



Aalto University

Project delivery methods

CIV-E.1040 Construction Management

Lecture 1b

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Previous lecture

- **Role of construction sector and its sub-sectors**
 - **Special characteristics of construction**
 - **Three viewpoints for production performance**
 - **Project vs. process management in construction**
 - **Construction project phases and main stakeholders**
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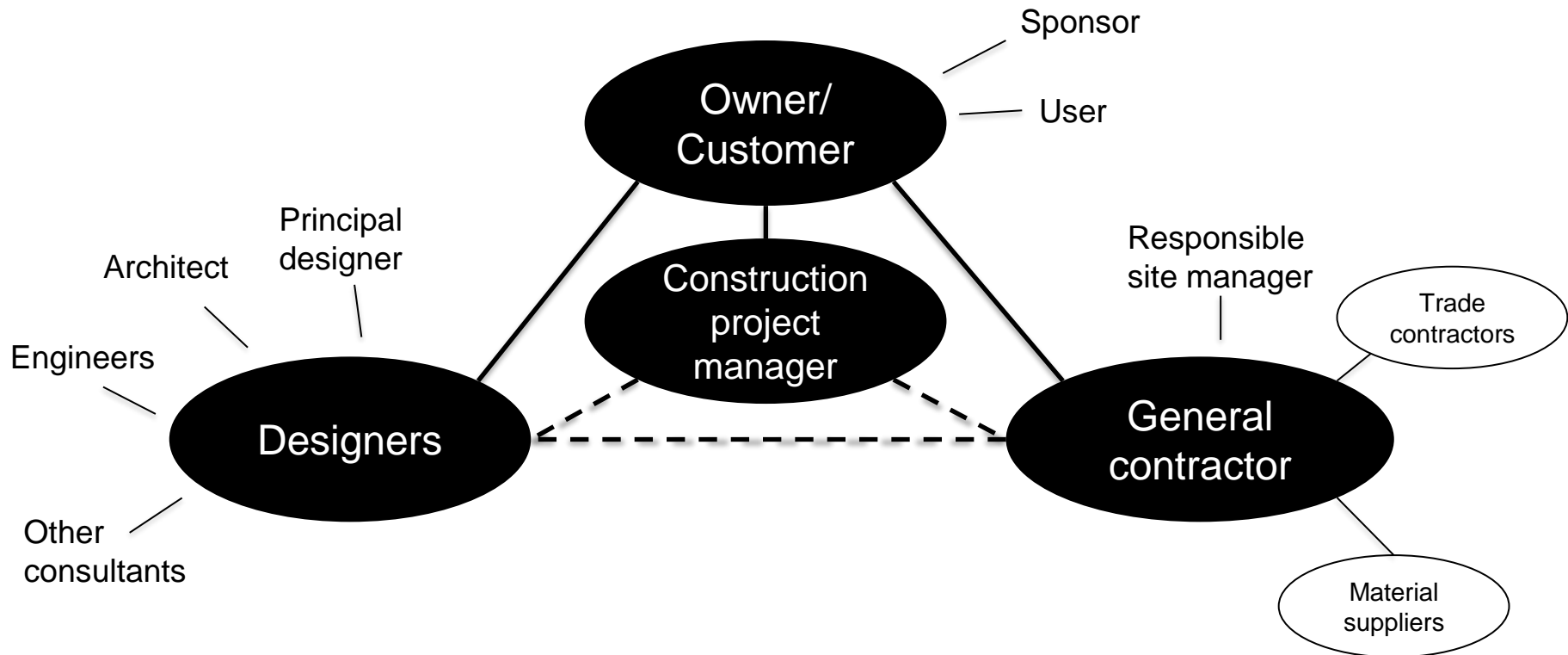
Agenda

- **Project delivery methods**
- **Introduction to the teamwork about project delivery methods**

Tasks of construction project management (CPM)

- **Set** quality, scope, time and cost **objectives** for the project, and **monitor** their fulfillment
 - **Select** designers and prepare needed design contracts
 - **Control costs** of the project or recruit cost consultant
 - Make needed decisions and acquire **construction permits**
 - Select **project delivery method**, organize competitive biddings, and prepare contracts
 - **Control** construction **work**, and make necessary changes in the contracts
 - Manage tasks related to start-up of operations and commitments during guarantee period
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Main stakeholders in construction projects and their typical relations



In Finnish:

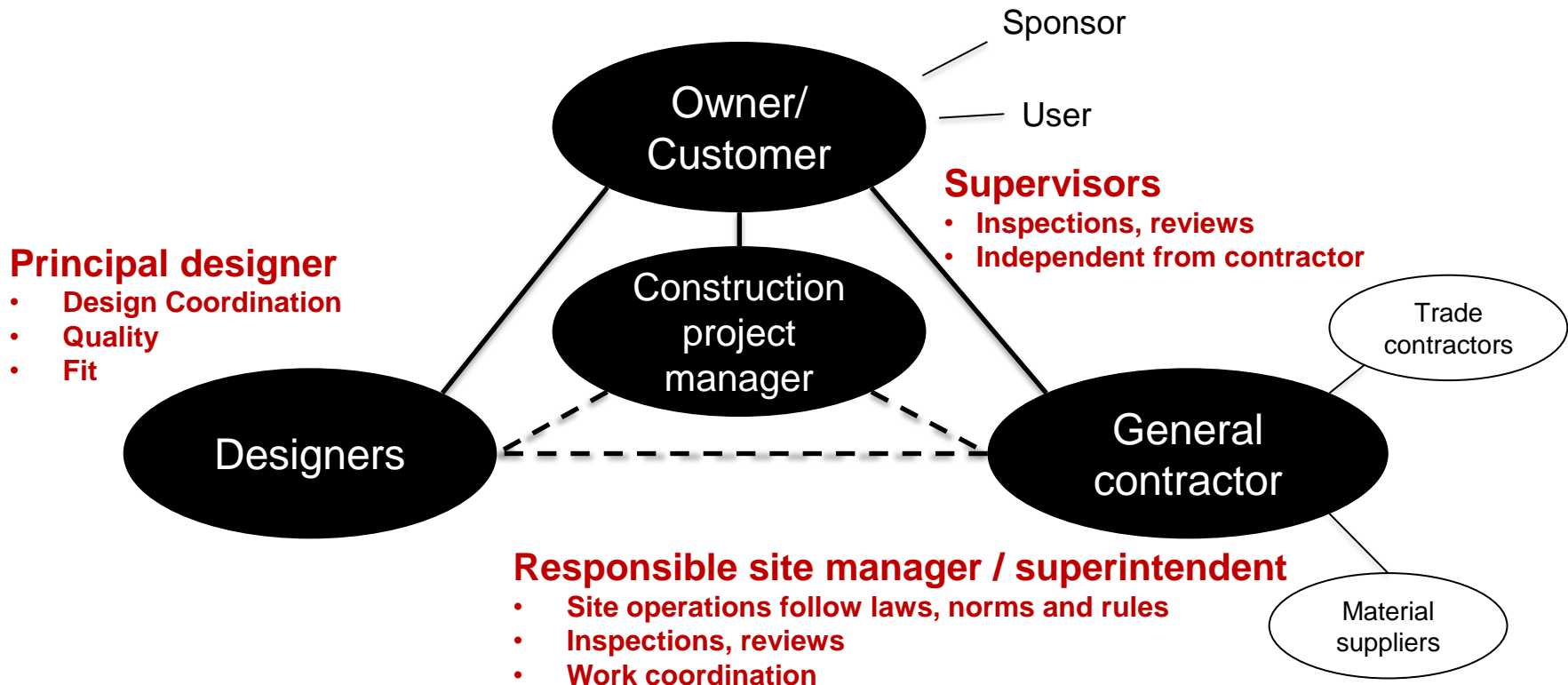
Construction project manager = rakennuttaja

Principal designer = pääsuunnittelija

General contractor = pääurakoitsija

Responsible site manager = vastaava työnjohtaja

Responsible individuals in construction projects



In Finnish:

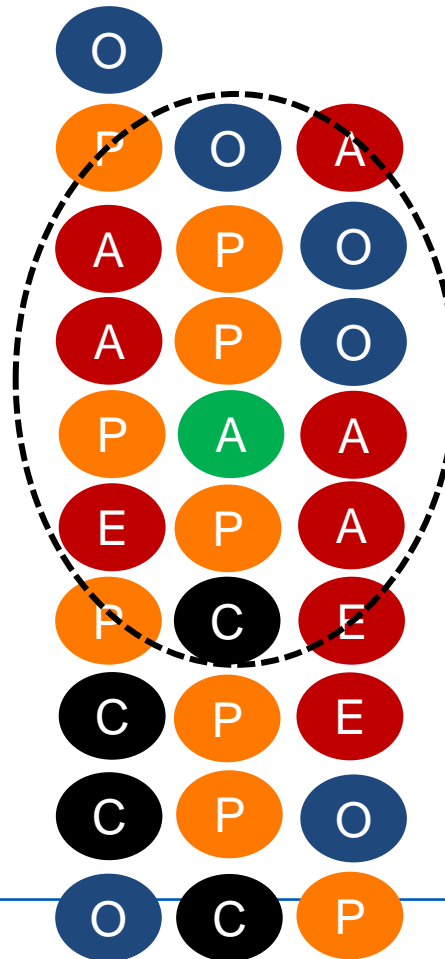
Principal designer = pääsuunnittelija

Responsible site manager = vastaava työnjohtaja

Supervisor = valvoja

Typical involvement of main stakeholders during project phases

1. Needs assessment
2. Program planning
3. Design proposals
4. Master plan design
5. Construction permit tasks
6. Detailed design
7. Production planning
8. Construction
9. Start-up of operations
10. Period of guarantee



O	Owner/Customer
P	Project manager
A	Architect
E	Engineers
A	Authorities
C	General contractor

Project delivery methods

”Project delivery method as a project owner’s tool to achieve targets and control risks”

How to tackle or prepare for those risks?

