Aalto University
School of Chemical
Engineering

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

Lecture 3 – part 2
Project Controls
September 21, 2023
Henni Matikainen & Pasi Gullsten

Agenda

I. Introductions
II. Scope Management
III. Time Schedule Management
IV. Cost Management

Aalto University
School of Chemical
Engineering

I. Introductions

Henni Matikainen

I. Work Experience

- AFRY, Finland: Project Planner, Schedule Management — 05/2022 –
- Neste Finland & Germany: Project Engineer — 03/2019 – 05/2022
  - Scheduling
  - Cost Control
  - Cost Estimation

II. Education

- Master of Science (Tech.), Aalto University, Finland — 03/2017 – 04/2019
  - Fiber and Polymer Engineering
- Bachelor of Science (Tech.), Aalto University, Finland — 09/2013 – 03/2017
  - Bio and Chemical Engineering

Pasi Gullsten

I. Work Experience

- AFRY, Finland: Senior Project Engineer, Cost Management 09/2022 –
- Andritz, Finland & Chile: Project Commercial Manager/Director 10/2018 – 08/2022
- Andritz, Finland & overseas: Project Controller 11/2010 – 02/2019
  - 2017-2019: Project controlling of fiberline global capital projects, based in Finland
  - 2010-2016: Project controlling of large EPC pulp mill projects in Chile, Uruguay and Brazil
- Stora Enso, Spain: Development Engineer, Barcelona Mill 02/2010 – 08/2010

II. Education

- Master of Science (Tech.), Aalto University, Finland 02/2009 – 11/2010
  - Paper technology, Strategy & international business, Industrial management
- Doing Business in Latin America, Universidad Argentina de la Empresa 01/2009 – 05/2009
- Bachelor of Science (Tech.), Helsinki University of Technology, Finland 09/2004 – 02/2009
  - Paper technology, Industrial management
- Study exchange, Universidad Politécnica de Valencia, Spain 09/2005 – 06/2006

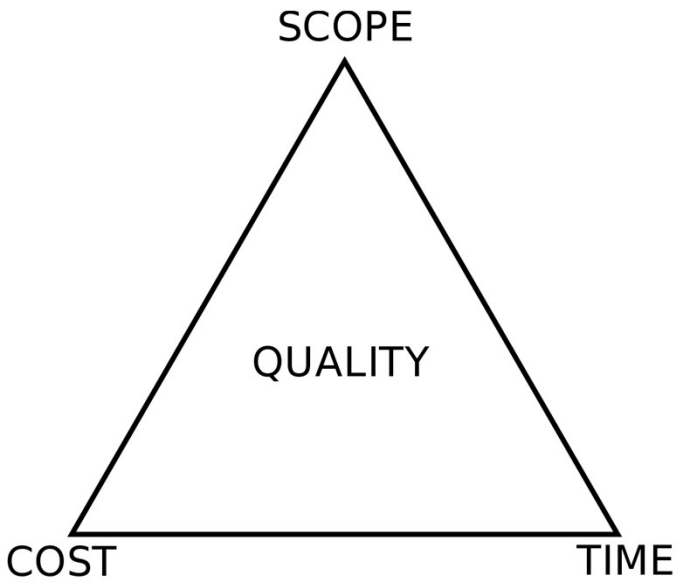
Learning Objectives

I. To understand that it all depends on the Scope

II. To understand the principles related to dynamic scheduling/control with Microsoft Project

III. To understand the importance of Cost estimation and control in projects

Definitions - Project Management Triangle



Scope

Requirements specified to achieve the end result. The overall definition of what the project is supposed to accomplish

Time

Time allocated to a project in order to meet scheduled deliverables and conclude all work by or before the project completion date

Cost

Budget and resources allocated to achieve project end result

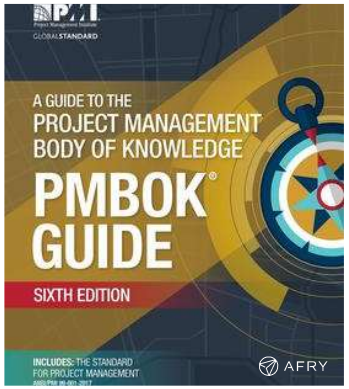
Quality

is the fourth part of the project triangle. It sits at the center, where any change to any side affects it.

Resources

I. **Please read the PMBOK as it is usually the basis of company specific project management guidelines and processes!**

II. AACE International's **Recommended Practices**



II. Scope Management

Project Scope Management?

"Project Scope Management includes the processes required to ensure that the project includes **all the work** required, and **only the work** required, to complete project successfully." – PMI

"**Product scope.** The features and functions that characterize a product, service, or result" – PMI

-> Scope of Supply

"**Project scope.** The work that needs to be accomplished to deliver a product, service, or result." – PMI

-> Activities needed to deliver the Scope of Supply

Project Scope Management Processes

I. **Collect requirements**

II. **Define Scope**

III. **Create Work Breakdown Structure (WBS)**

   i. "Create WBS is the process of subdividing project deliverables and project work into smaller, more manageable components." – PMI

