

건설발주시스템 (발주유형 및 특성/DBB/DB/TK/PPP)

건축시공 및 건설관리 입문

Introduction to Building Construction Engineering & Management

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발주방식

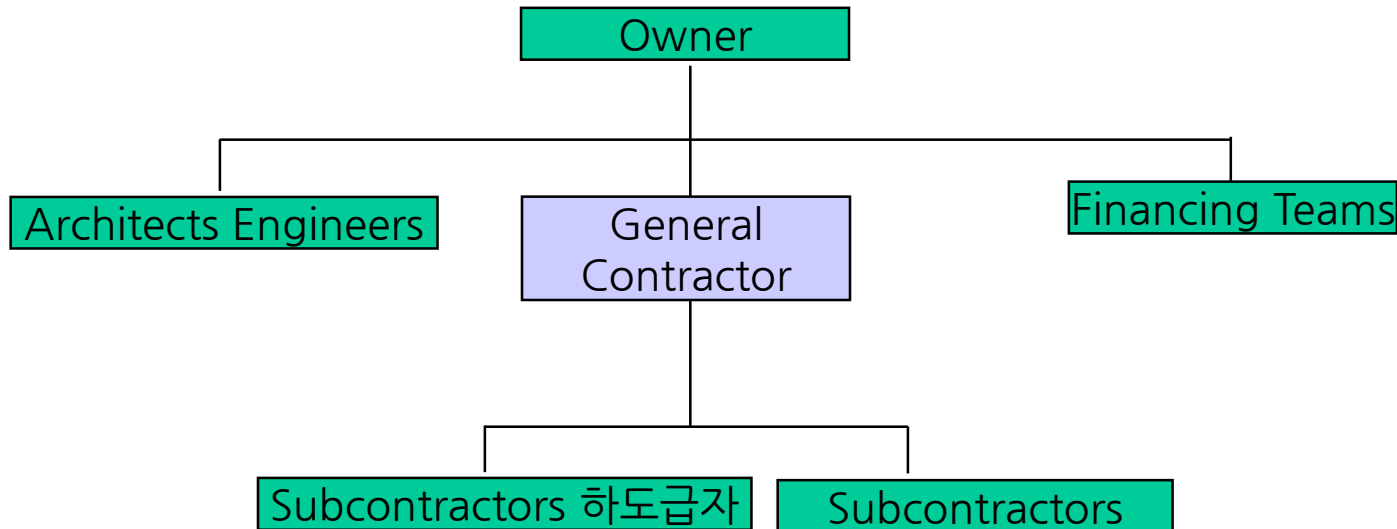
(Delivery Systems)

PJ Delivery Methods/Organizations

(사업수행 방식/주체에 따른 분류)

- Design-Bid-Build (DBB, 일식도급)/General Contractor (GC/일반건설업체)
 - Design-Build (DB, 설계시공일괄도급)
 - Turnkey
 - Build-Operate-Transfer (BOT)
-
- Construction Manager (CM, 건설사업관리방식)/건설사업관리자
 - Multiple Primes (분할도급)

General Contractor *DBB (Design-Bid-Build)*



A single business entity acting as the contractor in complete and sole charge of the field operations (Clough 1981).

General Contractor: Fixed Price

Advantages

- Selection of wide range of design professionals
- Having the design professional monitor construction with the owner
- Exploring design alternatives and making changes during design phase
- Total cost known at the start of construction
- Total site construction responsibility delegated to one entity

Disadvantages

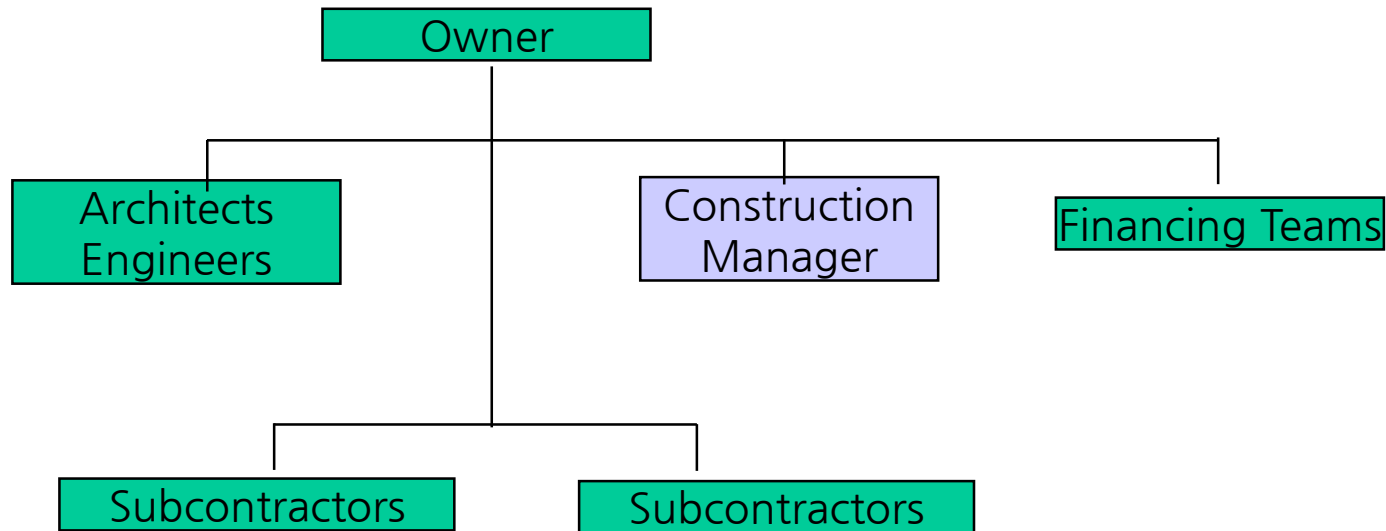
- Depriving the owner of contractor's planning knowledge
- Possibly creating an adversarial relationships among parties
- Making design changes during construction expensive and difficult
- Linear nature of waiting to start construction
- having no share in any savings the contractor may find during construction

General Contractor: Reimbursable Price

* Only those different from GC working for a fixed price are listed below;

Advantages
<ul style="list-style-type: none">• Not necessarily having design documents complete before awarding a contract, which allows the contractor to be involved in pre-construction planning and the use of fast-tracking
<ul style="list-style-type: none">• Easy changes, provided that the portion of the work has not been awarded to a subcontractor
Disadvantages
<ul style="list-style-type: none">• Less price accountability and possibly less efficiency, since the contractor has no motivation to limit costs
<ul style="list-style-type: none">• Total construction cost not known until the end

Construction Manager



A single business entity acting as a construction consultant to the owner, either for a fixed fee or a fee as a percentage of the cost (Christopher, 1998) → CM for Fee (Agency CM)