- **Weak prediction of costs due to imperfect source information**
 - **Delays due to problems in assembly work or material delivery**
 - **Design bugs leading to problems in construction phase**
 - **Unknown conditions (e.g. soil) leading to extra time and costs**
 - **Scope fixed too early, no room for needed changes**
 - **Cost increase due to weak estimation of unit and contract prices**
 - **Quality problems due to incapable contractors and workers**
 - **Design is not easily buildable**
 - **Bad weather conditions**
 - **Contractor or supplier goes bankrupt**
-

Delivery method answers to the questions about:

1. What are the **contractual relationships** between the main project stakeholders?
 2. How project **tasks** and **responsibilities** are distributed?
 - Project management, design & procurements (material and work)
 3. How **risks** are distributed between the project stakeholders?
 - Quality, cost & schedule impacts of risks
- **Project owner has to choose the delivery method based on:**
 - What are the target priorities of the project?
 - *Cost, schedule, quality, functionality, flexibility during the project...*
 - *Predictability vs. absolute value in costs and schedule?*
 - What are owner's own resources and capabilities for the project?
 - What are the available providers and resources?
 - How complex the project is technically? Is there need for collaboration?
-

In Finnish:

Project delivery method = toteutusmuoto, hankemuoto

Main project delivery methods

1. Design-Bid-Build (DBB)

- Single prime / Multiple primes

2. Design-Build (DB)

3. Construction Management at Risk (CMR)

4. Collaborative delivery methods

- Alliance and Integrated project delivery (IPD)

5. Lifecycle delivery methods

- Design-Build-Operate-Maintain (DBOM), Build-Operate-Transfer (BOT), Public-Private-Partnership (PPP)

**Conventional
delivery methods**

In addition, owner often utilizes consultants in project management tasks

Responsibilities in different conventional project delivery methods

1. Program planning

2. Design proposals

3. Detailed design

4. Procurement and site management

5. Construction works

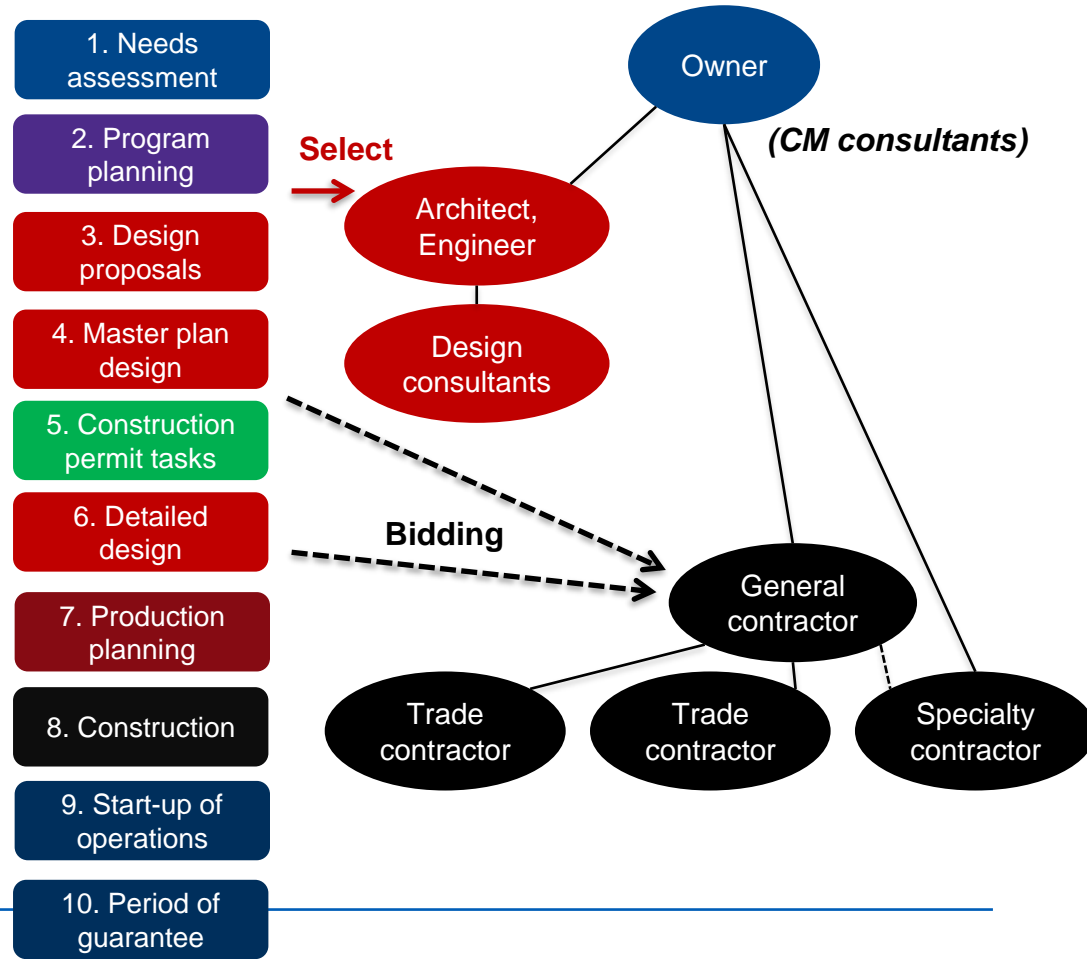
		OWNER/CLIENT	
			Client and/or CM consult
CONTRACTOR			
Design-Build	DBB Single prime / CM at Risk	DBB Multiple primes	

Design-Bid-Build (DBB) – Single prime contract

- The traditional project delivery method typically involves three sequential project phases:

1. **Design phase**, owner/CM consult -driven design for customer needs; up to detailed level design for competitive bidding
2. **Bid phase**, when a general contractor is selected;
3. **Construction phase**, when the project is built by the selected (typically lowest bid) contractor

- This sequence usually leads to a sealed bid, fixed-price contract

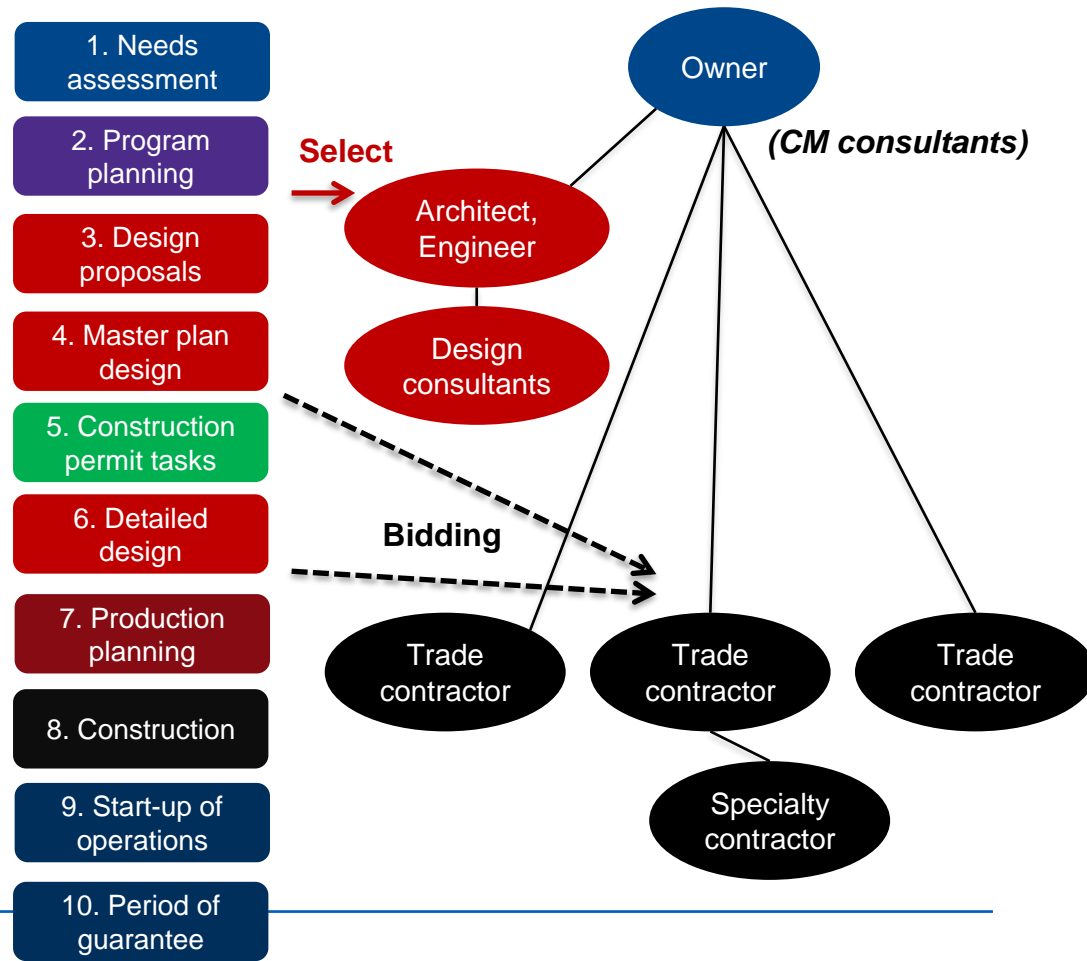


In Finnish:

