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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 14, 2023
Antti Mattelmäki*

Lecture 2

Investment planning and decision making phase

- 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**

Learning Objectives

- I. To understand what is a Project**
- II. To understand different phases of the investment planning**
- III. To understand the types and differences of project implementation methods**
- IV. To understand the basics of project budgeting**



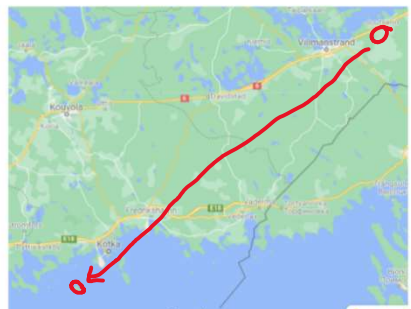
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I. Introductions

Antti Mattelmäki

AFRY Finland Oy	Senior Project Manager, Process Industries Project Manager, Process Industries	04/2023 – 01/2020 – 03/2023
Andritz Oy	Sales Manager, Recovery Boilers Sales Engineer, Recovery Boilers	06/2013 – 12/2019 02/2011 – 05/2013
Pöyry Finland Oy	Department Manager, Process engineering	12/2008 – 01/2011
Andritz Oy	Process Engineer, White Liquor Plants Sales Engineer, White Liquor Plants	07/2005 – 11/2008 09/2001 – 06/2005
Andritz-Ahlström Oy	Research Engineer, Heat Engineering	11/2000 – 08/2001
University of Oulu	Department of Process and Environmental Engineering	1995 – 2000





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



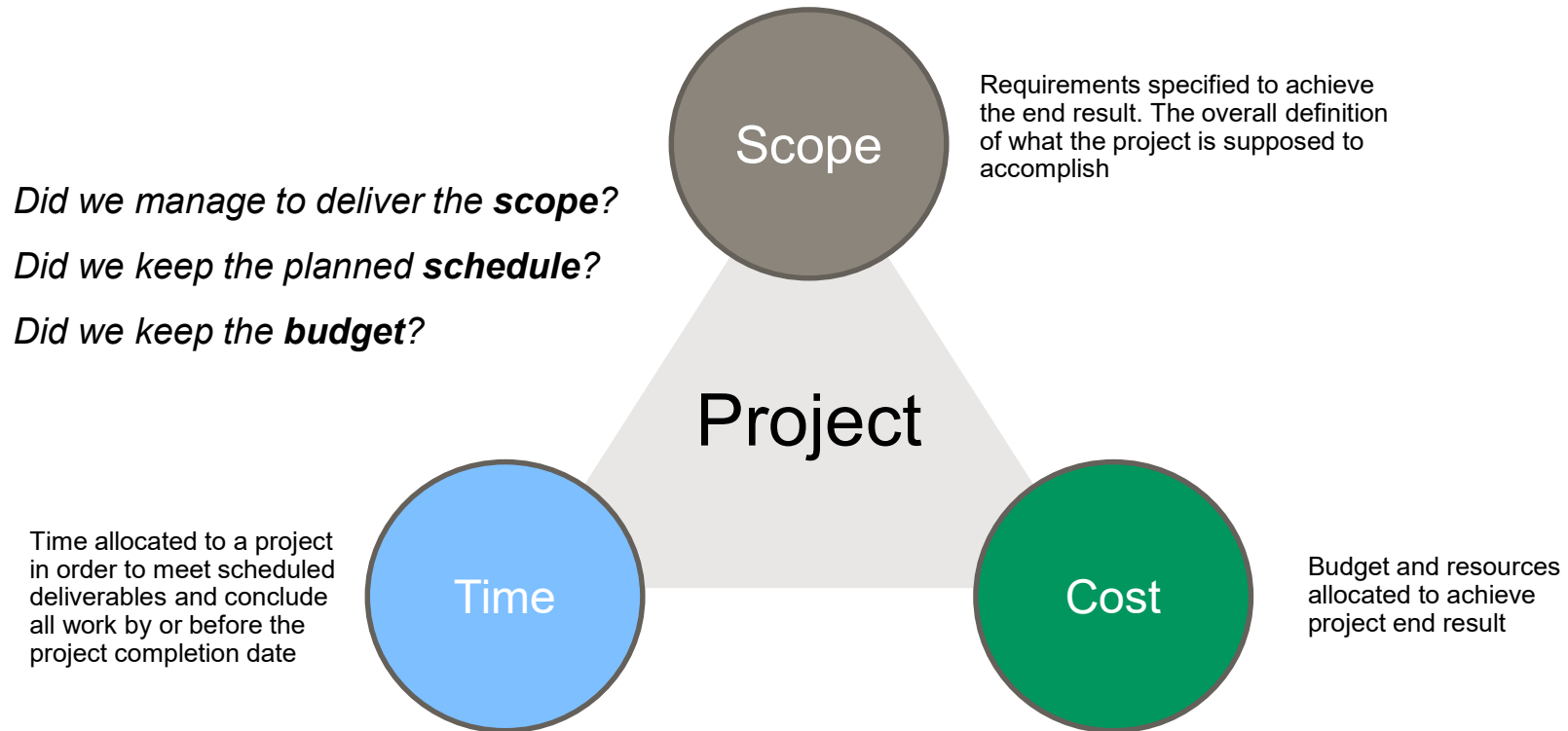
Project characteristics

Defined **scope**

Defined time **schedule**

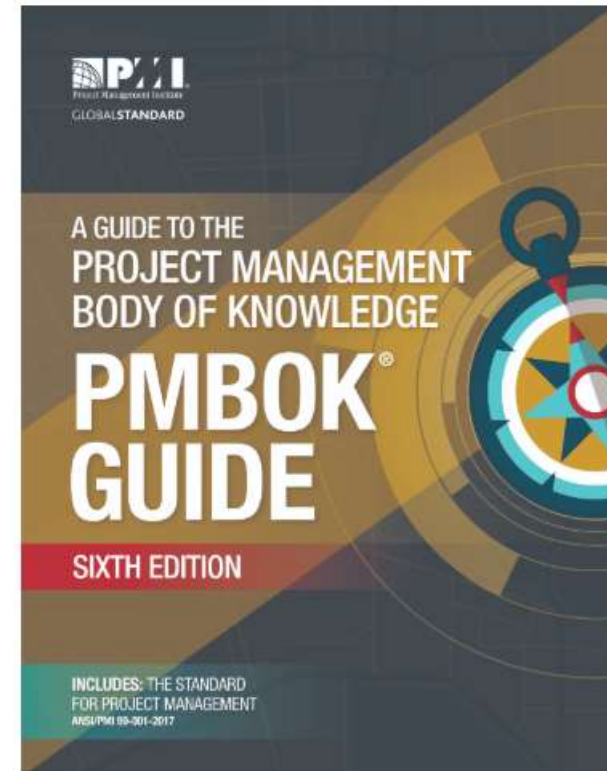
Defined **budget**

Dimensions of Project Management



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 FUNCTIONS		Production
PROJECT SUPERVISION		<p>These main Functions cover the whole sphere of responsibilities required in any project – irrespective of who does them</p>
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	

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.*



Case

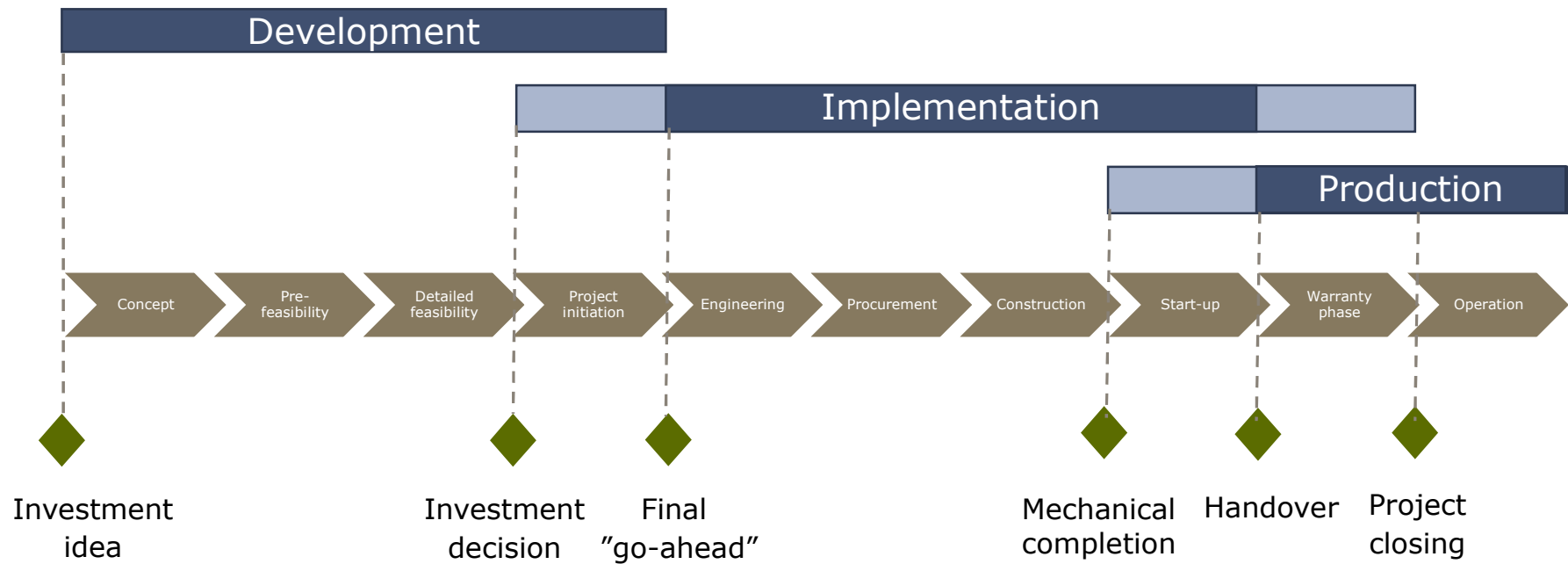
You are a Project Manager and you receive phone call from one of your engineers. He says that he has not been able to send his engineering documents to the customer for customer's approval due to issues with the documents.

