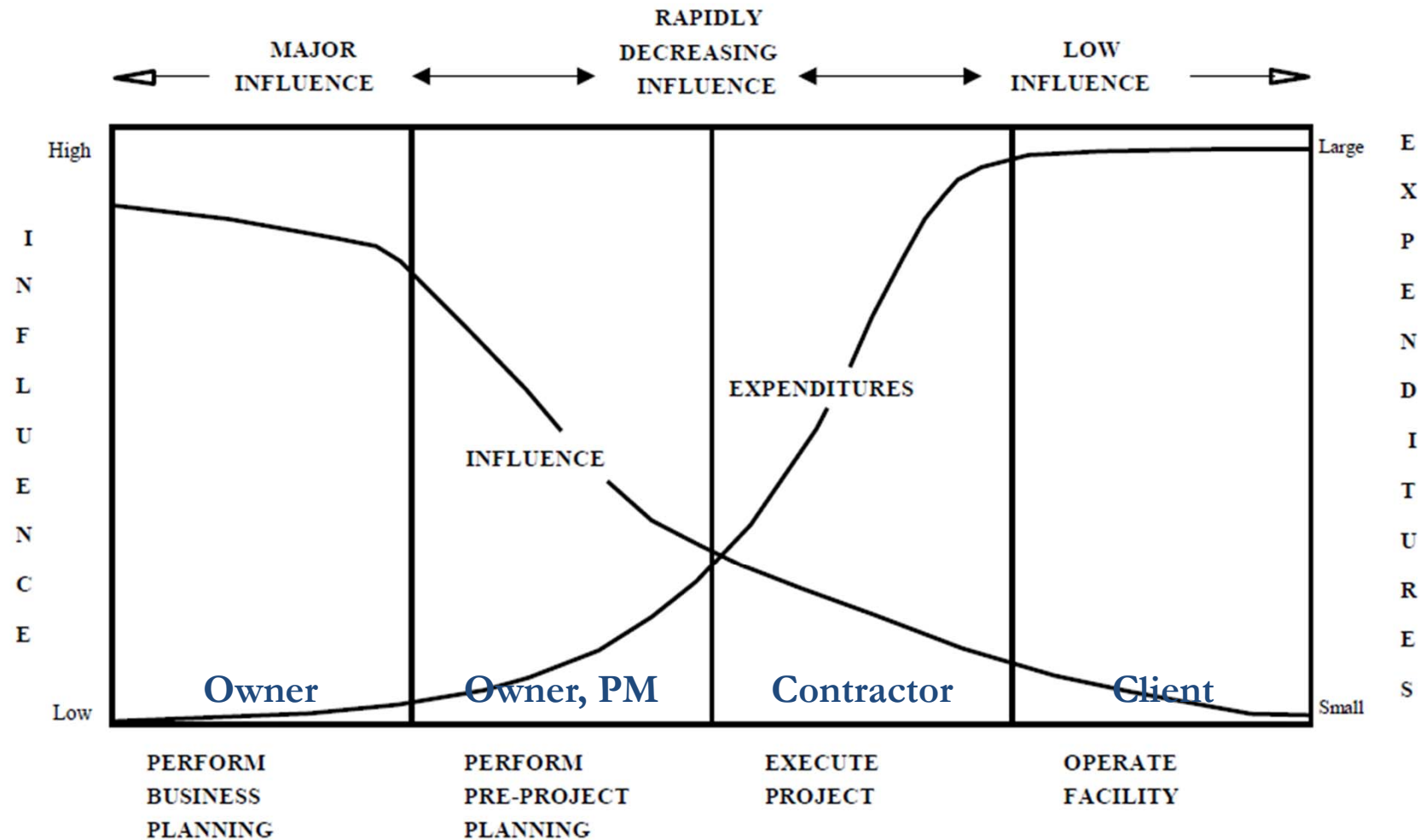
건설환경공학부 35동 304호

# Pre-Project Planning (PMBOK Chapter 4 and Chapter 5)

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- “Process for developing sufficient strategy information with which owners can address risk and decide to commit resources to maximize the chance for a successful project.”
- Simply,
  - Performing the right project
  - Scoping the right “things” for a good design basis
  - Setting the stage for successful execution


# Cost-Influence Diagram



“Influence” reflects a company’s ability to affect the outcome of a project. It is much easier to influence during the early project stages, when expenditures are relatively lower.

