Capital Cost Estimation

(TBWS, 2nd Ed., Chapter 5)

What is *capital*?

Upfront money (cash)

that is *invested* in the plant

prior to receiving product revenues.

In the context of chemical process design.

Capital Projects

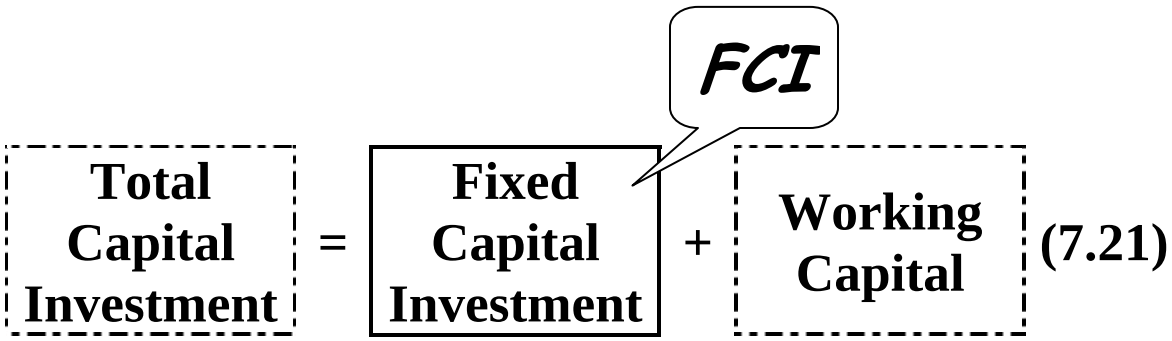
Projects to invest capital on equipment, buildings, roads, etc.

Involves formulation, budgeting, and implementation.

Project Engineers

Engineers who work on capital projects.

How is capital calculated?



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Fixed Capital Investment - *FCI*

Upfront money (cash)
to pay costs for
building (or modifying) the plant
before production starts.

Examples

Equipment, piping, valves

Instruments and computers

Tanks and utilities

Structures, buildings, internal roads, parking lot

Design of facility

Construction and installation

Land

Working Capital

Upfront money (cash)

to pay costs for

startup of the plant and

first few months of operation

before product revenues start.

Examples

Initial stock of raw materials

Initial salaries

Startup costs

How is *FCI* determined?

Cost *accountants* add up all the individual expenditures from the capital project.

***Post*-spending analysis**

What we really want is a

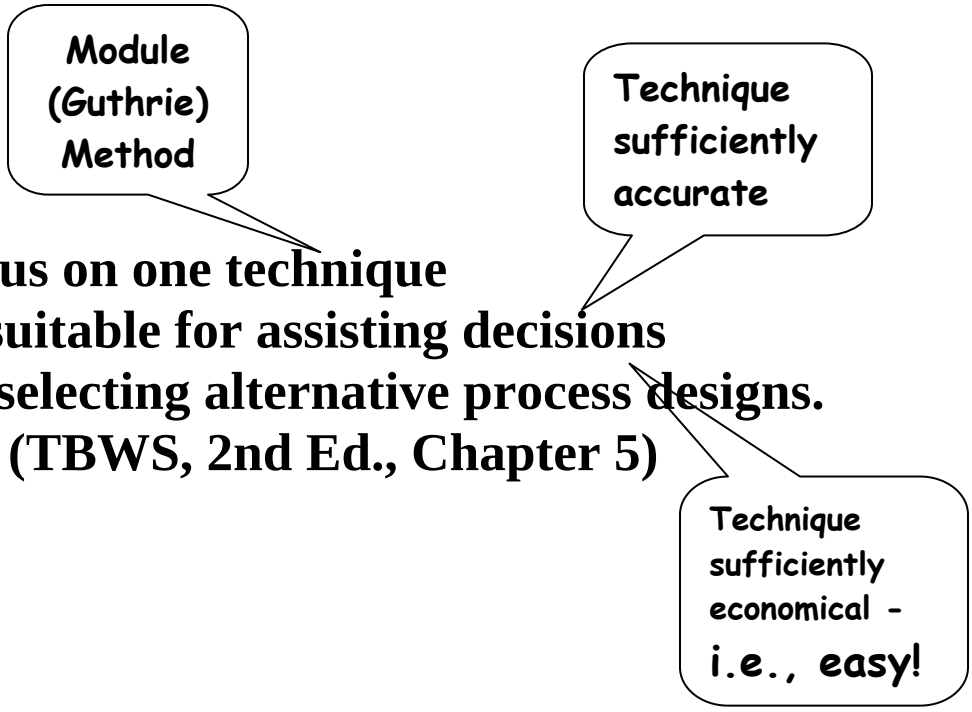
***Pre*-spending analysis**

Assist the process design.