IV. **Define activities**

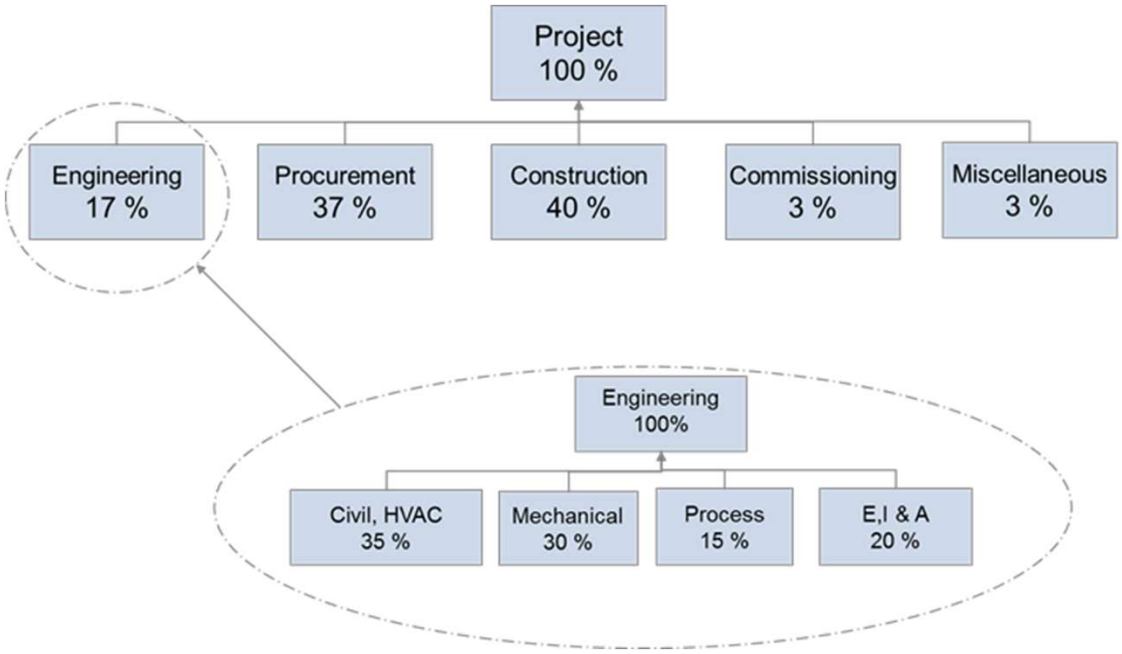
   i. "Define Activities is the process of identifying the specific actions to be performed to produce the project deliverables." – PMI

V. **Verify Scope**

VI. **Control Scope**

Aalto University
School of Chemical
Engineering

Work Breakdown Structure



10 golden rules of successful implementation

1. Be clear and precise when defining scope
2. Avoid words that leave room for interpretation
3. Do not assume, but communicate
4. Be careful with references to the Request for Proposal
5. Separate technical and legal/commercial terms
6. Document Management and Quality
7. Follow up and project change management
8. Scope-Time-Cost status and revision
9. Duty to warn
10. Client satisfaction

III. Time Schedule Management

Aalto University
School of Chemical
Engineering

Aalto University
School of Chemical
Engineering

Case

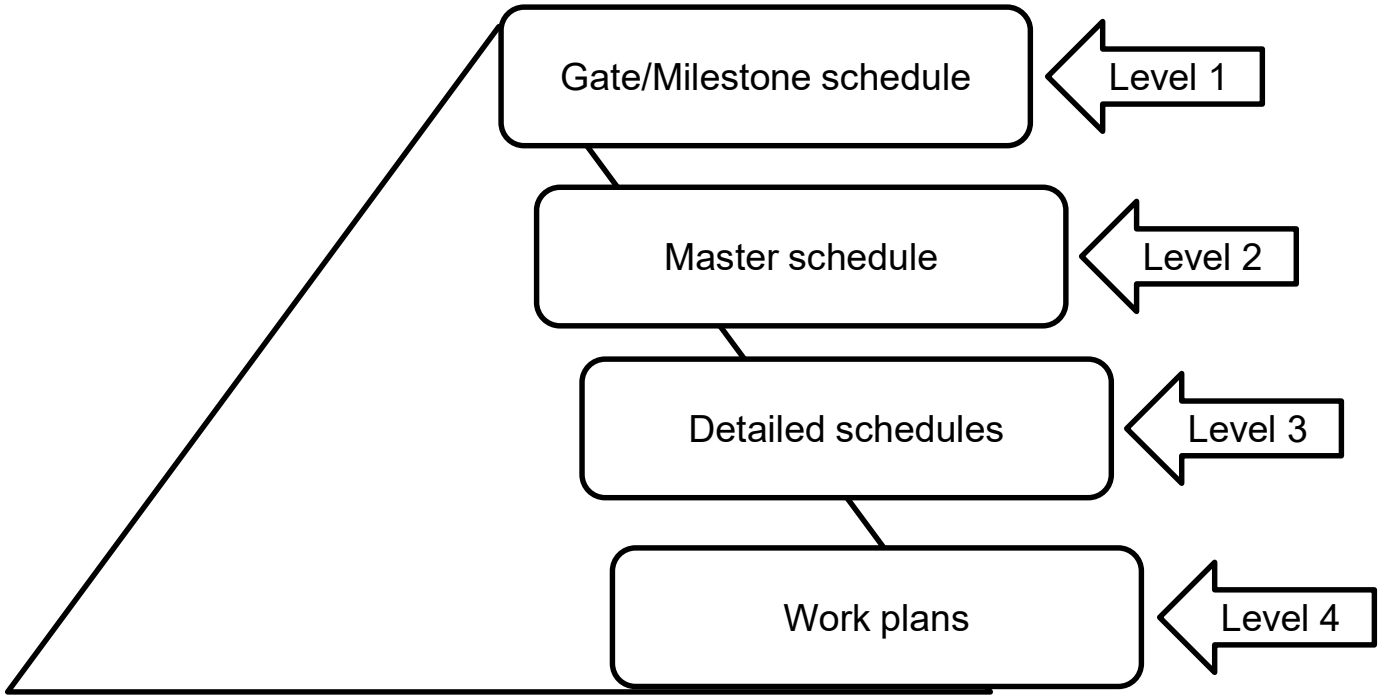
Why scheduling? Is it important?