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?

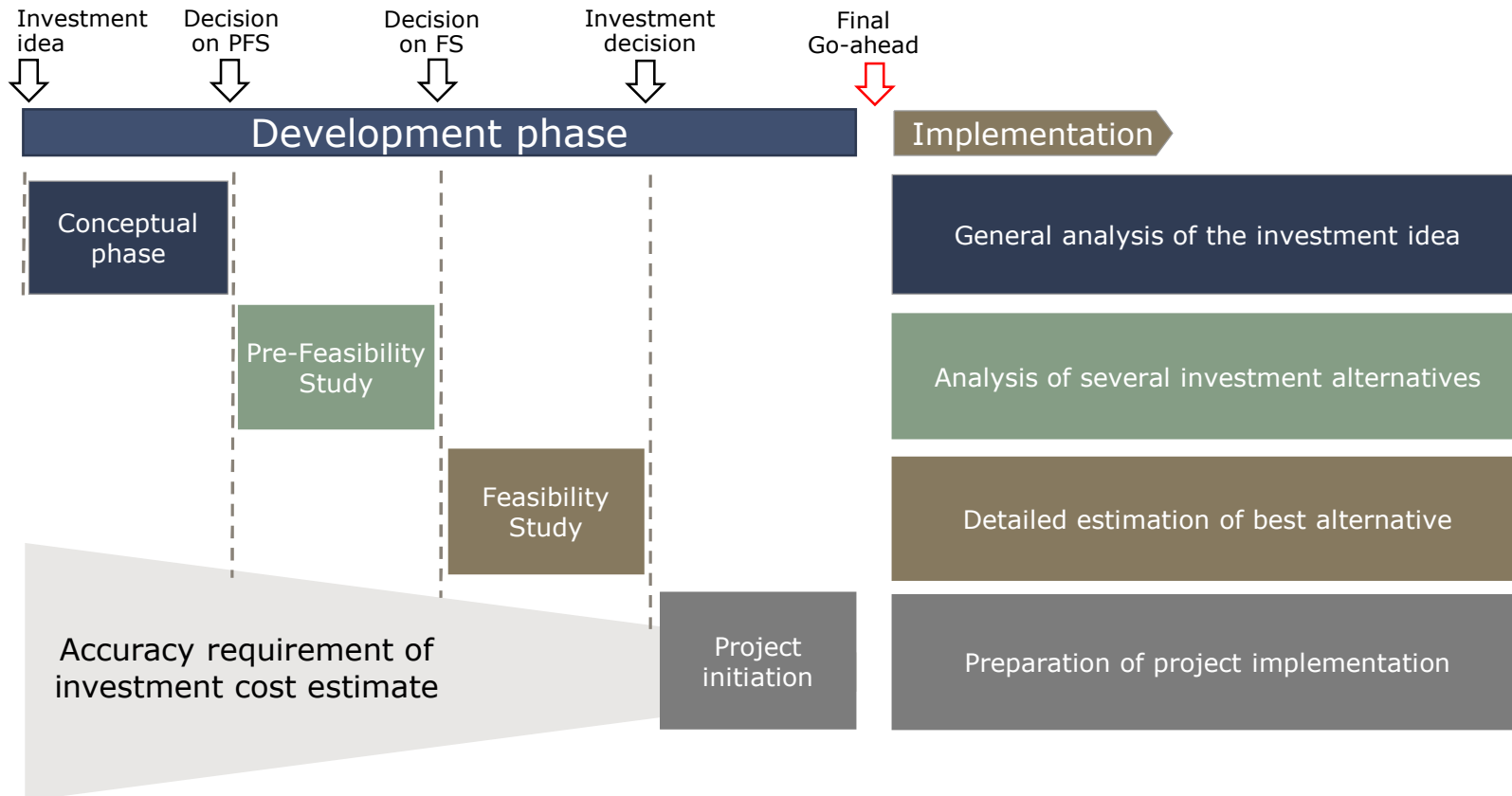
(10 minutes)

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

Infinited Fiber Company Plans to Build EUR 220 mln Flagship Factory in Finland

APRIL 30, 2021



PRESS RELEASE

April 30, 2021

Circular fashion and textile technology group Infinited Fiber Company is looking for a location in

Other press releases

SSAB and Fortum explore possibilities for the production of hydrogen-reduced sponge iron in Raahе

JUNE 05, 2023 9:00 CEST

3 MIN READ

SSAB and Fortum will launch a FEED* study to explore the possibilities of making hydrogen-reduced sponge iron also in Raahе.



The FEED study will explore the possibilities of making fossil-free sponge iron at an industrial scale in Raahе and of building a hydrogen production plant. The study is scheduled to complete in the first quarter of 2024.

Infinited Fiber plans €400m investment at Stora Enso Veitsiluoto mill

30 June 2022 | ~ 2 min | Published in issue 27/2022

'A new factory at Stora Enso's idle Veitsiluoto woodfree uncoated and coated magazine paper mill in Kemi, Finland, is to recycle waste textiles and produce regenerated textile fibre for 100 million T-Shirts, says Infinited Fiber.'

Infinited Fiber Company will build its first commercial-scale regenerated textile fibre factory at Stora Enso's Veitsiluoto industrial site in Kemi, Finland. The Finnish company plans to convert a building currently housing a discontinued paper machine and install a production



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Four-billion-euro investment planned into a green steel plant in Inkoo, Finland

3.1.2023

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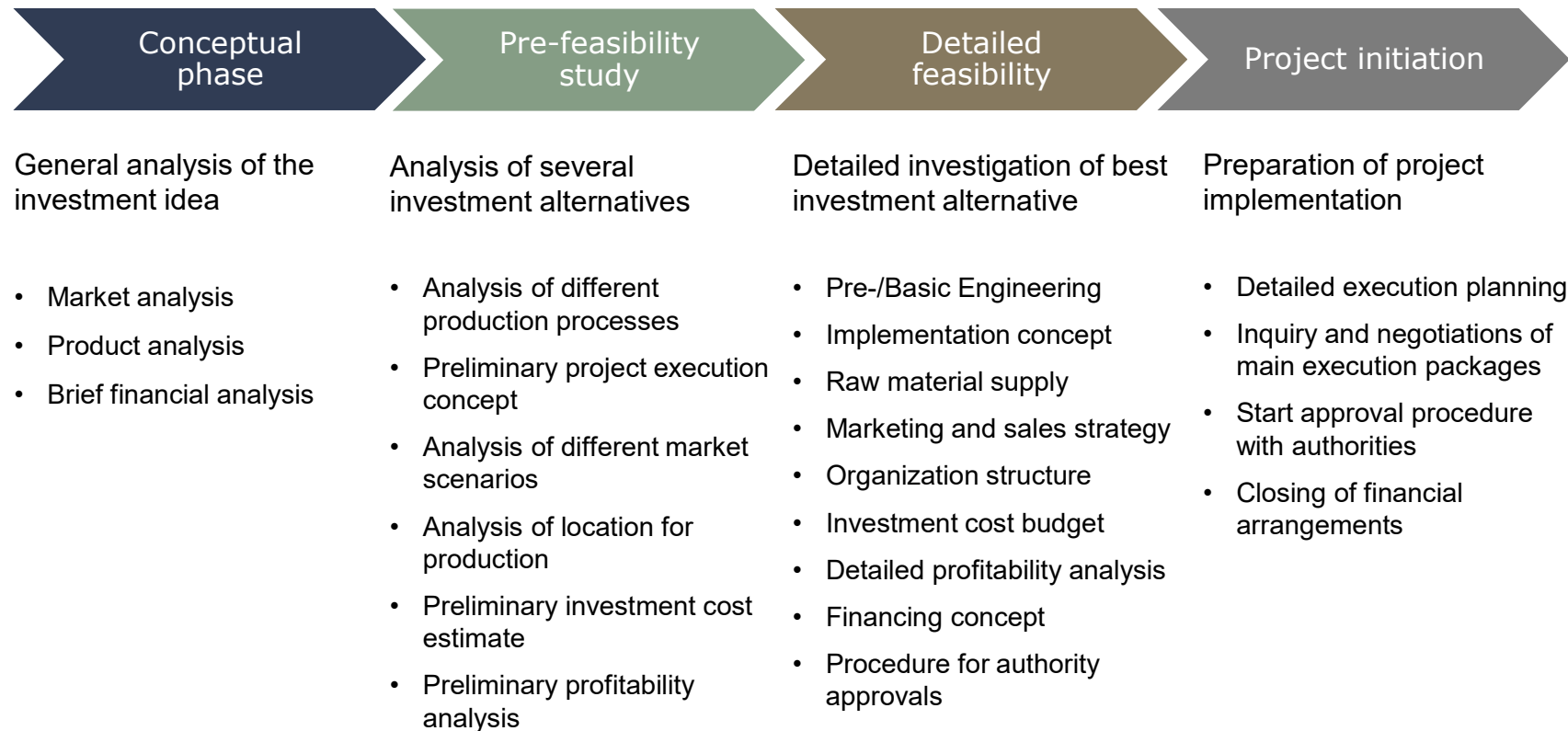
How We Can Help