# Pre-Project Planning

- **Key Beliefs**
  - Early PPP plays an essential role in producing high quality projects.
- **When PPP effort is:**

Cost			
Effort	Avg.	Std. Dev.	
High	-4%	7%	
Medium	-2%	10%	
Low	+16%	45%	
Schedule			<b>Scope Changes</b>
Effort	Avg.	Std. Dev.	
High	-13%	17%	
Medium	+8%	24%	
Low	+26%	44%	
Effort	Avg.	Std. Dev.	
High	3%	3%	
Medium	2%	3%	
Low	11%	13%	

# Pre-Project Planning

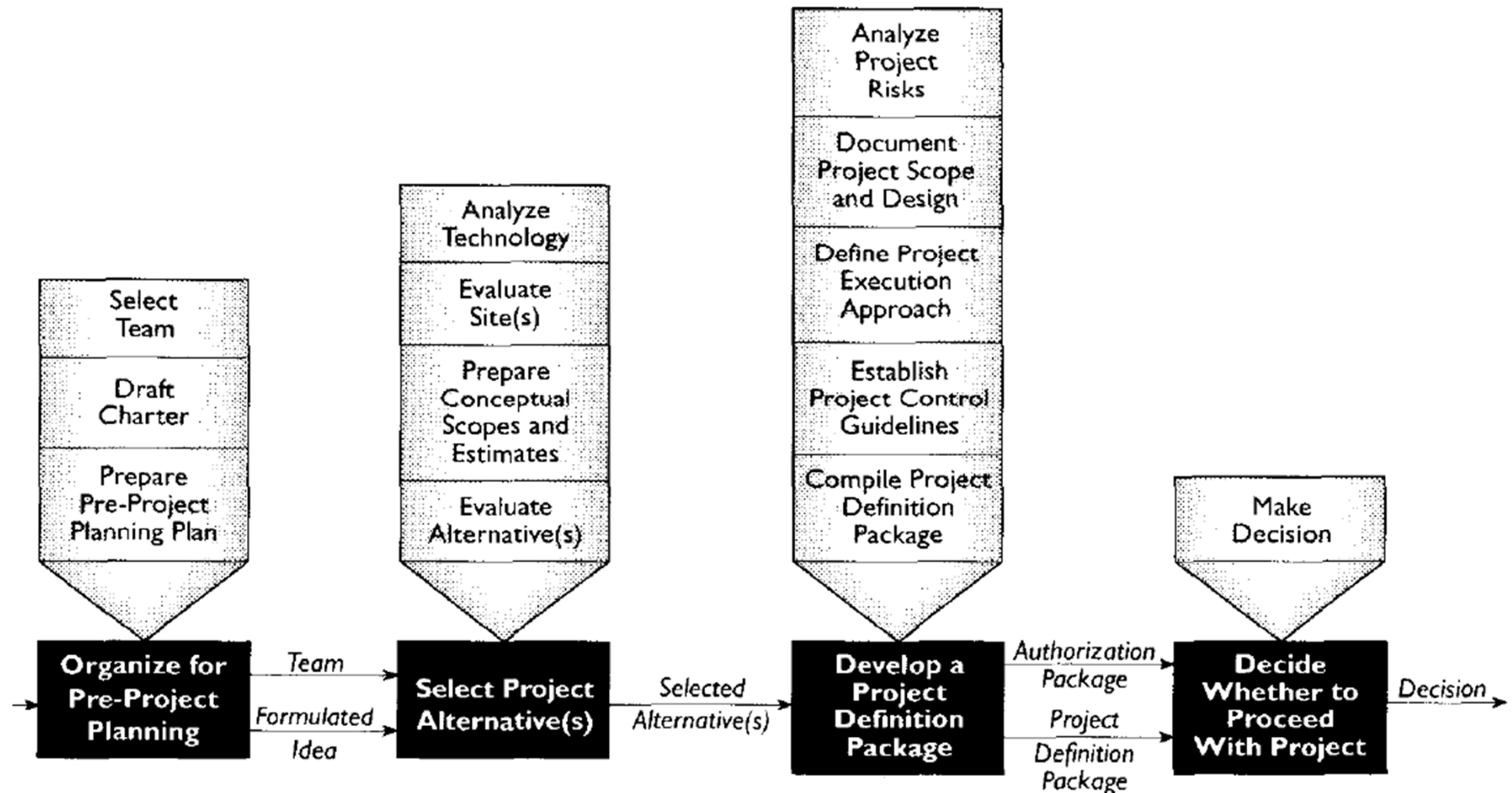
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- **Reasons for Poor Early Planning**

- Pressure to get product into the marketplace faster
- Perceived delays and higher overhead costs
- Lack of engineering capability
- Desire to limit engineering costs
- Overly optimistic management
- Not enough or wrong efforts

