Aalto University
School of Chemical
Engineering

CHEM-E0115 Planning and Execution of a Biorefinery Investment Project (5 cr)

Lecture 2
Investment planning and decision making phase
September 15, 2022
Antti Mattelmäki

Agenda

I. Introductions
II. What is a Project?
III. Investment Planning Process
IV. Feasibility Studies & Pre-Engineering Activities
V. Project Implementation Methods
VI. Project Financials: Budgeting and Financials Reporting
VII. Conclusions

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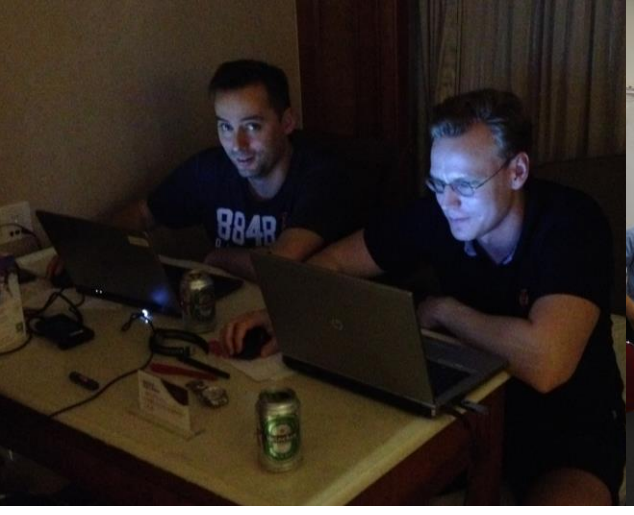
I. Introductions

Antti Mattelmäki

Project Manager, Process Industries at AFRY,	**01/2020 –**
Andritz Oy, Sales Manager, Recovery Boilers	06/2013 - 12/2019
Andritz Oy, Sales Engineer, Recovery Boilers	02/2011 - 05/2013
Pöyry Finland Oy, Department Manager, Process Engineering	12/2008 - 01/2011
Andritz Oy, Process Engineer, White Liquor Plants	07/2005 - 11/2008
Andritz Oy, Sales Engineer, White Liquor Plants	09/2001 - 06/2005
Andritz-Ahlström Oy, Research Engineer, Heat Engineering	11/2000 - 08/2001
Unversity of Oulu, Department of Process and Environmental Engineering	1995-2000

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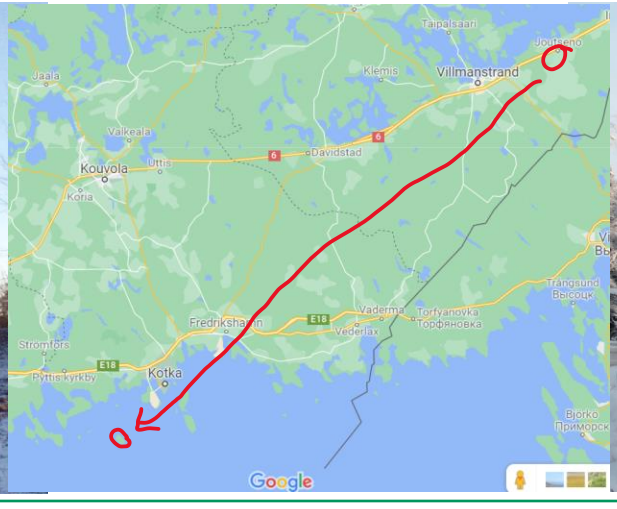
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Klemis
Villmanstrand
Valkeala
Kouvola
Utti
Davidstad
Koria
Fredrikshamn
Vaderma
Vederlax
Torfyanovka
Торфяновка
Stromfors
Kotka
Google

II. What is a project?

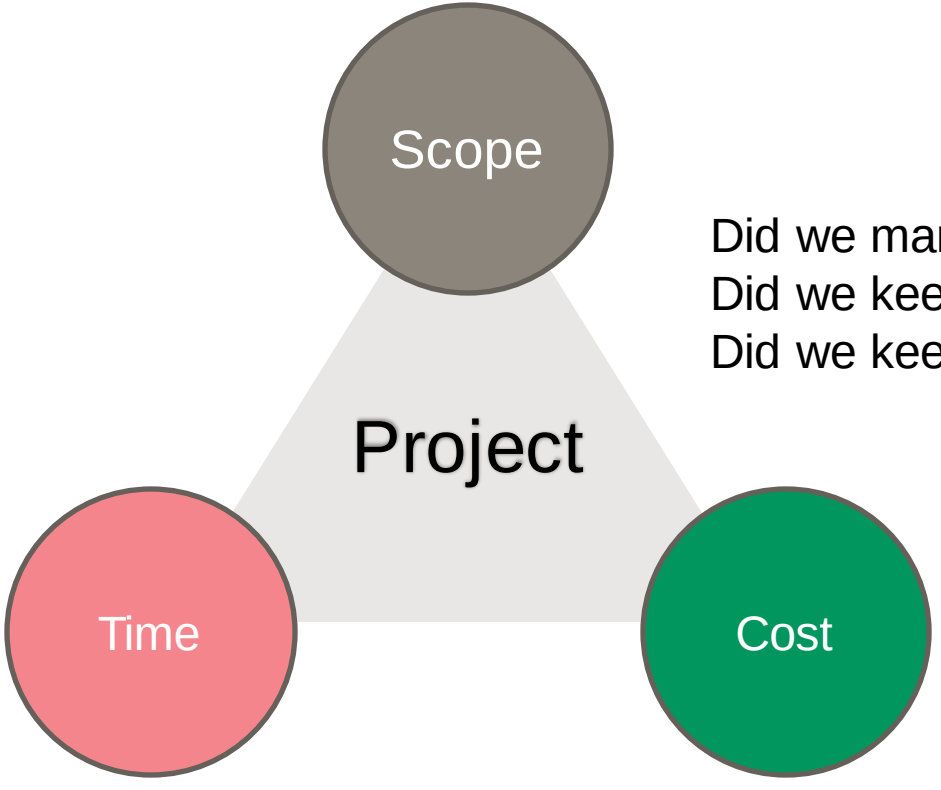
What is a project?

A project is a temporary effort that aims to a targeted goal, creating a unique outcome with limitations of time, costs and resources

Project characteristics

Defined scope	Defined time schedule	Defined budget

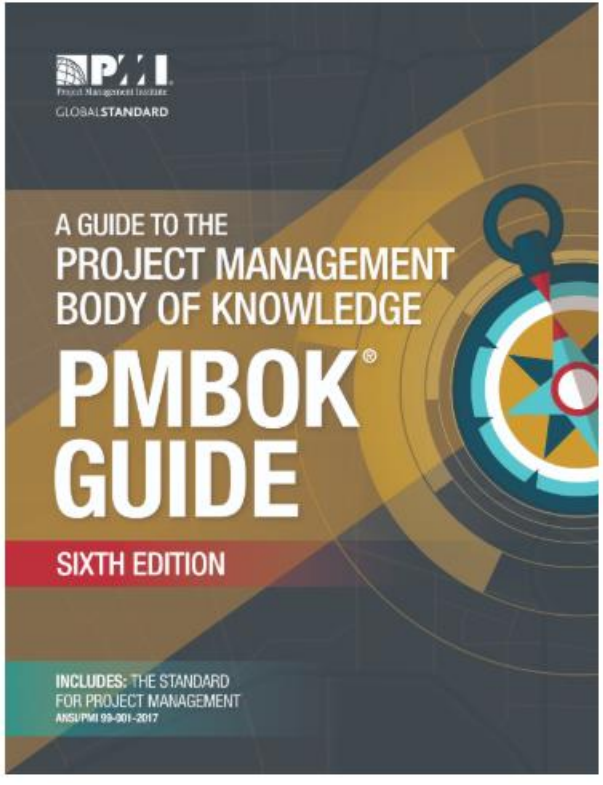
Dimensions of Project Management



Did we manage to deliver the scope?
Did we keep the planned schedule?
Did we keep the budget?

PMBOK Knowledge Areas

I. Project Integration Management
II. Project Scope Management
III. Project Schedule Management
IV. Project Cost Management
V. Project Quality Management
VI. Project Resource Management
VII. Project Communications Management
VIII. Project Risk Management
IX. Project Procurement Management
X. Project Stakeholder Management



Scope Related Processes

Include a description of the project product, its characteristics and how they are to be measured or assessed:

Concept Development
- Defining outlines of what the project product will do

Scope Development and Control
- Documenting characteristics of the project product in measurable terms and controlling them

Activity Definition
- Identifying documenting activities and steps required to achieve the project objectives

Activity Control
- Controlling actual work carried out in the project

Time Related Processes

Aim to determine duration of activities and to ensure timely completion of the project:

Activity Dependency Planning
- Identifying inter relationships and the logical interaction and dependencies among project activities

Duration Estimation
- Estimating duration of each activity in connection with the specific conditions and with the resources required

Schedule Development
- Inter relating the project time objectives, activity dependencies and their durations as the framework for developing general and detail schedules

Schedule Control
- Controlling realisation of the project activities, for confirming the proposed schedule or for taking adequate actions for recovering from delays

Cost Related Processes

Aim to forecast and manage the project costs and to ensure that the project is completed within budget:

Cost Estimation

- Developing cost estimates for the project

Budgeting

- Using results from cost estimation to produce the project budget

Cost Control

- Controlling costs and deviations from the project budget

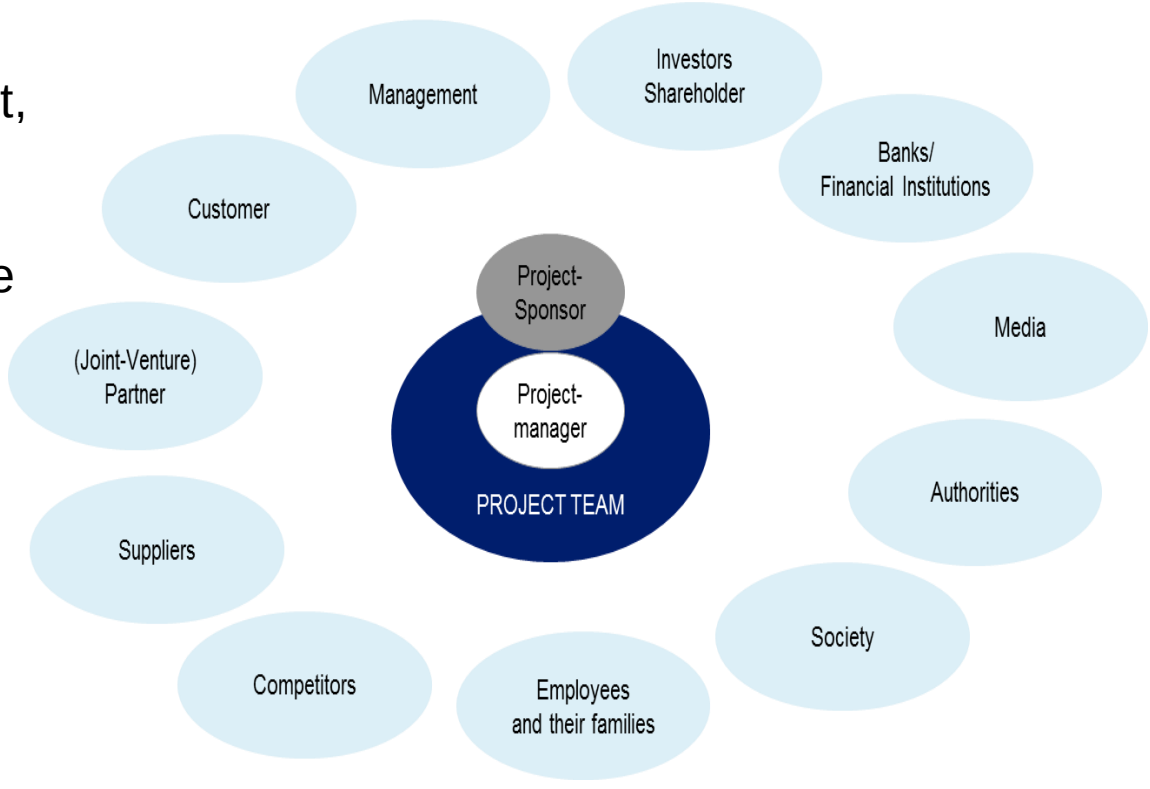
Project Functions

MAIN PROJECT FUNTIONS		Production
PROJECT SUPERVISION		
PROJECT MANAGEMENT		
ENGINEERING MANAGEMENT		
PROCUREMENT MANAGEMENT		
CONSTRUCTION MANAGEMENT		
COMMISSIONING MANAGEMENT		
PROJECT CONTROL	PREPARATION FOR OPERATION	
QUALITY ASSURANCE	HEALTH, SAFETY AND ENVIRONMENT	
SECURITY MANAGEMENT	PERMITTING ASSISTANCE	