Single prime contract = kokonaisurakka

Design-Bid-Build (DBB) – multiple prime contracts

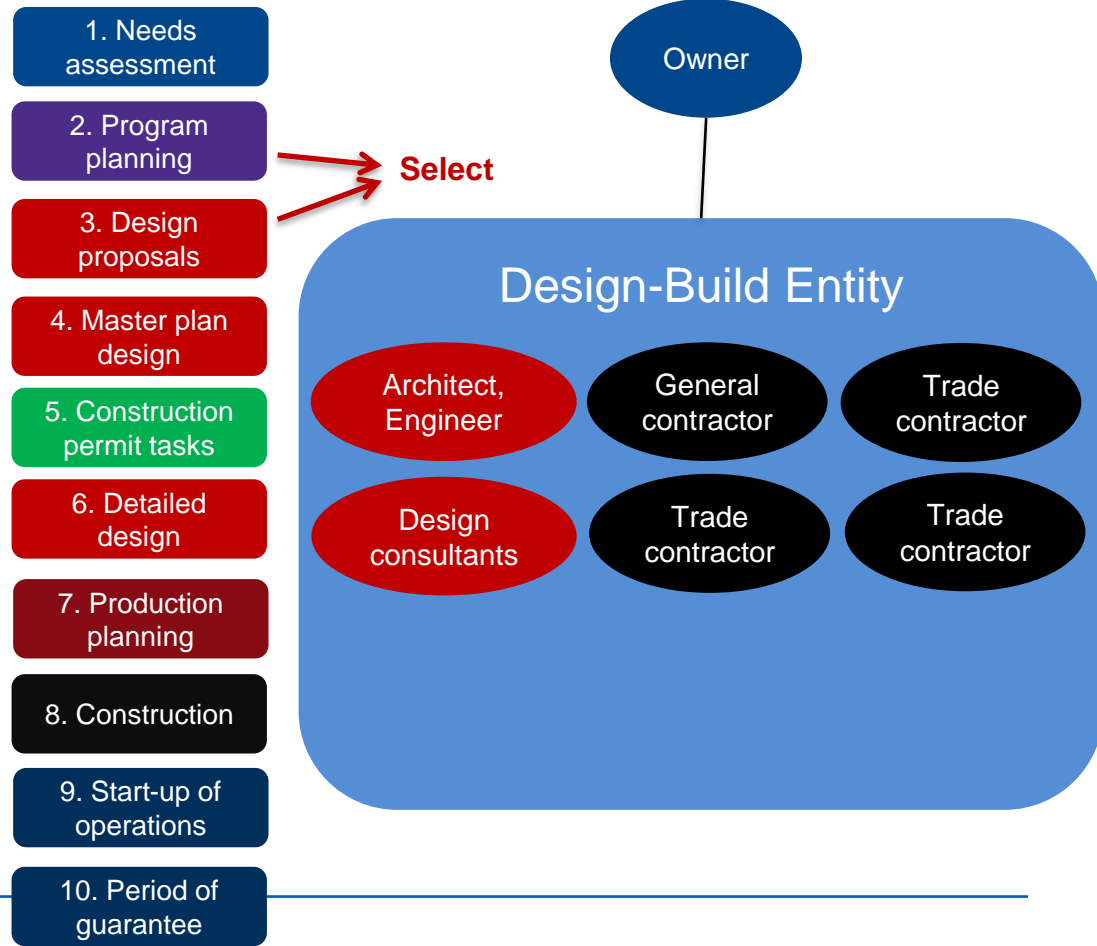
- Similar to “DBB Single” relative to the three sequential project phases and sealed, fixed price contracts
- The owner contracts directly with separate specialty contractors for specific and designated elements of the work, rather than with a single general or prime contractor
- Owner or one contractor performs as general contractor who coordinates site activities



*In Finnish:
Multiple prime contracts = jaettu urakka*

Design-Build (DB)

- Includes one entity (design-builder) and a single contract with the owner to provide both architectural/engineering design services and construction
 - Often contractor-led
- Project targets and functional objectives as primary content of call for bids material
- "Architectural competition"
- Fixed lump sum, a guaranteed maximum price (GMP) or target price

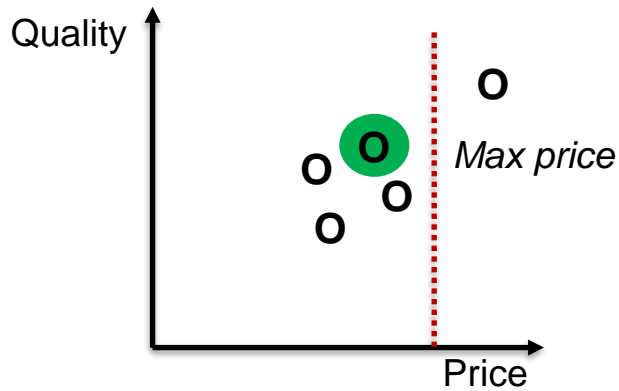


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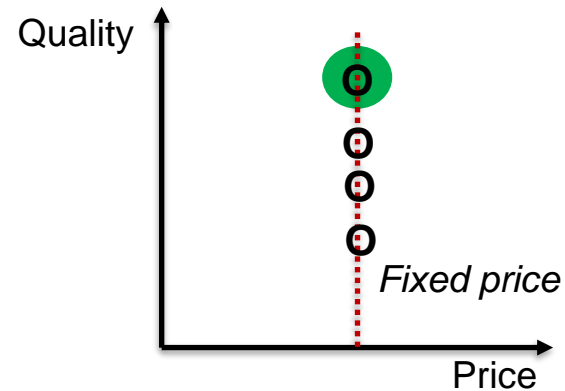
*Design-Build = Suunnittele ja rakenna (SR);
Kokonaisvastuu-urakka (KVR)*

Variation of targets in DB projects

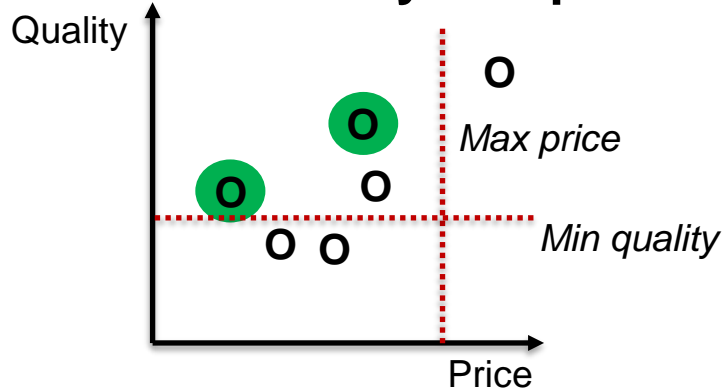
Quality competition



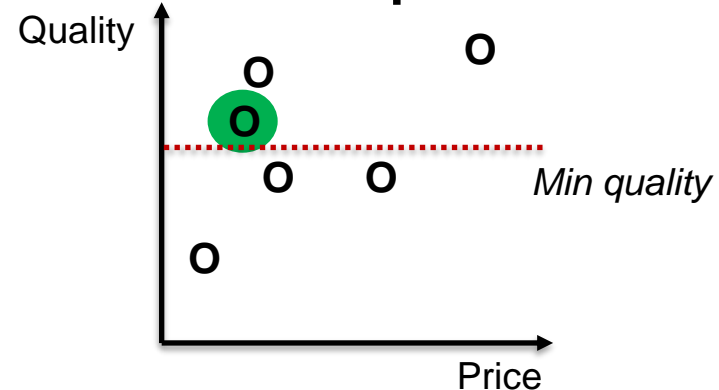
Quality competition (reverse)