*PPP whose responsibility?*

# PPP Process



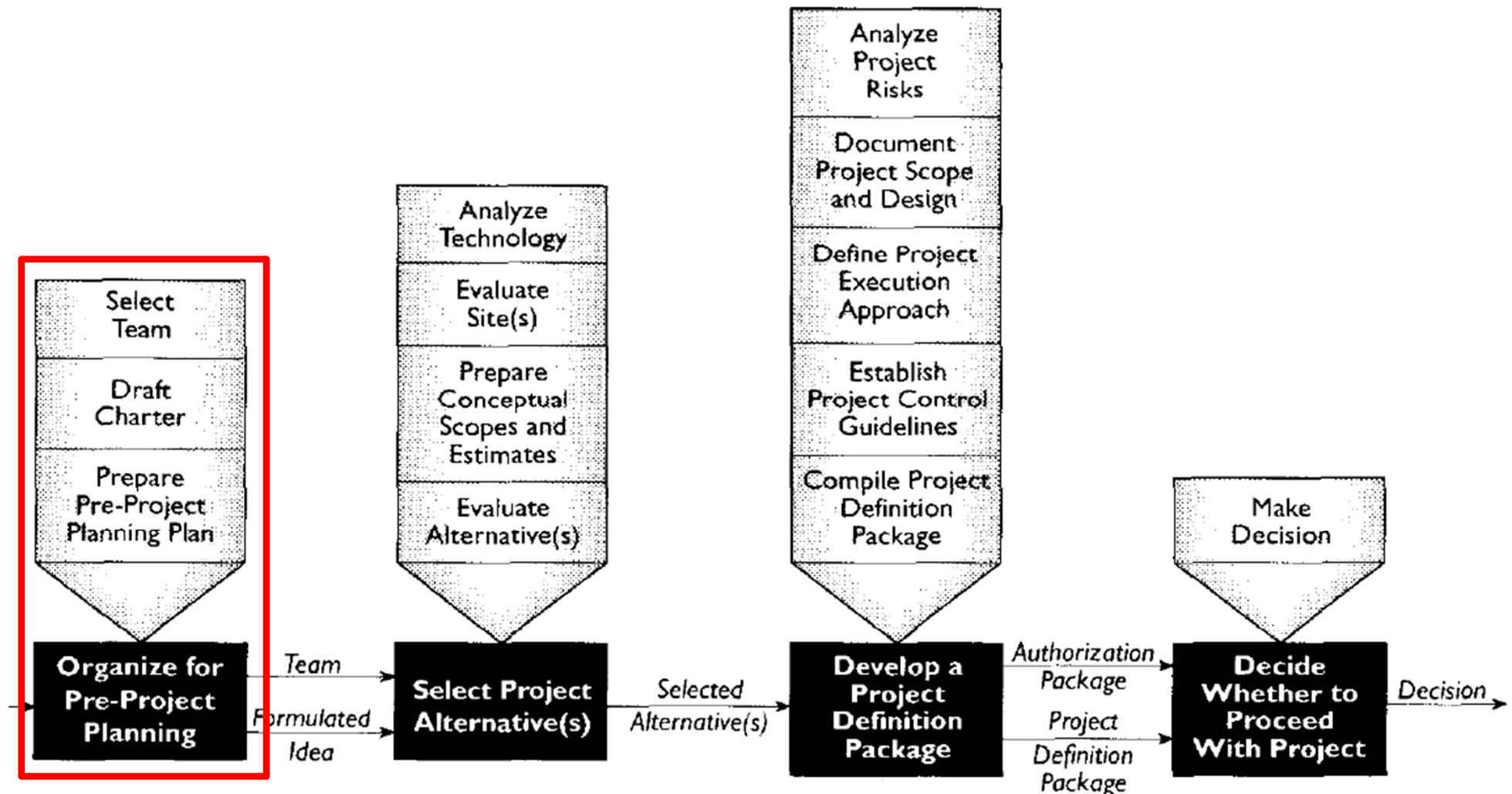


# When is PPP Complete?

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- Technology selected
- Site chosen
- Scope defined
- Cost and schedule determined
- Team assembled
- Project execution documentation
- Project team understands the project
- Decision maker's needs addressed
- Coherent recommendations
- Commitment

# (1) Organize for PPP



# (1) Organize for PPP

---

- **Select Team**

- The correct functional and technical expertise, team training, team objectives and leadership are essential.
- Expertise (knowledge), capability (skills), and authority (right for decision making)
- Balance between project management, technology, and human factors
- Long-term continuity with alignment

# PPP Example

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- Scenario

- VP of Chemical Products conducted our business meeting and discussed the possibility of **manufacturing a new product, called FOCUS XP™**, that provides a unique opportunity for our company, Aggressive Chemical, Ltd (ACL), to develop a huge market that currently does not exist. This chemical compound was recently piloted and improved upon in ACL's R&D organization and all of the tests have been outstanding. Everyone seems upbeat and excited about the chance for success.

# PPP Example

---

- Scenario (Cont'd)

- Our forecast is that the product needs to be available on the market within the next 30 months in order to provide optimum return. The company anticipates **100 percent market share during the first year and erosion during subsequent years to 50 percent after five years of operation**. Two of our competitors are also developing a similar product, but we feel that we currently have a slight lead in our ability to capture the market, if we are able to reach the market. If we are late, **our market share could be reduced by 25 percent or more during the first year**.