(Open discussion)

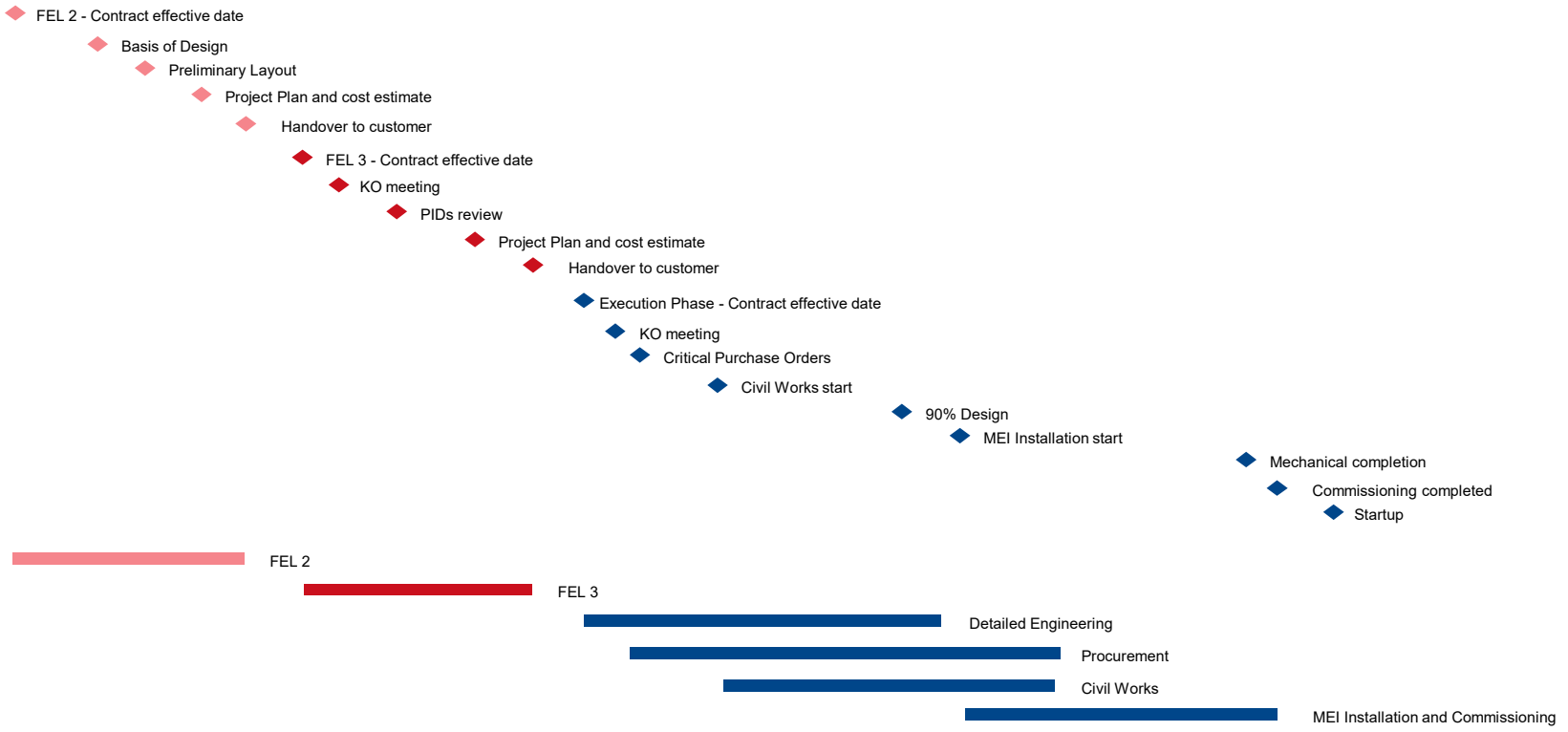
Time Schedule Basics

- Time schedule is an important tool to manage the project, not only for reporting
- Dynamic, complete and detailed schedule makes it easier to control the project
- Focus on the remaining work