Affordability competition



Price competition



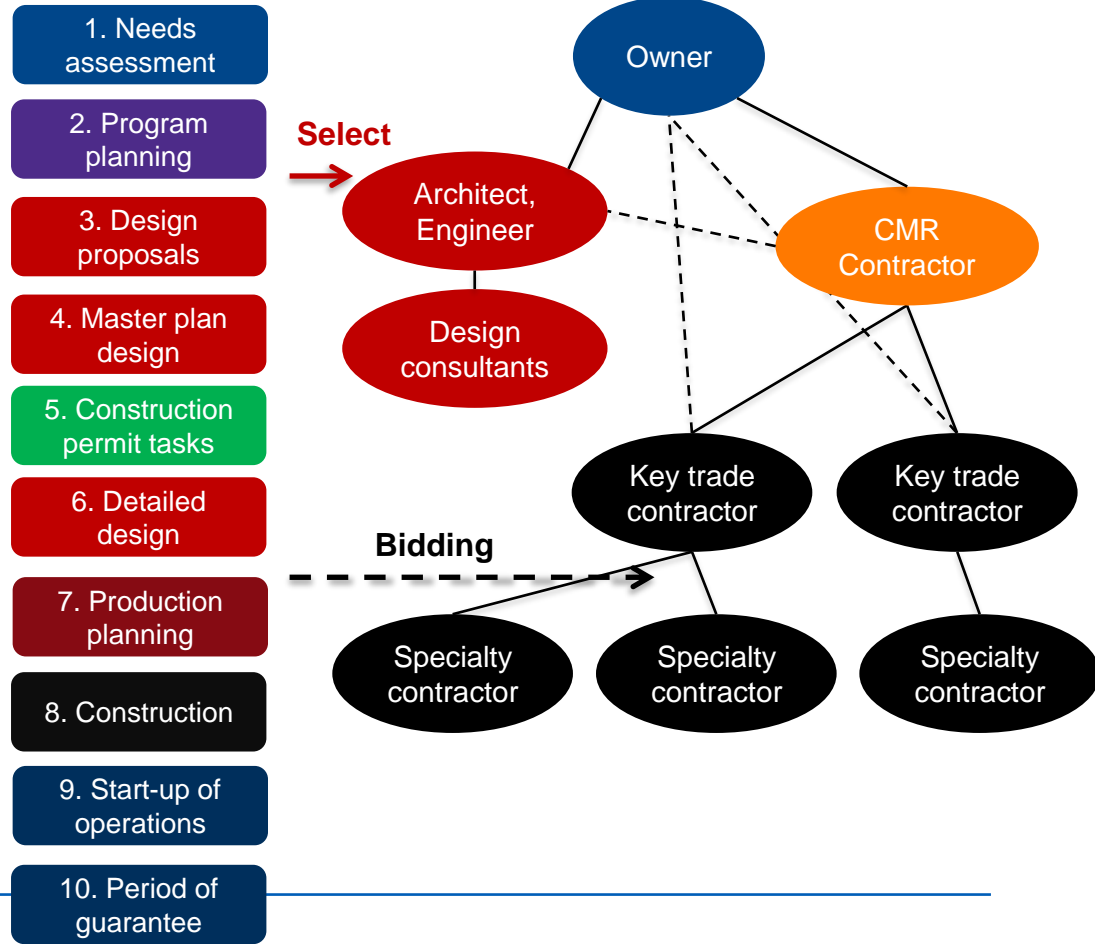
Example: Espoo Hospital

- 270 single patient rooms, day-hospital, geriatric clinic, dental service clinic...
- Costs around 150 m€
- Contractor-led Design-Build consortium was selected based on negotiations
- Includes also maintenance service for 10 years
- Set maximum price and schedule were exceeded due to claims about extra work and quality targets

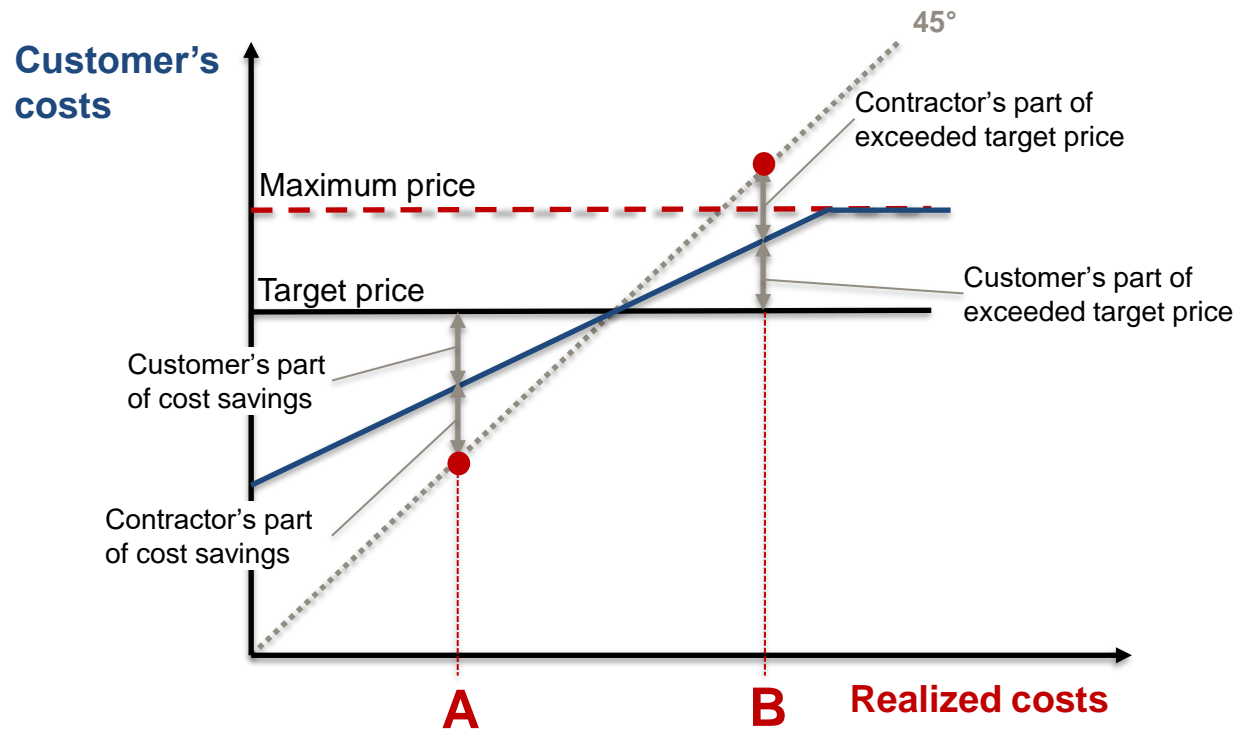


Construction Management at Risk (CMR)

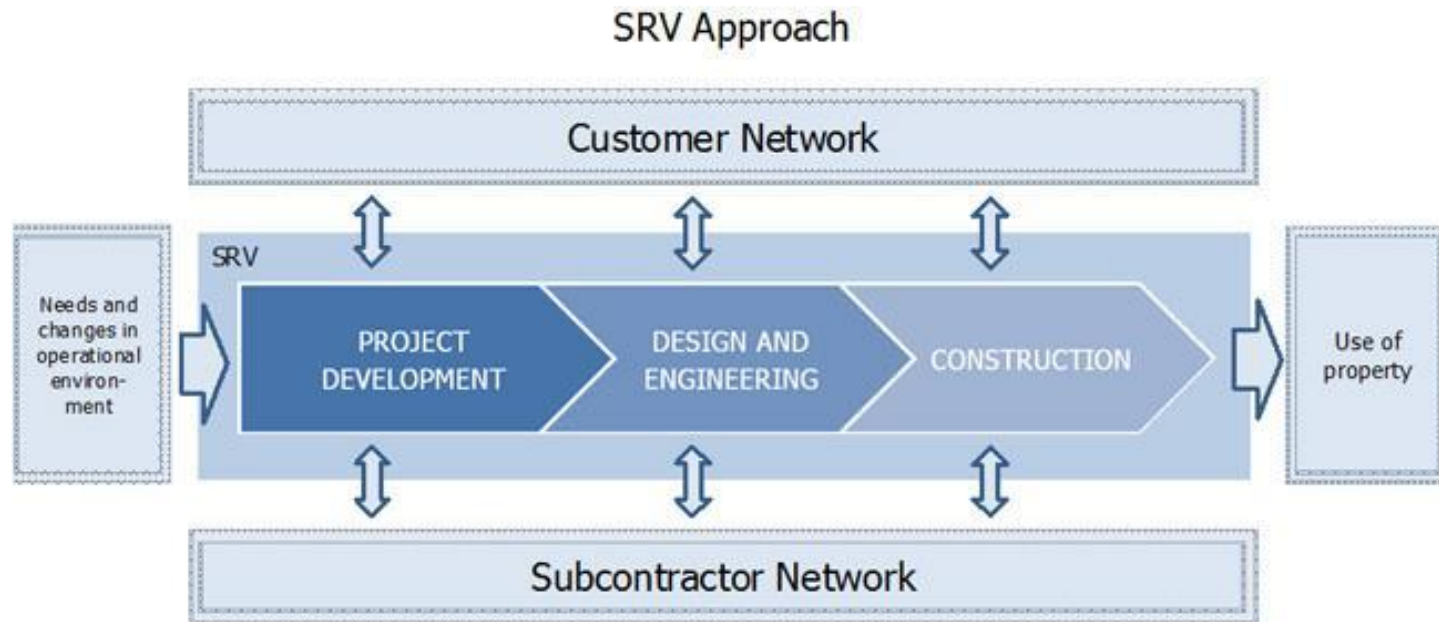
- **CMR contractor commit to deliver the project within a defined schedule and price**
 - Either a fixed lump sum or a guaranteed maximum price (GMP)
- **The CMR provides construction expertise to the owner during the design phases and becomes the general contractor during the construction phase**
- **Design and procurements are directed collaboratively between the owner and CMR contractor**