# PPP Example

---

- **Scenario (Cont'd)**
  - It is important to discuss construction timing of manufacturing facilities, volume, and return on investment (ROI). To meet the ACL's general corporate guidelines for return, our forecasters feel that the volume of FOCUS XP™ needed to meet **the market demand is 300 millions lbs. per year after two years of operation.**

# Example – Select Team

---

- Matrix of Stakeholders

NO.	CRITICAL TEAM SKILLS NEEDED	SOURCE
1.	Planning/ Scheduling/ Costing	In-house/ Consultant
2.	Operations	In-house
3.	Process/Engineering	In-house/ Consultant
4.	Hazop/ Safety	In-house
5.	Construction	In-house/ Consultant
6.	Marketing	In-house
7.	Human Resources	In-house
8.	Finance	In-house

# (1) Organize for PPP

---

- **Draft Charter**

- Transform the project concept into a valid approach to competing the project
- Typical contents
  - Mission statement (business needs, objectives)
  - Quality of deliverables
  - Organization chart with roles/responsibilities
  - Major milestones for PPP
  - Teambuilding procedures
  - Reporting requirements
  - Coordination procedures
  - Limits of authority
  - Time requirements
  - Budget requirements
  - Team code of conduct



# Example – Charter

---

- **Mission/Objective Statement**

- To aggressively lead the chemical industry
- To run state of the art R&D facilities developing products ahead of competition
- To expand markets on global platform
- To capture market imagination through innovative products
- To be ever sensitive to safety at work and uphold the HSE principles in totality
- To maximize ROI on investment capital

# Example – Charter

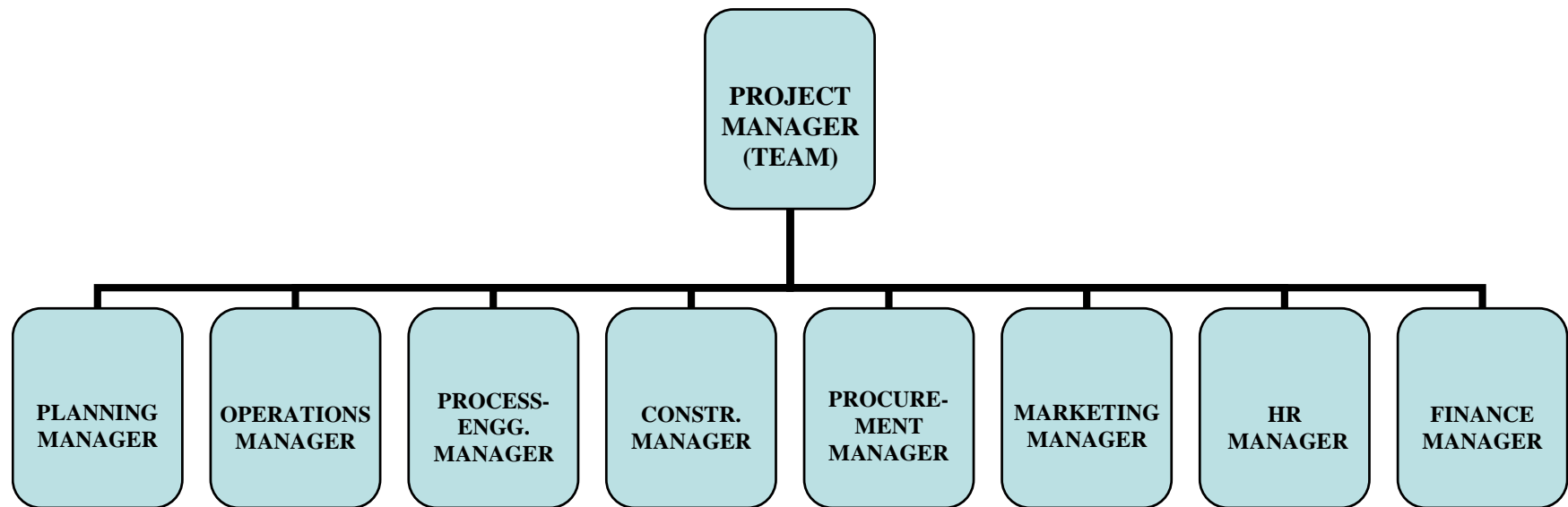
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- **Statement of Business Needs**
  - Product to be available in the next 30 months
  - 300 million lbs production after 2 years
  - Select best location to maximizing yield and minimizing cost
  - Identify worldwide distribution networks
  - Identify various interfaces with existing facilities, concurrent projects and study interrelations and impacts

# Example – Charter

---

- Organization Chart



# (1) Organize for PPP

---

- **Prepare PPP Plan**

- Based on approved charter, document who, how, and when
- More clearly focused, organized, and validated concepts
- To develop PPP plan, formulate and document
  - Defined deliverables
  - Schedule for PPP
  - Budget for PPP
  - Resources
  - Information
  - Location for PPP
  - Contract strategy
  - Permit analysis
  - Risk mitigation
  - Project outline
  - Work priorities
  - Specific team responsibilities

# Example – PPP Plan

---

- **Quality and Quantity**

- Quality of function/product
  - 90% yield directly impacts on quality.
- Quantity of function/product based on assumptions

Year	Year 1	Year 2	Year 3	Year 4	After Year 5
Market demand (million lbs)	250	300	400	500	600
Market share (%)	100	97	75	60	50
Expected yield (%)	90	90	90	90	90
Quantity (million lbs)	278	323	333	333	333

- Example: 323 in 2nd year =  $300 \times 0.97 / 0.90$
- The function needs to produce about 330 million lbs per year.