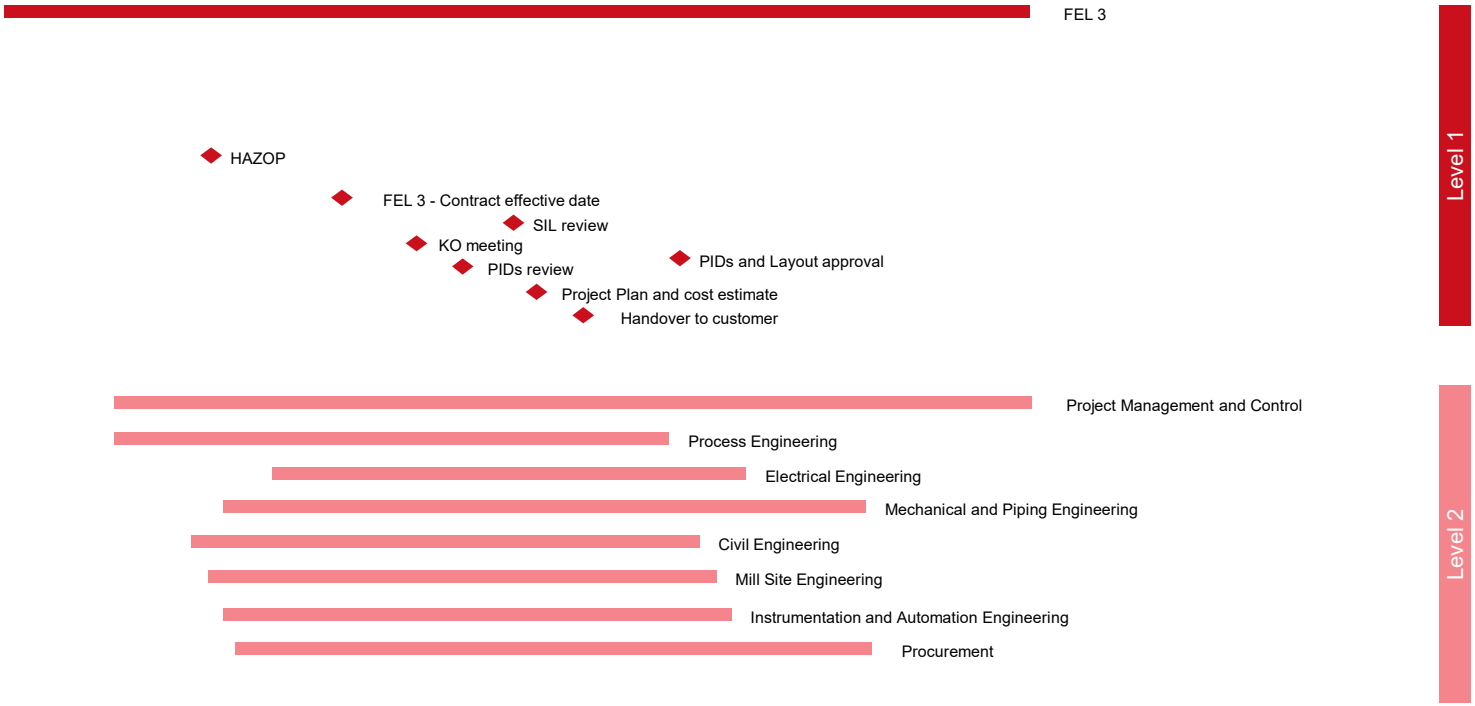
Schedule Hierarchy



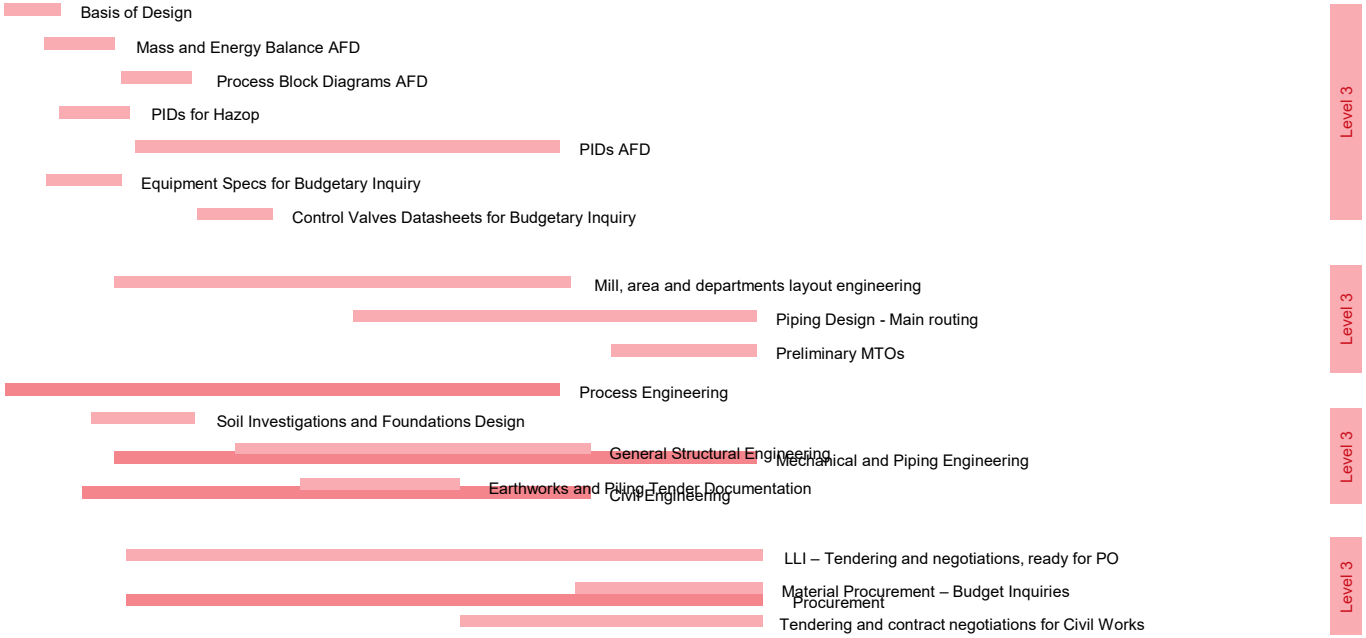
Level 1 schedule – Overall Project Lifecycle