*cf. CM at Risk (Constructor CM, CM/GC, Construction Manager as Constructor: CMc)

Construction Manager

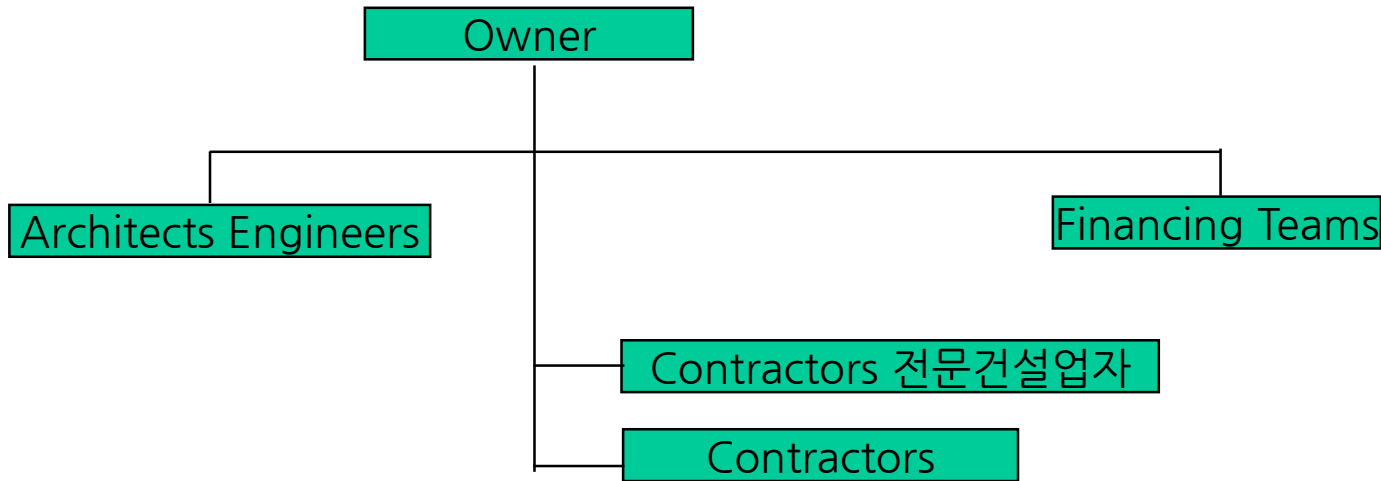
Advantages

- Allowing fast-tracking, since the individual contracts can be awarded as soon as the design documents are complete
- Increasing flexibility for changes
- Reducing the potential for adversarial relationship among parties
- CM involved in pre-construction phases such as estimating, scheduling, value engineering, and labor issues
- Allowing the owner to directly access to material and sub-contractor markets, which can realize savings from bid packaging and contract types (portfolio effect by reducing owners dependence on one large contractor)

Disadvantages

- Total costs and schedule normally not known nor guaranteed at the start of construction
- Hiring an unqualified CM can result in chaos

Multiple Primes (Contractors)



The owner is responsible for overall project management and coordination. More than one contractor hold contracts directly with the owner to perform specific parts of the same project.

Multiple Primes

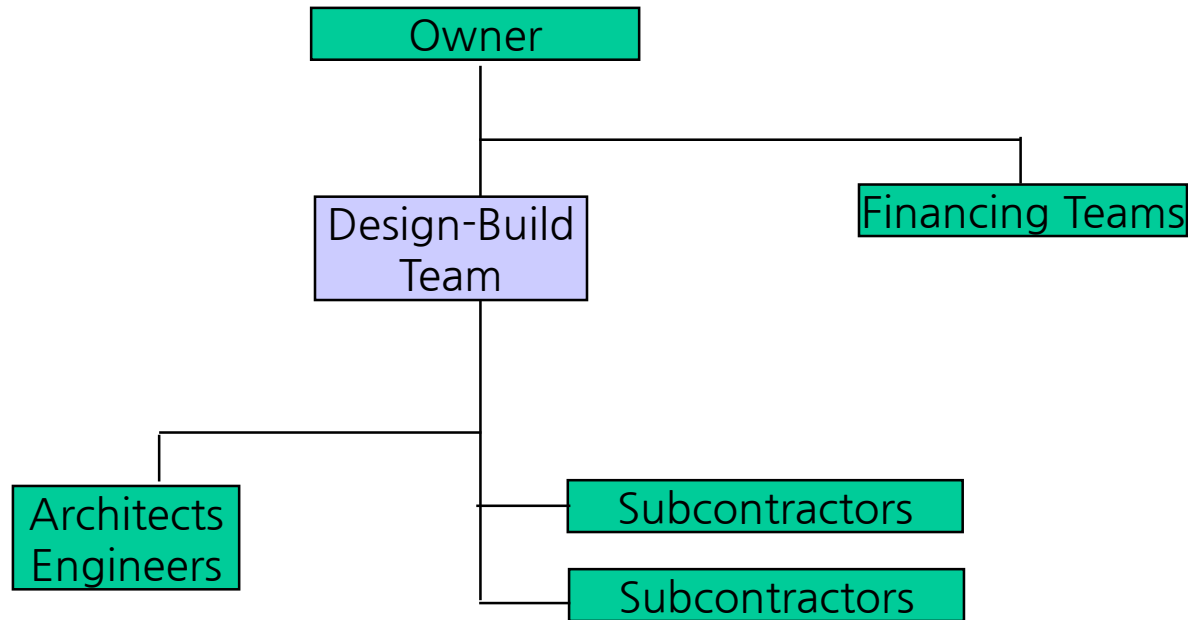
Advantages

- Allowing fast-tracking, since the individual contracts can be awarded as soon as the design documents are complete
- Increasing flexibility for changes
- Allowing the owner to directly access to material and sub-contractor markets, which can realize savings from bid packaging and contract types (portfolio effect by reducing owners dependence on one large contractor)

Disadvantages

- Total costs and schedule normally not known nor guaranteed at the start of construction
- Requiring owners' knowledge on construction and heavy involvement
- Having no pre-construction services from a contractor

Design-Build



A single business entity that performs both the design and construction of a project. The team can be one company or a partnership of firms (Christopher, 1998).

