

# Sample of 2010 Front - End / Conceptual Estimating Yearbook

## Table of Contents

Section / Reference Number	Page Number
<b>A-1 Introduction to Capital Cost Estimating:</b>	<b>1 - 28</b>
• The General Forecast for 2010 and beyond:	
• The Project Control Cycle:	
• Cost breakdown of a typical Chemical process facility:	
• The CAPEX estimating process:	
• Presenting the estimate to Senior Management:	
• Optimizing the estimating effort:	
<b>A-2 - Capital Cost Estimating Fundamentals:</b>	<b>1 - 30</b>
• Questions that need to be asked:	
• The Estimating four step process:	
• Capital Cost Estimating Terms:	
• Estimating Types / Accuracy:	
• Engineering Deliverables & Budget:	
• Pricing to compile various estimates:	
• Resolution allowance / Undefined Scope Allowance:	
• Developing an Estimating Plan:	
<b>A-3 - Capital Cost Estimating Methods:</b>	<b>1 - 47</b>
• CAPEX estimating (10 +) approaches:	
• Various factoring methods:	
• Seven historical Ratio / M.E. percentage cost models:	
• Typical Solids, Fluids M.E. multiplying values:	
• General Process Industry Benchmarks	
• Summarizing the CAPEX Estimate:	
<b>A-4 - Basic Man-Hour Benchmarking Data &amp; Reference Tables:</b>	<b>1 - 77</b>
<b>A-5 - Site Selection / Cost Data Sources / Estimating Checklist:</b>	<b>1 - 25</b>
<b>A-6 - Value Engineering / Change Orders / Claims / Contingency:</b>	<b>1 - 33</b>
<b>B-1 - Scale of Operations / Exponents (150 + Plants / M.E. items):</b>	<b>1 - 6</b>
<b>B-2 - Additional Estimating Factors Cost Models (10 +examples):</b>	<b>1 - 23</b>
<b>B-3 - Square Foot / M2 Estimating Data (104+ Buildings / Facilities) Revamp / Rehabilitation cost values.</b>	<b>1 - 16</b>
<b>B-4 - Unit Price Data (1,000+ unit cost items):</b>	<b>1 - 40</b>
<b>B-5 - General Cost Estimating Data.</b>	<b>1 - 26</b>
• Location Factors (200+ North American / International Cities):	
• International Location Factors / Productivity:	
• Engineering / Engineering / CM Fee's:	
• Union Labor Costs (10 trades):	
• Open Shop Labor Costs (10 trades):	
• Sales Tax (50 US states and 10 Canadian Provinces):	
• Inflation / Compass Cost Index:	
• Rebar / Pipe / Concrete / Bricks Pricing (14 cities)	

• <b>General Condition / Preliminaries Data:</b>	
<b>C-1 - Major Equipment / Process Equipment Cost &amp; Labor Models (125 # Major Equipment Items).</b>	<b>1 - 85</b>
<b>D-1 - Front End / Semi-Detailed Estimating Methods.</b>	<b>1 - 73</b>
• <b>Front End Issues / Types of Data Required:</b>	
• <b>Benchmarking Metrics:</b>	
• <b>Detailed Design / Engineering Metrics:</b>	
• <b>Civil, Structural, Architectural / Miscellaneous Costs:</b>	
• <b>Structural Steel Costs:</b>	
• <b>Facilities / Buildings Costs:</b>	
• <b>Piping / Insulation Metrics:</b>	
• <b>Electrical Systems:</b>	
• <b>Instrumentation:</b>	
• <b>Security Equipment / Robotics:</b>	
• <b>Miscellaneous estimating items:</b>	

**Sample from Section A 2 page 7**

The activity of Capital Cost Estimating is a procedure realized in four basic and important activities that need to be completed. These activities are as follows (note these four steps are depicted earlier in this section):

<b>Item #</b>	<b>Step</b>	<b>Description</b>
<b>1</b>	<b>Knowledge of Scope / Site Visit:</b> Familiarization with SOW.	Reviewing documents and scope issues, becoming familiar with the goals of the proposed project, visiting the proposed project location (if time / estimating budget permits).
<b>2</b>	<b>Take-Off:</b> Quantifying all SOW items.	Quantifying, collection and grouping the physical quantities of work, preparing a detailed listing of all materials, equipment and labor required for the proposed project, basically the take-off is a “shopping list” of all the required scope items / work items that are depicted on the available drawings or that are described in the scope of work statement.
<b>3</b>	<b>Compiling:</b> Pricing out the work items.	Applying the take-off and the data contained and described. In the scope of work statements with appropriate cost values man-hour units to the items of work earlier collected in the take-off phase. Selecting the value / amount to be charged to the owner / client so as to completely include all cost elements including engineering, procurement, construction, productivity, waste, square foot or M2 units, risk items, contingency and profit and all other project related cost elements such as overheads needed to successfully execute the project and realize a profit, this compiling or formatting effort could also include assigning the work to a work breakdown structure.
<b>4</b>	<b>Summarization:</b> Finalizing	Compiling and calibrating the capital cost estimate into a

	the CAPEX estimate.	final capital cost estimate or the following “bid or proposal” document, includes assigning contingency funds, risk, profit margin and possibly shared saving.
--	---------------------	--