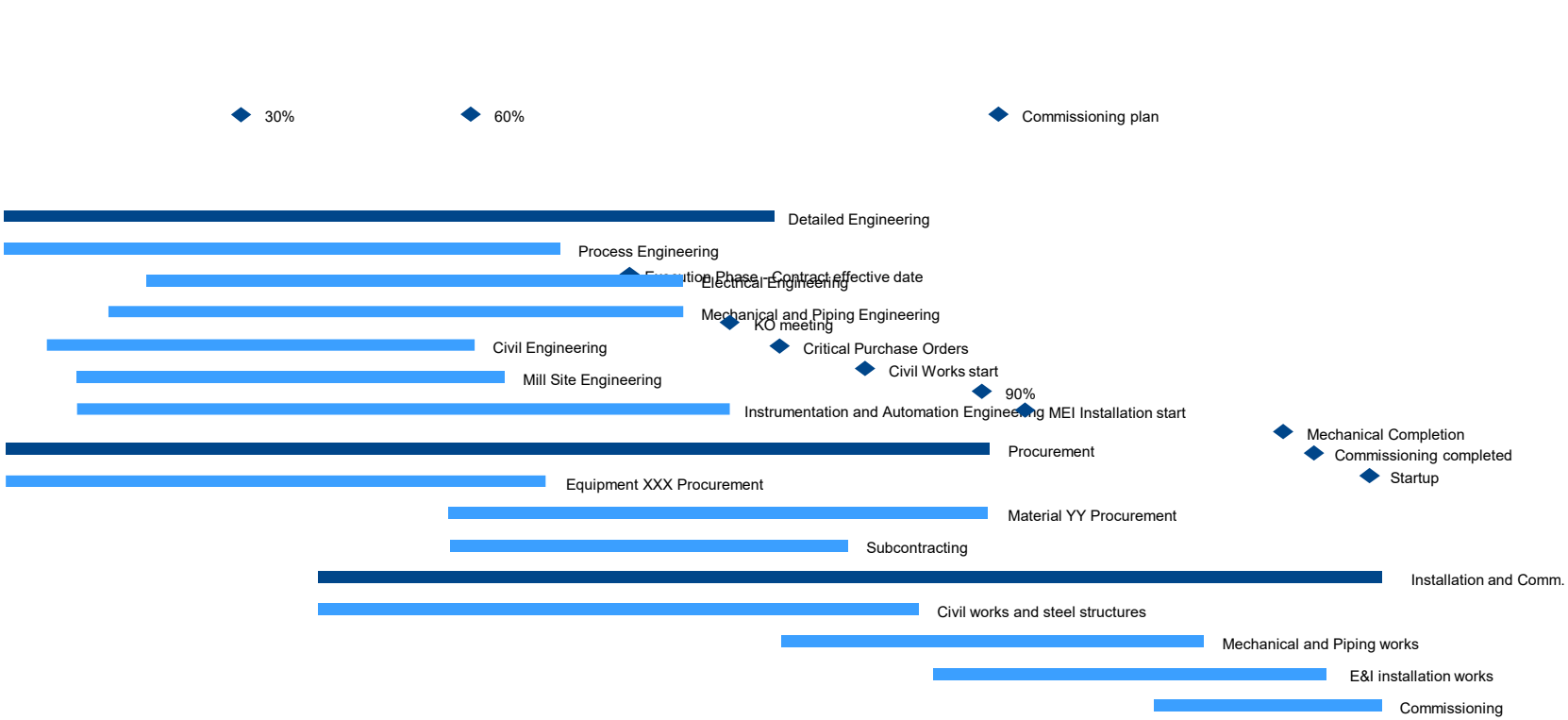
Level 2 schedule – FEL 3



Level 3 schedule – FEL 3



Level 2 schedule – Execution Phase



Schedule Definitions 1/2

Proposal time schedule

- Is prepared as part of the proposal package
- Defines the tasks to be executed during the project (a rough time schedule possibly with hidden dates)

Target time schedule for the whole project

- Is prepared typically as one deliverable of FEL1 and FEL2
- One page time schedule defining the time frame for the entire project including important project milestones, engineering, procurement and construction phases.

Master / area time schedule

- Defines engineering, procurement and construction phases in details for each process area.

Engineering time schedule

- Defines all the deliverables that are included in the scope and timelines for each deliverable. Schedule should be resource loaded with budgeted hours to make the progress follow-up and reporting more precise

Procurement time schedule

- Describes the work flow for engineering as well as procurement activities in the procurement process. Engineering is producing the enquiry specifications but is also dependent on the initial data from purchases/machine suppliers.

Schedule Definitions 2/2

Construction and Installation time schedule

- Time schedule for construction phase including all the civil tasks as well as installation activities. It should be logically linked to be able to follow the work flow at construction site. Could be done also with excel when the amount of details/activities are on hourly level.
- Installation time schedule which includes time schedules from each machine supplier and each contractor.
- The planner is coordinating all interfaces between suppliers.

