Ministry of Higher Education and Scientific Research

Al-Mustaqbal University College

Chemical Engineering and Petroleum Industries Department

Chemical Engineering Economics
Fourth Stage
Lecture No.6

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Plant Location

The geographical location of the final plant can have strong influence on the success of an industrial venture. Considerable care must be exercised in selecting the plant site, and many different factors must be considered. Primarily, the plant should be located where the minimum cost of production and distribution can be obtained, but other factors, such as room for expansion and safe living conditions for plant operation as well as the surrounding community, are also important.

A general consensus as to the plant location should be obtained before a design project reaches the detailed estimate stage, and a firm location should be established upon completion of the detailed-estimate design. The choice of the final site should first be based on a complete survey of the advantages and disadvantages of various geographical areas and, ultimately, on the advantages and disadvantages of available real estate. The following factors should be considered in selecting a plant site:

1. Raw materials availability

The source of raw materials is one of the most important factors influencing the selection of a plant site. This is particularly true if large volumes of raw materials are consumed, because location near the raw-materials source permits considerable reduction in transportation and storage charges.

2. Markets

The location of markets or intermediate distribution centers affects the cost of product distribution and the time required for shipping. Proximity to the major markets is an important consideration in the selection of a plant site, because the buyer usually finds it advantageous to purchase from nearby sources.

3. Energy availability

Power and steam requirements are high in most industrial plants, and fuel is ordinarily required to supply these utilities.

Consequently, power and fuel can be combined as one major factor in the choice of a plant site. Electrolytic processes require a cheap source of electricity, and plants using electrolytic processes are often located near large hydroelectric installations. If the plant requires large quantities of coal or oil, location near a source of fuel supply may be essential for economic operation. The local cost of power can help determine whether power should be purchased or self-generated.

4. Climate

If the plant is located in a cold climate, costs may be increased by the necessity for construction of protective shelters around the process equipment, and special cooling towers or air-conditioning equipment may be

required if the prevailing temperatures are high.

5. Transportation facilities

Water, railroads, and highways are the common means
of transportation used by major industrial concerns. The kind and amount of products and raw materials determine the most suitable type of transportation facilities.

6. Water supply

The process industries use large quantities of water for cooling, washing, steam generation, and as a raw material. The plant, therefore, must be located where a dependable supply of water is available. A large river or lake is preferable, although deep wells or artesian wells may be satisfactory if the amount of water required is not too great.

7. Waste disposal

Many legal restrictions had been placed on the methods for disposing of waste materials from the process industries. The site selected for a plant should have adequate capacity and facilities for correct waste disposal. Even though a given area has minimal restrictions on pollution, it should not be assumed that this condition
will continue to exist. In choosing a plant site, the permissible tolerance levels for various methods of waste disposal should be considered carefully, and attention should be given to potential requirements for additional waste-treatment facilities.

8. Labor supply

The type and supply of labor available in the vicinity of a proposed plant site must be examined. Consideration should be given to prevailing pay scales, restrictions on number of hours worked per week,

9. Taxation and legal restrictions

State and local tax rates on property income, unemployment insurance, and similar items vary from one location to another. In fact, zoning difficulties and obtaining the many required permits can often be much more important in terms of cost and time delays than many of the factors discussed in the preceding sections.

10. Site characteristics

The topography of the tract of land and' the soil structure must be considered, since either or both may have a pronounced effect on construction costs. The cost of the land is important, as well as local building costs and living conditions. Future changes may make it desirable or necessary to expand the plant facilities. Therefore, even though no immediate expansion is planned, a new plant should be constructed at a location where additional space is available.

11. Flood and fire protection.
Many industrial plants are located along rivers or near large bodies of water, and there are risks of flood or hurricane damage. Before selecting a plant site, the regional history of natural events of this type
should be examined. Protection from losses by fire is another important factor in selecting a plant location. In case of a major fire, assistance from outside fire departments should
be available.
12. Community factors
If a certain minimum number of facilities for satisfactory living of plant personnel do not exist, it often becomes a burden (load) for the plant. Cultural facilities of the community are important to sound growth. Churches, libraries, schools, civic theaters, concert associations, and other similar groups, if active and dynamic, do much to make a community progressive.