Design-Build: Fixed Price

Advantages

- Total cost known before the start of design and construction
- Enhanced teamwork between the designer and contractor
- The owner has no liability for change orders
- Allowing fast-tracking
- Total design and construction responsibility delegated to one entity
- No needs for a separated selection process for the designer and contractor

Disadvantages

- Making design changes often expensive and difficult for the owner
- Reduced flexibility in and control over the detailed design process
- Requiring owners' knowledge to establish the initial parameters and monitor the process
- Entirely dependent on one entity: low design quality
- having no share in any savings the contractor may find during construction

Design-Build: Reimbursable Price

* Only those different from DB working for a fixed price are listed below;

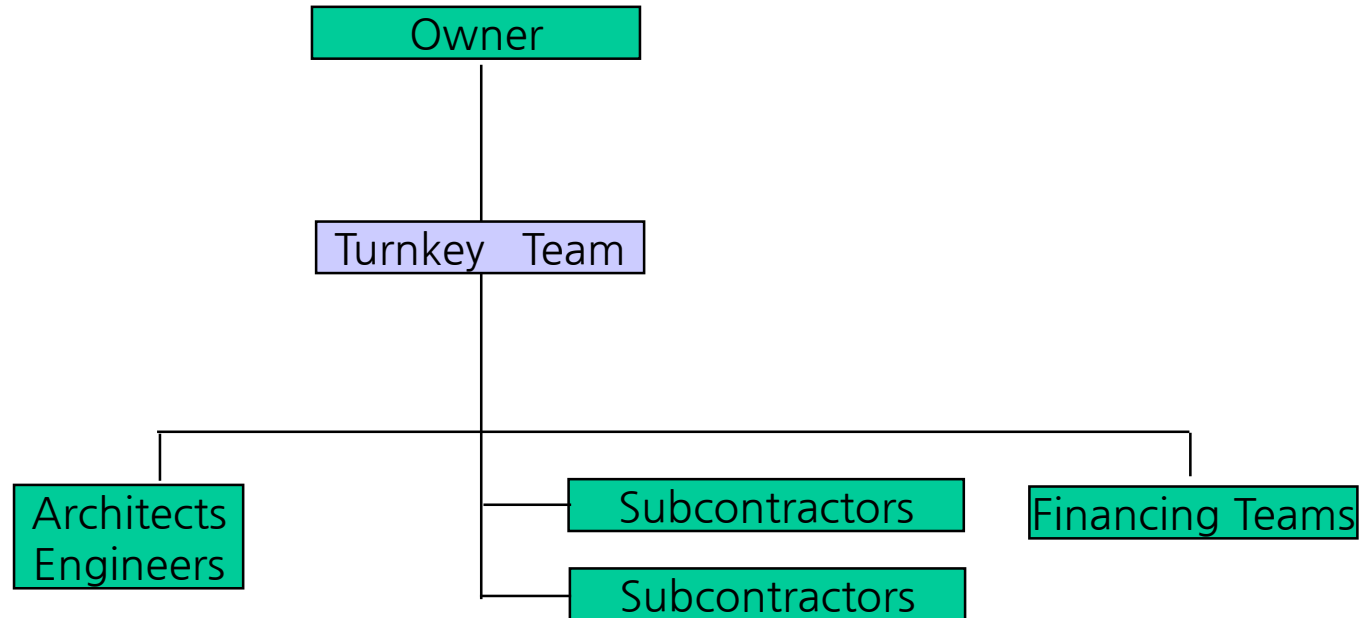
Advantages

- Expecting a high quality work, since design-build team selection is made only on qualifications
- Easy changes, provided that the portion of the work has not been awarded to a subcontractor

Disadvantages

- Less price accountability and possibly less efficiency, since the contractor has no motivation to limit costs
- Total construction cost not known until the end

Turnkey



DB+Financing, A single business entity that performs the design, construction and financing of a project. The project is turned over to the owner, when construction is complete (Christopher, 1998).

Turnkey: Fixed Price

Advantages

- Total cost known before the start of design and construction
- Enhanced teamwork between the designer and contractor
- The owner has no liability for change orders
- Allowing fast-tracking
- No needs for a separated selection process for the designer and contractor
- Total design, construction, short-term financing and responsibility delegated to one entity
- Maximizing the project value by the use of a cap, since the turnkey team carries the financing costs as well

Turnkey: Fixed Price

Disadvantages

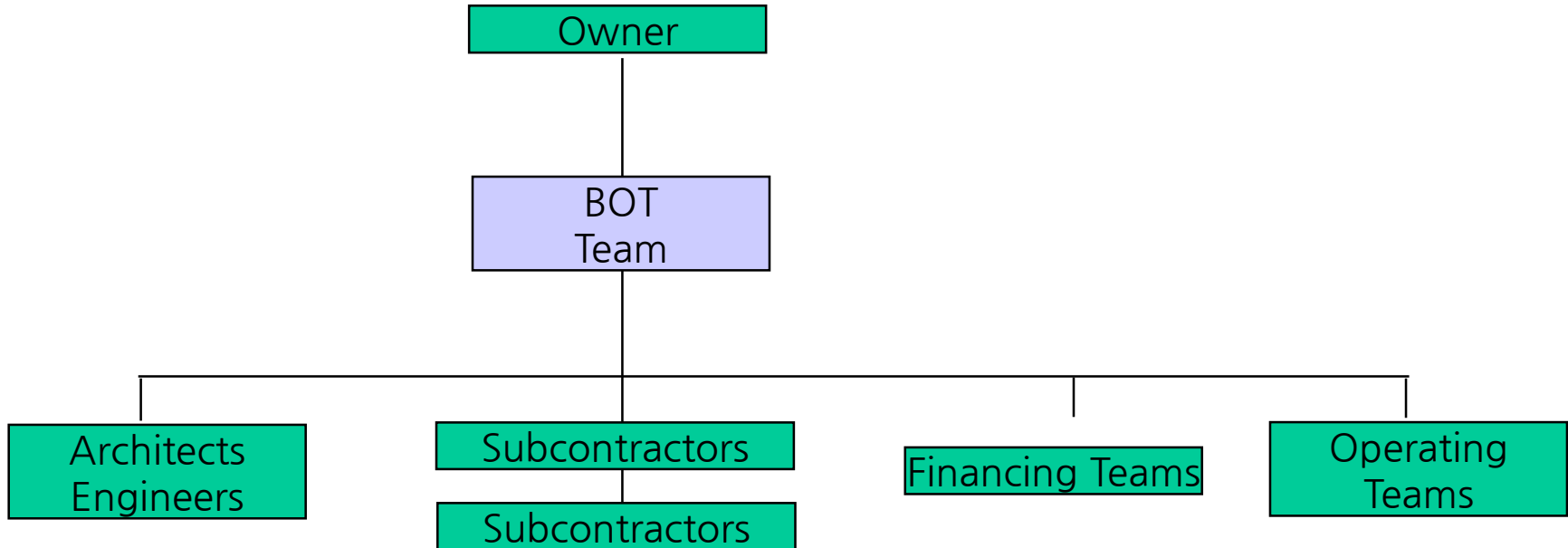
- Making design changes often expensive and difficult for the owner
- Reduced flexibility in and control over the detailed design process
- Requiring owners' knowledge to establish the initial parameters and monitor the process
- Entirely dependent on one entity
- having no share in any savings the contractor may find during construction

Turnkey: Reimbursable Price

* Only those different from Turnkey working for a fixed price are listed below;

Advantages
<ul style="list-style-type: none">• Expecting a high quality work, since design-build team selection is made only on qualifications
<ul style="list-style-type: none">• Eliminate the lengthy proposal process
<ul style="list-style-type: none">• Easy changes, provided that the portion of the work has not been awarded to a subcontractor
Disadvantages
<ul style="list-style-type: none">• Less price accountability and possibly less efficiency, since the contractor has no motivation to limit costs
<ul style="list-style-type: none">• Total construction cost not known until the end

Build-Operate-Transfer



Turnkey+Operation, A single business entity that performs the design, construction, financing and temporary operation of a project. The project is turned over to the owner at the end of the operation period (Christopher, 1998).