Commissioning and start-up time schedules

- Detailed schedule for commissioning activities including all water run/commissioning groups defined with equipment, motors, I/O loops etc.

Document delivery schedules

- Is prepared during detailed engineering phase and usually part of the RFQs
- Schedule to be included in machine/equipment supplier's contracts defining delivery dates for documents needed as an initial data for engineering. Usually dates are defined as C+weeks (C=contract date) and format for the document can be excel or word.

Contract control schedules

- Is typically prepared during detailed engineering and is part of the RFQs.
- Schedule to be included in machine supplier's contracts and other contractors defining the dates for delivery, installation start and finish, commissioning dates, take-over and guarantee period. Format for the document can be excel or word.

Scheduling Process

i. **Activity definition**
   - Scope (contract), PM maturity, organizational process capabilities, work breakdown structure

ii. **Activity sequencing**
   - Identify and document relationships between activities (all dependencies, no open ends)

iii. **Activity resource estimation**
   - Type and quantities of material, people, equipment, etc. to perform the activity

iv. **Activity duration estimation**
   - Duration x Units = Work (not applicable for all tasks e.g. shipments)

v. **Schedule development**
   - Analyze activity sequences, durations, resource requirements and constraints to create the project schedule

vi. **Schedule control**
   - Measure project progress to update the schedule and manage changes to the baseline

Schedule Control - Process

Reports typically include:

- Summary Follow-up Schedules (Planned vs Actual Progress)
- Summary S-curves & Histograms
- Project Highlights & Concerns

AFRY is normally using standard S-curves report templates.

The input consists of:

- Engineering progress from lead engineer
- Construction progress from construction management (input from contractors)
- Procurement services progress from procurement team
- Vendor progress from Expediting team

Progress data updated into the master schedule:

- Physical progress
- Actual start & finish dates
- Estimated start and finish dates and/or remaining duration

While working on forecast:

- Focus on the activities on the critical path
- Use earned value principles (manhours, quantities, costs)
- Remaining duration and/or forecast finish dates typically estimated by leads/vendors/contractors

During reviews:

- Project planner challenges discipline leads on forecasted dates and estimated duration based on productivity and benchmarking
- Notify Project Management & all project team of possible delays and schedule risks!!

Dynamic Scheduling and Control with Microsoft Project

Dynamic scheduling means the following:

i. **Only one task does not have a predecessor (task that starts the project)**

ii. **Only one task does not have a successor (task that ends the project)**

iii. **Links or dependencies should be carefully selected so that you don't break the dynamism**

Dynamic scheduling should be one thing that separates Microsoft Excel "schedules" from Microsoft Project "schedules"

Aalto University
School of Chemical
Engineering

Case

Discussion around the potential implications of the failed Wärtsilä engine delivery to the project schedule?

(Open discussion)


THAT'S IT.
BY THE WAY, NO TIME
SCHEDULE IMPACT
AFTER ALL.

IV. Cost Management

Aalto University
School of Chemical
Engineering

Cost Management Basics

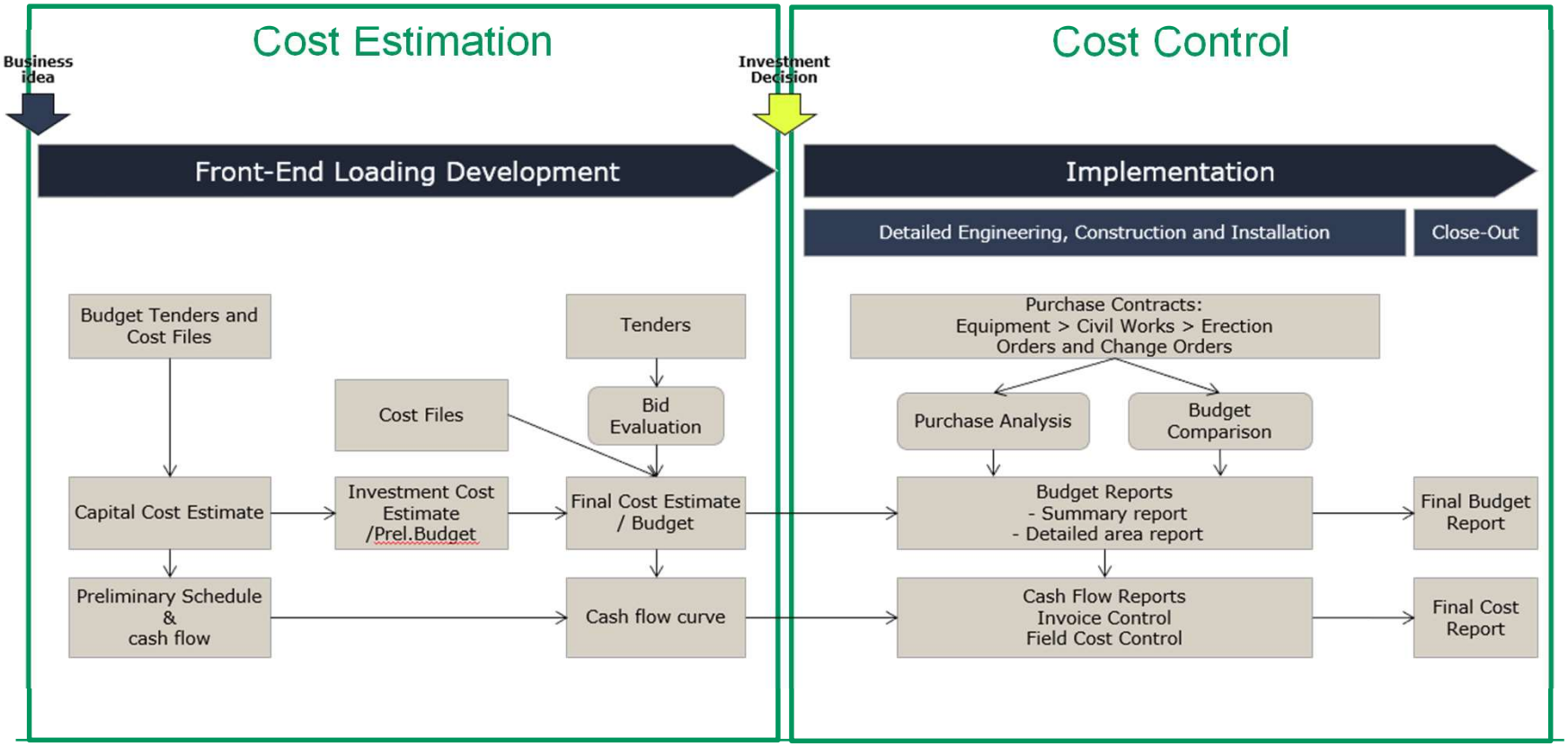
“Estimating, budgeting and controlling costs so that the project can be completed within the approved budget.” – PMI

