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Aalto University
School of Chemical
Engineering

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

*Lecture 6
Workshop 1
October 12, 2023*

IV. Cost Management

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**

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.**

CAPEX Estimation - Example (EPCM)

Customer
Project Name
Additional Description

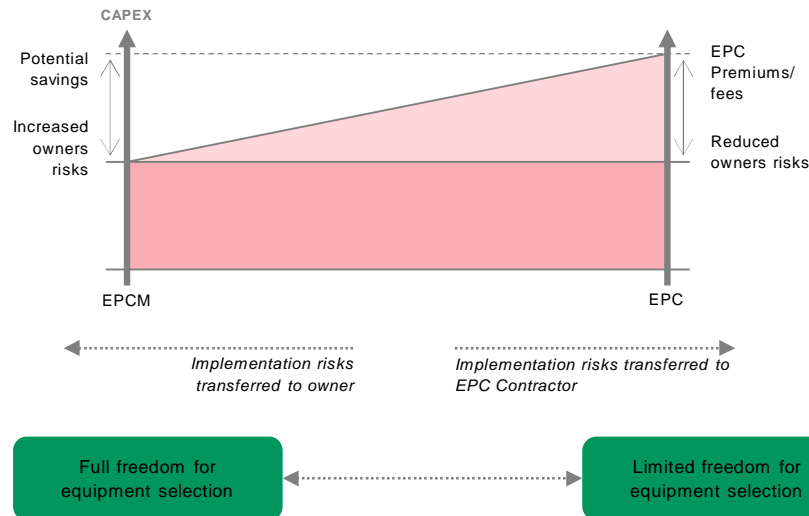
Cost estimate
 Summary
 - 1 000 EUR -

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											
<hr/>												
	Direct Costs, Total											
00	Indirect Costs:											
01	Temporary Facilities and Services											
02	Engineering											
03	Project and Construction Management											
04	Commissioning and Start-up											
<hr/>												
	Base Estimate, Total											
	Breakdown, excluding contingency (%)											
	Contingencies, XX %											
	TOTAL											<hr/> <hr/>

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								
		<u>Main machinery</u>								
		According to XX quotation ABC12345-678								
		Date: XXX YY, 202X								
		Delivery term: XXX								
		Quoted price:								
		Scope:								
		- ...								
		- ...								
		Options:								
		- ...								
		- ...								
		Exclusions:								
		- ...								
		- ...								
		<u>Auxiliary equipment</u>								
20	2	2								
		Pumps								
		- ...								
		- ...								
20	2	3								
		Heat exchangers								
		- ...								
		- ...								
20	2	4								
		Agitators								
		- ...								
		- ...								
20	2	5								
		Others								
		- ...								
		- ...								
20	2									
		Machinery - Total								

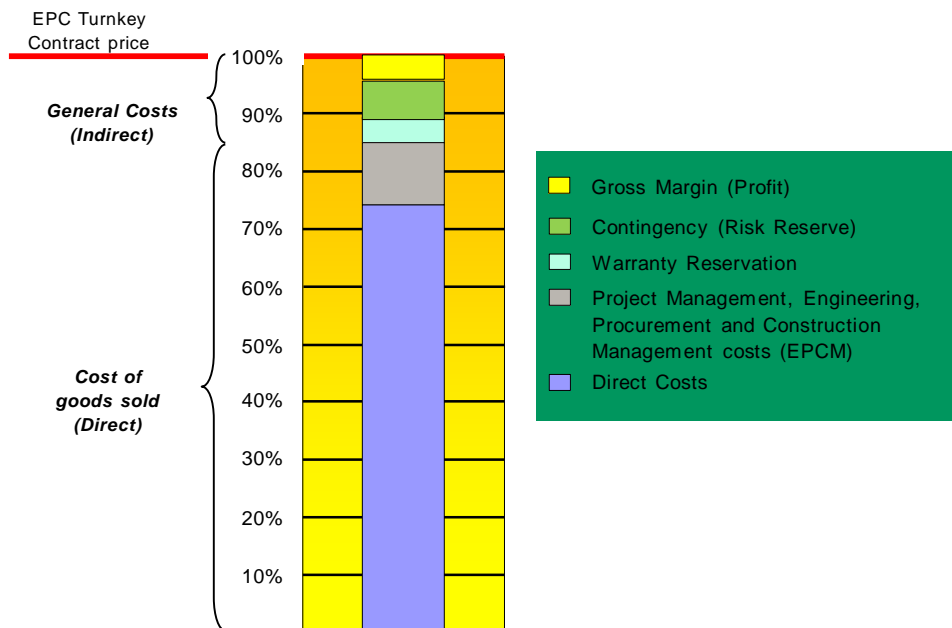
CAPEX Estimation for EPC Project



EPCM – Split of scope into Few or Multiple Packages. EPCM consultant manages technical system integration & engineering and overall project management. Owner has full freedom on equipment selection but takes full project implementation risks. The higher the no. of packages the more risk assumed by the owner.