These main Functions cover the whole sphere of responsibilities required in any project – **irrespective of who does them**

Stakeholders

"an individual, group, or organization, who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of a project"



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90% of Project Manager's tasks are about communication

Quick quiz:

- *Form a three person groups and discuss for 10 minutes how would you deal the following situation.*
- *Make notes and prepare to share two most important findings with the class.*

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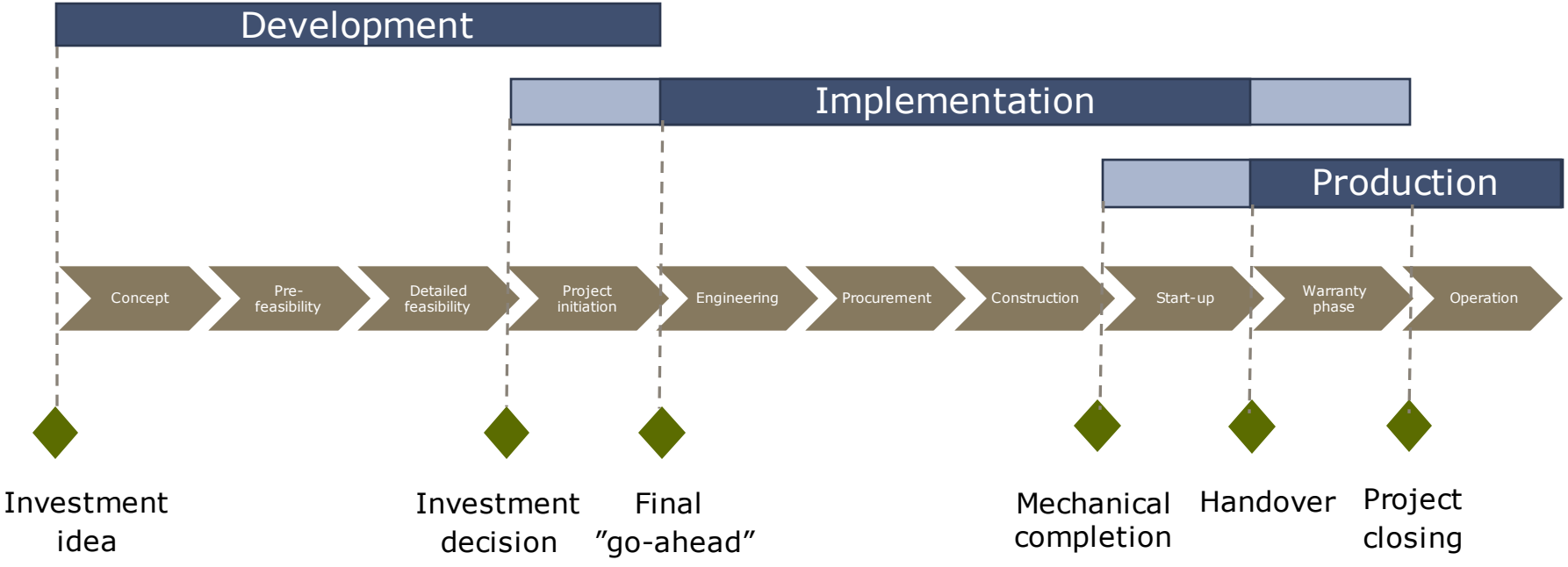
Case

You are a project manager and you receive phone call from one of your engineers. He says that he has not been able to send his engineering documents to the customer for customer's approval due to issues with the documents.

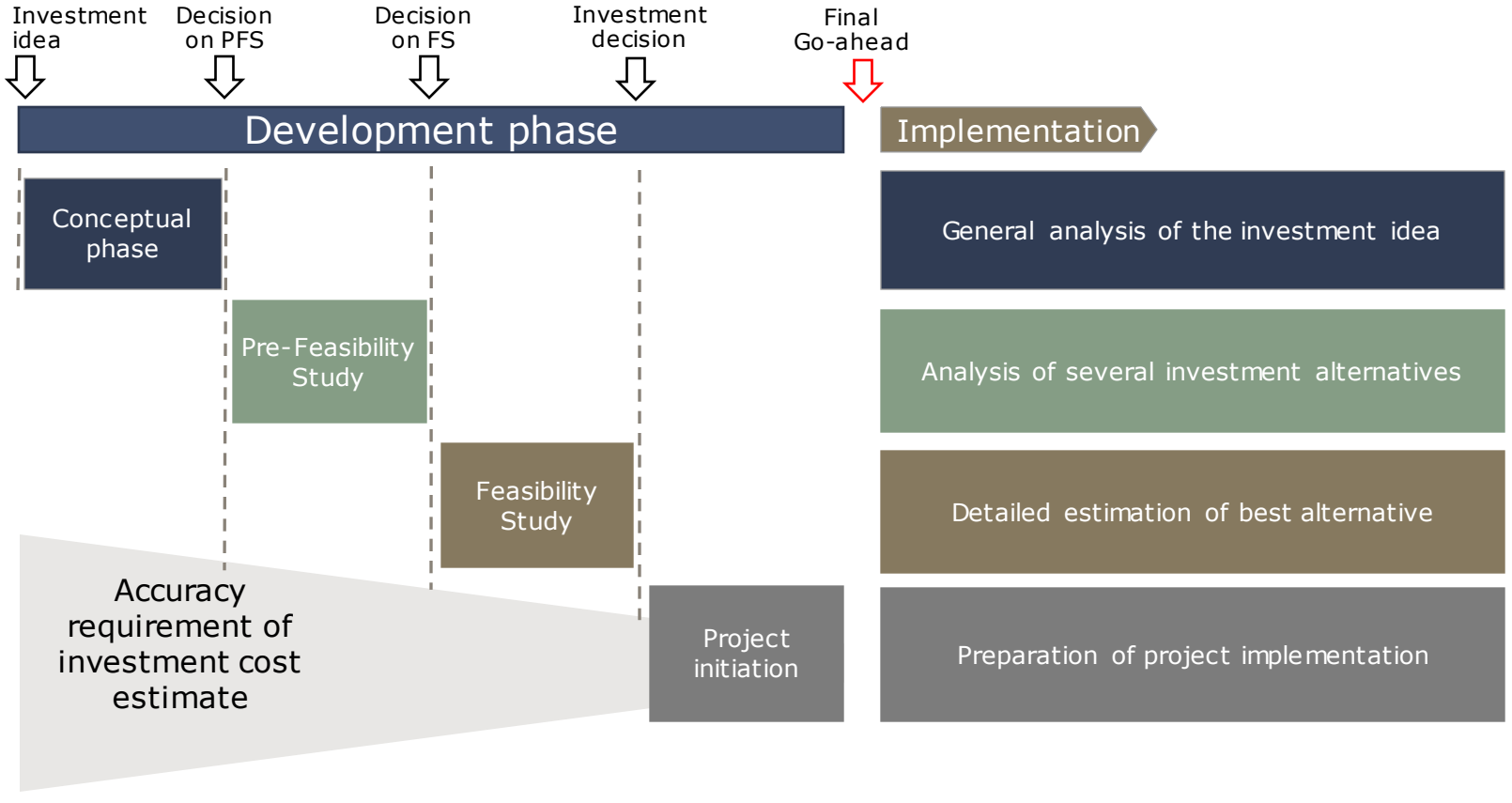
Project assistant has not been able to send out the material because the engineer did not use correct document management practices. Time is running and you would need to receive the customer comments to the engineering documents by next week to keep the project time schedule. What do you do?
(10 minutes)

III. Investment Planning Process

Investment Project Life Cycle



Investment Planning Process



Investment Planning Process

MT Metsä | Metsäteollisuus 7.6.2022 09:40

Stora Enso suunnittelee sanomalehtipaperikoneen muuttamista kartonkikoneeksi Langerbruggessa Belgiassa – investointi maksaisi noin 400 miljoonaa euroa

Kartongin raaka-aineena käytettäisiin keräyskuitua. Koneen tuotantokapasiteetti olisi 700 000 tonnia kierrätettyä pintakartonkia ja aallotuskartonkia, joista valmistettaisiin aaltopahvia.

yle Uutiset Areena Urheilu

10.1. 15:03 • Päivitetty 11.1. 10:40

Fazer suunnittelee uutta makeistehdasta Suomeen – korvaisi nykyiset tehtaat Lappeenrannassa ja Vantaalla

Fazer on tehnyt Lappeenrannassa vuosikymmenien ajan muun muassa nostalgisia karamellejään, kuten Marianne-makeisia, Vihreitä kuulia sekä Turkin pippuri -salmiakkeja.

Investment Planning Process

Talous | Metsäteollisuus

Stora Enson miljardi-investointi tekisi Oulun-tehtaasta Imatran kaltaisen ”megaintegraatin”

Pakkausmateriaalitoimialaa johtavan Hannu Kasurisen mukaan suunniteltu investointi on jo pitkälle valmisteltu ennen viimeistä harkintavaihetta. Yhtiö muutti jo vuosi sitten Oulun yhden paperikoneen kartonkikoneeksi.

Stora Enson uusi aaltopahvin pintakartonkia valmistava linja käynnistyi Oulussa runsas vuosi sitten. KUVA: MIRJA RINTALA

Anni Lassila HS
23.2. 9:36

METSÄYHTIÖ Stora Enso kertoo kartoittavansa miljardiin euroon nousevia investointeja Oulun-tehtaalleen. Käynnissä on nyt lopullinen kannattavuusarvio ja lopullinen päätös tehdään tämän vuoden aikana.