News Hub

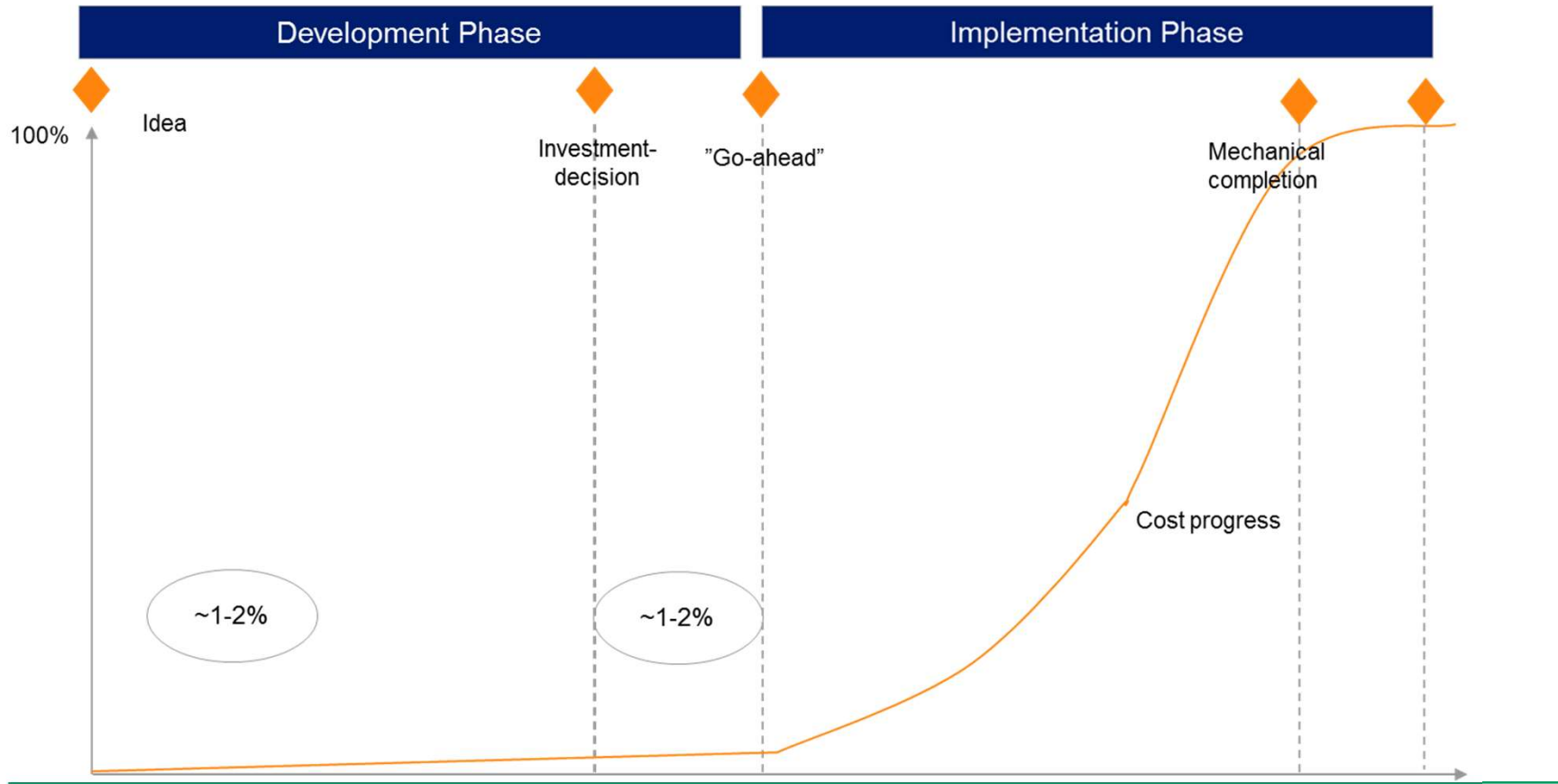
Four-billion-euro investment planned into a green steel plant in Inkoo, Finland