ID	Task Name	Start	Finish	Duration	Jan 28 2007				Feb 4 2007							Feb 11 2007							Feb 18 2007							Feb 25 2007							Mar 4 2007						
					31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	
1	Organize for FEP	1/31/2007	2/12/2007	1.8w																																							
2	- Select team	1/31/2007	2/5/2007	.8w																																							
3	- Draft charter	2/6/2007	2/12/2007	1w																																							
4	- Prepare FEP plan	2/6/2007	2/12/2007	1w																																							
5	Select project alternatives	2/13/2007	2/19/2007	1w																																							
6	- Analyze technology	2/13/2007	2/15/2007	.6w																																							
7	- Evaluate sites	2/13/2007	2/15/2007	.6w																																							
8	- Prepare conceptual scopes/estimates	2/13/2007	2/15/2007	.6w																																							
9	- Evaluate alternatives	2/16/2007	2/19/2007	.4w																																							
10	Develop a project definition package	2/20/2007	2/21/2007	.4w																																							
11	- Analyze project risks	2/20/2007	2/21/2007	.4w																																							
12	- Document project scope and design	2/20/2007	2/21/2007	.4w																																							
13	- Define project execution approach	2/20/2007	2/21/2007	.4w																																							
14	- Establish project control guidelines	2/20/2007	2/21/2007	.4w																																							
15	- Compile project definition package	2/20/2007	2/21/2007	.4w																																							
16	Make decision	2/22/2007	2/26/2007	.6w																																							
17	Decision analysis	2/27/2007	3/9/2007	1.8w																																							
18	- Project Definition Rating Index	2/27/2007	3/9/2007	1.8w																																							

# Example – PPP Plan

---

- **Budget**

- Total conceptual estimated cost = \$160 million
  - Cost for technology = \$80 million
  - Other project cost = \$80 million
- Budget for PPP
  - 3-5% of total project budget
  - Since Go/No Go decision needs to be made in a complicated situation that has many alternatives, it had better put the maximum 5% for the PPP budget.
  - Therefore, budget for PPP =  $5\% * \$160 \text{ million} = \$8 \text{ million}$

# (1) Organize for PPP

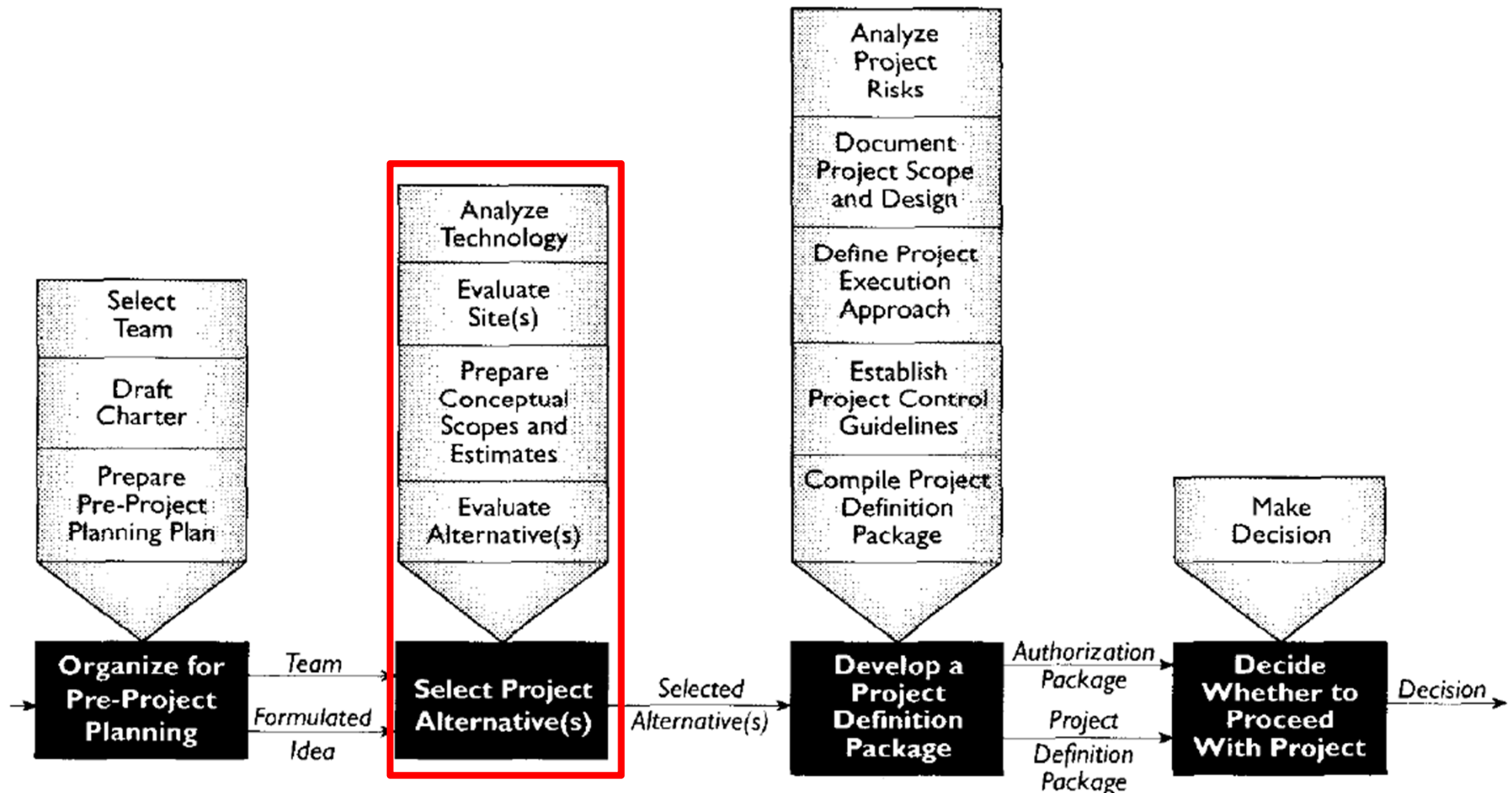
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- **Key Issues**