Kauppalehti

Veitsiluodon lakkautettuun paperitehtaaseen 400 miljoonan investointi: Infinited Fiber aikoo tuottaa uusiokuitua muotijäteille

20.6.2022 10:23 | päivitetty 20.6.2022 11:59 TEOLLISUUS

Uusiokuitu. Infinited Fiber Company tuottaa puuvillapitoisesta tekstiilijätteestä uutta kuitua vaateteollisuudelle. KUVA: OUTI JÄRVINEN

Infinited Fiber Company suunnittelee 400 miljoonan euron investointia Kemin Veitsiluotoon.

Project Development

General analysis of the investment idea

- Market analysis
- Product analysis
- Brief financial analysis

Analysis of several investment alternatives

- Analysis of different production processes
- Preliminary project execution concept
- Analysis of different market scenarios
- Analysis of location for production
- Preliminary investment cost estimate
- Preliminary profitability analysis

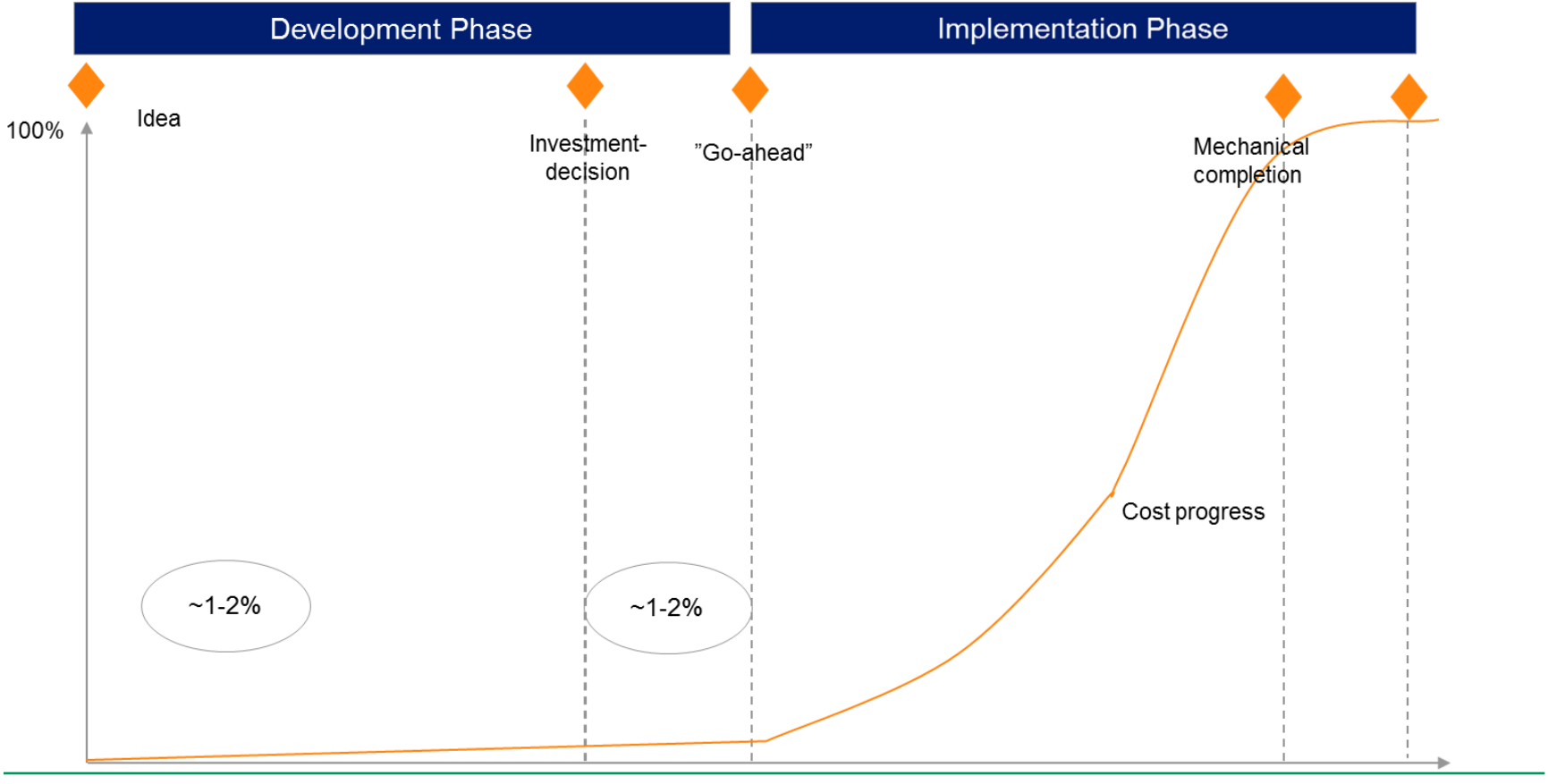
Detailed investigation of best investment alternative

- Pre-/Basic Engineering
- Implementation concept
- Raw material supply
- Marketing and sales strategy
- Organization structure
- Investment cost budget
- Detailed profitability analysis
- Financing concept
- Procedure for authority approvals

Preparation of project implementation

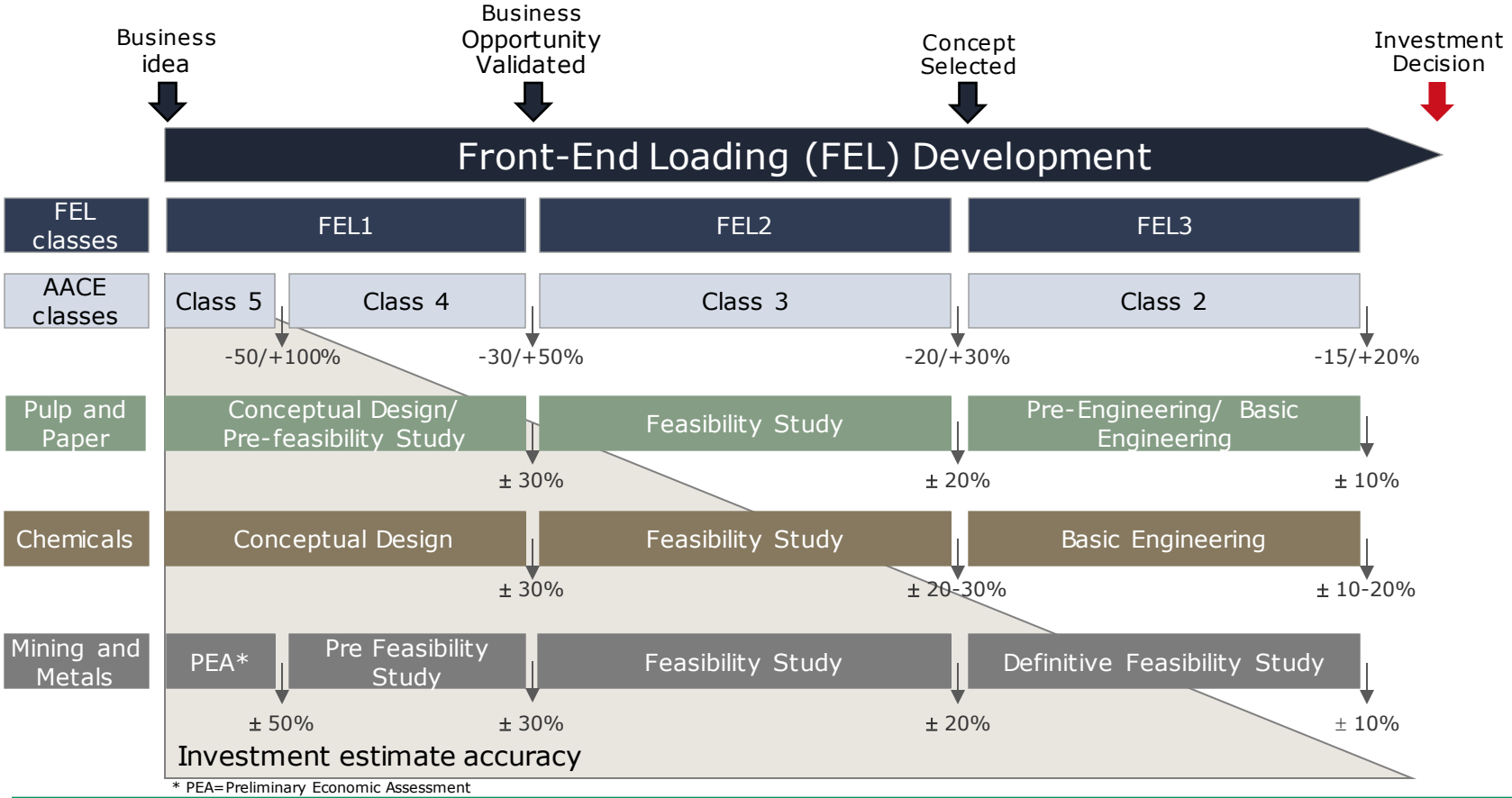
- Detailed execution planning
- Inquiry and negotiations of main execution packages
- Start approval procedure with authorities
- Closing of financial arrangements

Time Frame of Investment Cost



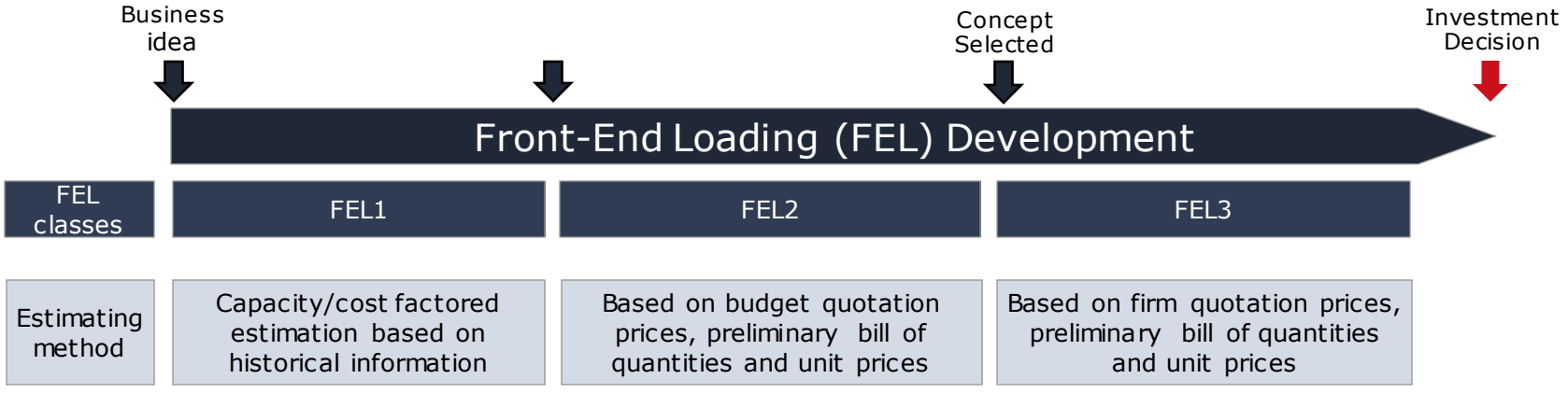
IV. Feasibility Studies & Pre-Engineering Activities