Build-Operate-Transfer

Advantages

- Total cost and financial arrangement known before the start of design and construction
- Enhanced teamwork between the designer, contractor and operator
- The owner has no liability for change orders
- Allowing fast-tracking
- Total design, construction, financing, and operation responsibility delegated to one entity
- No needs for a separated selection process for the designer, contractor, and operator, and financial arrangement
- Potentially introducing new technologies and management techniques

Build-Operate-Transfer

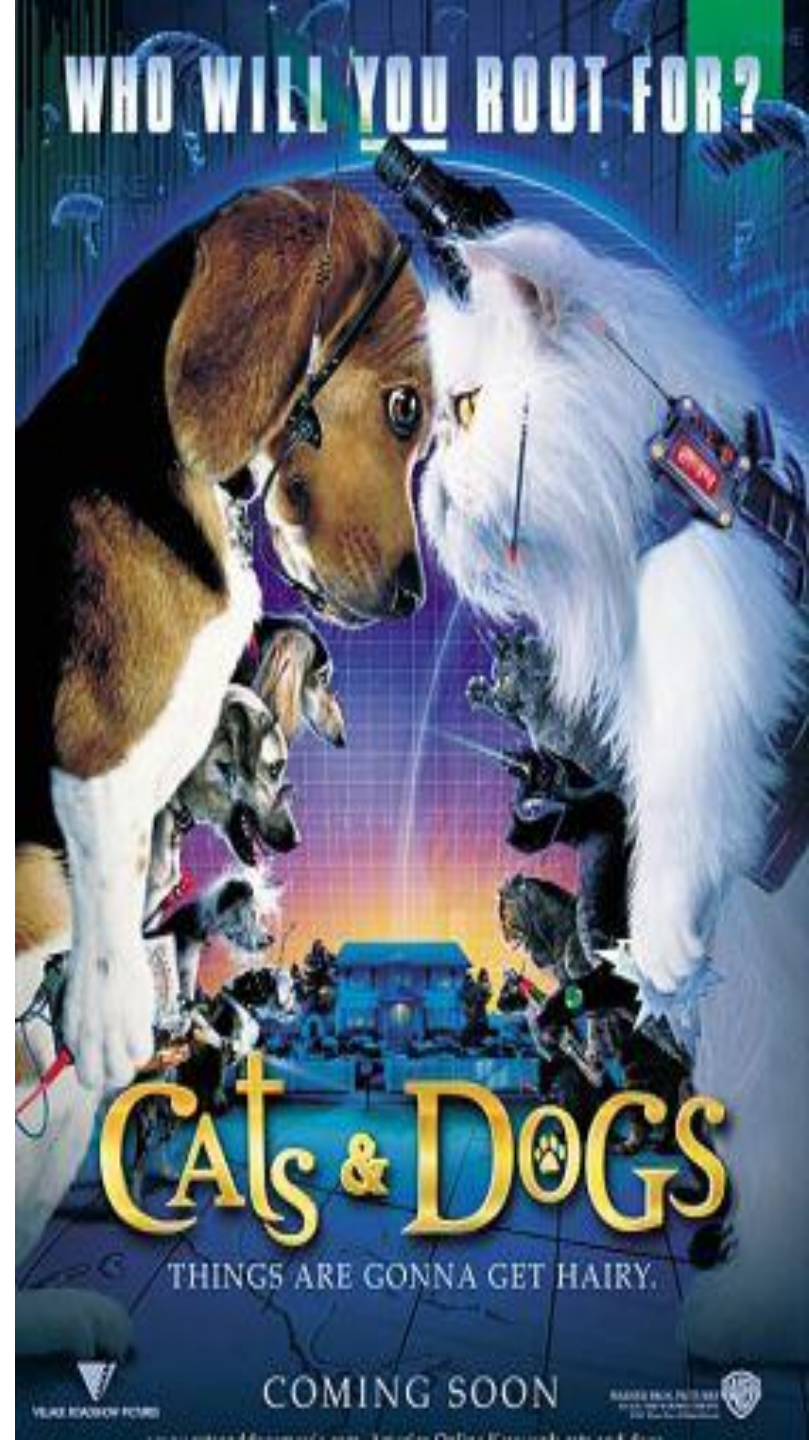
Disadvantages

- Making design changes often difficult for the owner
- Reduced flexibility in and control over the detailed design process
- Requiring owners' knowledge to establish the initial parameters and monitor the process
- Entirely dependent on one entity

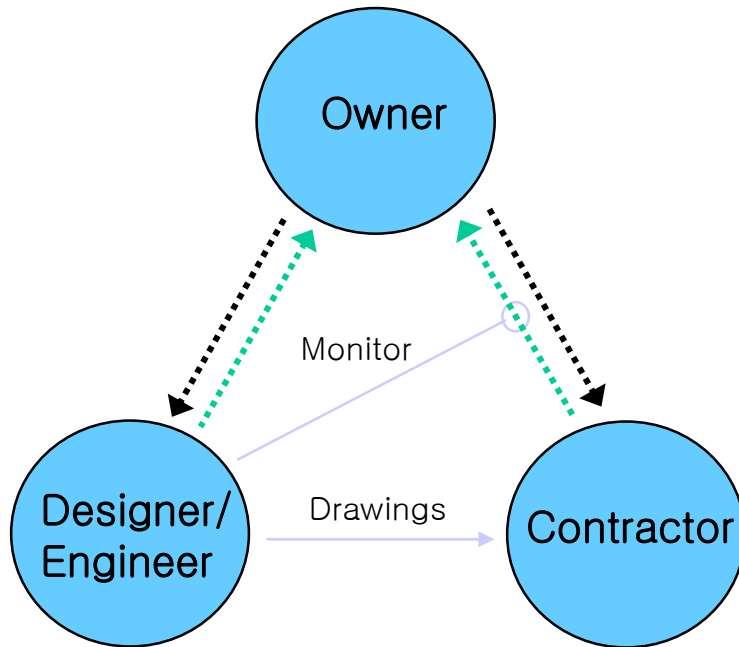
Discussions

Cats & Dogs Analysis

- The owner wants a project to be delivered with quality, in time, and within budget.
- Meanwhile, project functions pursuit profits from the project, while providing quality service in time.
- Then, given contractual and functional relationships, who would be cats and dogs, and
- What are potential problems that would be caused by contractual and functional relationships?