3.1.2023

Project Development

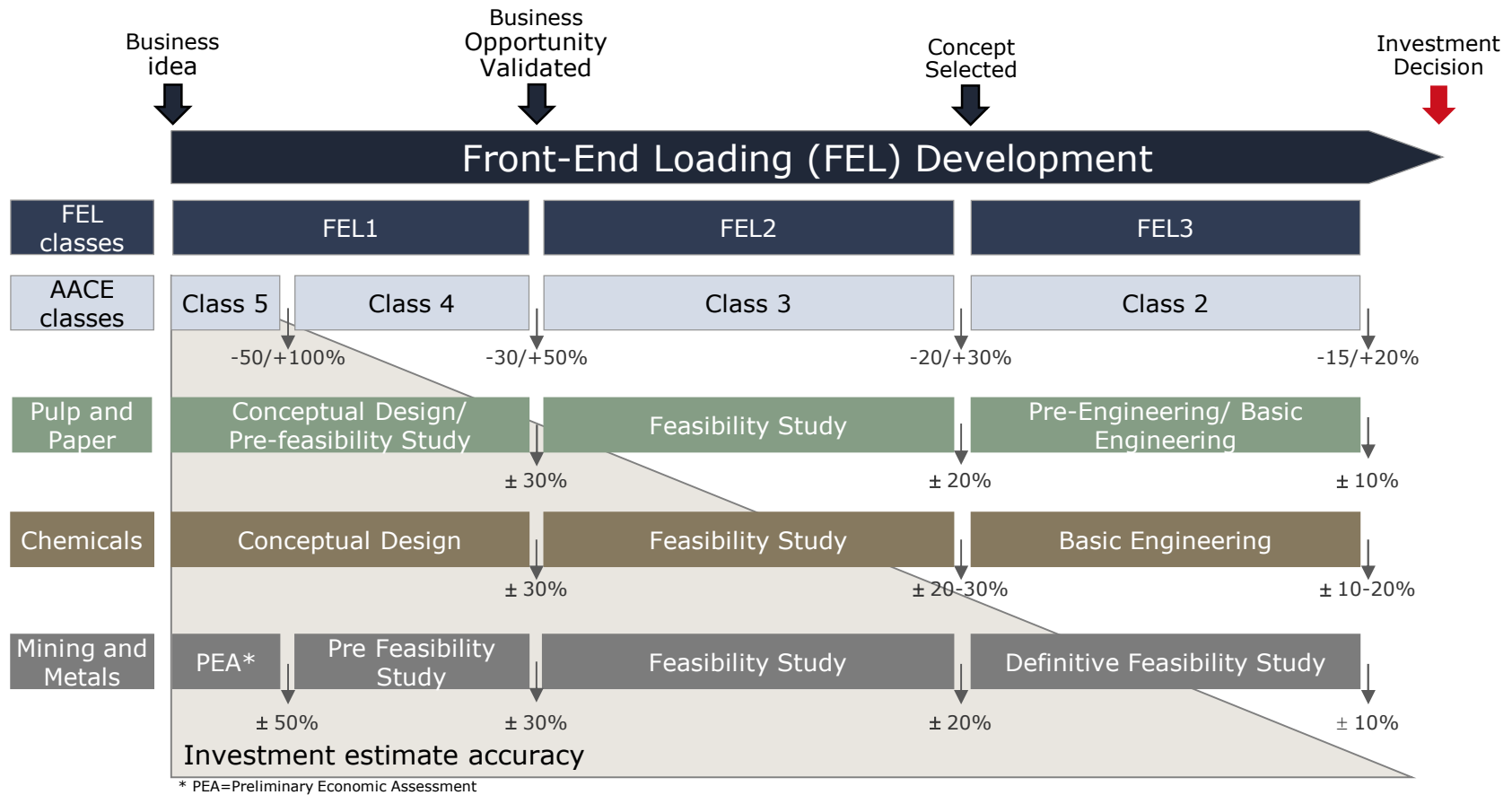


Time Frame of Investment Cost

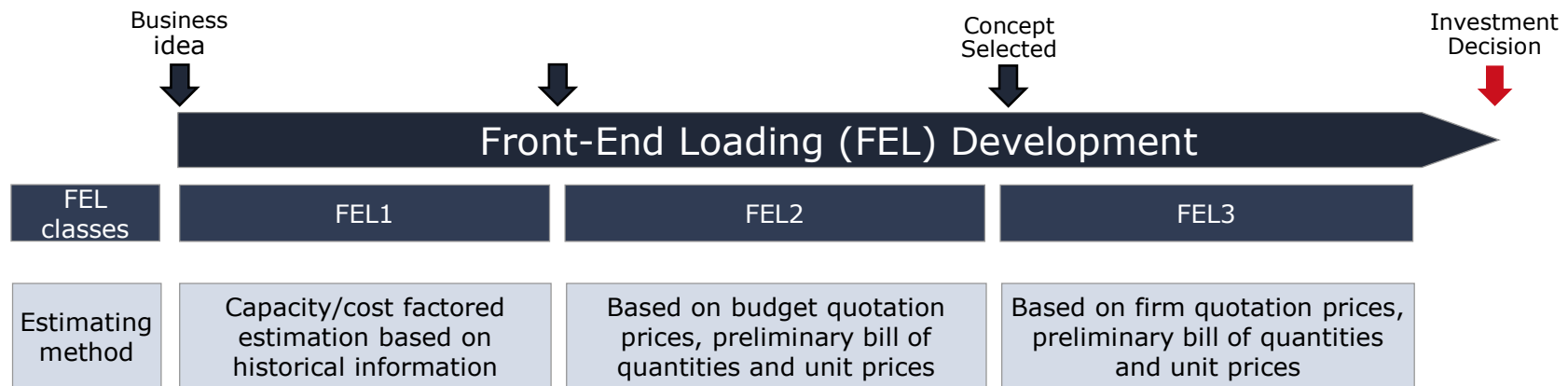


IV. Feasibility Studies & Pre-Engineering Activities

FRONT END-LOADING (FEL) AND COST ESTIMATE ACCURACY

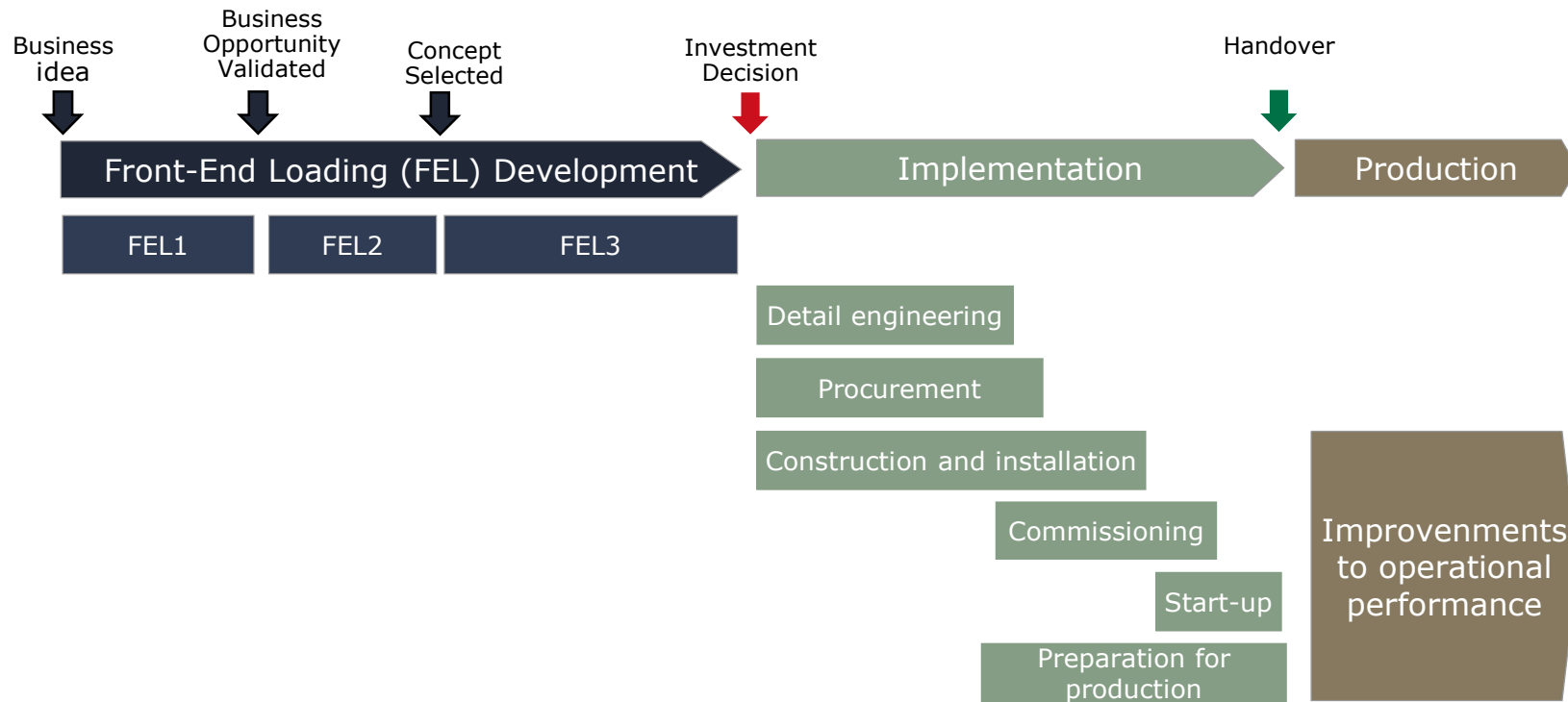


FRONT END-LOADING (FEL) AND ESTIMATING METHODS



1. The estimating method is selected according to the accuracy required
2. The method may also be influenced by consultant'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	<ul style="list-style-type: none">• Forest resources• Forest operations• Wood supply	<ul style="list-style-type: none">• Forest inventory• Forest management• Logging & Wood transportation• Cost of raw material
Markets	<ul style="list-style-type: none">• Demand and competition• Product mix• Sales prices	<ul style="list-style-type: none">• Product development• Market shares & Sales volumes• Marketing strategy• Distribution system
Infrastructure	<ul style="list-style-type: none">• Mill location• Transport connections• Supplies and facilities	<ul style="list-style-type: none">• Site & community development• Water, power & fuel supply• Materials & chemicals supply• Logistics development

Main Components of Feasibility Studies

	Pre-Feasibility study	Feasibility study
Mill concept	<ul style="list-style-type: none">• Process development• Environmental protection• General layouts	<ul style="list-style-type: none">• Process flow diagrams• Material balance sheets• Building & structures• Description of main equipment
Human resources	<ul style="list-style-type: none">• Manpower survey• Manpower requirements• Manpower costs	<ul style="list-style-type: none">• Detailed organisation structure• Recruitment and training plan• Detailed personnel costs• Know-how transfer
Economic aspects	<ul style="list-style-type: none">• Manuf. & investment cost• Economic and financial evaluation• Financing• Institutional and legal aspects	<ul style="list-style-type: none">• 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:

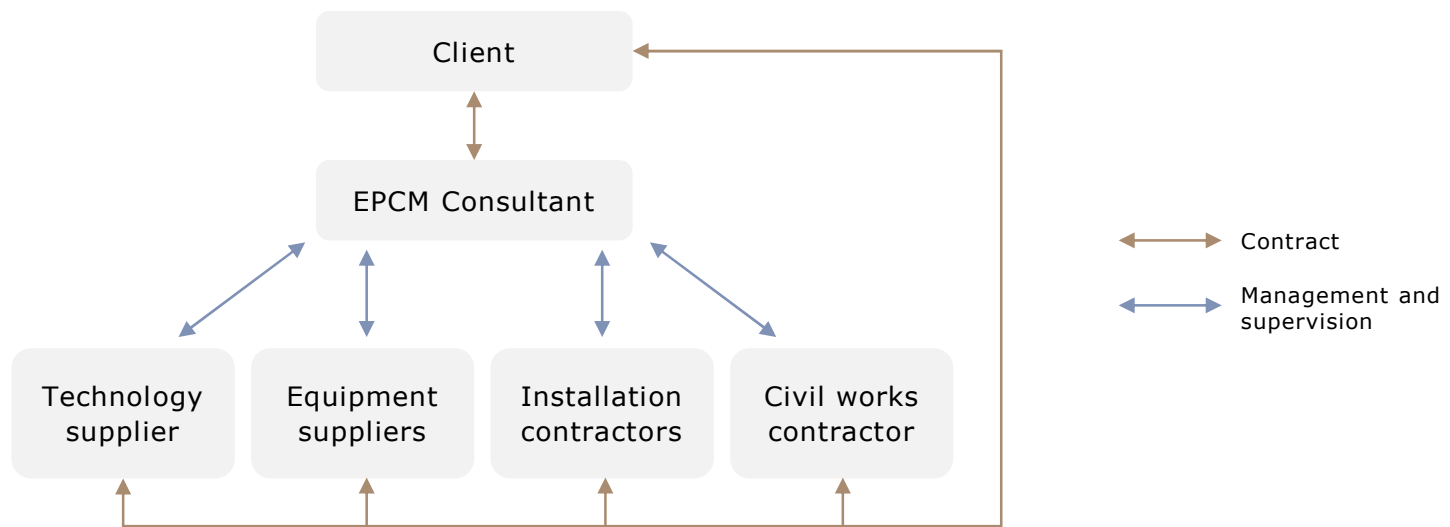
- Financing concept?
- Previous experiences of methods, pros and cons?
- Availability of own personnel to manage and control the project?
- Availability of experienced suppliers, contractors, service providers?
- Who has the main process core knowledge in several processes?
- How to effectively integrate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