FRONT END-LOADING (FEL) AND COST ESTIMATE ACCURACY



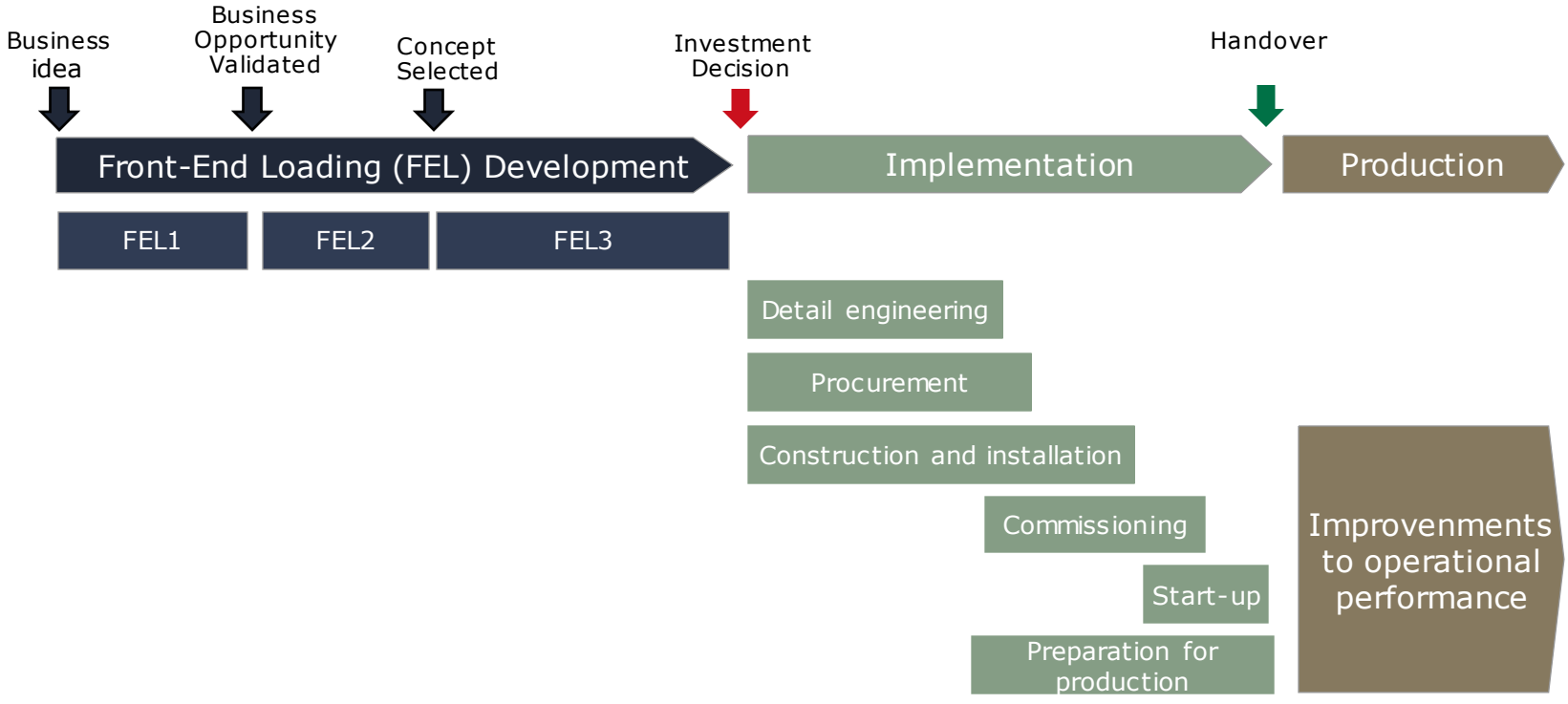
* PEA=Preliminary Economic Assessment

FRONT END-LOADING (FEL) AND ESTIMATING METHODS



1. The estimating method is selected according to the accuracy required
2. The method may also be influenced by AFRY's familiarity with the type of project and the content of our cost database
3. Existing methods for the various disciplines and cost categories varies from project to project
4. Requirements for engineering deliverables also define reasonable and achievable accuracy level

Project Lifecycle



Main Components of Feasibility Studies

	Pre-Feasibility study	Feasibility study
Raw material	• Forest resources • Forest operations • Wood supply	• Forest inventory • Forest management • Logging & Wood transportation • Cost of raw material
Markets	• Demand and competition • Product mix • Sales prices	• Product development • Market shares & Sales volumes • Marketing strategy • Distribution system
Infrastructure	• Mill location • Transport connections • Supplies and facilities	• Site & community development • Water, power & fuel supply • Materials & chemicals supply • Logistics development

Main Components of Feasibility Studies

	Pre-Feasibility study	Feasibility study
Mill concept	• Process development • Environmental protection • General layouts	• Process flow diagrams • Material balance sheets • Building & structures • Description of main equipment
Human resources	• Manpower survey • Manpower requirements • Manpower costs	• Detailed organisation structure • Recruitment and training plan • Detailed personnel costs • Know-how transfer
Economic aspects	• Manuf. & investment cost • Economic and financial evaluation • Financing • Institutional and legal aspects	• Detailed manufacturing & investment cost estimates • Financing & Construction schedules • Commercial profitability • Contribution to National Economy

IV. Project Implementation Methods

Introduction

- The project implementation policy or –method is a model which describes how a single project will be implemented
- In addition to main models there are mixtures of all these, and also different names given to these mixtures or even to same methods
- Money is one driver in selection of the implementation method
- Different players in the project favor different implementation policies but also their main driver is money
- End of the day its the client who decides which way to go and will also take the consequences
- There is no one single policy or method that is superior to others in all cases. The evaluation have to be done case by case
- Selection of any policy or method will not make any work to disappear but it will cast the corner stone for project success or failure

Decision Parameters

What could be parameters for the project implementation method?

Project Implementation Method

- The right implementation method is crucial to meet cost and schedule targets of the project
- Regardless of the implementation method same work has to be done
- Selection of the implementation method determines the roles, responsibilities and liabilities of the project parties in performing, supervising and approving
- Interactive work is a necessity to reduce the investment costs
- Common language, standard scope definitions, transparency and clarity are needed

Decision Parameters

In implementation method decision-making process, a large number of aspects related to the project execution need to be taken into account, such as:

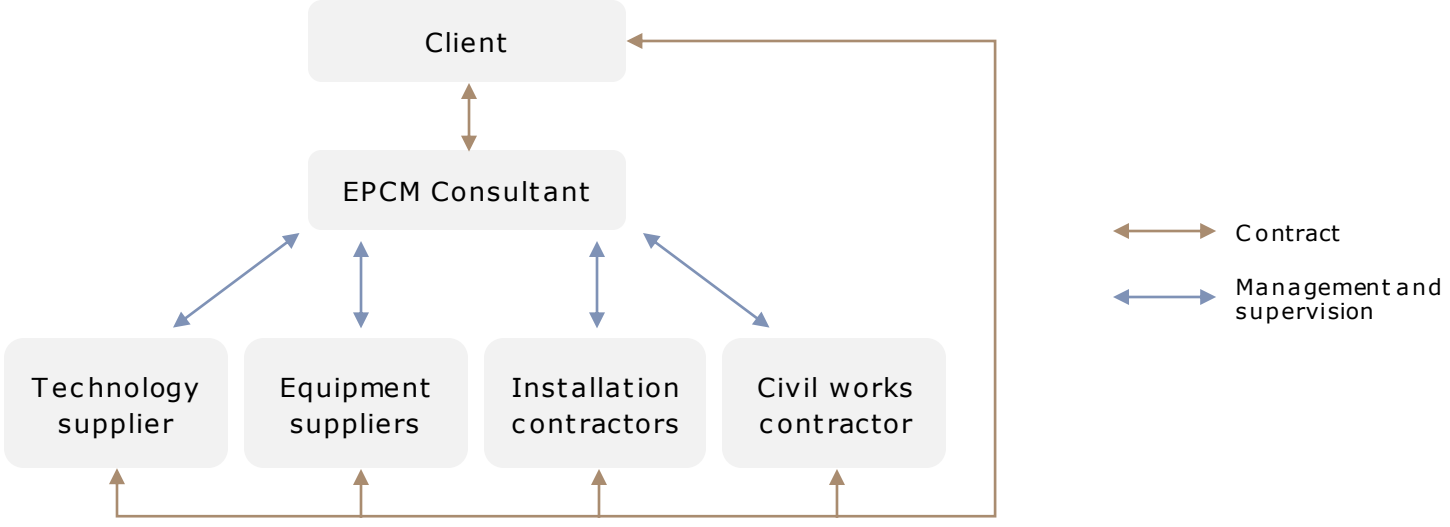
- Financing concept?
- Previous experiences of methods, pros and cons?
- Availability of own personnel to manage and control the project?
- Availability of experienced suppliers, contractors, service providers?
- Who has the main process core knowledge in several processes?
- How to effectively integrate several processes i.e. efficient interface management?
- Main challenge in project – Project Driver?
- Project complexity and degree of tailoring?
- Own risk taking?

Implemetation Methods, examples

- EPCM = **E**ngineering - **P**rocurement - **C**onstruction **M**anagement
- EPS = **E**ngineering - **P**rocurement – **S**upervision/Service/Supply
- EPC = **E**ngineering - **P**rocurement - **C**onstruction
- OB = **O**pen **B**ook
- EP = Engineering - Procurement
- ESS = Extended Scope of Supply
- BOO = Build-Own-Operate
- BOOT = Build-Own-Operate-Transfer
- BOT = Build-Own-Transfer
- DB = Design-Build
- DBO = Design-Build-Operate
- DBFO = Design-Build-Finance-Operate
- FBO = Finance-Build-Operate
- FBOM = Finance-Build-Operate-Maintain