- Input of right people at right time affects the budget and schedule estimate
- Project objectives must be set early and align with business objectives
- PPP should integrate into the capital budgeting schedule
- Break work into manageable pieces and assign responsibility
- Begin early and expect to expend resources



## (2) Select Project Alternatives



## (2) Select Project Alternatives

---

- **Analyze Technology**
  - Which technology is available for us? New or existing?
  - Needs and constraints of the technology in relation to objectives and problems of the project
  - Experience with processes?
  - Applications and market factors (common?)
  - Cost effective analysis
    - Maximize the net benefits
    - Minimize the amount of resources required
    - Maximize the level of service or other system performance measures
    - Life Cycle Cost Analysis (LCCA)

# Example – Analyze Technology

---

- **Technology Alternative 1**

- License the APEX™ process owned by Process Improvement Technology Systems (PITS), Inc.
- Modify for use by adding other associated process technology in advanced development at ACL R&D
- Research time: 3 months
- Expected yield: 90%

- **Technology Alternative 2**

- Develop all new technology process technology in-house
- Research time: 6 -12 months
- Expected yield: 95%
- More expensive

*What would be good criteria  
to compare alternatives?*

# Example – Analyze Technology

- Best choice: Alternative 1 Customization

<b>TECHNOLOGY CONSIDERATION</b>						
NO.	<u>TECHNOLOGY OBJECTIVES</u>	WEIGHT	Tech 1 (PITS)	SCORE (PITS)	Tech 2 (New-in-house)	SCORE (New-in-house)
1.	Cost	20	2	40	1	20
2.	Research Time and Pilot testing	15	2	30	1	15
3.	Efficiency	15	1	15	2	30
4.	Product Quality	10	1	10	2	20
5.	Environmental	5	1	5	2	10
6.	Up gradation	5	1	5	2	10
7.	Feasibility	5	2	10	1	5
8.	Ease of Operation	5	1	5	2	10
9.	Process flexibility	5	2	10	1	5
10.	Safety considerations	5	2	10	1	5
11.	Long-term competitive position	5	1	5	2	10
12.	Risk involved	5	2	10	1	5
	<b>TOTAL SCORES</b>	100		<b>155</b>		<b>145</b>

*2: Best choice, 1: Second choice*

## (2) Select Project Alternatives

---

- Evaluate Sites

- Strengths and weaknesses of alternate locations to meet owner requirements and maximize benefits for the owner
- Concurrent with Analyze Technology
- Consideration
  - Overall economic choice (present + future)
  - Benefits standpoint (market)
  - Cost standpoint (raw materials, labor, utilities, supply, and distribution cost)
  - Initial investment standpoint (ROI)

# Example – Evaluate Sites

---

- Location Alternative 1: Texas
- Location Alternative 2: California

*What would be good criteria  
to compare alternatives?*

# Example – Evaluate Sites

- Best choice: Alternative 1 Texas

<b>LOCATION CONSIDERATION</b>						
<b>NO.</b>	<b>LOCATION FACTOR</b>	<b>WEIGHT</b>	<b>TX</b>	<b>SCORE</b>	<b>CA</b>	<b>SCORE</b>
1.	Permit time requirement	20	2	40	1	20
2.	Distribution	20	1	20	2	40
3.	General construction cost	15	2	30	1	15
4.	Lowest labor cost	10	2	20	1	10
5.	Feedstock supply	8	2	16	1	8
6.	Close to raw material supply	5	2	10	1	5
7.	Land availability	5	2	10	1	5
8.	Taxes	5	2	10	1	5
9.	Environmental restriction	5	2	10	1	5
10.	Building codes for seismic zones	5	2	10	1	5
11.	CEO's preference	2	1	2	2	4
	<b>TOTAL</b>	<b>100</b>		<b>178</b>		<b>122</b>