I. **Estimating: In order to estimate costs you need scope, time schedule, resource plan, contingency information, cost information about each activity and**

II. **Budgeting: Cost aggregation + expert judgement (technical experts, historical experience, etc.)**

III. **Cost control tools and techniques include: project team forecast compared to sales forecast, earned value management, performance reviews**

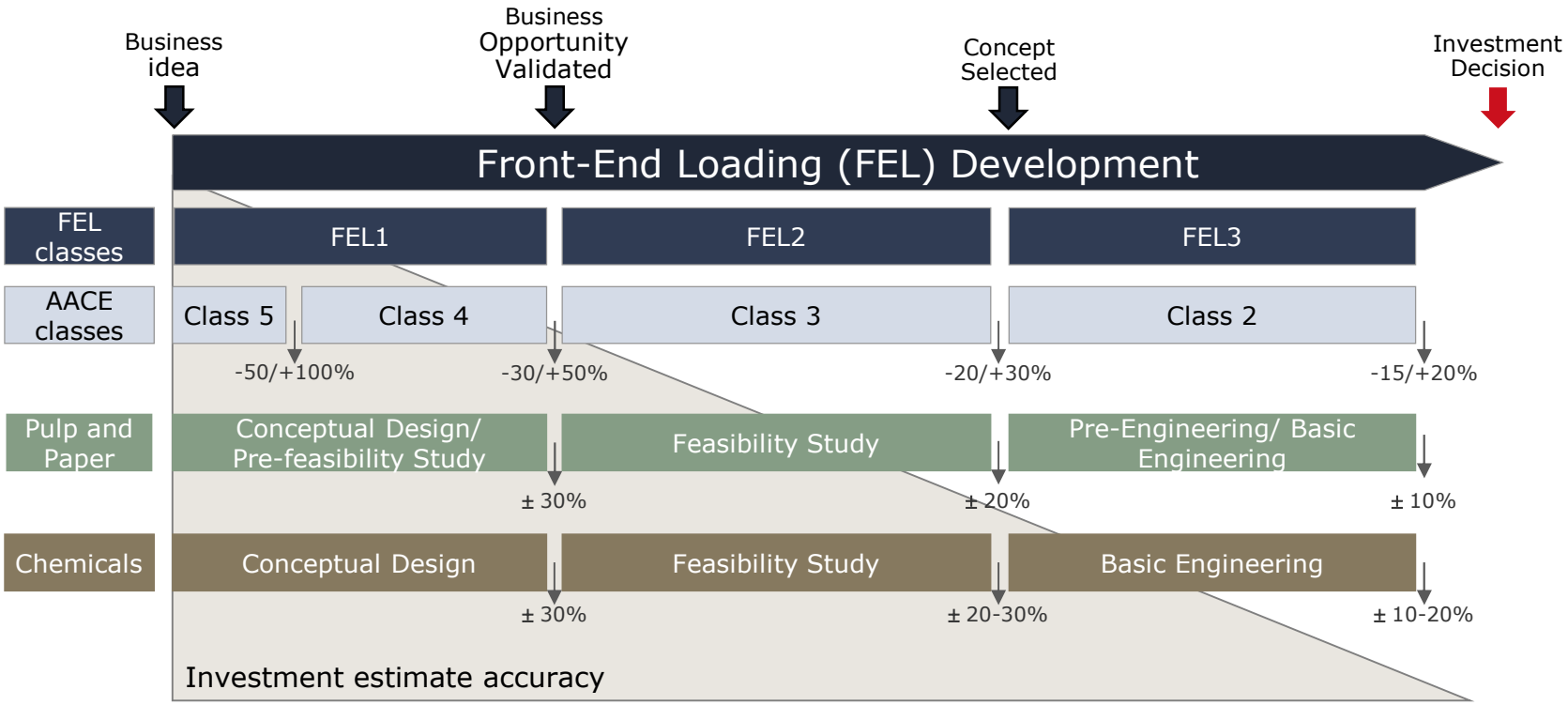
Cost Management vs project life cycle



Investment Cost Estimate

- Investment cost estimate is one of the key deliverables what customers require to have in many projects
- The customer wants to know the total investment cost of the project before committing to the investment
- Cost estimate accuracy expectations are based on the project phase.