EPC Turnkey – single contractor/point of responsibility. Implementation risks included in contract and covered by liquidated damages and warranties.

CAPEX Estimation – EPC Turnkey Price

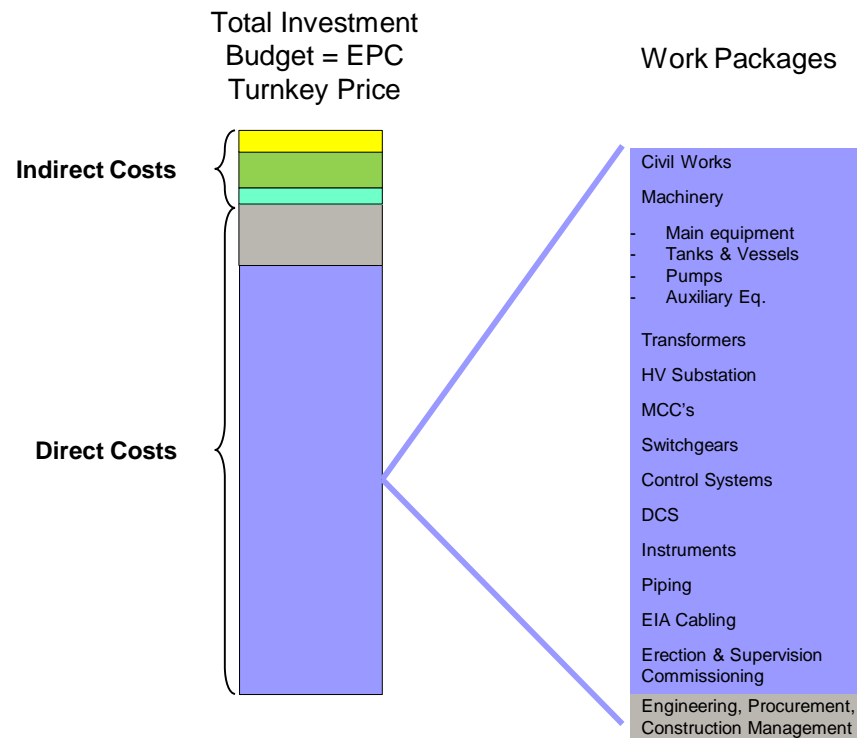


EPC Turnkey approach

- **‘EPC Direct Costs’ portion; Cost of Goods sold:**
 - All direct costs (equipment, civil, piping, electrical, automation and erection, etc.); line-item target execution costs
 - ‘EPCM’ cost, Engineering, Procurement, Construction Management + Project Management - project specifically defined

- **‘EPC Indirect Costs’ portion; General costs:**
 - Warranty reservation - % of the direct costs
 - Contingency - Contractor’s risk allowance - % of the direct costs
 - Gross Margin; contractor’s profit - % of the direct costs

CAPEX Estimation – EPC Turnkey Price



CAPEX Estimation – Resources

- **Cost Estimation tools:**
 - Aspen Capital Cost estimator (Aspentech)
 - <https://www.youtube.com/watch?v=W6LzN5MFSxY>
 - <http://www.mhhe.com/engcs/chemical/peters/data/> (older data)
 - <https://www.matche.com/equipcost/Tank.html> (older data from 2014, remember to index)'
- **Literature for Capital Cost Estimation**
 - Perry's Chemical Engineers' Handbook, 9th Edition
 - Plant Design and Economics for Chemical Engineers, 5th Edition
- **Key word search**
 - CAPEX Estimation
 - Capital cost estimation
 - Lang Method

TABLE 9-53 Estimate Using Factors from Table 9-51

Details (solids-fluid, grass-roots plant)	Factor assumed	Cost, \$	Percentage of total
Equipment, delivered	1.00	1,000,000	23.4
Installed	0.41	410,000	9.6
Piping	0.34	340,000	8.0
Electrical	0.13	130,000	3.0
Instruments	0.13	130,000	3.0
Battery-limit building and service	0.30	300,000	7.0
Excavation and site preparation	0.15	150,000	3.5
Auxiliaries	0.52	520,000	12.2
Total physical plant	2.98	2,980,000	69.7
Field expense	0.39	390,000	9.1
Engineering	0.39	390,000	9.1
Direct plant costs	3.76	3,760,000	87.9
Contractor's fees, overhead, profit	0.13	130,000	3.0
Contingency	0.39	390,000	9.1
Total fixed-capital investment	4.28	4,280,000	100.0



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Thank you!

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