Cats & Dogs



* Contractual Relation

Money

Service (with quality & in time)

* Functional Relation



- What if the designer provides low buildability design?
- What if the designer is too strict during monitoring the construction process?
- Who would be cats and dogs? And what would be potential problems?

Terminologies

발주 delivery system [發注]

*조달 procurement

*구매 purchase

입찰 bidding

낙찰 awarding

계약 contracting

*도급공사 vs 직영 (Force Account Method)

Bidding (입찰)

- Competitive Bid (경쟁입찰)
 - General Open Bid (일반/공개 경쟁입찰)
 - Limited Open bid (제한 경쟁입찰): 군 (群)제한입찰, 지역제한입찰, PQ
 - Nominated bid (지명 경쟁입찰)
- Negotiated Contract/ Contract Ad-libitum (수의계약)

Bond/Security (보증)

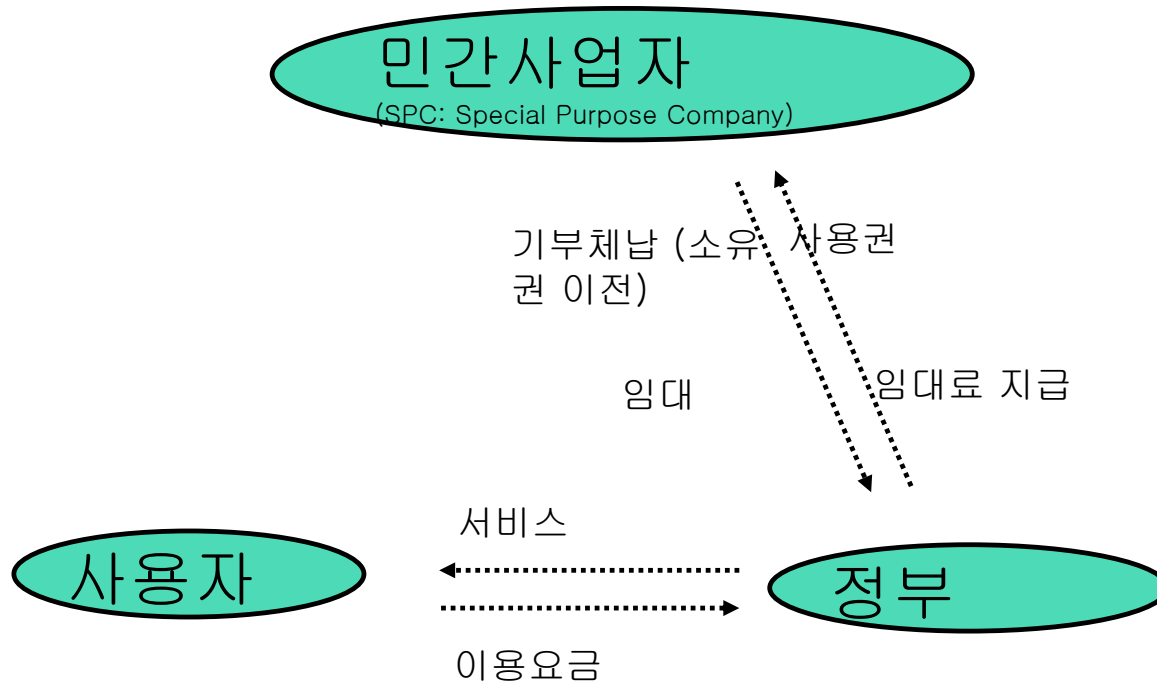
선계약후생산 계약체계하에서 보증채권자 (obligee: 발주자)에 대한 주채무자 (principal: 도급자)의 계약 이행 의무를 제3자인 보증인 (surety: 보증회사)가 담보하는 제도

- Bid bond/Security (입찰보증: 입찰금액 5% 이상)
- Contract Security/Performance bond (계약보증/이행보증)
- Retention money bond (유보금보증, 하자보수보증금)
- Liquidated Damage (지체보상금)

BOT, BTO, BTL

	BOT	BTO	BTL
투자비회수	최종사용자 이용료		시설임대료
대상시설	도로, 다리, 터널 등		학교 등 공익 시설
사업리스크	사업자	정부보장	
사업리스크 보장 방법	NA	개발시 보조금 및 운영중 수익율보장	

BTL



GC vs CM at Risk

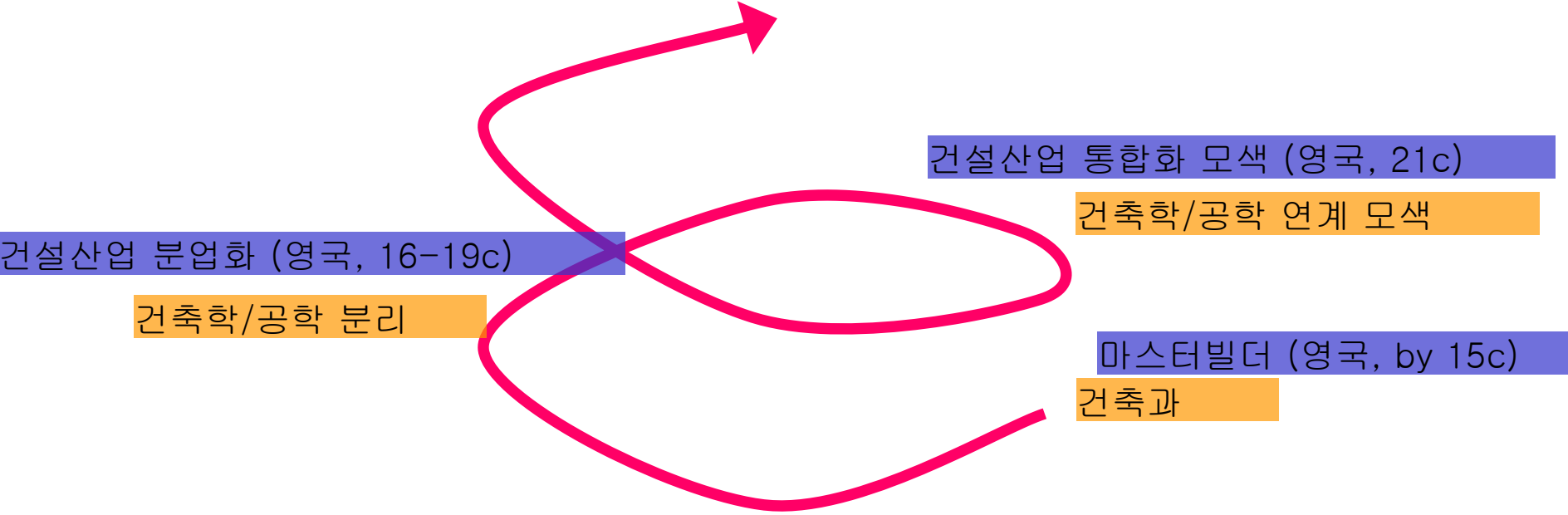
- CM for Fee 방식에서의 CM 기능 유지
 - 프로젝트 초기부터 계획 주도 (초기에는 agent로 출발)
 - 예비설계 후 GMP 제안
 - 시공책임 (보수에 대한 보증, 인센티브)

Black Box vs White Box ?