CMR with target price and maximum price



Example of a CMR-related business model - SRV Approach



<https://www.srv.fi/en/srv-company/srv-company/srv-approach>

Example: Koivusaari metro station

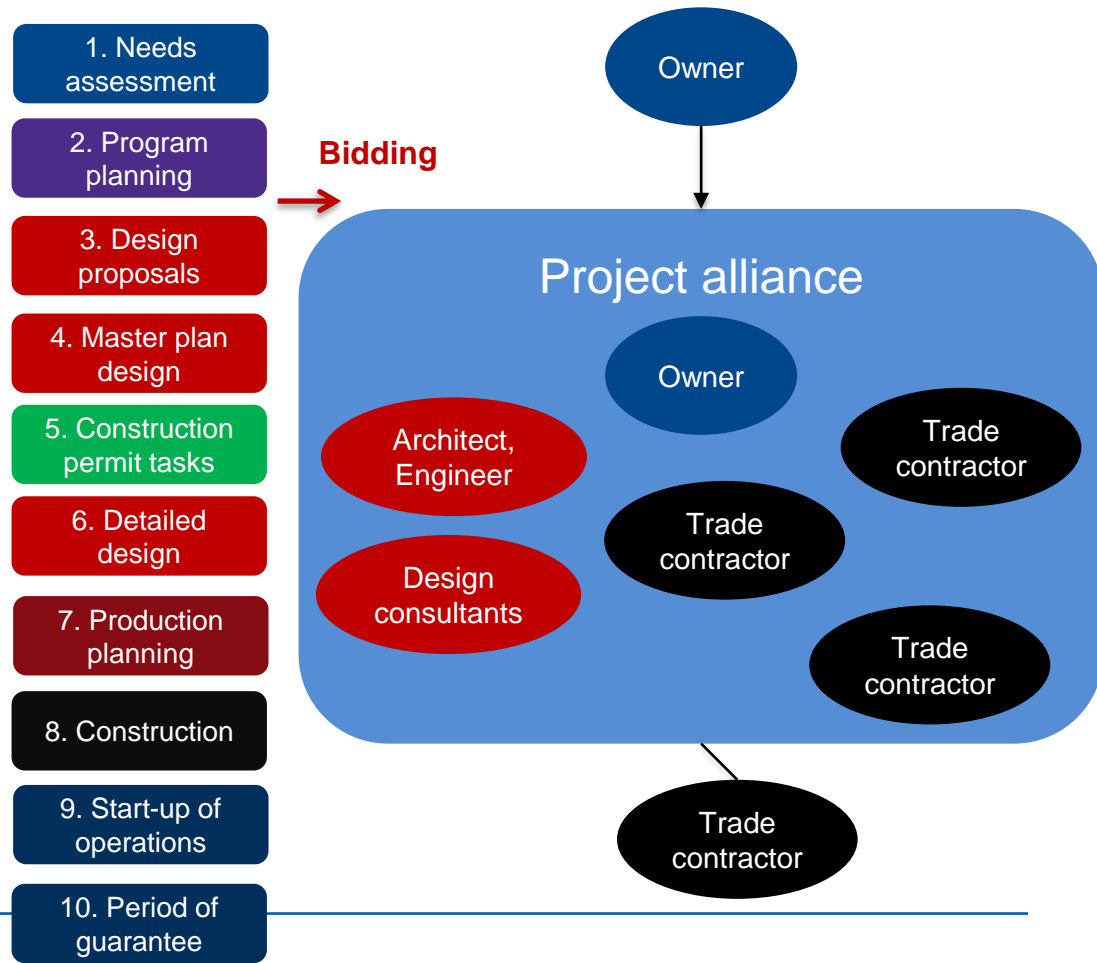
- **Tight schedule, challenging structure of building**
- **CMR was selected to get design and management innovations from contractor**
 - Contractor's initial project plan had a big role in the selection process
- **Challenges in design and schedule were able to tackle with good design management and innovative structural design solutions**



<http://liijat.fi/2013/11/miksi-esitin-koivusaaren-metroaseman-rakentamatta-jattamista/>

Collaborative delivery methods

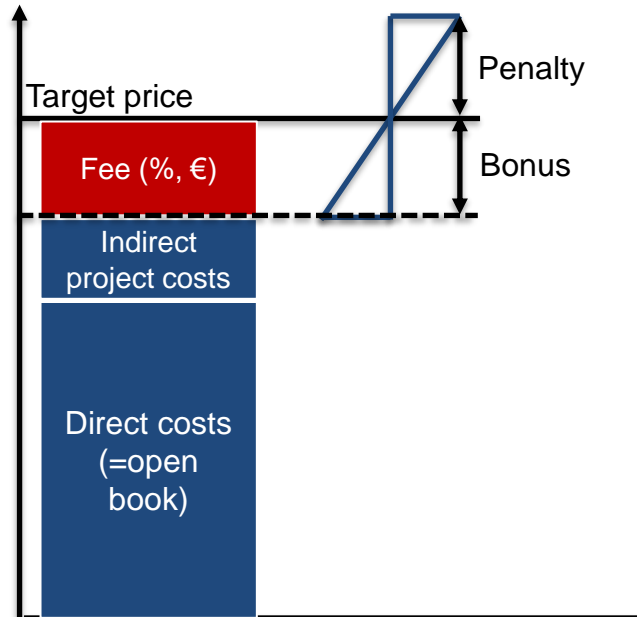
- Seek to **align** interests, objectives and practices through a team-based approach
- **Negotiation-based selection of key designers and contractors in early phase after initial program planning**
- **Three phases:**
 1. Selection phase
 2. Development phase
 3. Implementation phase
- **In the development phase, plans are collaboratively developed and target cost is defined**
- **Overruns and underruns from the target price are allotted to the alliance parties**
- **Collaborative way to manage challenges and opportunities during implementation**



Alliance vs. Integrated Project Delivery (IPD)

- **No big differences in organization, process, or contracts**
 - Development phase vs. delivery phase
 - Collaborative decision-making, open book, no blame culture, identity
 - **Alliance was originally developed in infrastructure projects in Australia**
 - Managing complexity of public-funded large infrastructure projects
 - **IPD was originally developed in hospital projects in California, USA**
 - Finding innovations to technically and functionally complex hospital investments
-

Commercial model of Alliance and IPD



- **Maximum bonus and penalty for designers and contractors are limited to the amount of fee**
 - vs. non-limited in CM at Risk
- **Bonus / penalty often divided 50/50 between owner and other parties**
- **Non-monetary key performance indicators essential in commercial model (-100/+100)**
 - Schedule, Quality, Safety, Environment, Durability, Stakeholder management...
 - Connected to the share of penalty/bonus

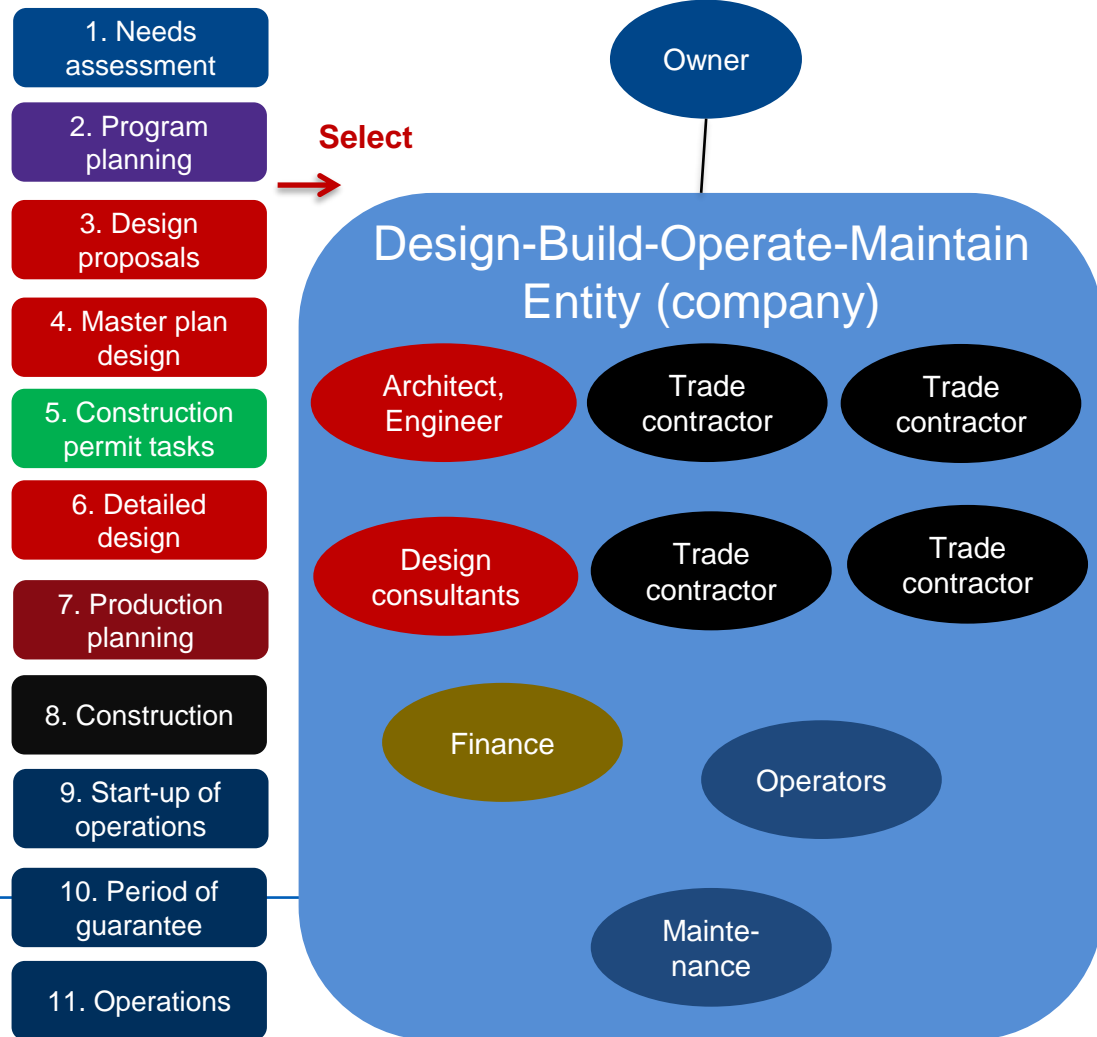
Example: Tampere Strand tunnel

- Alliance organization including City of Tampere, Traffic Authority, Lemminkäinen Infra, A-Insinöörit and Engineering Office Saanio & Riekkola
- No big surprises in schedule or budget, opening time in May 2017
 - Six months in advance
 - 1 million under target price of 180,3 M€
- During the project, 39 innovations that decrease estimated costs have been identified and implemented
 - E.g how to organize quarrying work & design of service tunnels