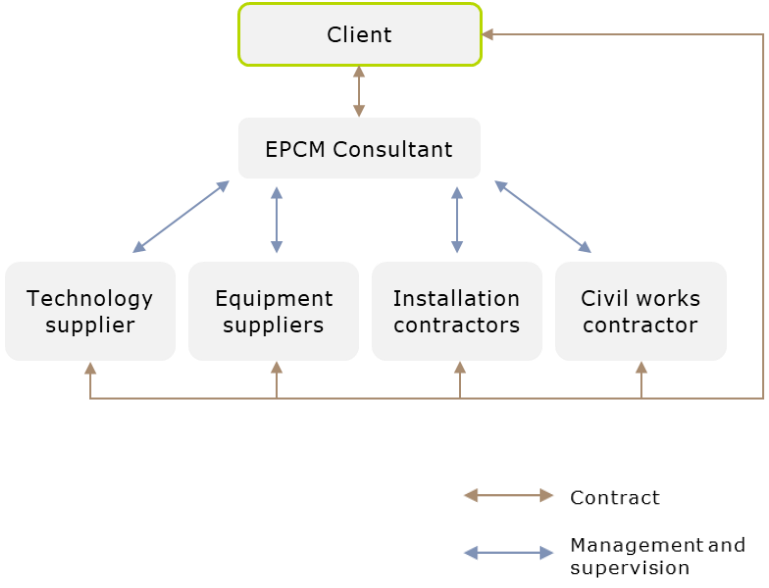
EPCM – Principle Structure

Engineering – Procurement – Construction Management



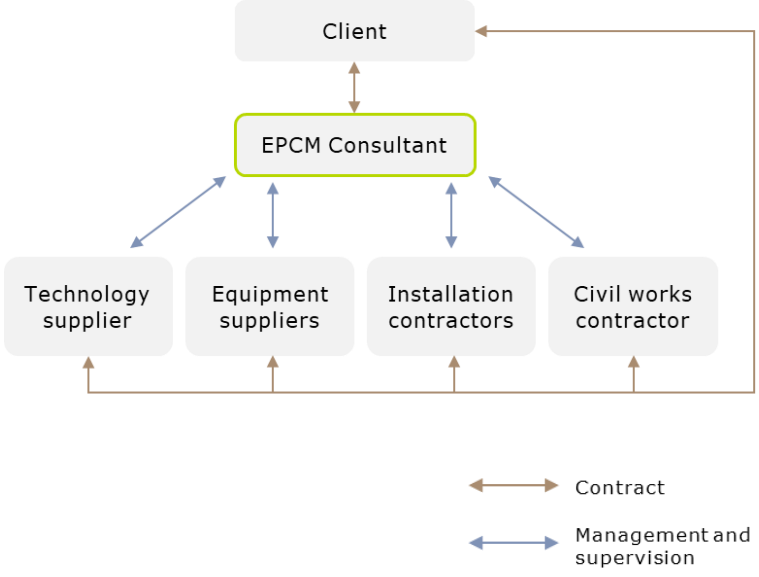
EPCM – Roles and responsibilities

- **Client** is the owner of the project
- Has the ultimate responsibility of the project
- Is in contractual relationship with suppliers and contractors
- Makes all critical decisions in the project to ensure
  - Minimum risks in execution
  - Minimum risks in cost escalations
  - The quality of the services provided
- Is responsible to apply all permits needed



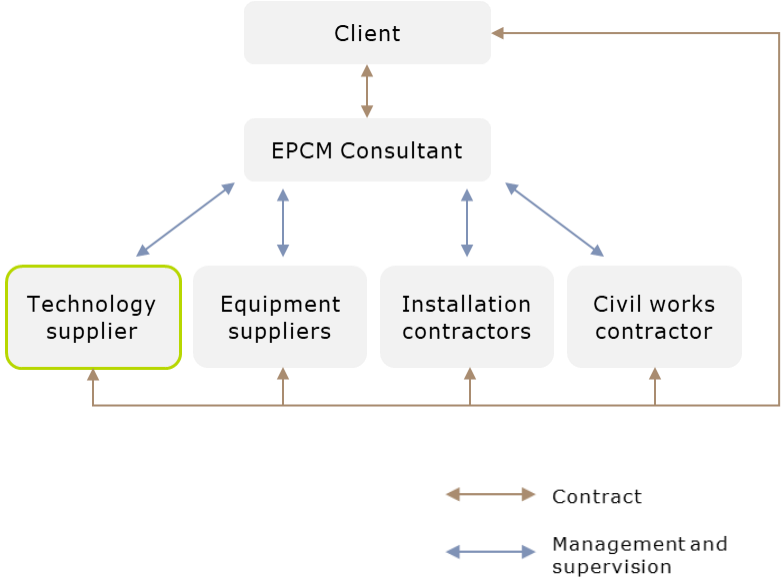
EPCM – Roles and responsibilities

- **EPCM Consultant** ensures the execution of the project within the scope of the EPCM Contract
- Manages the project incl. detail engineering, procurement and construction within the time schedule and budget
- Responsible to coordinate the activities between the project parties
- Responsible for detailed engineering
- Facilitates permitting



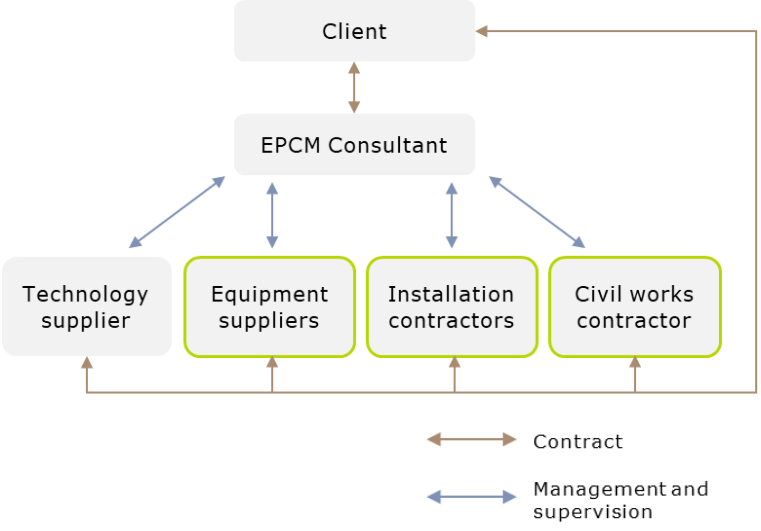
EPCM – Roles and responsibilities

- **Technology Supplier** provides technology licensor package and may supply main equipment
- Gives performance guarantees for the technology
- Participates in the detailed engineering
- Participates in the commissioning and start-up
- Gives operational instructions

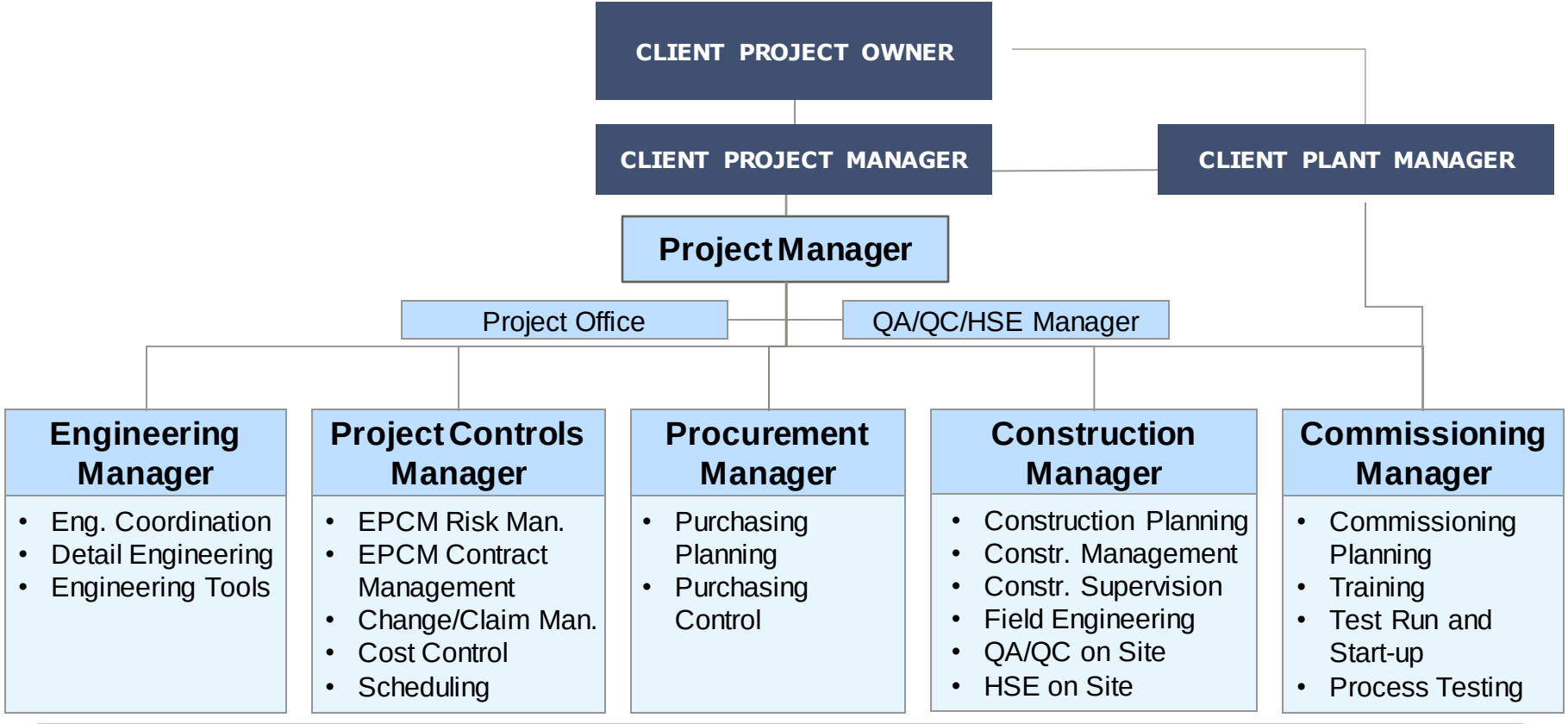


EPCM – Roles and responsibilities

- Managed by the EPCM consultant
- Liable for their works
- Equipment suppliers
  - Manufacturing and supply of equipment
  - Guarantees for the equipment
  - Training of the operating personnel
  - Participates in the commissioning and start-up
- Installation contractors
  - Typically two main installation contracts signed
    - Automation & electricity
    - Piping & equipment assembly
- Civil works contractor
  - Responsible for the building and infrastructure construction