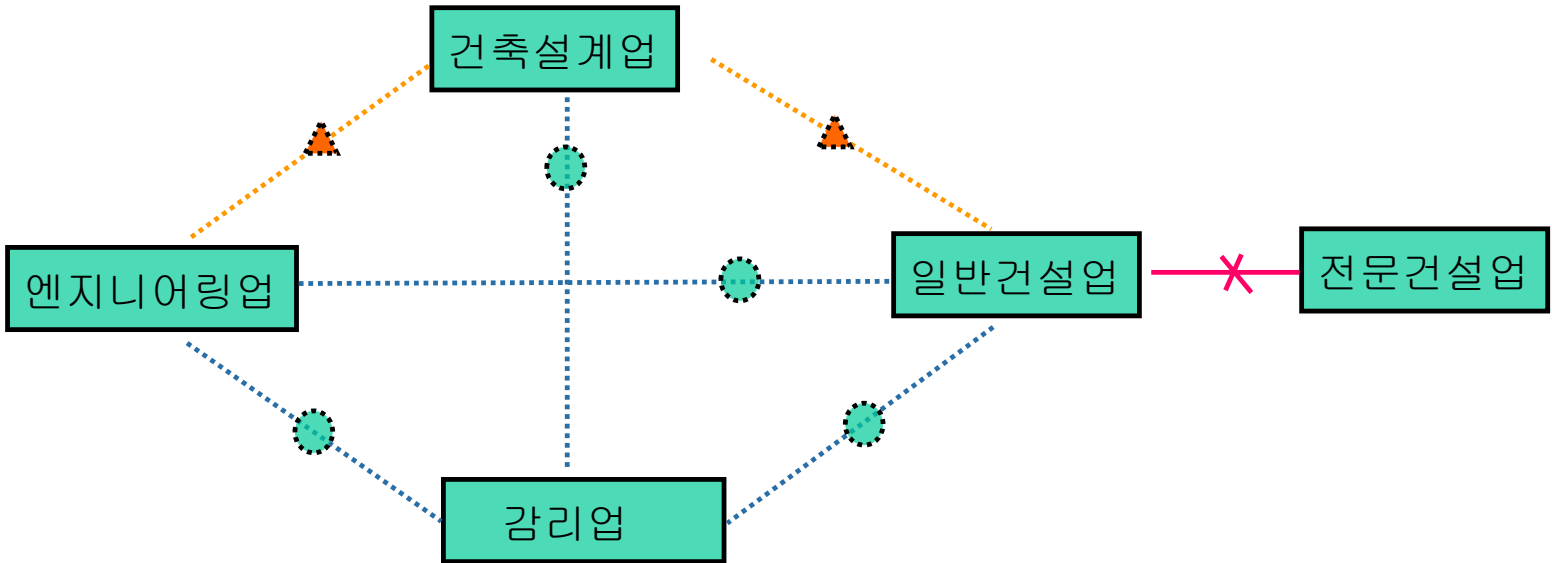
	GC	CM at Risk	CM for Fee
Precon service	NA	CM 검토/조언	
Trade selection	GC*	CM 선정 / 발주자 승인	CM 조언 / 발주자 선정
Trade subcontracts	GC	CM	owner
Construction service	Direct control	Direct control	Admin contract
공사비보장 (risk sharing)	△	보수, 인센티브	x
공기보장	o	△	x
품질보장	o	o	x
시공책임 (안전/공법)	o	o	x

*NSC: Nominated Sub-Contract

Spiral Evolution



경업제한



X : 명시적 금지

▲ : 명시적 금지 조항은 없으나 건축사법에 의거 현실적 제약

● : 허용

감리

구분		감리대상범위	감리자격	감리대가기준	감리 및 감독방법	감리원배치기준	관계 법령
국민부 민간부	토목	100억원 이상 공사	감리전문회사	-	책임감리	건설공사 감리원 배치 기준에 따라 배치	건설기술 관리법
		100억원 미만 공사	소속 공무원	-	공사감독	공사규모에 따라 인원 배치	
	건축	100억원 이상 공사	감리전문회사	-	책임감리 (전면/부분)	건설공사 감리원 배치 기준에 따라 배치	건설기술 관리법
		100억 미만 공사	건축사	-	공사감리	건축물 규모에 의한 상주 또는 비상주배치	건축법
공동 주택	300세대 이상	감리전문회사 (건축/종합)	-	공사감리	주택법시행령에 따라 배치 (감리 제외공종 미포함)	주택법	
	20세대 ~ 300세대 미만	건축사					
다중 이용 건축물	연면적5000㎡ 이상 다중이용시설물 16층이상 건축물	감리전문회사 건축사	-	공사감리	건설공사 감리원 배치기준에 따라 배치	건축법	
주상복합건물	주택 300세대 이상	감리전문회사	-	공사감리	주택법시행령에 따라 배치 (감리 제외공종 미포함)	주택법	
	주택 300세대 미만	감리전문회사 / 건축사	-	공사감리	건설공사 감리원 배치 기준에 따라 배치	건축법	
민간부 공공부	토목	민간 발주공사	엔지니어링 활동 주체	엔지니어링 사업대가기준	공사감리	-	엔지니어링 기술진흥법
	건축	공공부문의 건축공사 및 다중 이용건축물을 제외 한 민간 발주공사	건축사	-	공사감리	건축물 규모에 의한 상주 또는 비상주 배치	건축법
공통	소방	소방설비공사	소방감리 등록업체	엔지니어링 사업대가기준	소방감리	-	소방법
	전기	전기공사	전력시설감리 등록업체	전력기술용역 대가 및 공사감리원 배치기준	전기감리	공사감리원 배치기준에 따라 배치	전력기술 관리법
	정보통신	정보통신공사	정보통신감리 등록업체	정보통신설비 공사감리대가 표준품셈	통신감리	감리원의 배치기준에 따라 배치	정보통신 공사업법