Lifecycle delivery methods

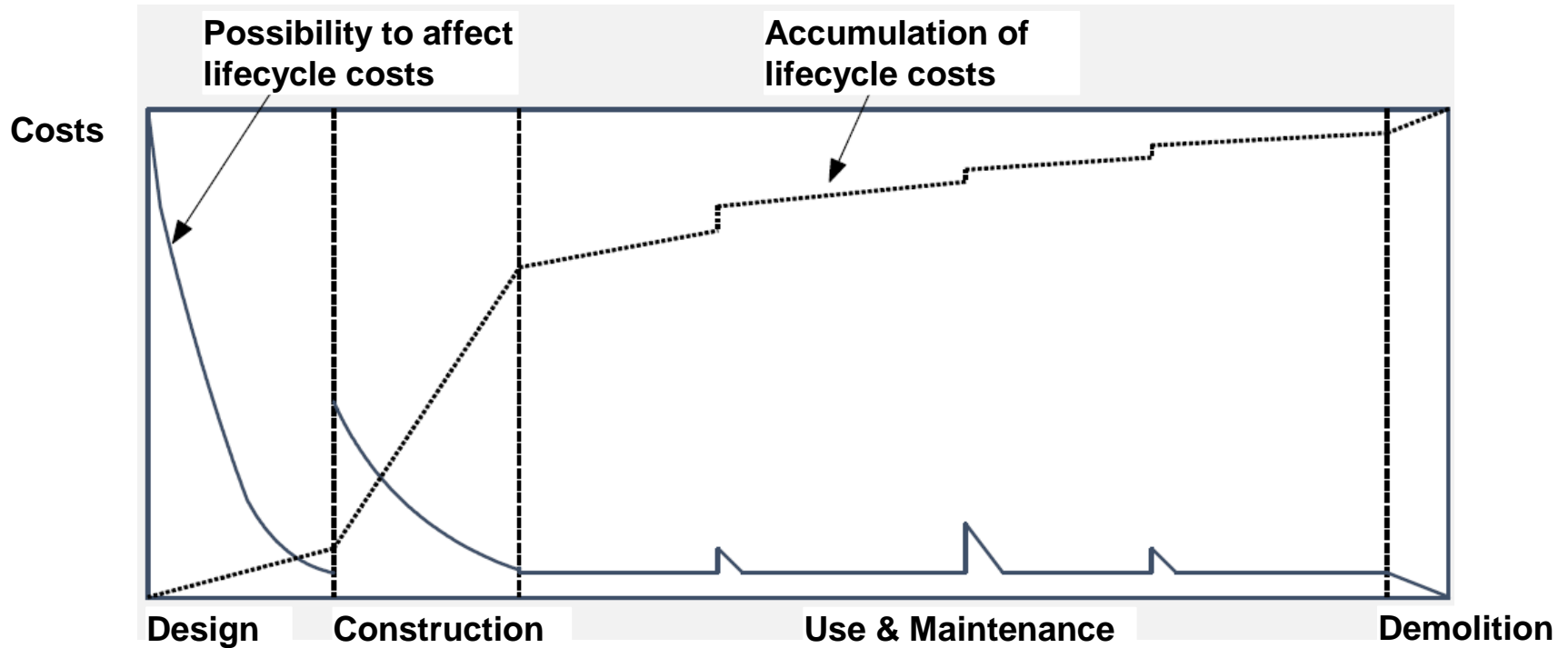
- An integrated partnership that combines the design and construction responsibilities of Design-Build procurements with operations and maintenance
- A private entity is responsible for design and construction as well as long-term operation and/or maintenance services (e.g. 10 years)
- The public sector can secure the project's financing and keeps the operating revenue risk



Special characteristics of Lifecycle methods

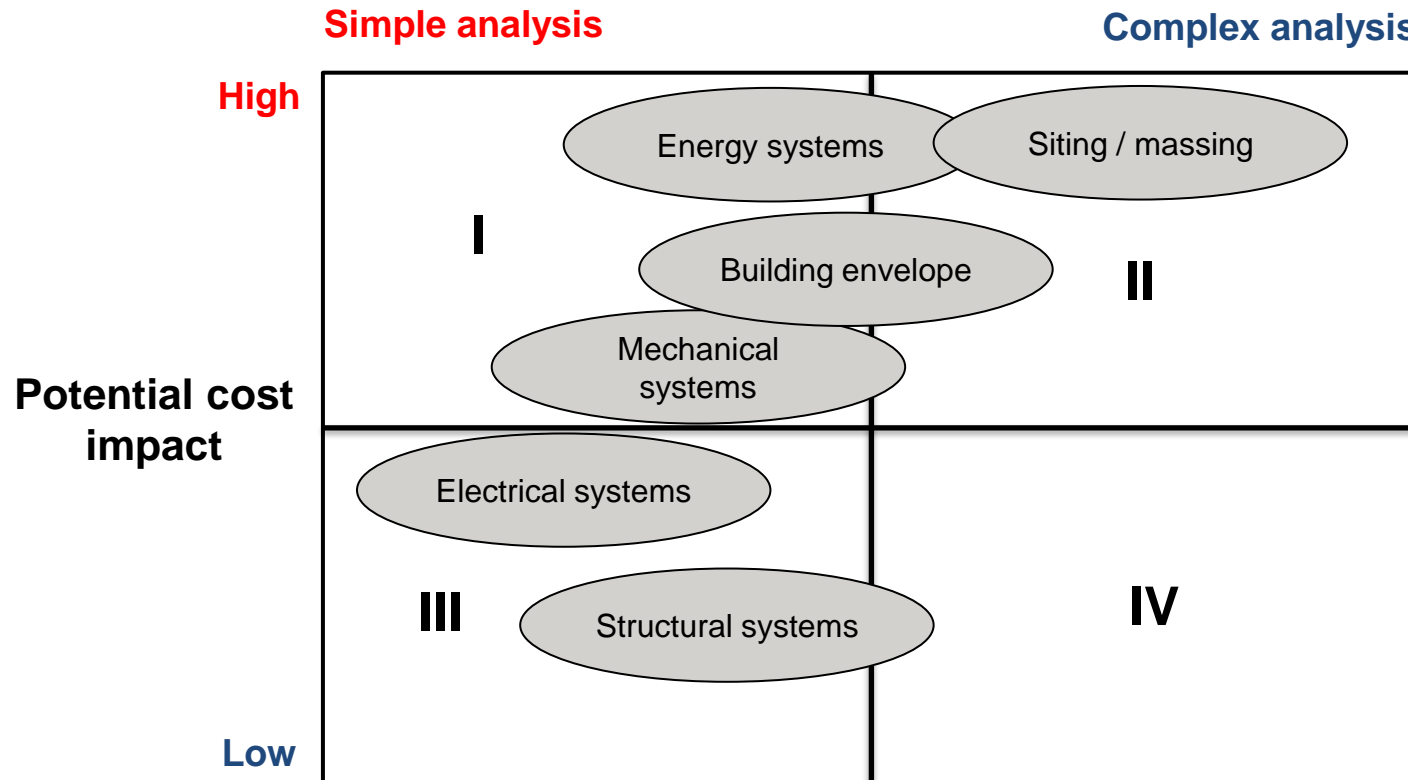
- **What is the primary reason for Lifecycle delivery method?**
 - Value for money, innovations, improved quality
 - **How to finance investment? (partners, lenders)**
 - **What is the scope of the contract?**
 - e.g. design of technical systems
 - **How to define basis for payment? (operability vs. demand)**
 - How to define operability? (e.g. no of lanes, speed limits, quality and timing of maintenance work)
 - **Motivation to speed up project time**
 - **Motivation to find innovations such as in DB or collaborative methods**
-