*2: Best choice, 1: Second choice*

# Example – Evaluate Sites

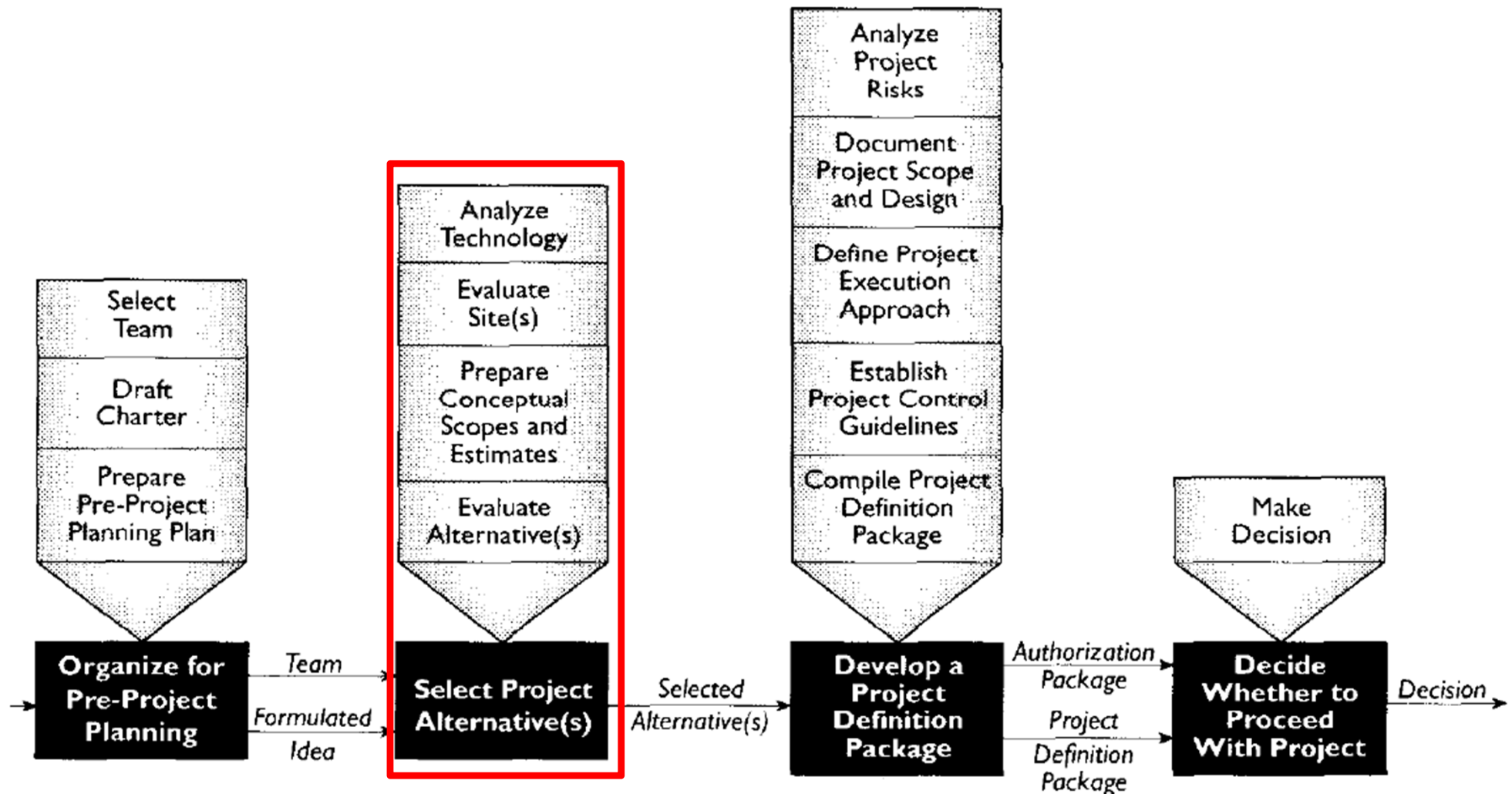
- Best choice:  
Alternative 1 Texas

<b>SITE SPECIFIC CONSIDERATION</b>						
NO.	<u>SITE OBJECTIVES</u>	Weight	TX	Score	CA	Score
1.	Ability to expand for future Capacity	15	2	30	1	15
2.	Access to markets	12	1	12	2	24
3.	Technology Compatibility	10	2	20	1	10
4.	Access to raw material/ feed stock	9	2	18	1	9
5.	Land availability	9	2	18	1	9
6.	Ability to attract and retain professional employees	8	2	16	1	8
7.	Competitor considerations	8	1	8	2	16
8.	Legal and Taxation issues	7	2	14	1	7
9.	Property tax rate	6	2	12	1	6
10.	Construction Costs	6	1	6	2	12
11.	Environmental Site Constraints	5	1	5	2	10
12.	Land acquisition cost	5	2	10	1	5
	Sub-Total	100		169		131
NO.	<u>SITE CHARACTERSTICS</u>	Weight	TX	Score	CA	Score
1.	Soil characteristics	13	2	26	1	13
2.	Seismicity	13	2	26	1	13
3.	Contiguous/neighboring area characteristics	9	2	18	1	9
4.	Hazardous waste clean up considerations	9	2	18	1	9
5.	Historical implications	9	1	9	2	18
6.	Weather and Climate	8	1	8	2	16
7.	Traffic/ communications/convenience	8	2	16	1	8
8.	Minimum start up time	7	2	14	1	7
9.	Hydrological considerations	7	1	7	2	14
10.	Topography	6	1	6	2	12
11.	Site layout	6	2	12	1	6
12.	Surface run off considerations	5	2	10	1	5
	Sub-Total	100		170		130
	<b>TOTAL</b>			<b>339</b>		<b>261</b>