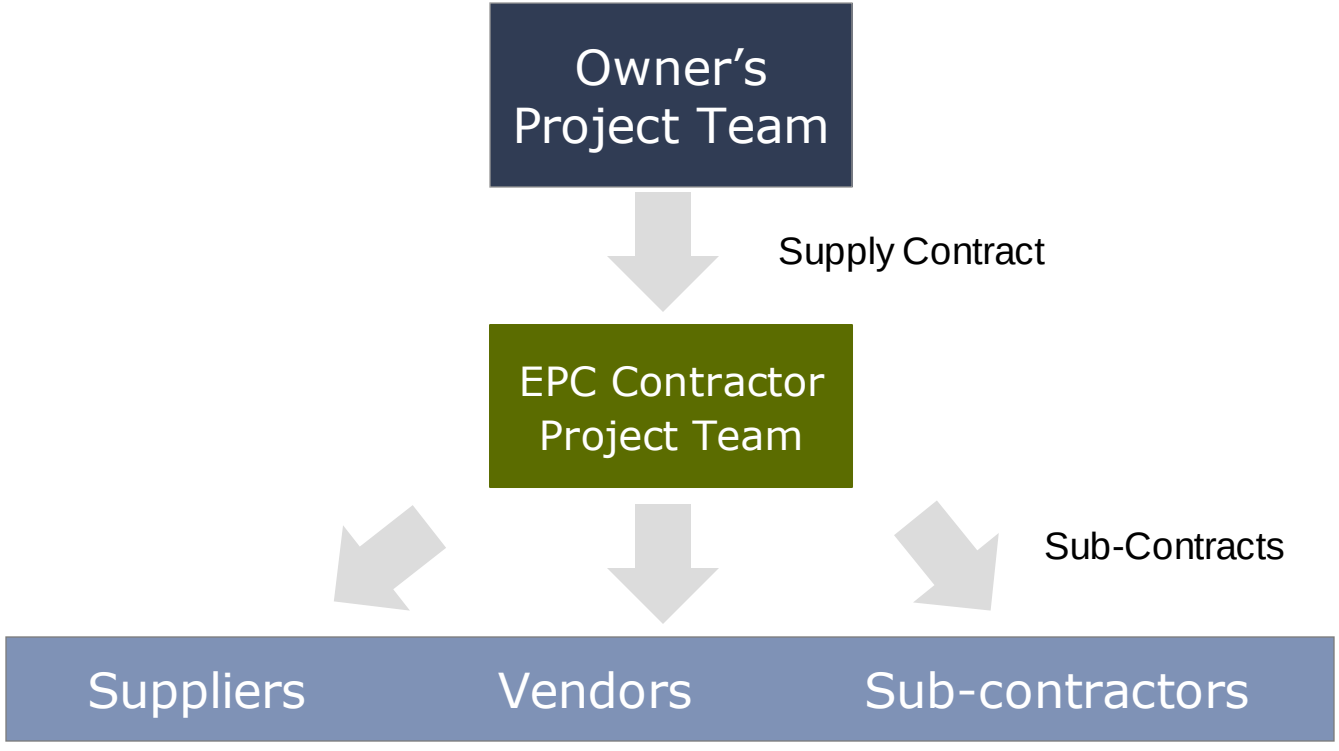


EPCM Project Organisation



EPC – Principle Structure

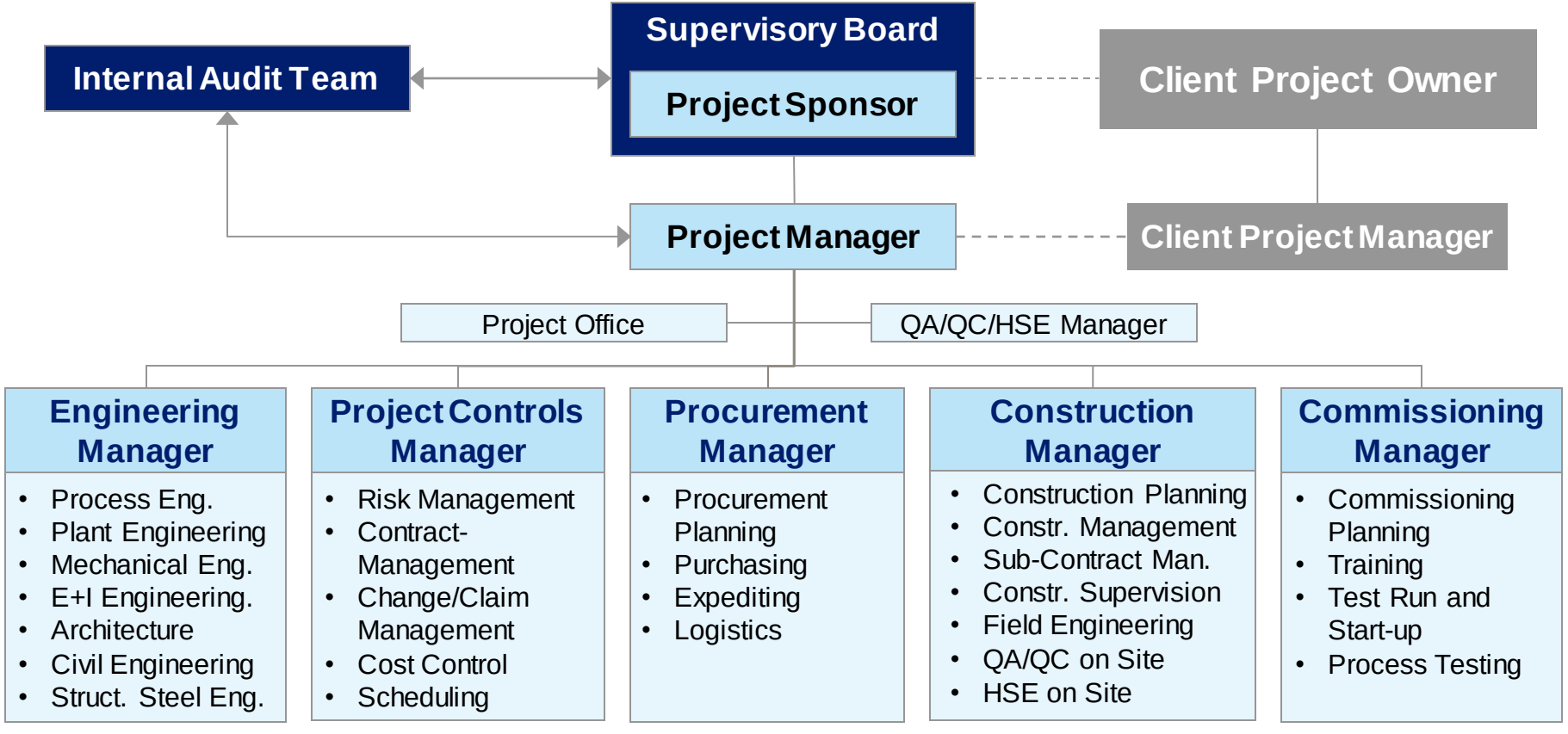
Engineering – Procurement – Construction



EPC – Main Characteristics

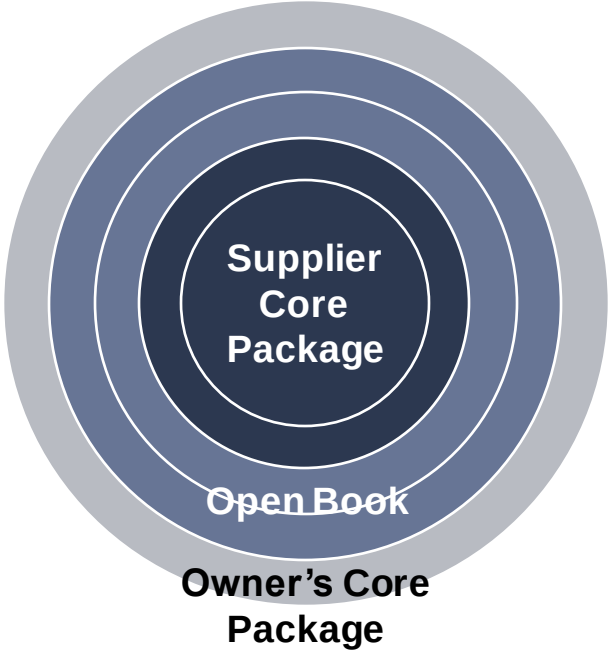
- EPC-Contractor takes over full responsibility for the project execution through a fixed price contract
- All Sub-Contracts in the project are placed by the EPC-Contractor with the resp. supplier/vendor/sub-contractor
- Project owner has limited rights to take decisions after signature of the EPC-contract
- Risks, but also possible gains are transferred to the EPC-Contractor
- To cover such risk, EPC-Contractor will include a risk provision/contingency in his fixed price

EPC Project Organisation



OB – Main Characteristics

Open Book

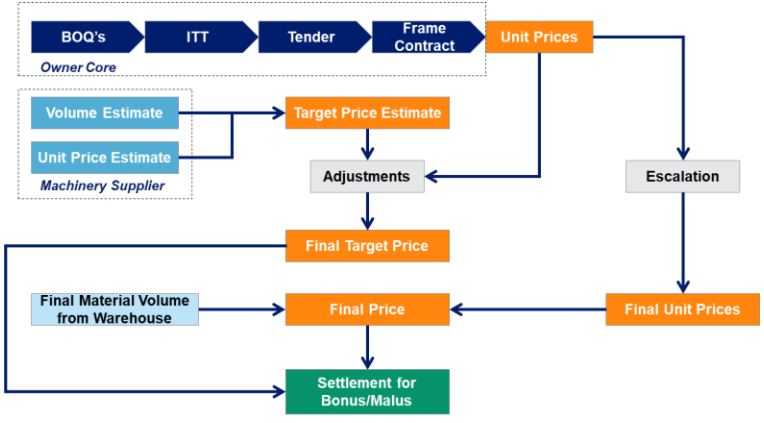


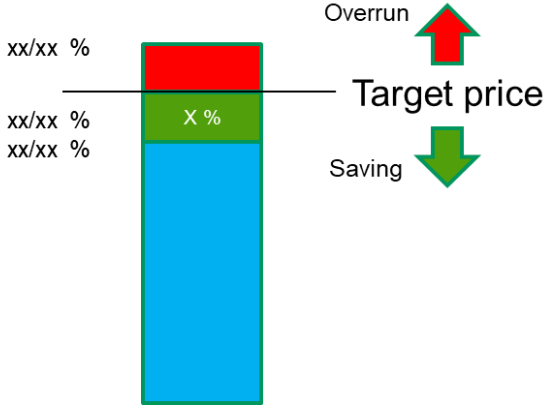
Supplier Core package includes Supplier's core capabilities and profit from core + OB portion (e.g. main process machinery, basic engineering, detailed process engineering, MEI erection supervison for main process machinery and open book items)

Open Book contains items with shared cost budget and limited risk portion. (e.g. AEI components, tanks and towers, mechanical and piping erection, steel structures)

Owner Core Package includes their core capabilities (e.g. civil, overall project management, BoP, site management, site infra etc.)

OB – Main Characteristics





- **Target price agreed between supplier and customer**
- **Orders placed in Owner's name**
- **Risk and opportunity divided**

Comparison EPCM vs. EPC

Advantages/Disadvantages of the two methods ?

Comparison EPCM vs. EPC

EPCM

Advantages

- Owner keeps full control on the project
- Owner benefits from cost savings
- Transfer of certain risk to several parties
- Selection of Suppliers/sub-contractors on basis of detailed specification

Disadvantages

- Complex project structure -> Increased coordination effort
- No cost cap for Owner
- Financing more difficult
- Full process responsibility and project risk remain with the Owner

EPC

Advantages

- Full project responsibility with contractor
- Clear structure – single point of contract
- Completion guarantee
- Fixed lump sum price
- Sound basis for financing