◎ 공사규모별 발주관련 법규 제한사항

구분		30억	50억	74억	100억 대형공사	300억
발주 방법	DBB DB CM	건설사업관리(CM) : 필요하다고 인정시 -국계법 시행령 제73조의2			설계시공분리 원칙	발주계획(일괄, 대안, 등) 견교부 제출 및 심의 의무 (중앙건설심의위원회) -국계법 시행령 제80조
	PPP					민간투자방식 추진 : 주무관청에서 대상사업지정 -민투법 제8조의2 국내 허용 민간투자방식 : BOT, BTL, BTO, BOO -민투법 제4조
입찰 방법	경쟁 방법	2억(전문공사 1억)이하 수의계약 가능 -국계법 시행령 제26조	실적제한 가능(전문공사 3억) -국계법 시행규칙 제24조	일반경쟁 원칙 -국계법 시행령 제10조		입찰자격사전심사(PQ) 의무 -국계법 시행령 제13조
	공동 도급	3억(전문공사 1억)이하 지명경쟁 가능 -국계법 시행령 제23조	지역제한 가능(전문공사 5억) -회계예규 2200.04-159-3 (2006.12.29)	지역공동도급 의무 -국계법 시행령 제72조		
입찰 서류 제한	입찰 서류 제한	국내입찰 (정부기관) -재정경제부 고시제2006-58호 (2006.12.29)			국제입찰 의무 (정부기관) -좌동 ※정부투자기관 222억	내역입찰 의무 -회계예규 2200.04-159-3 (2006.12.29) 제18조 부대입찰 의무 -국계법 시행규칙 제23조
	DBB					적격심사 의무 -국계법 시행령 제45조 ※심사기준 : 회계예규 2200.-04-149-18 (06.12.29)
낙찰 자 선정 방법	DB	※ 일괄, 대안입찰은 설계자문위원회, 중앙건설기술심의위원회의 설계점수로 낙찰 -국계법 시행령 제86/87조 ※ 단, 대안입찰에서 대안이 없는 경우는 DBB와 같은 낙찰자 선정법 적용 -국계법 시행령 제86조				
	CM PPP	※ 건설사업관리 계약에 관한 사항은 재정경제부 장관이 정함 -국계법 시행령 제73조의2 제2항에 ※ 민간투자사업은 사업계획서 검토 및 평가를 통하여 우선협상대상자(2인)를 선정 -민투법 제13조				

※국계법 : 국가를당사자로하는계약에관한법률, 민투법:사회간접시설에대한민간투자법

Contract Selection

- Determining how the owner will pay the contractor for work performed.
 - **Fixed Price** (확정계약) : lump sum (총액계약) , unit prices (단가계약), 총액 단가, (순수)내역입찰
 - **Reimbursable** (개산계약) : cost-plus (실비정산보수가산) / a fixed fee, a percentage, etc
 - **Hybrid**: a guaranteed maximum price (GMP: 최대공사비 보증가격)
- Contract decision needs to revolve around risk (mainly financial risks) allocation. An appropriate contract type can be selected by properly assess risks involved, allocating the risks, and ensuring that each party can properly manage the risks allocated to them.

Allocating Risks

- Risk allocation should be balanced between the owner and the contractor or designer so that each party can utilize the incentive value of bearing risks, while minimizing a contingency charged for accepting the risks.
- A group's efficiency in handling risks is determined by 1) its power to control the risks, 2) potential rewards for controlling the risks, and 3) its financial position to assume the risks.

Award Selection

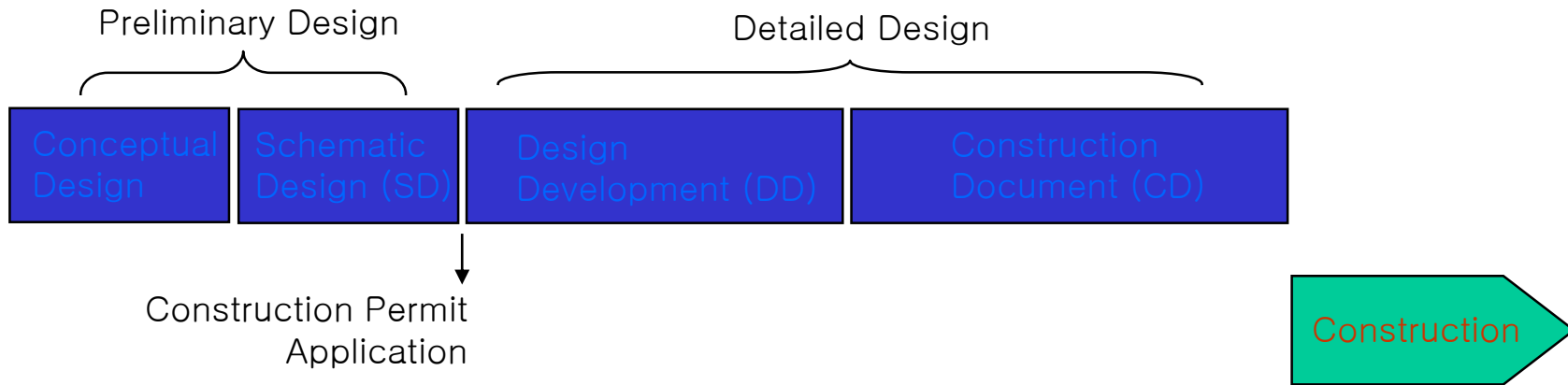
- The method used to select the contractor and/or the price
 - **Two Extremes:** lump sum competitive bidding, single-source negotiation
 - **Common Variations:** bidding with prequalification of contractors, competitive negotiation
- Challenges
 - **Competitive Bidding:** Incapable contractors, low quality work
 - **Negotiation:** hard to determine the market price, vulnerable to favoritism or corruption

Key to a Successful Award

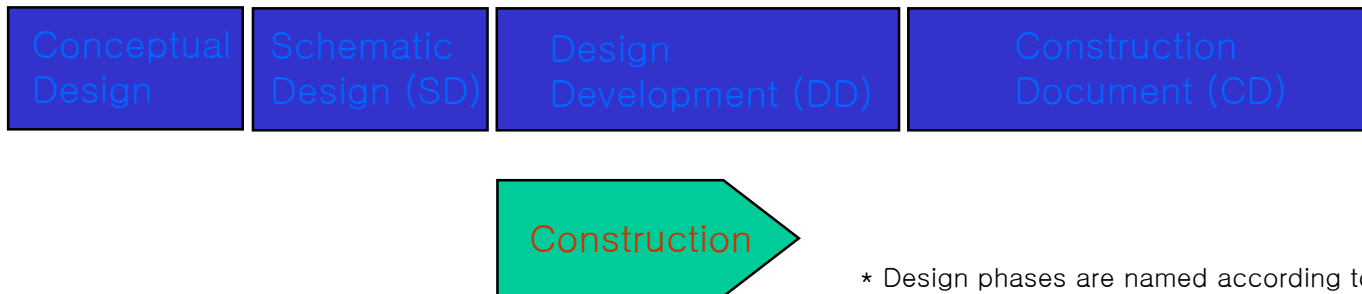
- Different perceptions of construction as either a *commodity* or *a service*
- Isolate the two types of products
 - **Commodities:** e.g., materials and some labor available on the market
 - **Services:** e.g., technical expertise and management abilities (less able to be bought on a price-only basis)
- Award each in an appropriate way
 - **Commodities:** bidding
 - **Services:** negotiation or multiparameter bidding

Fast-Tracking

Sequential Delivery



Fast-Tracking



* Design phases are named according to the AIA Standard.