Early phase decisions have long-term impacts on costs



Source: Kosonen, 1999

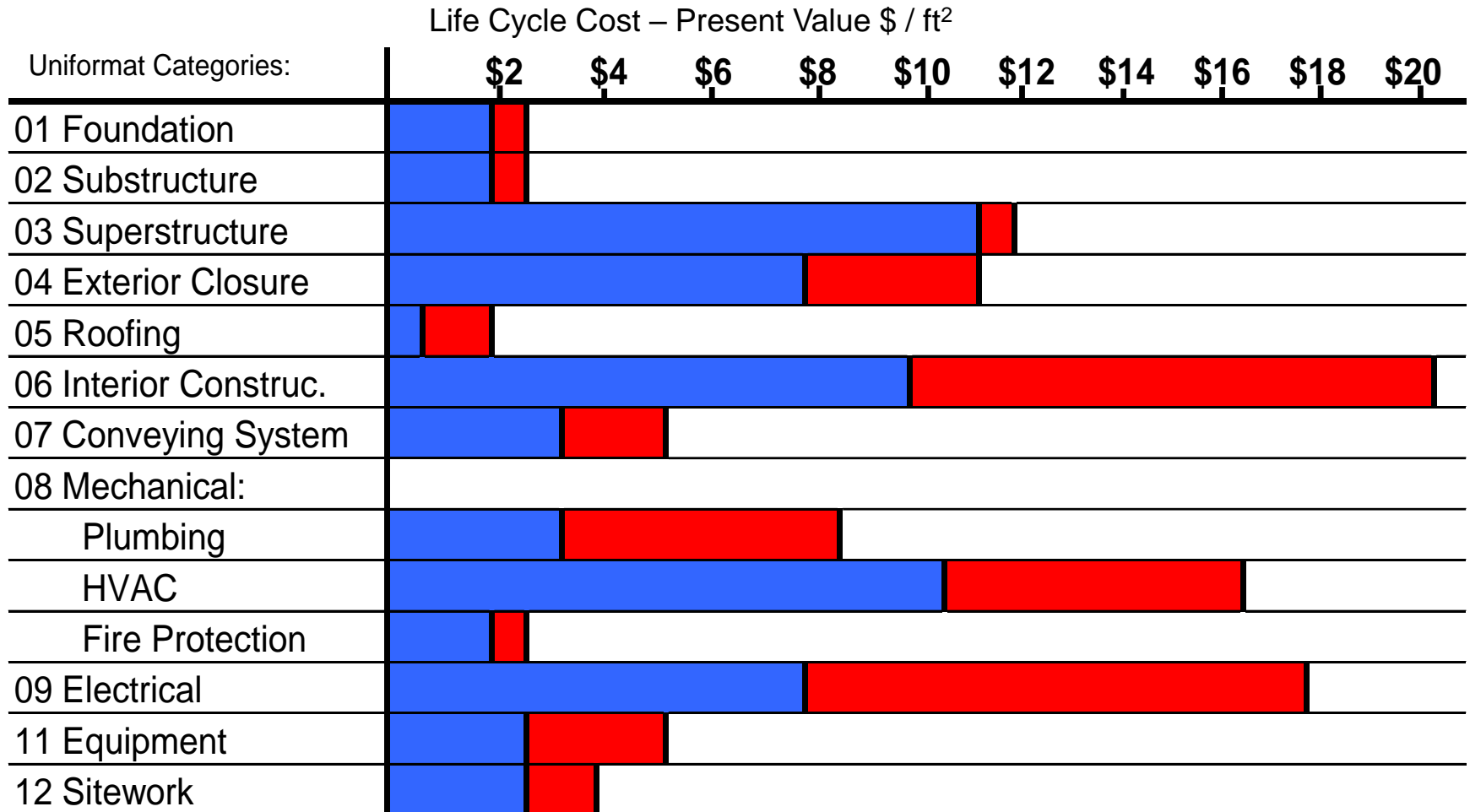
How decisions on different building sub-systems contribute on life-cycle costs?



Source: https://lbre.stanford.edu/sites/all/lbre-shared/files/docs_public/LCCA121405.pdf

Life Cycle Cost – Office Building - \$200 / SF

■ Initial Cost
 ■ Operational Cost



Example: Koskenkylä-Kotka Highway (53 km)

- **Objectives**
 - Improved safety (avoid three deaths / year)
 - Speed up driving time (8 min)
 - Aesthetical and natural values
- **Road was opened in 2013**
 - Design, build, finance & maintenance contract until 2026
 - Total value of service 623 M€
- **Partners: YIT, Destia, Ilmarinen etc.**



What would have been the best project delivery method for Länsimetro project?

- **Stop the video and think about pros and cons of different delivery methods in Länsimetro phase I -project**
 - Project scope: 14 km, 8 stations
 - Budget: 1186 M€
- **What would have been the most suitable project delivery method according to your knowledge and experience?**
 - Did they select that method? If not, ponder why not?



Delivery method can also be a modification of these major methods

- **Design-build contract involving a development phase (DBd)**
 - Combination of DB and alliance
 - Developed especially for road and infrastructure projects
 - **Light version of alliance**
 - E.g. selecting first only contractor or designer
 - **Modified alliance**
 - E.g. maximum price defined, client has more power
 - **Alliance can be very similar than Construction management at Risk -method**
-

Project delivery methods and design responsibilities

Owner manages design

- Design-Bid-Build (DBB)



Scope risk for owner if design has to be changed

Collaborative design management

- Alliance and Integrated project delivery (IPD)
- Public-Private-Partnership (PPP)
 - Construction Management at Risk (CMR) (*not contractually; in detailed design*)

General contractor manages design

- Design-Build (DB)
- DBOM & BOT



Quality risk for owner if requirements are not well described in bidding

Project delivery methods and procurement responsibilities

Owner manages procurements

- Design-Bid-Build (DBB) multiple primes



Scope risk for owner in contract interfaces

Collaborative procurements

- Alliance and Integrated project delivery (IPD)
- Public-Private-Partnership (PPP)
 - Construction Management at Risk (CMR) (*not contractually*)