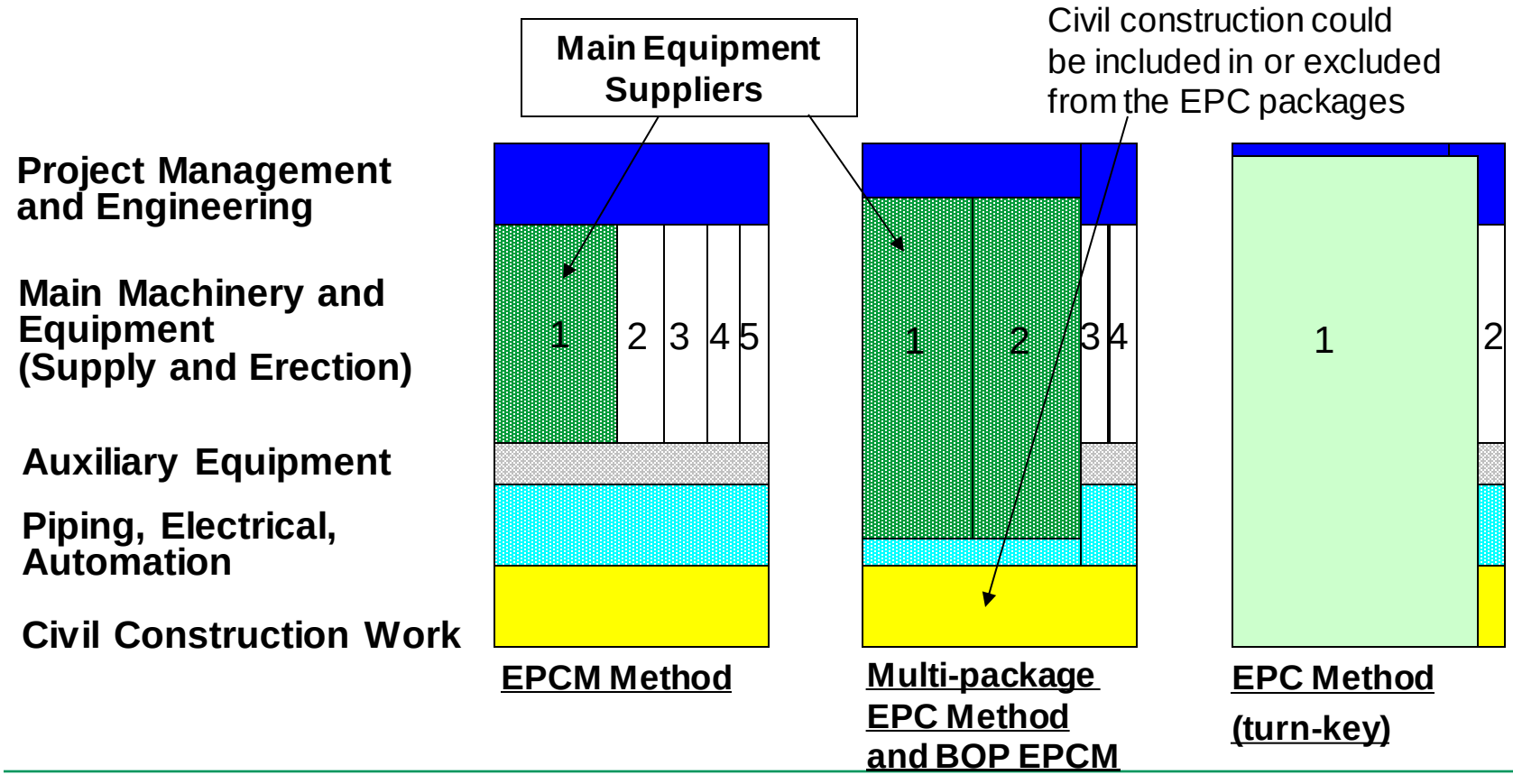
Disadvantages

- Need for early detailed specification of technical solution
- Owner's participation is limited
- Owner will still suffer from bad performance of contractor
- Contractor may compromise on quality in order to save cost

Comparison from Owner's point of view

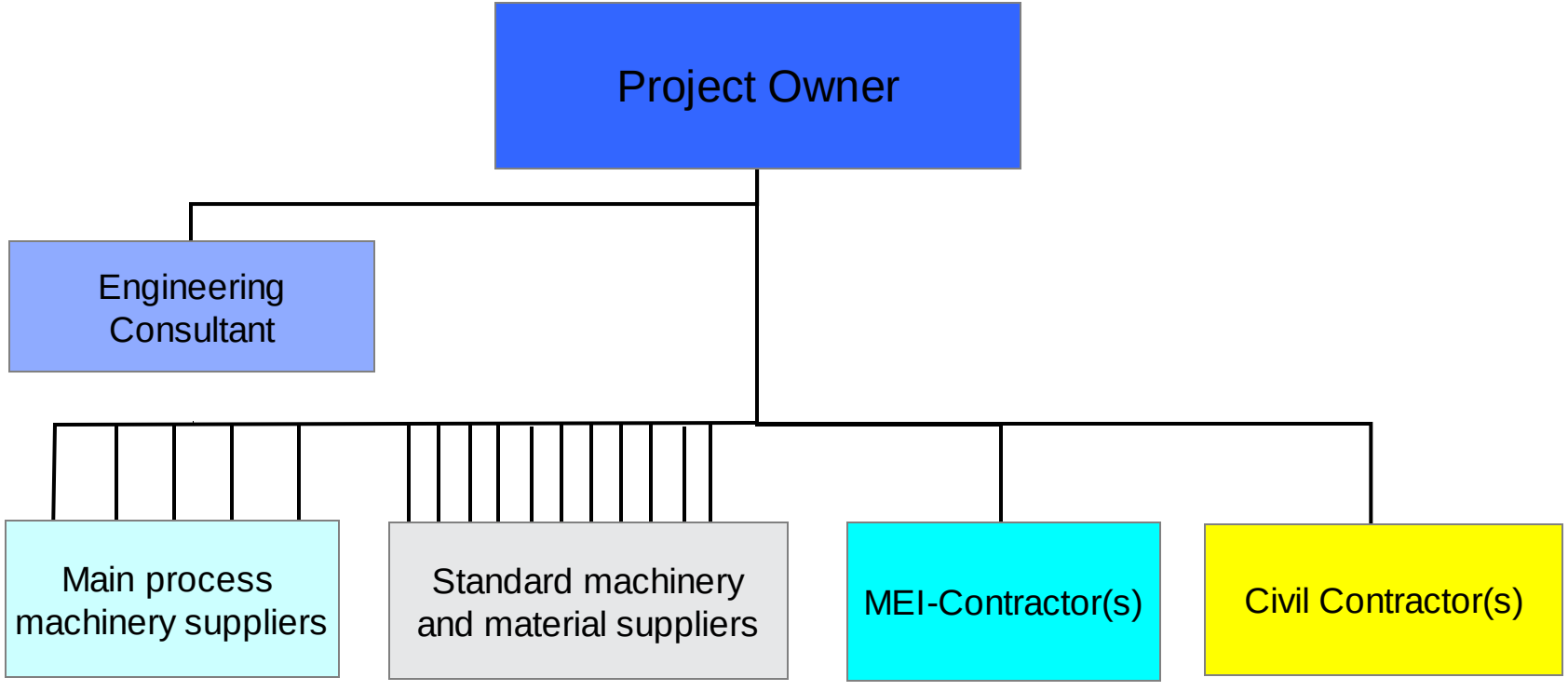
	EPCM	EPC
Need for early decisions	Low	High
Flexibility for modifications	High	Low
Owner's influence possibility	High	Low
Cost budget	Estimate	Fixed lump sum
Financial risk exposure	Medium	Low
Risk provision	Only realized risk	Incl. in contract price
Transparency of cost	High	Low
Overall project risk	High	Medium