Potential Risk of Fast-Tracking

- Fast-tracking has received considerable attention over the last decade.
- Despite its promise of speed, fast-tracking also has greater potential to impact the project development process than the traditional more sequential method.
- In reality, often results in unexpected costs and does not necessarily lead to the expected shorter project duration [Fazio et al., 1988].

Partnering



Objectives

“Partnering, through improved communication, aims to help parties to be less protective and to find a better way for whole project”.

Background

- The structure of construction projects is getting more **complex** and their management becomes more **difficult**.
- Project participants **rarely understand their obligations under the contract**, resulting in an increase in disputes and project costs.
- These industry environments increased **the need for additional process steps** to assure that potential problems are discussed and evaluated clearly by all parties.

As a process architecture

- Used to encourage and allow for [inter-disciplinary exchange of ideas and identification of project risks](#).
- [Neutral facilitators play a central role in the success of partnering](#).
- It is voluntary process and [not legally-binding](#), and it does not alter the contractual obligations.

IPD (Integrated Project Delivery)



- A collaborative alliance in that all participants maximize efficiency through all phases of design, fabrication, and construction
- Using ideas from Toyota Production System, brings all participants together early to maximize value for the owner.
- Allows data sharing directly between the design and construction team

- First established in May 2007 by the AIA California Council Integrated Project Delivery Task Force
- IPD vs BIM

Case Study

In Warsaw, Poland, in 1996...



Market Situation

- Privatization actively undergoing
- Steep increases in office rent in Warsaw expected within a few years
- A lot of office buildings already being developed by western construction companies (mostly the US and German companies)
- Land acquisition cost still cheap
- Shortage in local subcontractors and labor market

Warsaw Trade Tower



- Developer: D Corporation
- Building Type: Business Center (42 floors)
- Budget: U\$120 M
- Construction Period: 36 Months (Planned)
- Delivery Method: Fast-tracking, Construction Management

Project Chronicle

- Land purchase in Jan, 1996
- Mobilizing a site office in Feb, 1996
- Groundbreaking in June, 1996
- Earth caving start in Dec., 1996
- Construction start for sub-structure of the building, in May, 1997
- Construction start for super-structure of the building, in Nov, 1997
- Construction completion, May, 2000 (one year delayed and within the budget)

View of Completed Project



Successes/Failures of the Project

- The construction of the project has not started yet, since its groundbreaking 6 months ago.
- Due to the late start of construction and frequent design changes during construction, the completion of the project has been one year delayed.
- However, despite delayed construction, the project has been completed within the initial budget.
- Why? delays, a lot of changes, but within the budget.

FT without Well Planned Strategies

Delays in the start of construction are mainly attributed to the following reasons:

- It took longer to get a construction permission than expected.
- Difficulties in hiring sub-contractors also contributed to the construction delays.
- Frequent owners' scope changes created a lot of design changes, which in turn resulted in subsequent construction changes.

Hiring CM was successful...

Construction completion with the initial budget was possible by adopting the construction management delivery method for the project.

- CM's good understanding on the local construction code made it easier to execute construction.
- CM played a role as a coordinator to mitigate possible conflicts among diversified project functions.
- All of these factors, together with management cost-saving, contributed to the construction completion within the initial budget.

Hiring CM was successful...

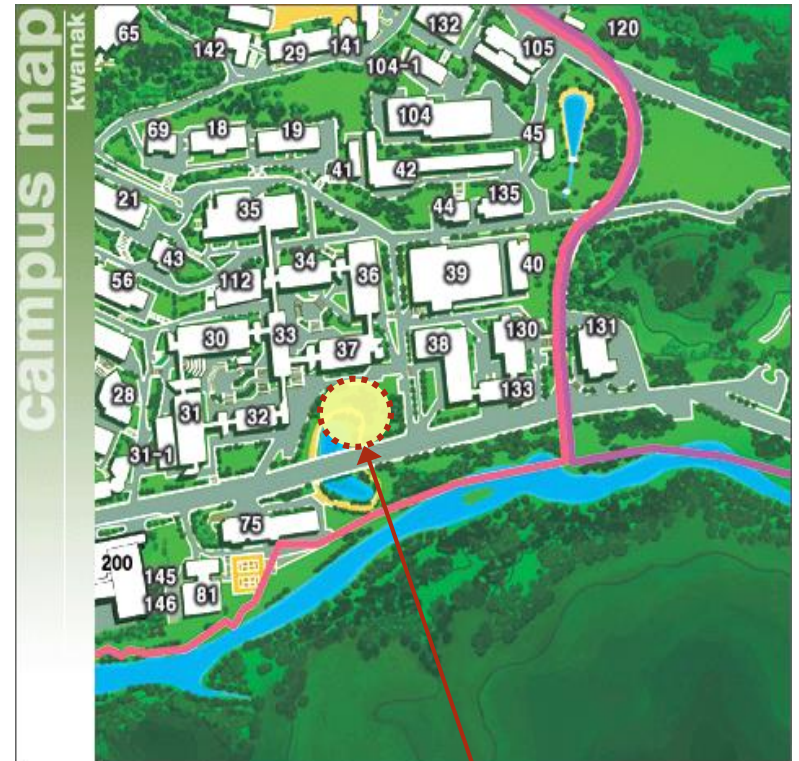
Staff Cost	Gen. Con.	CM
D Corporation	12 MIL	1.8 MIL
CM hired		3 MIL
Local	0.6 MIL	0.6 MIL
Total	12.6 MIL	5.4 MIL

A1: Delivery System

Suppose SNU is planning to build...

A new IT research center near the College of Engineering (37 동), for which a budget of U\$ 100 M was assigned.

The research center will consist of multiple intelligent buildings equipped with many high-tech facilities.



Project site
for the
proposed IT
research

The campus expansion program board has recently decided to award a **Design Build** contract for the IT research center project to 'X' construction company, hoping to deliver the project in time and within their budget.

Since 'X' company does not have an in-house design team to carry out such a mega project they hired 'Y' design company, which is renowned in the local area.

As a project manager, please find **potential** problems that might be caused by functional and contractual relationships among the project organizations.



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