Implementation 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

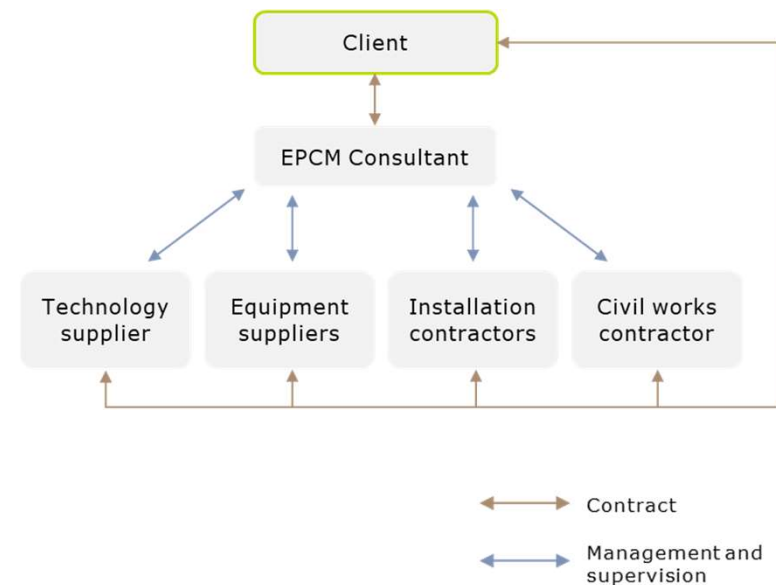
EPCM – Principle Structure

Engineering – Procurement – Construction Management



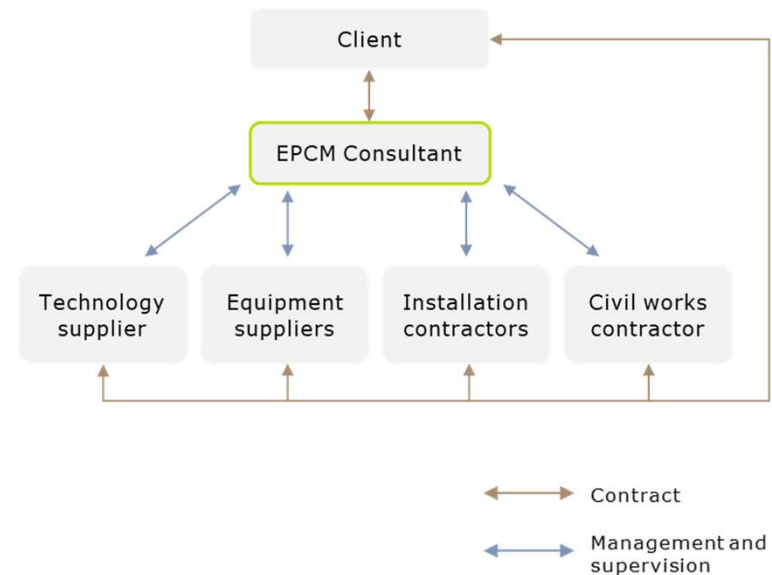
EPCM – Roles and responsibilities

- **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



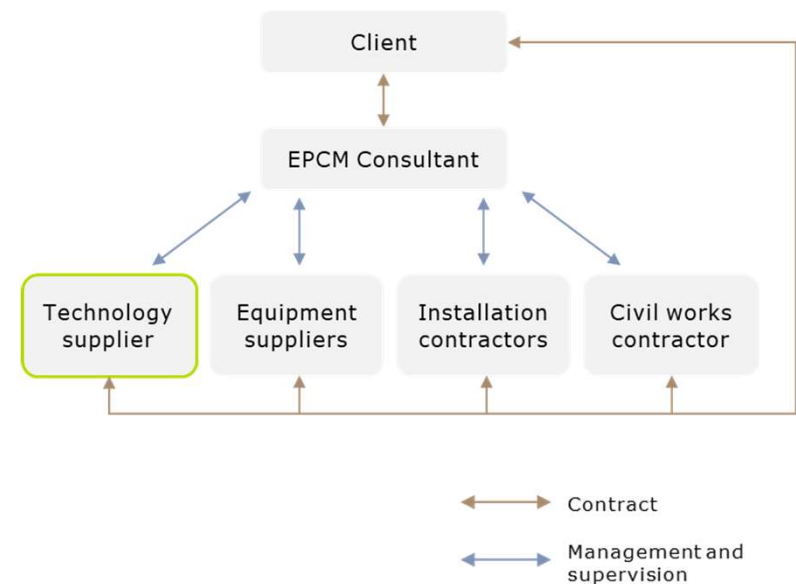
EPCM – Roles and responsibilities

- **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

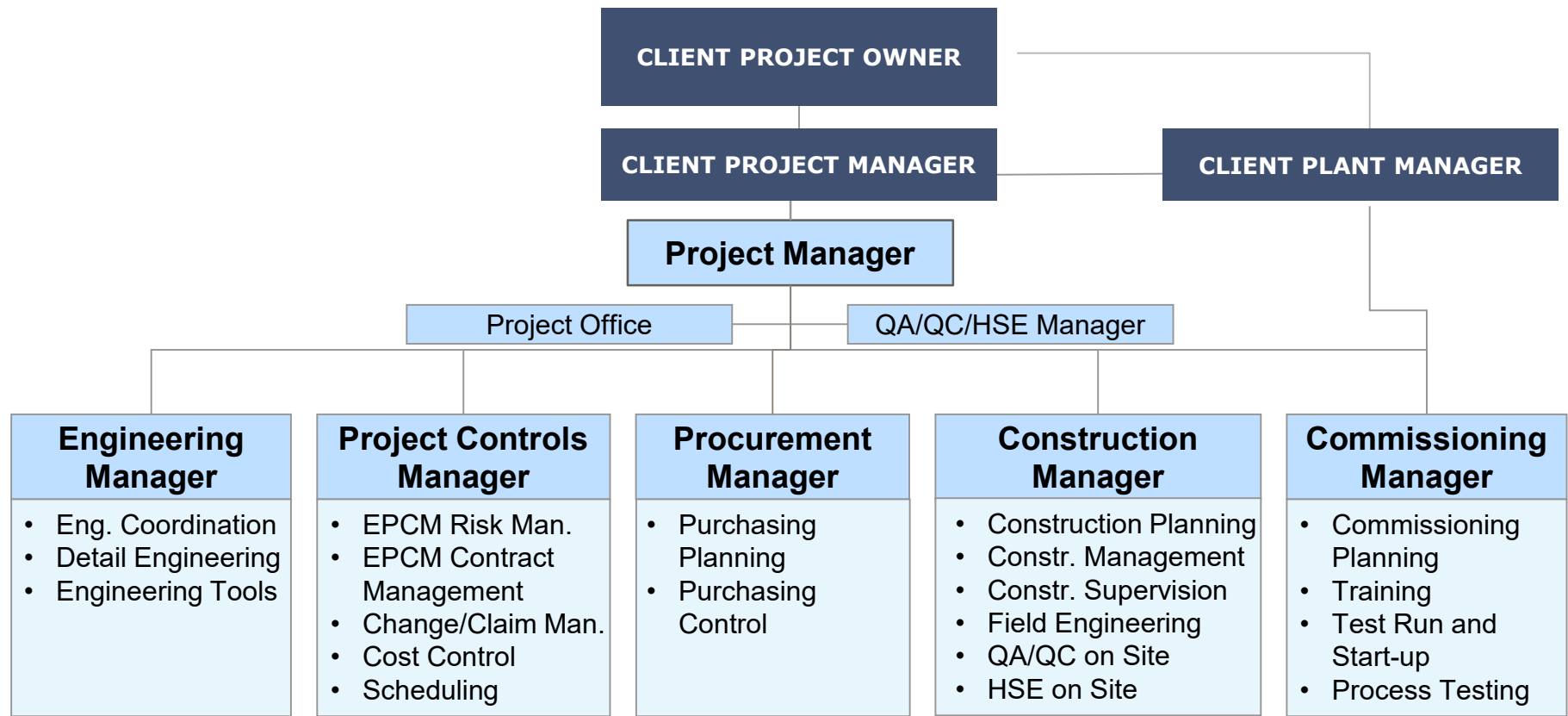


EPCM – Roles and responsibilities

- **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

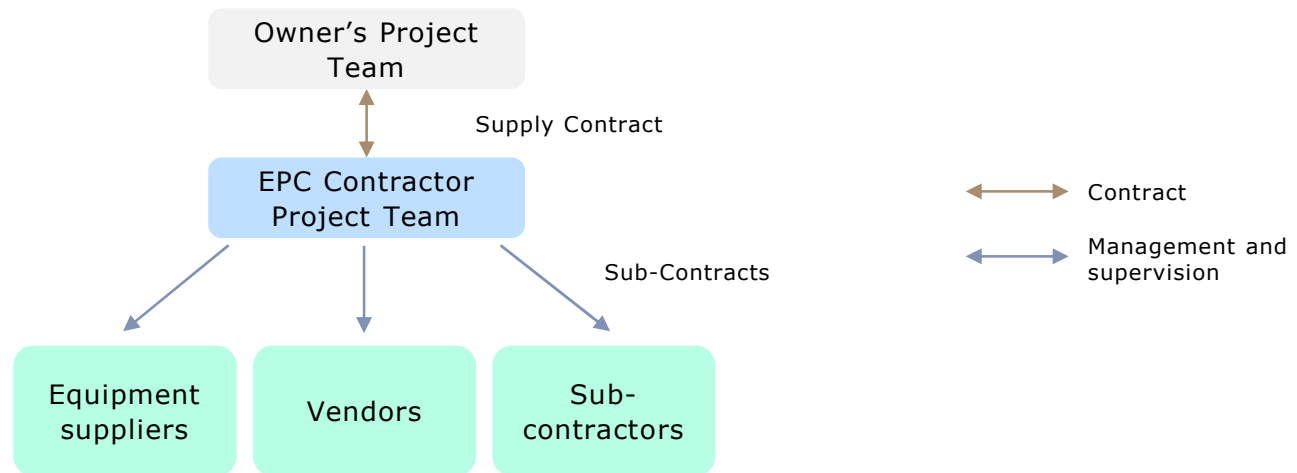


EPCM Project Organisation



EPC – Principle Structure

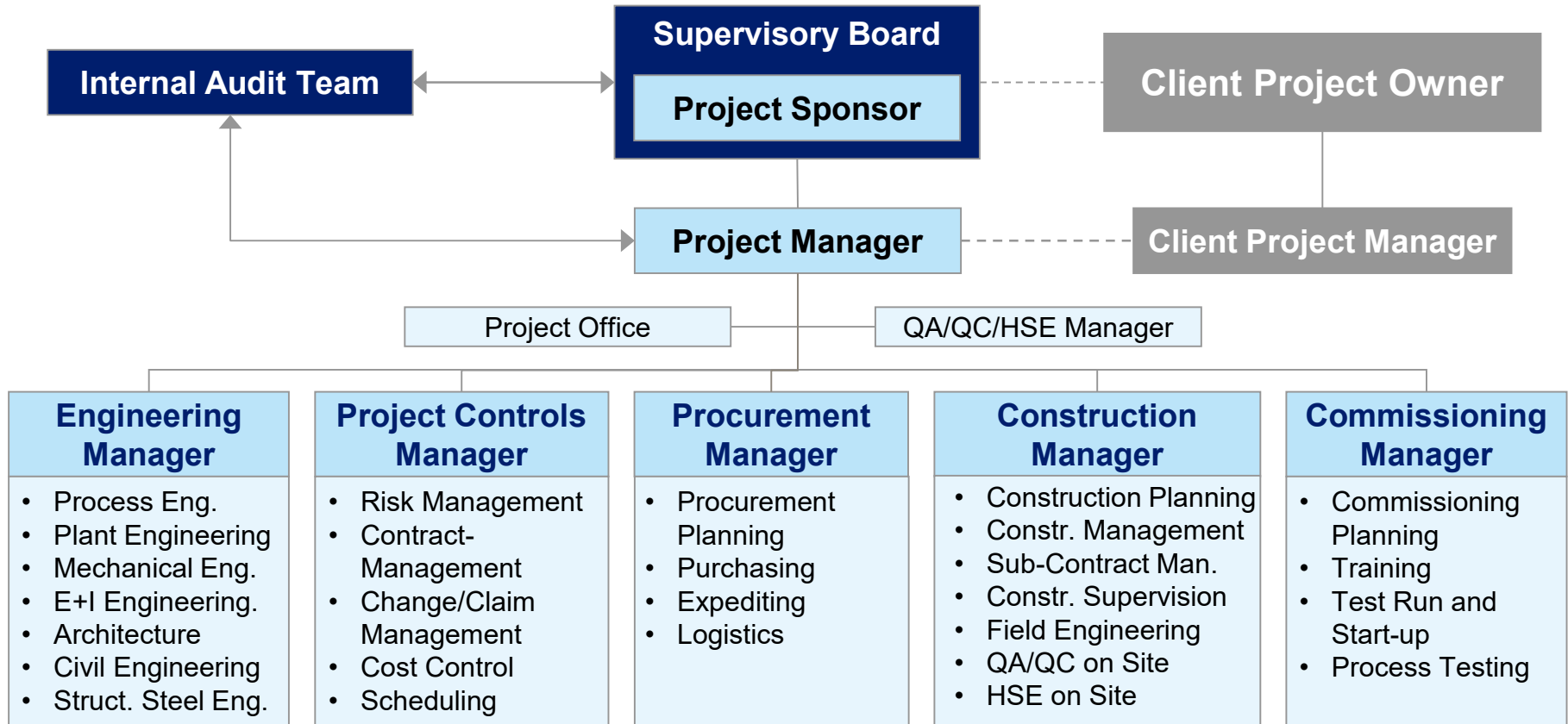
Engineering – Procurement – Construction