How is *FCI* estimated?

Subject of many books.

There are many estimation approaches.



We shall focus on one technique
that is suitable for assisting decisions
on selecting alternative process designs.
(TBWS, 2nd Ed., Chapter 5)

We shall also briefly comment on:
Reliability of cost estimates
Cost of cost estimates

FCI Estimation - Two Parts

Part 1
Purchasing major pieces of equipment

Towers
Pressure Vessels
Heat Exchangers
Fired Heaters
Pumps
Compressors
Fans
Drives
Turbines
Storage Tanks

Gross Error

Failure to recognize the need for a major piece of equipment.

Part 2

Purchasing everything else!

Piping
Insulation
Foundations
Structures
Instrumentation
Computers
Electrical
Painting

Labor to install all of above

Shipping costs of above to site

Fringe benefits for construction workers
Social security for construction workers
Supervisors for workers (salaries & overhead)
Engineers (salaries and overhead)
Engineering, drafting, management

Contingencies

Land
Developing land

Admin offices, cafeteria, maintenance shop
etc., etc., etc.

Part 1 (continued)
Purchasing major pieces of equipment

Factors influencing purchase cost

a. Size

Typically the most important factor
Could be in terms of volume, area, length, power

b. Material of construction – MOC

Typically the next most important factor
Often need to consult experts

c. Operating pressure

Specifications for above factors should be placed on PFD.

Operating temperature

Usually does not appear directly in equipment cost estimate

Impacts equipment cost indirectly through:

- **Need for heat exchangers, heaters, etc.**
- **Selection of MOC**
- **Achieving operating pressure.**

Impacts cost of manufacturing estimate through:

- **Chemical reaction yield**
- **Energy demand**

Part 1 (continued)
Purchasing major pieces of equipment

Sources for Equipment Cost Estimates

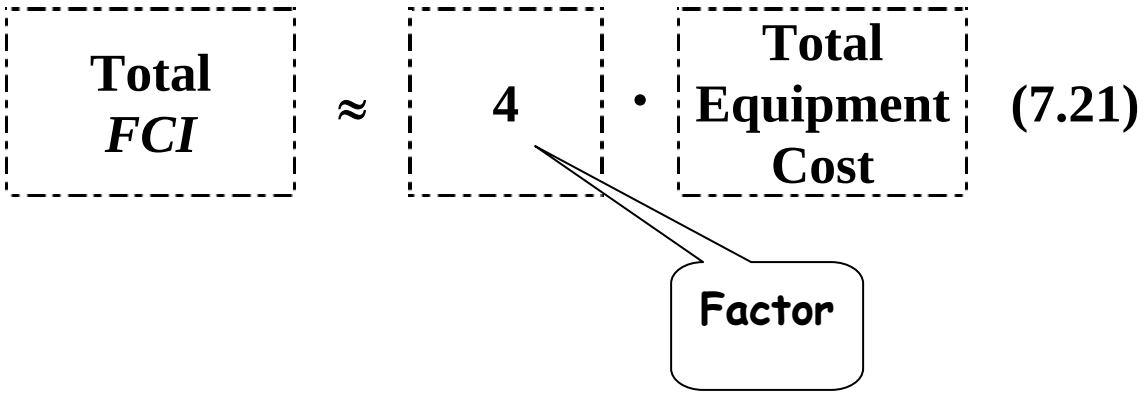
a. Quotations from vendors
Refer to flow-meter exercise in ECH 3274L

b. Experience internal to one's organization
For a worked example, refer to file in Blackboard:
TBWS Problem 5.1 - Discussion

c. Experience external to one's organization
Use CAPCOST software (or other software)
Use consulting company

Part 2 (continued)
Purchasing everything else!

Guesstimate:



Refine Estimate of Factors:

a. **Algorithm TBWS, page 175**

b. **Use CAPCOST on TBWS CD**
   Equipment Summary spreadsheet
   Utilities spreadsheet (Total Module and Grass Roots costs)

c. **Refer to TBWS CD for instruction video.**
   TBWS Example 5.14 and Table E4.14b

d. **For key equations, refer to file in Blackboard:**
   Symbol Scorecard – Capital Cost