Project life cycle



CAPEX Estimation - Example

Customer
Project Name
Additional Description

Cost estimate
Summary
- 1 000 EUR -

Code	Cost Area	0 Indirect Costs	1 Civil Works	2 Machinery	3 Tanks & Towers	4 Piping	5 Electrification	6 Process Control	7 HVAC	8 Insulation	9 Spare Parts	0-9 Total
10	Area 1											
20	Area 2											
30	Area 3											
90	Plant Common											
	Direct Costs, Total											
00	Indirect Costs:											
01	Temporary Facilities and Services											
02	Engineering											
03	Project and Construction Management											
04	Commissioning and Start-up											
	Base Estimate, Total											
	Breakdown, excluding contingency (%)											
	Contingencies, XX %											
	TOTAL											

CAPEX Estimation - Example

20			Process Area 2				- 1 000 EUR -				
Account No.		Item No.	Specification	Qty	Unit	Source	Unit Price	Material	Freight	Installation	TOTAL
20	2		**Machinery**								
20	2	1	Main machinery								
			According to XX quotation ABC12345-678 Date: XXX YY, 202X Delivery term: XXX Quoted price:								
			Scope: - ... - ...								
			Options: - ... - ...								
			Exclusions: - ... - ...								
			Auxiliary equipment								
20	2	2	Pumps - ... - ...								
20	2	3	Heat exchangers - ... - ...								
20	2	4	Agitators - ... - ...								
20	2	5	Others - ... - ...								
20	2		Machinery - Total								

Cost Control – Example: Länsimetro

Original budget (2008)	714 million €
Index correction (= 19%)	135 million €
Corrected budget	849 million €
Final costs without changes (= corrected budget + 9%)	933 million €
Final costs with scope changes (= corrected budget + 40%) (= original budget + 66%)	1186 million €

Toteutettu metro on enemmän kuin hankesuunnitelmassa määritelty

Mikäli länsimetron ensimmäinen vaihe olisi toteutettu vain hankesuunnitelman mukaisessa laajuudessa, kustannukset olisivat olleet arviolta 933 miljoonaa euroa ja kustannusylitys kaikkiaan alle 10 prosenttia suhteessa indeksikorjattuun hankesuunnitelmaan. Arvioituna suhteessa hankesuunnitelman mukaiseen laajuuteen ja riskivaraus huomioiden, länsimetron kustannukset eivät poikkea merkittävästi suunnitellusta.

Rakentamisen aikana Länsimetron ykkösvaiheessa toteutettavien töiden laajuus muuttui paljon hankesuunnitelmassa määritellystä. Näillä muutoksilla metroa parannettiin ja sitä sovitettiin paremmin muuttuvaan kaupunkirakenteeseen, mutta muutokset myös vaikuttivat hankkeen kokonaiskustannuksiin. Ruoholahti-Matinkylä -osuuden kokonaiskustannusennuste on 1 186 miljoonaa euroa, ennusteeseen sisältyvät vielä toteutettavat aseman ympäristön hankkeet esimerkiksi Matinkylässä.

Hankkeen rakentamisen indeksikorjattu budjetti alkuperäisen hankesuunnitelman (2008) mukaiselle laajuudelle on 849 miljoonaa euroa (hankesuunnitelma 714 miljoonaa euroa + indeksikorjaus 135 miljoonaa euroa).

[…] https://www.lansimetro.fi/tietoa-hankkeesta/historia/nain-ykkosvaihe-rakentui/

Aalto University
School of Chemical
Engineering

Case

What reasons are there for budget overruns?

(Open discussion)

Budget overruns – some reasons

- Inaccurate Project Estimates (Cost, Time, Resource)
- Market situation (Uncertainties, Raw material prices, Inflation)
- Design mistakes
- Not Anticipating Change Orders/Scope Challenges
- Poor Site Management (Quality, Labour, Duration, Progress)
- Project Uncertainties (Unplanned costs etc)
- Inexperience of the Cost Estimator
- Lack of data or quality of the data at the time of the cost estimation (tendering, cost data)

In a Nutshell

Aalto University
School of Chemical
Engineering

Successful Investment Project – Project Controls

Development → Implementation → Production

"Plan the work"

- **Clearly defined and structured scope**
- **Reliable investment cost estimate**
- **Realistic dynamic time schedules**

Successful Investment Project – Project Controls

"Plan the work"

- **Clearly defined scope**
- **Reliable investment cost estimate**
- **Realistic dynamic time schedules**

"Work the plan"

- **Proper Scope and Change Management**
- **Continuous and meticulous cost control and estimate at completion**
- **Continuous control of the work vs. plan, realistic estimations of remaining durations**
- **Risk Management**

Successful Investment Project – Project Controls

Criteria

- **Production starts / develops as planned regarding product quality and quantity**
- **The plant is completed within schedule**
- **The plant is completed within budget**

Aalto University
School of Chemical
Engineering

AFRY
ÅF PÖYRY

Thank you!

Henni Matikainen & Pasi Gullsten
AFRY Finland Oy
henni.matikainen@afry.com
pasi.gullsten@afry.com
www.afry.fi