By -products, Intermediates, and Wastes
When a chemical reaction is carried out, other products in addition to the desired product may be obtained in the output stream. These may be products of the same reaction that produces the desired product, for example, the HC1 produced along with vinyl chloride in the pyrolysis of EDC, shown earlier. This HC1 is a cop duct of the main reaction; it is also an intermediate in reaction path 5, as is the EDC, because they are synthesized in the reaction path but are subsequently consumed in other reactions. In reaction path 4, HC1 is a product of the process and is then known as a by-product of the vinyl chloride process. Another type of by-product from a chemical process is a material produced from reactions other than the intended reaction, such as the trichloroethane and the 1,1-dichloroethane produced in small percentages in the TJ. M. Douglas, Conceptual Design of Chemical Processes, McGraw-Hill, New York, 1988.
Oxychlorination of ethylene. By-products may themselves have a commercial value and contribute to the sales revenue of a process; the sodium hydroxide by-product in the manufacture of chlorine is an example. If the by-product has insignificant value, it must be
removed from the process and disposed of in a responsible manner. Water from the oxychlorination of ethylene, which is contaminated with chlorinated hydrocarbons,is such a by-product. In such cases, the by-product is a waste and a liability because of the expense of its treatment and disposal. The chemistry of the process should always be examined for ways to minimize the amount of waste generated.

Separations

The mixtures inherent in chemical processing must be separated into nearly pure components or less complex mixtures. Mixture separation steps are therefore present in nearly every chemical process. Separation technologies are based on a variety of physical and physicochemical properties, a large percentage of which depend upon phase differences and phase changes.

In this early stage of flowsheet development, the purpose is only to identify where mixture separations are needed. General guidelines are that

1. Reactor product streams need to be separated into intermediate products, final products, by-products, and reactants for recycle.
2. Separations involve energy in many forms, often as inputs and outputs, indicated by Q arrows both into and out of each separation box.

Computer tools for cost estimation

Correct understanding, selection, use, and evaluation of software in process and economic evaluation begins with an examination of the structure of software. This reveals the major software functions that form the basis for the software, and forms the basis for the subsequent selection, use, and evaluation of the software. Next, software is selected

Software availability guide†‡

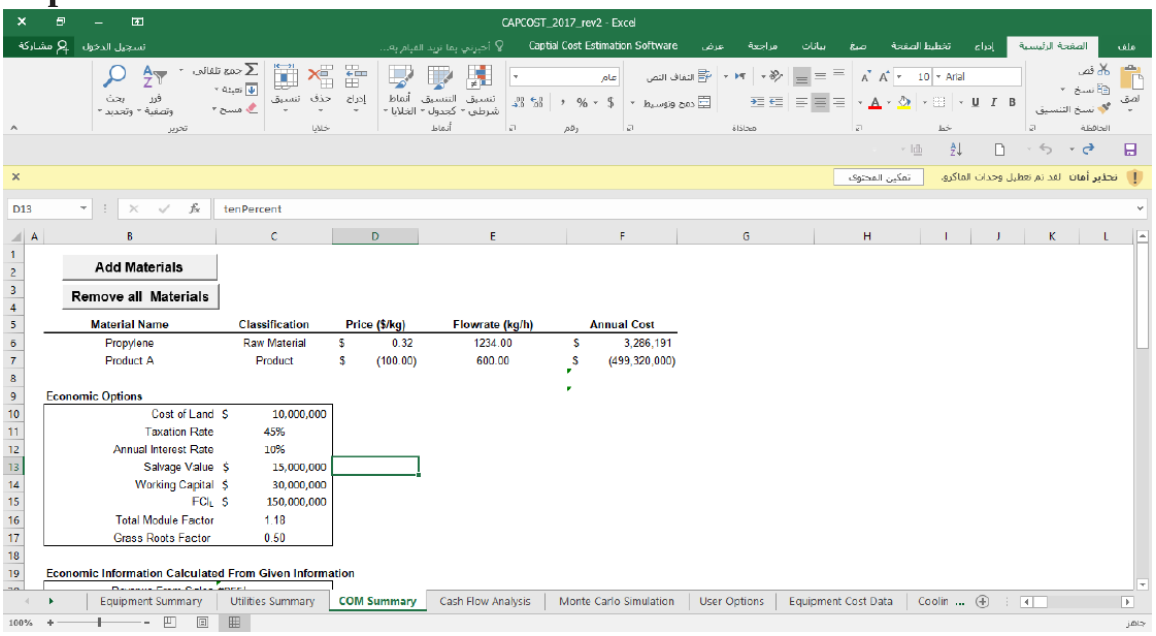
Design use			Designation	Provider¤
Flowsheet creation and optimization				
	Overall			
			NETOPT	Simsci
			SuperTarget	Linnhoff
			SYNPHONY	Epcon
		Heat exchange		
			Hyprotech.HX-Net	Hyprotech
		Heat integration		
			Aspen Pinch	Aspen Tech
			HEXTRAN	Simsci
		Separation trains		
			Aspen Split	Aspen Tech
			Hyprotech.DISTIL	Hyprotech
Process simulators				
	Overall			
		Steady-state		
			Aspen Plus	AspenTech
			BioPro/SuprePro	Intelligen
			CHEMCAD	Chemstations
			Hyprotech.Process (Hysys)	Hyprotech
			PRO/II	Simsci
			PROSIM	BR&E
			ProSimPlus	Prosim
		Dynamic		
			Aspen Dynamics	Aspen Tech
			gPROMS	BR&E
			Hyprotech.Plant (Hysys)	Hyprotech