General contractor manages procurements

- Design-Bid-Build (DBB) single prime
- Design-Build (DB)
 - DBOM & BOT

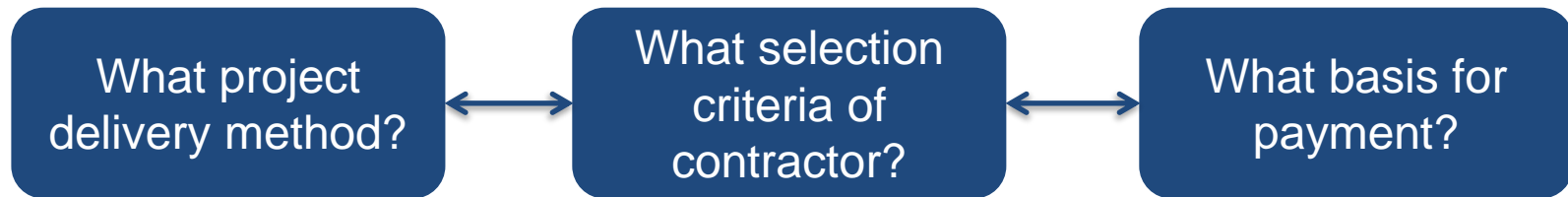


Owner cannot control contractors

Pros and Cons of the delivery methods

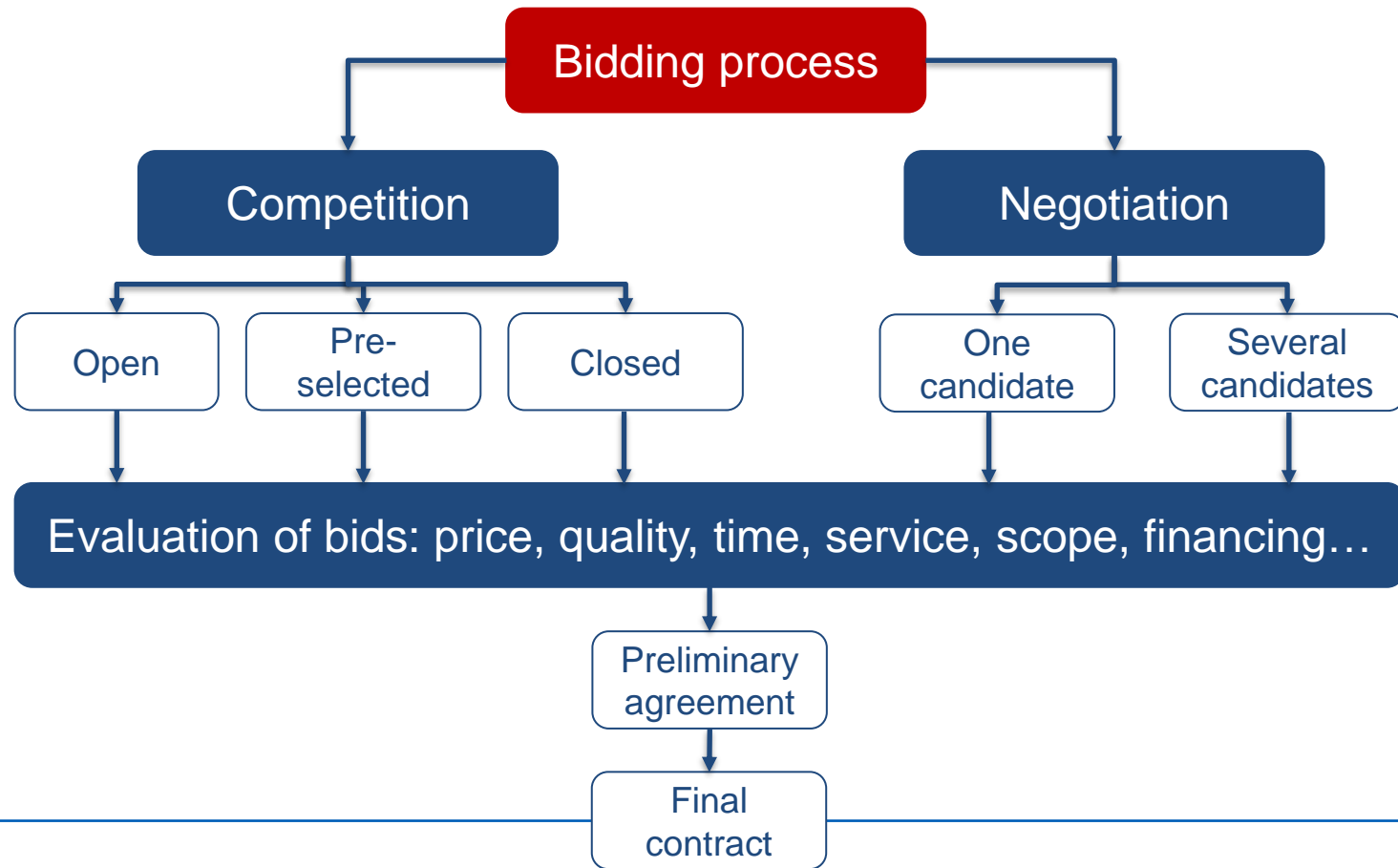
Project delivery method	Advantages	Challenges
Design-Bid-Build (DBB) – single prime	<ul style="list-style-type: none"> • Owner has power over design • Allows owner to be hands-off in construction • Ideally, low execution risk for owner 	<ul style="list-style-type: none"> • Poor constructability of design → high bids • Expect longer durations • Risk for adversarial relationships (if changes or surprises)
Design-Bid-Build (DBB) – multiple primes	<ul style="list-style-type: none"> • Control over the entire process • Competitive cost 	<ul style="list-style-type: none"> • Needs plenty of coordination effort from owner • Problematic contract interfaces
Construction Management at Risk (CMR)	<ul style="list-style-type: none"> • More constructable detailed designs • Short duration: overlapping detailed design and construction 	<ul style="list-style-type: none"> • Owner has a coordinator role between designers and general contractor • Heavy administration • Unclear cost estimations in the early phase
Design-Build (DB)	<ul style="list-style-type: none"> • Input from constructors early in design • Multiple design proposals • Improved technical quality and short duration 	<ul style="list-style-type: none"> • Needs for clear performance standards • Owner loses some control of design • Requires a project team experienced with DB
Collaborative methods	<ul style="list-style-type: none"> • Constructable and value-based designs • Better culture, less claims • Better circumstances, more innovations 	<ul style="list-style-type: none"> • To find suitable team and individuals • Heavy administration, long development phase • Hard to manage for openness and innovation
Lifecycle methods	<ul style="list-style-type: none"> • Reduces gap between construction and maintenance • Reduction of long-term operating costs 	<ul style="list-style-type: none"> • Further reduction of owner control over design and operation of the building • Requires additional planning from the owner in the conceptual stage

Delivery method – selection criteria – basis for payment

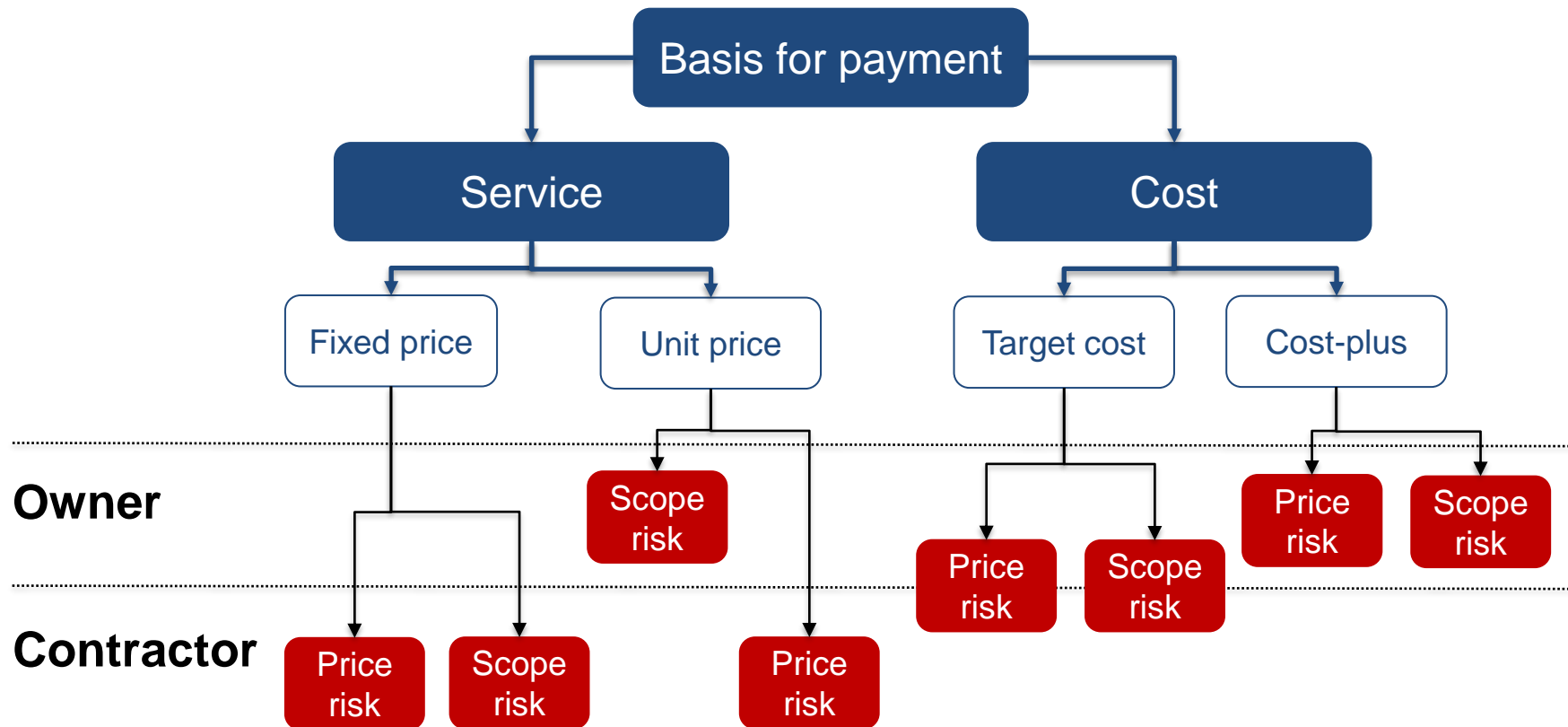


Project delivery method	Selection criteria	Basis for payment
Design-Bid-Build (DBB)	Low Bid	Cost Plus Fee
Design-Build (DB)	Best Value	Unit price
Construction Management at Risk (CMR)	Qualifications-based	Lump sum (fixed price)
Lifecycle delivery methods	Negotiated	Guaranteed maximum price
Alliance and Integrated project delivery (IPD)	Sole source (direct select)	Target price

Bidding process: procurement methods and contract forms



Basis for payment and risk division



Further readings

- **Love, P.E.D., Skitmore, M & Earl, G. (1998) Selecting a suitable procurement method for a building project, Construction Management & Economics, 16:2, 221-233, DOI: 10.1080/014461998372501**
- **Kankainen & Junnonen (2017) Rakennuttaminen. Rakennustieto.**
- **Karhu & Keinänen. Opas toteutusmuodon valintaan rakennushankkeessa. A-Insinöörit.**

Group assignment

Group assignment: Teamwork about project delivery methods

- **Form a team of 4 students**
 - Send me an email about your group's names → You will get your case project description in the response email
 - Inform IF you are a group of GEO students, so I will give you a road project!
 - If you cannot find group mates in next two weeks, I'll form groups from the remaining students
 - **Your group's task is**
 1. Select the most promising delivery method and basis for payment for your case project and justify your selection
 2. You should:
 - Analyze starting points for the selection of the delivery method: e.g. project characteristics, owner's expertise, risks, etc.
 - Analyze pros and cons of each project delivery method (at least all the five presented in this lecture) for your case project
 3. Prepare a **pdf/word-document** (5-10 text pages) of the analysis and conclusions
 4. Prepare a short (max 8 min/8 slides) **PP-presentation** about your analysis and conclusions for the presentation sessions (7 & 8.12 at 10-12 am)
 5. Deadline for both reports is **6.12.2021** (one of the students return the group's reports in MyCourses)
-

Group assignment: Teamwork about project delivery methods

- **In the PP-presentation, do not describe the project or its basic characteristics, but start directly from your results and justifications!**
 - I will introduce shortly the projects in the beginning of the presentation session
 - **The pdf/word-document must include:**
 - References at least to two scientific articles/books about project delivery methods or similar projects (you can use Scopus, Google Scholar etc.)
 - At least two real-life examples of delivery methods of (*almost*) similar investment projects (*do not use examples presented in this lecture*)
 - **Search for relevant information about similar projects and their delivery methods from the scientific literature and the web**
 - **Great part of the evaluation is based on your critical use of available information sources**
-

Case Projects

1. **Supermarket**
2. **Swimming hall**
3. **Shopping centre**
4. **Hospital**
5. **Road improvement project**
6. **Renovation and repair of drains and sewers**
7. **Apartment building**

Descriptions of the projects available in Assignments / My Courses