2: Best choice, 1: Second choice



## (2) Select Project Alternatives



## (2) Select Project Alternatives

---

- **Prepare Conceptual Scopes and Estimates**
  - Discuss how the conceptual scope will impact on project budget
  - Provide conceptual input for financial analysis during the next step
  - Reduce uncertainties to an acceptable risk level
  - Define boundaries
  - Avoid excess details
  - Not final estimate

## (2) Select Project Alternatives

---

- **Prepare Conceptual Scopes and Estimates**
  - Scope questions might include:
    - What type of construction is desired?
    - How much power is required to operate?
    - Where are the closest existing utilities located?
    - What size of equipment is needed to meet our volume production?
    - What are the emissions limitation?
    - How much maintenance can be anticipated?

# Example – Scope and Estimate

- Best choice: Alternative 1 Texas

			TX		CA	
<b>A.</b>	<b>PROCESS OPERATIONS</b>	<b>Weight</b>	<b>Impact</b>	<b>Score</b>	<b>Impact</b>	<b>Score</b>
1	Process reliability	20	3	60	3	60
2	Design concept	15	3	45	3	45
3	Emission parameters	13	2	26	2	26
4	Effluent characteristics	12	2	24	2	24
5	Feedstock proximity	9	3	27	2	18
6	O/M personnel availability	8	2	16	2	16
7	Existing employees' familiarity with process	8	2	16	2	16
8	Equipment List	5	3	15	3	15
9	Area requirement	5	3	15	3	15
10	Population separation requirement	5	3	15	3	15
11	Sub-Total (A)	100		259		250

*1: High, 2: Medium, 3: Low Impact to Estimate*

# Example – Scope and Estimate

- Best choice: Alternative 1 Texas

*1: High, 2: Medium, 3: Low*

<b>B.</b>	<b>SITE/BUILDING FACTORS</b>	<b>Weight</b>	<b>Impact</b>	<b>Score</b>	<b>Impact</b>	<b>Score</b>
	Impact on plant start-up	18	3	54	2	36
	New Facility/ Renovation	14	3	42	3	42
	Cost implications	10	2	20	2	20
	Time implication	10	2	20	2	20
	Adequate accommodation space	9	2	18	2	18
	Roadways and bridges requirement	9	3	27	3	27
	Seismicity	7	2	14	1	7
	Soil characteristics	6	3	18	1	6
	Parking requirements	5	2	10	2	10
	Topography	5	2	10	1	5
	Cafeteria requirement	4	2	8	2	8
	Landscape	3	1	3	1	3
	<b>Sub-Total (B)</b>	100		<b>244</b>		<b>202</b>
<b>C.</b>	<b>UTILITY CONSIDERATIONS</b>	<b>Weight</b>	<b>Impact</b>	<b>Score</b>	<b>Impact</b>	<b>Score</b>
	Electrical system layout	19	3	57	2	38
	Number of meters required	15	3	45	2	30
	State/ Captive generation requirements	17	3	51	3	51
	Service water layout	11	3	33	2	22
	Drinking Water Layout	8	2	16	1	8
	Sewerage system	8	2	16	1	8
	DM water layout	7	3	21	1	7
	Cooling Water system	7	3	21	1	7
	Steam system layout	4	3	12	1	4
	Compressed air layout	4	3	12	1	4
	<b>Sub-Total(C)</b>	100		<b>284</b>		<b>179</b>
	<b>TOTAL (A+B+C)</b>			<b>787</b>		<b>631</b>

## (2) Select Project Alternatives

---

- **Evaluate Alternatives**

- Identify best alternative(s)
- More than one alternative
  - Recognize
  - Allow time
  - Provide flexibility
- Consistent evaluation criteria for analysis and comparison
  - Benefits, investment and timing, working capital, operating/non-operating requirements, business risk/profitability, economic analysis

# Example – Evaluate Alternatives

---

- **Technology Alternative 1 (APEX™): Best Choice**
  - Proven technology, with some modification requirement
  - Lower cost
  - Safer
  - More flexible
- **Site Texas: Best Choice**
  - Lower construction cost
  - Lower green-field establishment permits
  - Good resources from Texas regions
  - Efficient layout
  - Preliminary findings suggest minimum impact of wetlands
  - Transportation infrastructure growth in Texas
  - Lower land cost and property taxes

# Example – Evaluate Alternatives

---

- **Critical scoping estimating parameters**
  - Process reliability
  - Design concept
  - Emission parameters
  - Effluent characteristics
  - Early commissioning
  - Technology/site cost implications
  - Electrical systems
  - Power generation
  - Service water systems



## (2) Select Project Alternatives

---

- **Key Issues**

- Cost vs. Time vs. Expertise
- Alternatives affect both initial cost and downstream costs, including dispute potential
- Economic vs. non-economic decision criteria
- Understand the accuracy of estimates at this phase
- Identify best alternative(s)