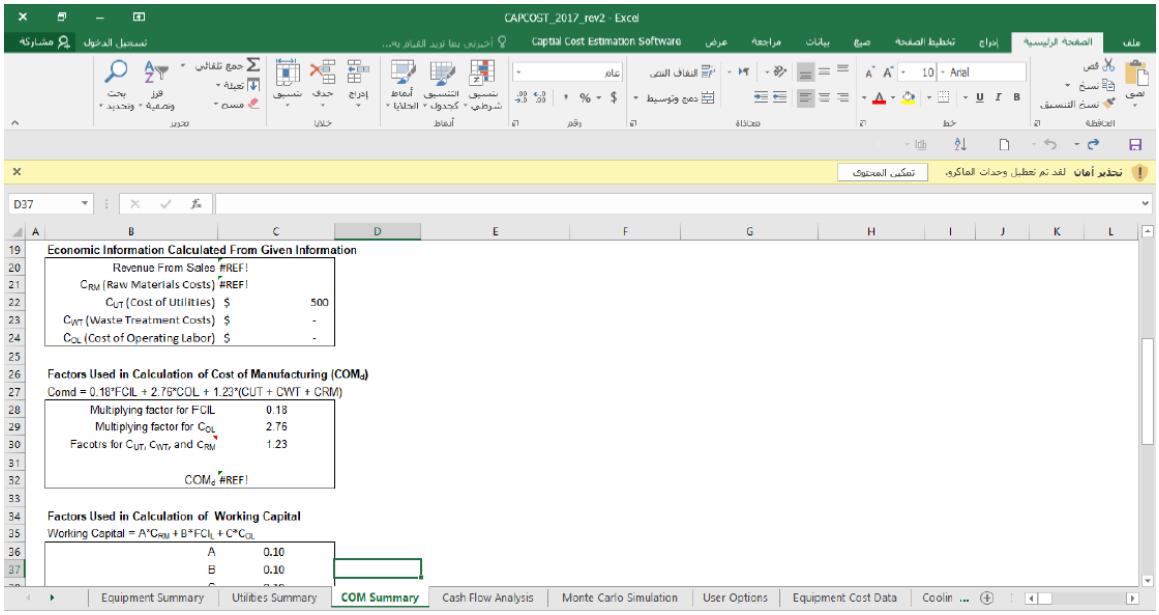
Continued

Design use	Designation	Provider[a]
Specific equipment simulation		
	Adsorption	
	ADSIM	Aspen Tech
	Heat exchangers	
	AeroTran	Aspen Tech
	CC-THERM	Chemstations
	Hetran	Aspen Tech
	Reactors	
	REACT	ChemEng
	Chemical Kinetics Simulator	Almaden
Process economic evaluation		
	Aspen IPE	Aspen Tech
	BioPro/SuprePro Designer	Intelligen
	CHEMCAD	Chemstations
	CostPlus	Epcon
	Hyprotech.Economix	Hyprotech
Process optimization		
	Aspen Optimizer	Aspen Tech
Material-transfer and piping		
	CHEMPRO	Epcon
	Hyprotech.Pipesys	Hyprotech
	Hyprotech.Pipesim	Hyprotech
	INPLANT	Simsci
	SINET	Epcon

to assist in carrying out design and economic evaluation tasks. The software is then implemented. These results are then evaluated for accuracy, including examinations to ensure that they are the result of proper software use.

Capital Cost Estimation




CAPCOST_2017_rev2 - Excel
Captial Cost Estimation Software
Economic Information Calculated From Given Information
Revenue From Sales #REF!
CRM (Raw Materials Costs) #REF!
CUT (Cost of Utilities) $ 500
CWT (Waste Treatment Costs) $ -
COL (Cost of Operating Labor) $ -
Factors Used in Calculation of Cost of Manufacturing (COMd)
Comd = 0.18*FCIL + 2.76*COL + 1.23*(CUT + CWT + CRM)
Multiplying factor for FCIL 0.18
Multiplying factor for COL 2.76
Facotrs for CUT, CWT, and CRM 1.23
COMd #REF!
Factors Used in Calculation of Working Capital
Working Capital = A*CRM + B*FCIL + C*COL
A 0.10
B 0.10
Equipment Summary
Utilities Summary
COM Summary
Cash Flow Analysis
Monte Carlo Simulation
User Options
Equipment Cost Data