EPC – Main Characteristics

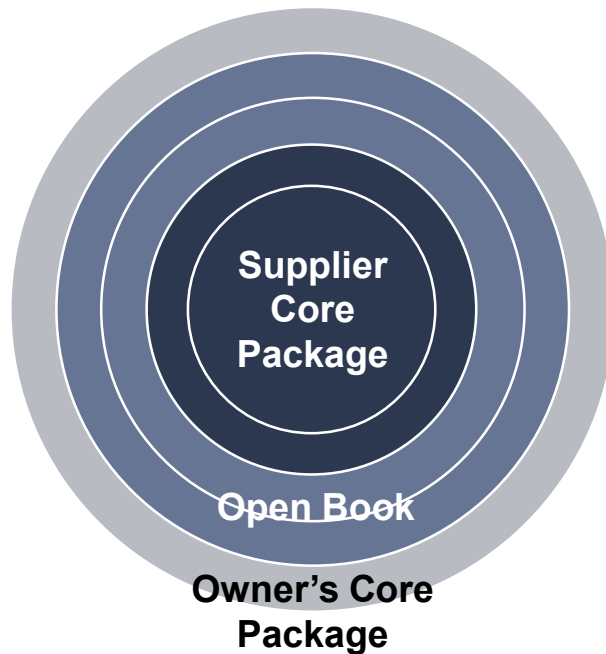
- **EPC-Contractor takes over full responsibility for the project execution through a fixed price contract**
- **All Sub-Contracts in the project are placed by the EPC-Contractor with the resp. supplier/vendor/sub-contractor**
- **Project owner has limited rights to take decisions after signature of 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

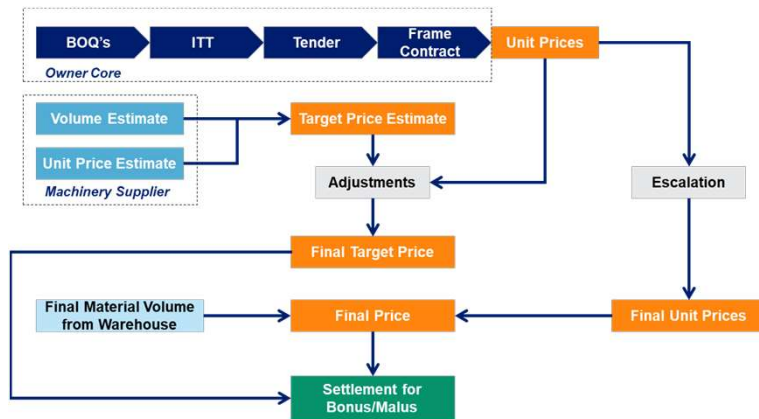


Supplier Core package includes Supplier's core capabilities and profit from core + OB portion (e.g. main process machinery, basic engineering, detailed process engineering, MEI erection supervision for main process machinery and open book items)

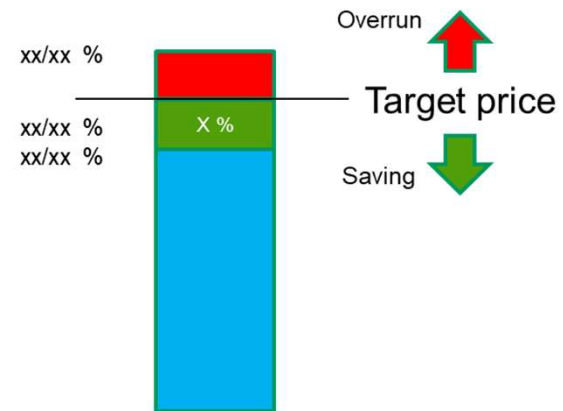
Open Book contains items with shared cost budget and limited risk portion. (e.g. AEI components, tanks and towers, mechanical and piping erection, steel structures)