**Sample from Section A 3 page 31 (Some values have been purposely removed)**

(13) Petro-Chemical Facility USA South East 2010 Cost basis  
 Direct Labor Cost \$XXX Million - all in labor rate for all trades \$67.70 / hour

Construction Category Major Equipment (M.E.)	# of Items	Material	Labor	Total	%
Columns c/w trays	4		100,482		8.29%
Compressor	1		80,478		6.21%
Drums	6			524,429	2.24%
Furnace / Heaters	3				8.85%
Heat Exchangers	10				6.44%
Miscellaneous Equipment	3			46,115	0.20%
Reactors	3			473,561	2.02%
Pumps with motors	12			86,604	0.37%
Stack / Ducting	1	99,540	6,122		0.45%
Tanks	4	596,000	31,290		2.68%
S/T			576,173		37.75%
Freight (2.75%)			-	227,521	0.97%
S/T					38.72%
Site work	4.75 Acres	364,780			2.39%
Foundations / Stone / Concrete	3,288 CY	581,735			4.14%
Structural steel / Pipe racks				678,500	2.89%
Piping (Aver 6" diameter CS \$xxx / LF)	25,450 LF	3,013,319			20.57%
Instrumentation & Controls	830 # Points				5.10%

**This cost model contains 26 # line items detailing costs related to Site works, Structural steel, Off sites, Detailed Design, Electrical Scope, Insulation and Other cost categories.**

**Sample from Section A 4 page 11 (some value have been purposely removed)**

**USA Productivity Factors (versus Gulf Coast):** The normal approach of comparing “process / refinery / manufacturing” construction productivity is to compare various locations around the USA to a known basis or benchmark of 1.00 or 100 for Texas Gulf Coast (open shop labor working from say Mobile, AL in the north and south to say Corpus Christi, TX, - because there is so much historical cost data that has been collected over the last 20 – 30 years, the term Gulf Coast productivity is well known and understood term in the construction industry):

State	Open Shop / Non-Union	Union
Alabama	1.00	1.10 - 1.15
Alaska		
Arizona (Phoenix / Tucson)		
Arizona		

Arkansas		
California (LA / Long Beach / SF / SD / SJ)		
California		
Colorado (Denver)		
Colorado		
Connecticut		
Delaware		
Florida (Jacksonville / Miami / Orlando / St P )		
Florida		
Georgia (Atlanta)		
Georgia		
Hawaii		
Idaho	1.05	1.25
Illinois (Chicago)	1.00 - 1.15	1.20 – 1.30
Illinois		
Indiana		
Iowa		
Kansas		
Kentucky		
Louisiana		
Maine		
Maryland (Baltimore)		
Maryland		
Massachusetts (Boston)		
Massachusetts		
Michigan (Detroit)		

**Sample from Section A 4 page 38 (some values have been purposely removed)**

**MISCELLANEOUS STRUCTURAL STEEL ITEMS: (Labor & Material Costs, excludes crane and scaffolding costs):**

<b>Description</b>	<b>Cost per Ton / Pound / SF</b>	<b>Cost per Kg / M2</b>
Structural Steel (Columns and Beams – 100 Ton and above)		
For applications less than 100 Ton multiply value by 1.15		
Light framing steel (tubular and channels)		
Heavy framing steel (RSJ's and wide flange beams)		
Metal studs / framing		
Miscellaneous lintels and angles / channels		
Corrugated metal decking, galvanized 2" rib 18 g		
Ditto 20 g		
Galvanized steel ladders connected to masonry or concrete w/o safety loops.		

Ditto with safety loops		
Handrails 1.5" diameter CS 2 rail system 30"- 36" high		
Stairs – galvanized steel 36" wide c/w side plate and handrails (open grating)		
Bollards 3" diameter 6' long (3' in ground filled with concrete)		
H.D. bolts 1/2" diameter x 8" long		

**Sample from Section B 5 page 9 (some values have been purposely removed)**

Country	City	Location Factor * A	Location Factor * B	Construction Productivity	Eng / Design Productivity
<b>Argentina</b>					
<b>Australia</b>	Melbourne				
	Perth				
	Sydney				
<b>Austria</b>					
<b>Belgium</b>					
<b>Brazil</b>					
<b>Canada</b>	Calgary				
	Edmonton				
	Fort McMurray				
	Halifax				
	Montreal				
	Toronto				
	Vancouver				
<b>China</b>	Beijing				
	Guangzhou				
	Shanghai				
<b>Cyprus</b>					
<b>Czech Republic</b>					
<b>Denmark</b>					
<b>Egypt</b>					

**Data includes another 37 Countries:**

**Sample from Section D 1 page 4 (some values have been purposely removed)**

**CAPEX COST ESTIMATING TYPES / ENGINEERING DELIVERABLES REQUIRED**

Note: some of these activities and deliverables may overlap from one estimate to another; use some judgment in determining specific engineering deliverable:

Ref #	Engineering Deliverables / Detailed Design Data	A	B	C	D	E
1	Approved written Scope Document / Scope of Work Statement.	1	2	3	6	6
2	Plant location	1	3			
3	Facility / Plant production target		1	3		
4	Milestone schedule dates / Bar chart listing Engineering / Procurement and Construction start and finish dates	1	2	3		

5	Detailed CPM / gnat chart schedule / Integrated project schedule			3	6	6
6	Permits (Environmental impact study / State / Local / Building)		4	4		
7	Approved Project Design Basis		3	3	6	6
8	Completion of similar project	5	5	5	5	5
9	Soil investigation / hydrology report / environmental survey		1	2	3	
10	Preliminary plot plan	1	2	3		
11	Final plot plan			3	6	6
12	Preliminary equipment list	1				

**Data includes another 60 + Categories:**

- A: OOM / Concept / Screening Estimate: Class 5 / FEL1 - Design typically 0 – 5% complete.
- B: Preliminary / Front – End / FEED / Feasibility Study: Class 4 / FEL2 - Design typically 5 – 10% complete.
- C: AFE / Board Approval Estimate: Class 3 / FEL3 - Design typically 10 – 15% complete.
- D: Budget Control / Baseline Estimate: Class 2 - Design typically 25 – 45% complete.
- E: Lump Sum / Bid / Definitive Estimate / Turnkey: Class 1 - Design typically 50 – 100% complete.

**Sample from Section D 1 page 29, 41, 42 and 59 (some values have been purposely removed)**

Carbon Steel A 53 - A 106 Schedule 40 (ISBL - Inside Facility) Piping - Diameter	\$ Material Cost per LF	\$ M-H Cost per LF	\$ Cost per LF	\$ Material Cost per M	\$ M-H cost per M	\$ Cost per M
1" / 25 mm						
1 1/2" / 37 mm						
2" / 50 mm						
3" / 75 mm						
4" / 100 mm						
6" / 150 mm						
8" / 200 mm						
10" / 250 mm						
12" / 300 mm						
14" / 350 mm						
16" / 400 mm						
18" / 450 mm						

The following chart indicates budget-pricing (material only for various types of stainless steel tubing / piping) conforming to ASTM 269 and ASTM 270 0.065 wall thickness  
Note - for large orders, discounts of 10% -35% are available on the following prices.

Type and Diameter	Material Cost per LF	MH' s per LF
304 1"		
304L 1"		
316L (no polish) 1"		
AL-6XN (polished ID / OD) 1"		
317 1"		

317L 1"		
321 1"		
347 1"		
Admiralty 1"		
304 Sanitary 1"		
304 Seamless 1"		
304 Sanitary 1.5"		
304 Sanitary 2"		

The following is a listing of various material adjustment values (specific to piping) calibrated against carbon steel A 53, A 36, A 515 and A 285C. These adjustments could be utilized to determine various OOM budget variables between differing material specifications (a word of warning: this is reasonable for the material content however the installation / welding activities should separately evaluated, welding of stainless steel and other exotic materials may require 10% - 35% more man hours).

<b>Material</b>	<b>Material uplift (Low)</b>	<b>Material uplift (High)</b>
PVC (Schedule 80)		
CPVC (Schedule 80)		
Base Case - Carbon Steel Material cost / LF for 2" Diameter A 53 (refer to above table for material cost)	1.00	1.00
C.S. Glass Lined		
C.S. Kynar Lined		
C.S. Polypropylene Lined (Schedule 40)		
C.S. TFE		
C.S. Rubber Lined		
C.S. Saran Lined (Schedule 40)		
C.S. PVDF Lined (Schedule 40)		
Aluminum		
S. S. 304		
S. S. 316		
S.S. 304 L (Schedule 10)		
S.S. 316 L (Schedule 40)		
FRP		
Glass (Solid)		
Inconel 625		
Titanium (Schedule 10)		
Zirconium (Schedule 10)		
Alloy 20 (Schedule 10)		
Monel (Schedule 10)		
Nickel (Schedule 10)		
Hastelloy G		
Hastelloy B		

**The following is a listing of some key instrumentation items.**

<b>Instrument Device</b>	<b>Material \$ Cost</b>	<b>Installation M. H. s</b>
--------------------------	-------------------------	---------------------------------

Pressure relief valve 2"		
Pressure relief valve 4"		
Electrical Indicating Controller		
Orifice plate 2" dia 300 #		
Ditto 4" dia 300 #		
Ditto 6" dia 300 #		
Differential pressure switch		
Orifice union		
Combustion control alarm switch		
Position Indicating Meter		
Gas Regulator		
Flow switch		
Sight Glass		
Flow Meter		
Electric Flow Transmitter		
Indicating Controller		
Annunciator Point		
Alarm Switch		
Thermowell		
Solenoid Valve		
Push Button Station		
Level Indicator Electronic		
Thermocouple temperature control		
2" Control Valve 150/300 lb CS Actuator		
4" ditto		
6" ditto		
2" ditto SS 304/316		
4" ditto		
6" ditto		
Thermocouple temperature control		

**End of Samples:**