Project Implementation Methods



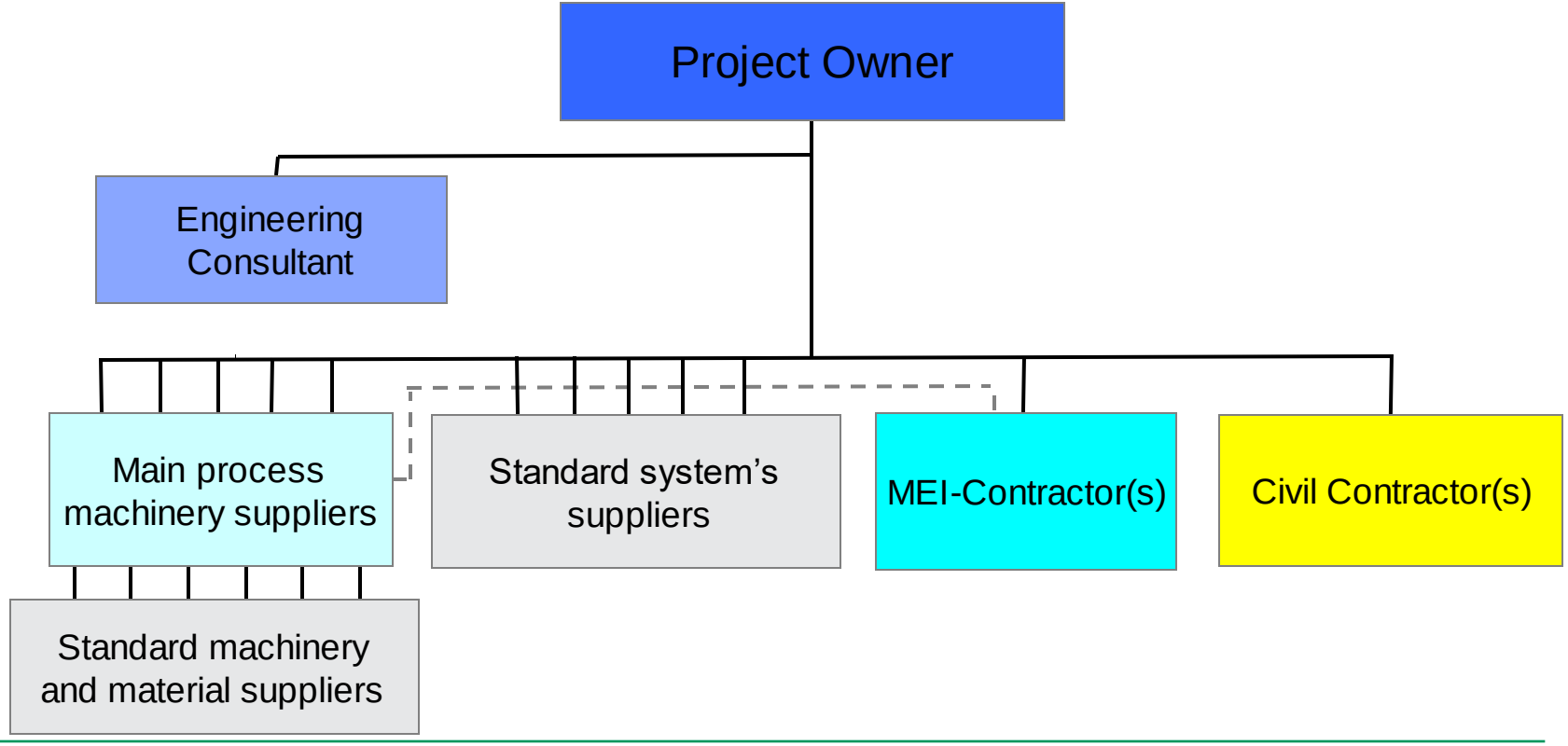
Implementation Methods

EPCM – Engineering, Procurement and Construction Management



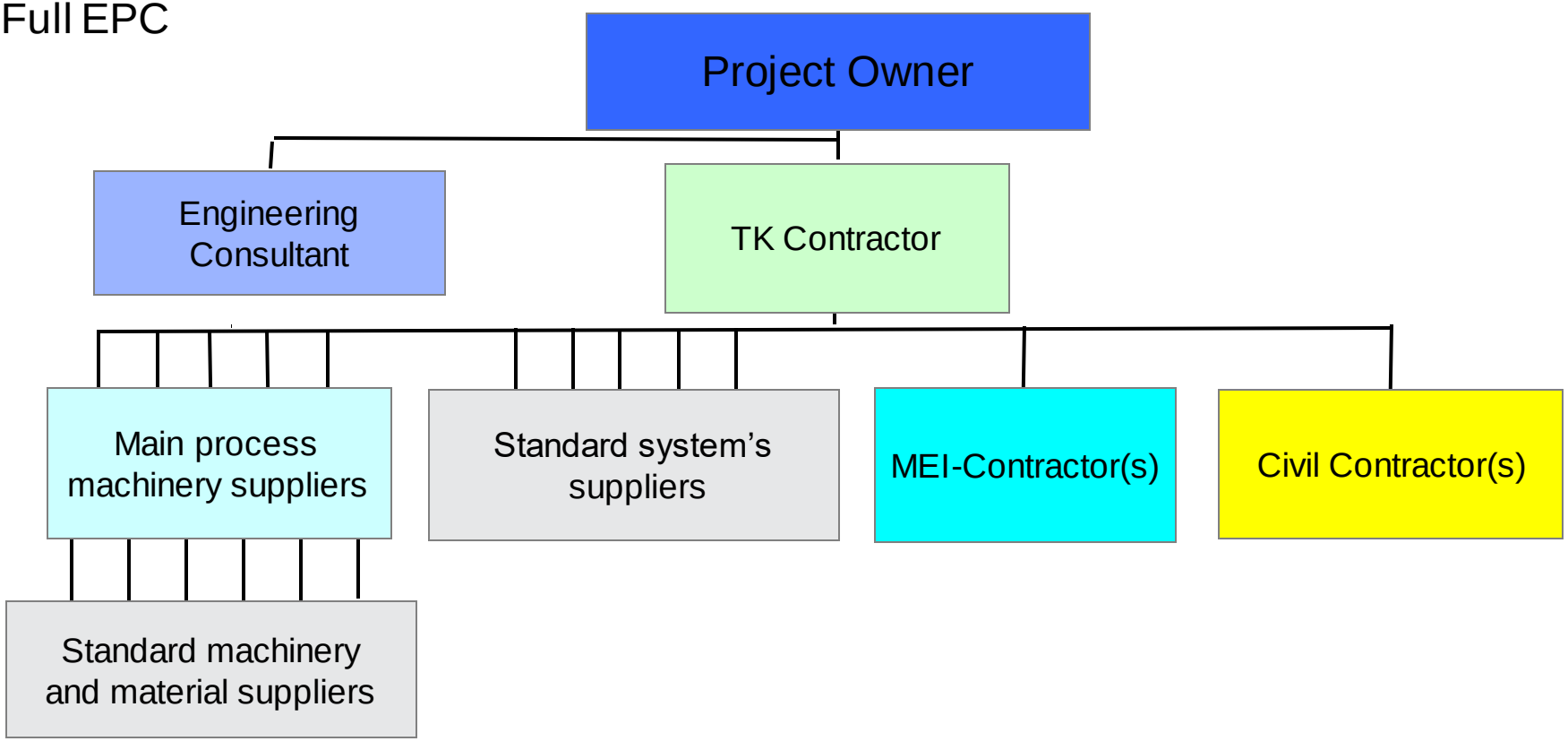
Implementation Methods

Multi-package EPC – Engineering, Procurement, Construction

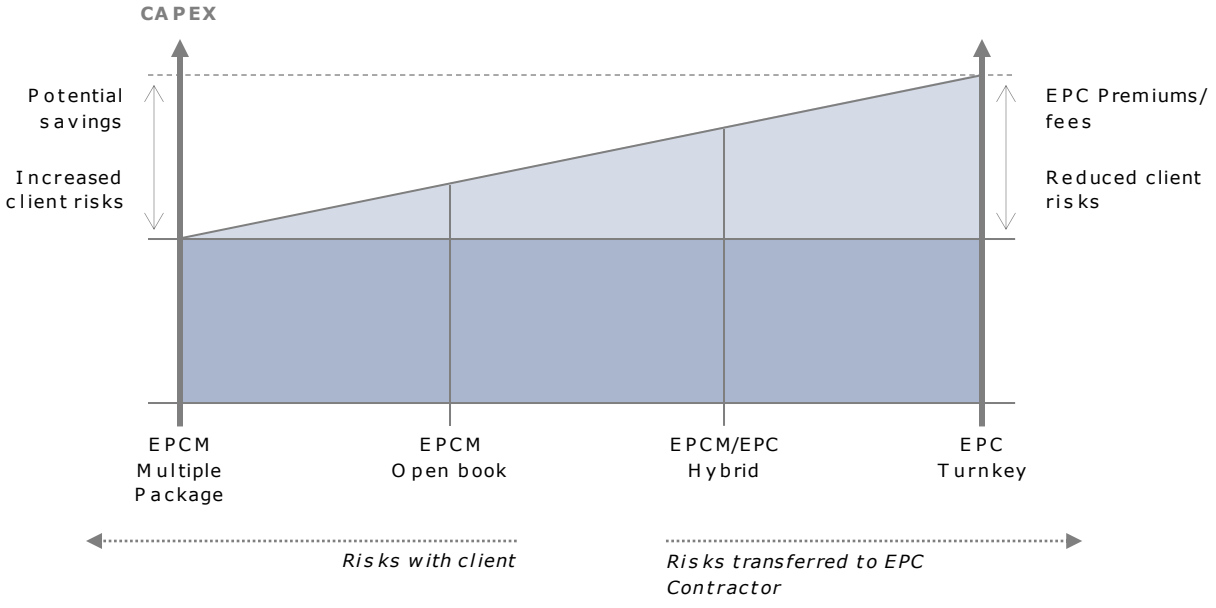


Implementation Methods

Full EPC



Who Carries the Risk



Full freedom for equipment & sub-contractor selection

Limited freedom for equipment & sub-contractor selection

VI. Project Financials: Budgeting and Financials Reporting

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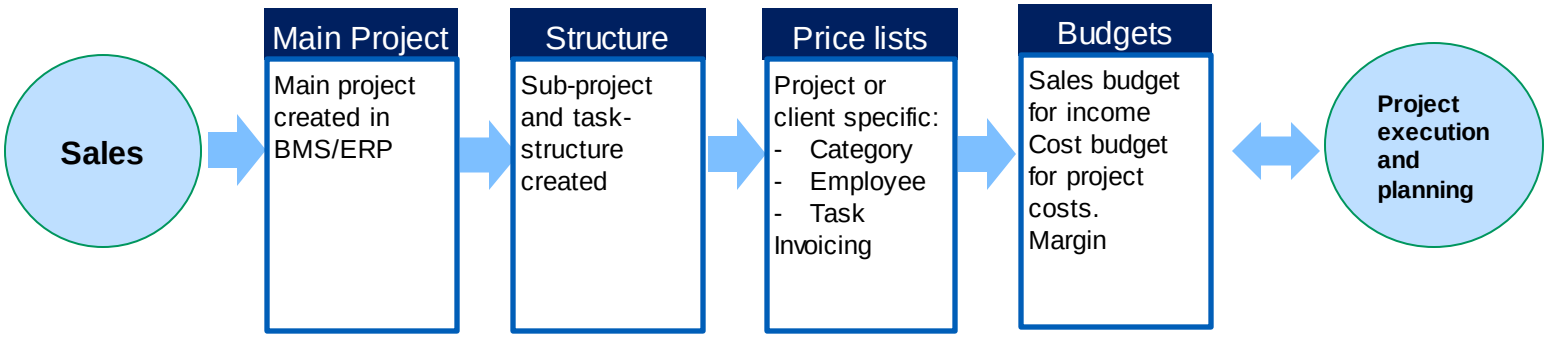
Project Budgeting

Already in the proposal phase, project sales and cost budgets are created to support the sales process and to understand project profitability. "As sold"-budgets are entered to company BMS/ERP as project is opened. Regular budget monitoring and updates when needed.



Business Management System (BMS) processes during project execution

Project execution

- Project manager tasks during project execution such as resource planning, timesheet entries & project cost verification, invoicing, progress evaluation, change order management and reporting are completed using Business Management System (BMS/ERP).
- During the Project execution these processes are recurring and eventually need to be done on a weekly or monthly basis or when required

Importance of Project Financial Reports

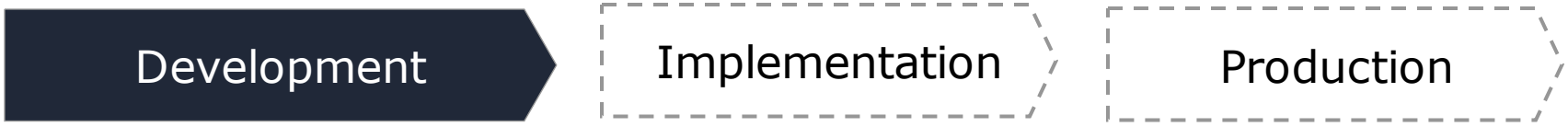
- Project Financial Reports form the basis of project company business reporting and are good pointers of business result
- Accurate Project Financial Reports will help management to mitigate eventual challenges in projects in their early phases, support in cost savings, support with change order management and secure cash flow.
- Project cash flow forecast should be planned already in the sales phase in order to secure positive cash flow, i.e. that more cash is coming in from client invoicing than what is going out as costs like salaries and other operational costs

Financial management in projects - key elements to success

Item	Action
Know the contract and scope (you and your team)	Read the contract and its appendices carefully
Project budgets up to date	Sales budget (Change Orders etc.) Cost budget / ETC: How many hours will still be needed to complete the work? What is the correct cost/hour? How much other project costs are still needed to complete the project?
Change order management	Agree price of the work outside original scope (or if scope is larger than agreed, e.g. increase in quantities) in advance with the client. Every invoiced hour counts
Positive cash flow	Front-heavy payment terms + advance payments WIP* = costs in, but invoice not yet sent to client -> minimize WIP (negative WIP is good); active, regular invoicing Back-heavy payment –terms to sub-consultants No errors in contents of the sent invoices Quick collecting of possible overdue sales invoices (*= Work In Progress)
Challenge your team & sub-cons	Strict control of used hours and costs, ask for clarifications, give limits
Challenge your client	Client´s delay or missing initial data -> notify client in writing and ask for more time/money as client has not followed the agreement
No claims	Take up problems as soon as you recognize them

VII. Conclusions

Successful Investment Project



"Plan the work"

Preconditions

- **Clear project rules**
- **Sound technical concept**
- **Reliable investment cost estimate**
- **Thoroughly prepared contracts**
- **Realistic time schedules**
- **Reliable product and market analysis, profitability calculations**

Successful Investment Project

"Plan the work"

"Work the plan"

Preconditions

- **Clear project rules**
- **Sound technical concept**
- **Reliable investment cost estimate**
- **Thoroughly prepared contracts**
- **Realistic time schedules**
- **Reliable product and market analysis, profitability calculations**

- **Continuous follow-up of the work vs. time schedules**
- **Professional contract management**
- **Proper Change Management**
- **Continuous cost control**
- **Work according to agreed standards**

Successful Investment Project

Criteria

- **The plant is completed within schedule**
- **The plant is completed within budget**
- **Production starts / develops as planned regarding product quality and quantity**
- **Product sales begins according to the market preconditions**
- **Operation & maintenance runs reliably**

Conclusion 1/2

- Safety during the project and of the operating mill
- Optimum life cycle costs – both investment and operating costs
- Project implementation within budget and schedule
- Fast ramp-up of the production to the projected level
- Production of required quality cost efficiently
- Environmental aspects in operations in compliance with regulations

Conclusion 2/2

Succesful project implementation
is all about
Management of Risk

Select project implementation method so,
that risks are allocated to such party,
which is best positioned to manage it!

Questions from students

Aalto University
School of Chemical
Engineering

Thank you!

Antti Mattelmäki
Project Manager, Process Industries
AFRY Finland Oy
Antti.mattelmaki@afry.com
www.afry.com