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

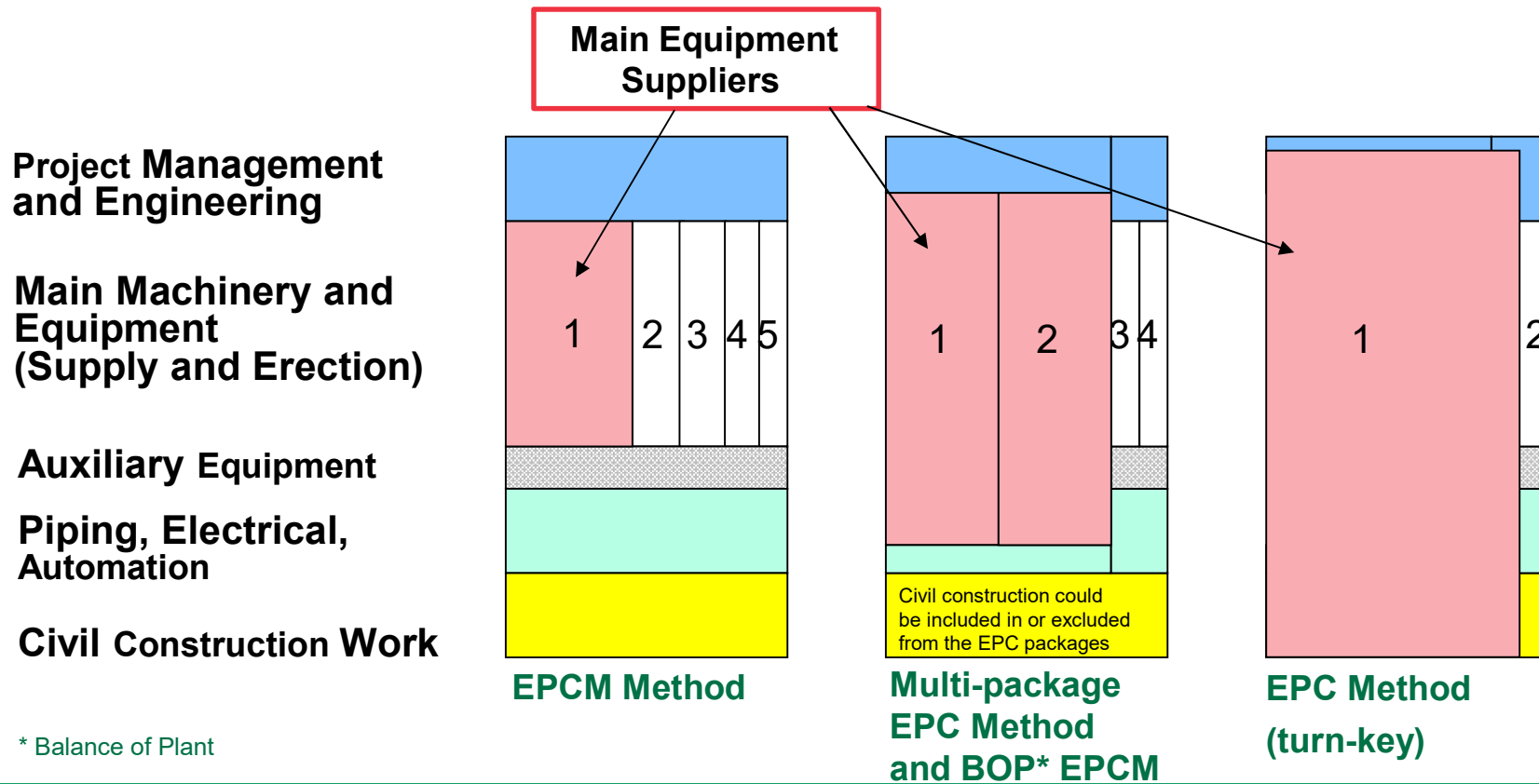
Disadvantages

- 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

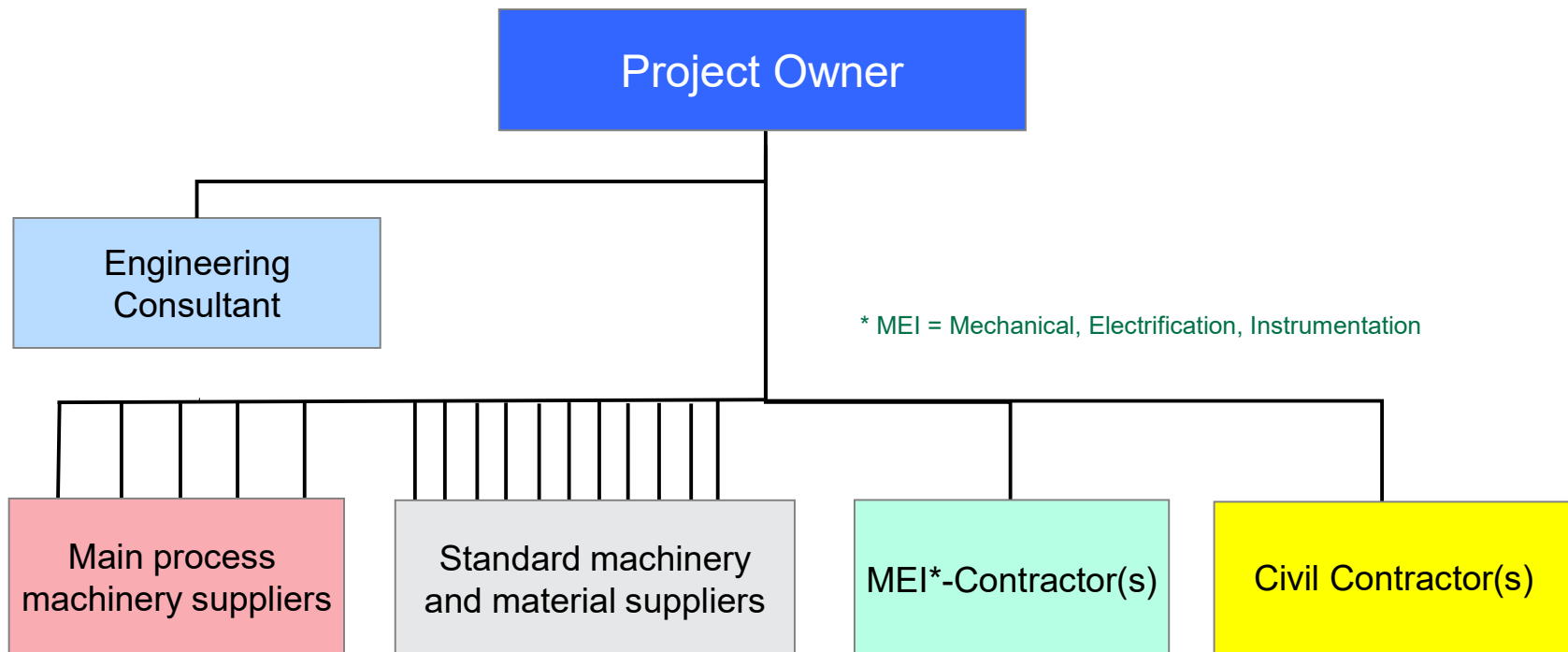
	EPCM	EPC
Need for early decisions	Low	High
Flexibility for modifications	High	Low
Owner's influence possibility	High	Low
Cost budget	Estimate	Fixed lump sum
Financial risk exposure	Medium	Low
Risk provision	Only realized risk	Incl. in contract price
Transparency of cost	High	Low
Overall project risk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

Project Implementation Methods



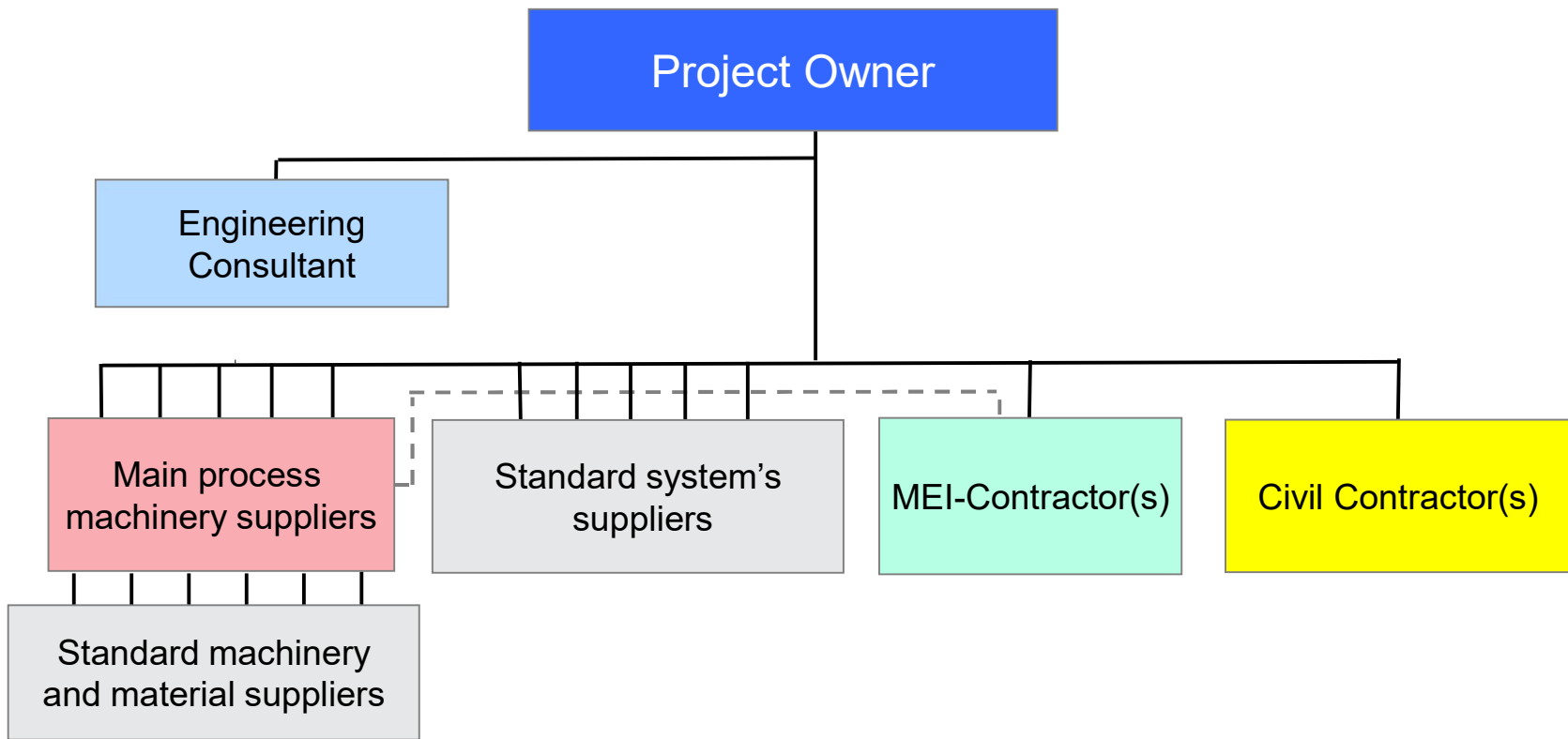
Implementation Methods

EPCM – Engineering, Procurement and Construction Management



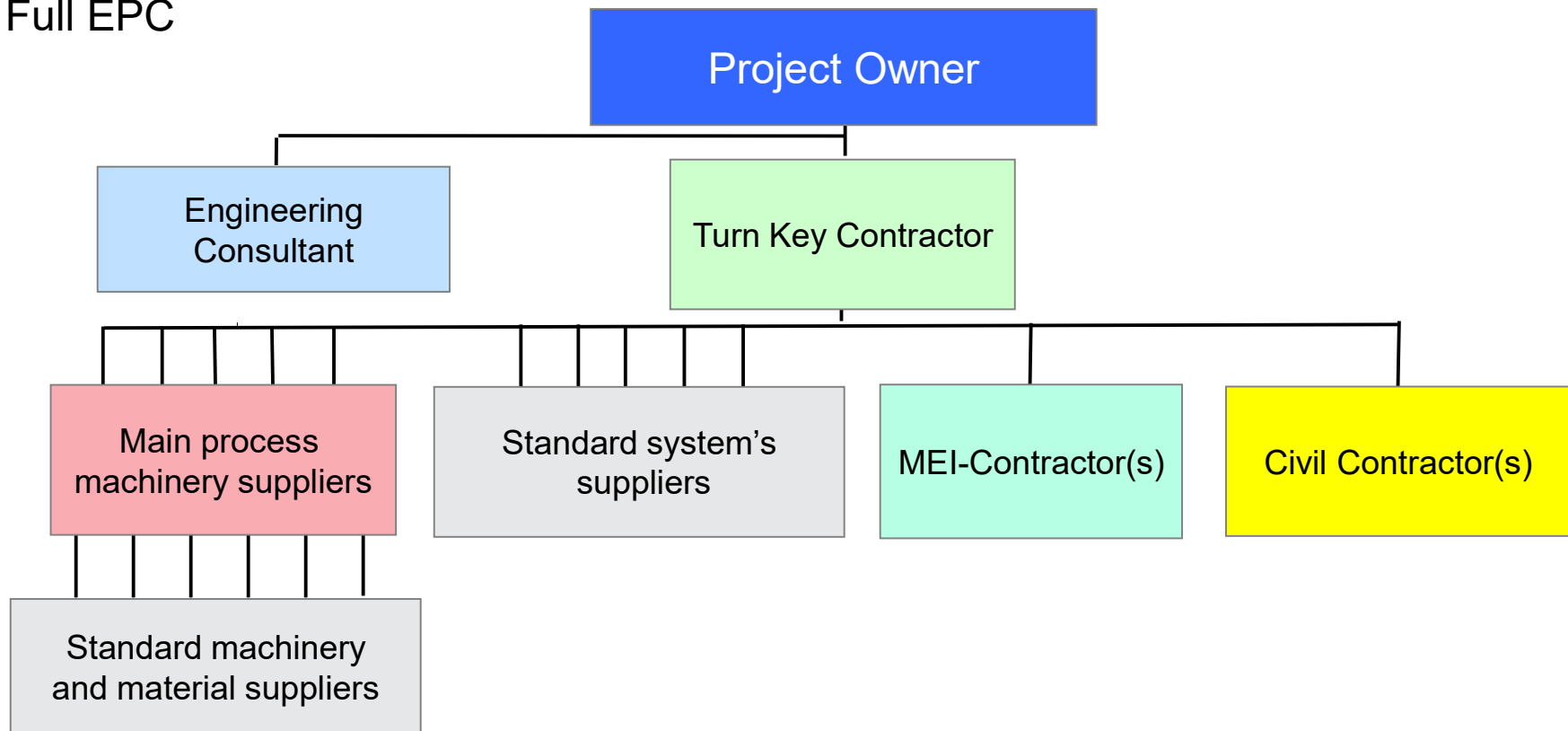
Implementation Methods

Multi-package EPC – Engineering, Procurement, Construction

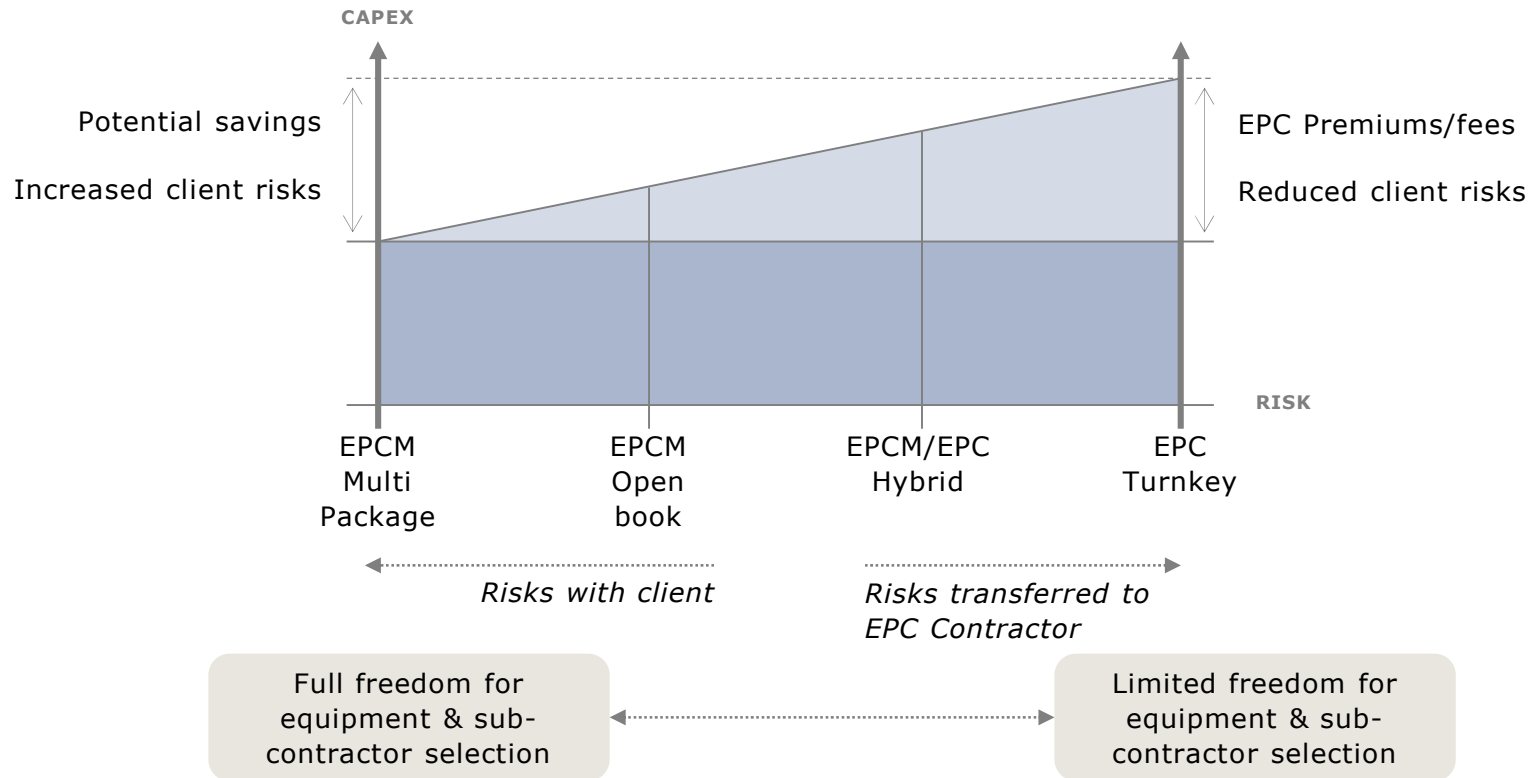


Implementation Methods

Full EPC



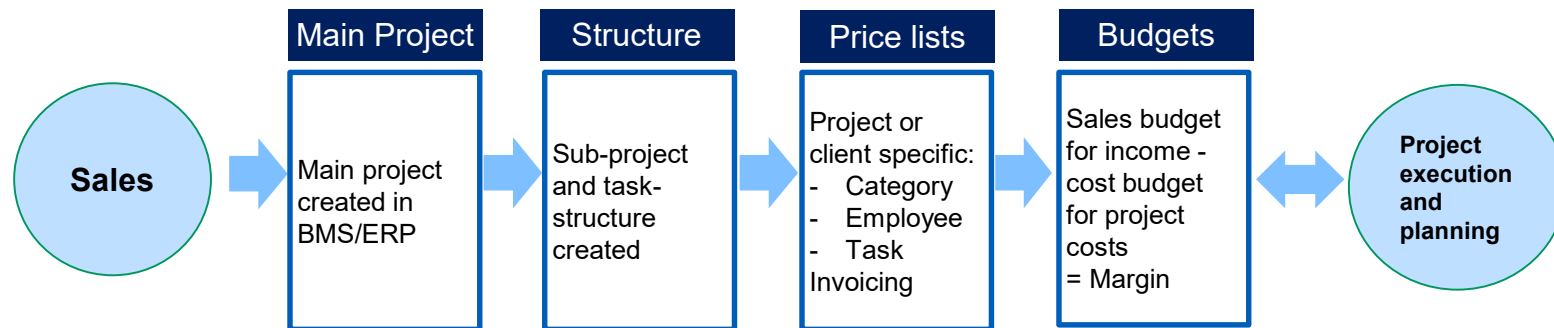
Who carries the risk?



VI. Project Financials: Budgeting and Financials Reporting

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.



BMS = Business Management System
ERP = Enterprise Resource Planning

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!)	<ul style="list-style-type: none">• Read the contract and its appendices carefully
Project budgets up to date	<ul style="list-style-type: none">• Sales budget (Change Orders etc.)• Cost budget / ETC (Estimate to Complete)<ul style="list-style-type: none">○ 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	<ul style="list-style-type: none">• Agree price of the work outside original scope (or if scope is larger than agreed, e.g. increase in quantities) <u>in advance</u> with the client.• Every invoiced hour counts

Financial management in projects - key elements to success

Item	Action
Positive cash flow	<ul style="list-style-type: none">• Front-end-weighted payment terms + advance payments• WIP* = costs in, but invoice not yet sent to client -> minimize WIP (negative WIP is good); active, regular invoicing (*= Work In Progress)• Back-end-weighted payment –terms to sub-consultants• No errors in contents of the sent invoices• Quick collecting of possible overdue sales invoices
Challenge your team & sub-consultants	<ul style="list-style-type: none">• Strict control of used hours and costs<ul style="list-style-type: none">◦ ask for clarifications, give limits
Challenge your client	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Take up problems as soon as you recognize them

VII. Conclusions

Successful Investment Project

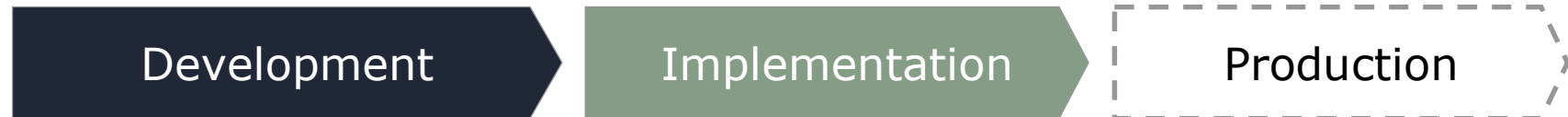


“Plan the work”

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”

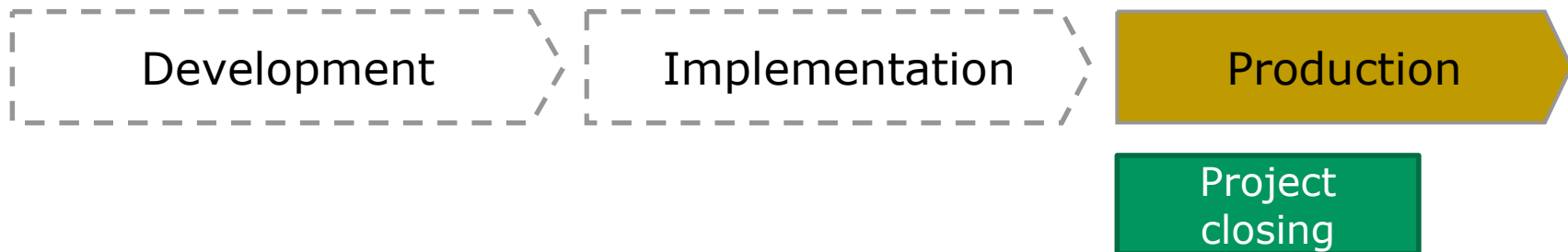
Preconditions

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

“Work the plan”

- 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

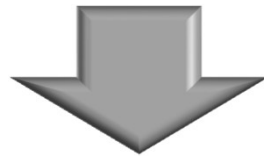
- The plant is completed within schedule
- The plant is completed within budget
- Production starts / develops as planned regarding product quality and quantity
- Product sales begins according to the market preconditions
- Operation & maintenance runs reliably

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

Successful 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
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