CONTENTS

COMPASS INTERNATIONAL INC.

# What is Benchmarking & how can it help you with your future estimating / budgeting

***Construction Benchmarking utilizes historical engineering and construction cost data to distinguish targets and best practice routines, specific to the performance and project delivery of construction related projects. Benchmarking is in many ways the analysis of what you're up against, how to we measure up or compare to our competitor's business practices and execution practices, in order to enhance the performance of your organizations performance. Used correctly benchmarking can fundamentally improve construction related performance and enhance the return on investment for the organization. Most of the successful construction organizations consistently benchmark their historical & latest performance / execution practices in the effort to improve the organizations standing in their particular market sector.***



So what is benchmarking as it applies to construction? Benchmarking is basically investigating & researching historical costs & performance, a benchmark was a master masons datum point or mark on a foundation, wall or building utilized as a specific location / height for determining future heights or lengths needed to successfully complete a future building. .

The benchmarking procedure encompasses the assessment of planned performance data versus actual performance / data achieved from comparable historical accomplished construction related projects.

Benchmarks require need to be validated by a well-defined and concise description of deviations between planned projected performance and the estimated benchmarking low and high ranges that are for the most part indicated in the following sections of this publication.

Compass International's five phase approach to benchmarking is detailed below.

**Phase 1:** Verify the project goals and established the major benchmark components to be analysed.

**Phase 2:** Document and compile a list of the major cost / performance drivers, key component and collect performance and specific historical cost data, this could include cost per square foot / square meter, cost of electrical systems compare to comparable projects.

**Phase 3:** Assemble relevant benchmark data by cooperation with internal team members, conferring with relevant stakeholders on their views and perspectives, contacting professional societies, industry experts, industry associations and data mining via the internet on comparable benchmark norms. This data is essential to accurate and beneficial benchmarking.

**Phase 4:** Confirm and validate initial benchmark cost and performance data.

**Step 5:** Finalize benchmark data cost and performance models, develop low and high cost / performance benchmarks and compile benchmark report on project being reviewed.

# Cost / Man-hour Model (3)

## PETRO-CHEMICAL & GAS FACILITIES - ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) BENCHMARKING DATA: (DATA COLLECTED FROM 12 # COMPLETED EPC PROJECTS IN USA & CANADA)

## TYPICAL BENCHMARK PERCENTAGES & COST RANGES RELATED TO NORTH AMERICAN PETRO-CHEMICAL, INDUSTRIAL & GAS FACILITIES. APPLICABLE TO FACILITIES NEW & REVAMP CAPEX / FACILITY PROJECTS WITH A TOTAL INSTALLED COST (TIC) VALUE BETWEEN $10 MILLION & $150 MILLION.

| # | PERCENTAGES & RATIOS | LOW RANGE | HIGH RANGE |
|---|---|---|---|
| 1 | Site Works as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 2.00% | 4.50% |
| 2 | Concrete as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 11.50% | 16.50% |
| 3 | Structural Steel / Platforms / Siding as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 10.50% | 18.50% |
| 4 | Piping as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 45.00% | 70.00% |
| 5 | Piping Material (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 19.00% | 48.50% |
| 6 | Piping Labor (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 40.00% | 125.00% |
| 7 | Direct Construction Labor as percent of Total Installed Cost (TIC). | 65.00% | 35.00% |
| 8 | Indirect costs (Support Labor, Field Establishment, and Construction Equipment) as percent Direct Labor Cost. | 25.00% | 125.00% |
| 9 | Piping Labor as percent Direct Labor | 15.00% | 55.00% |
| 10 | Instrumentation Labor (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 6.00% | 14.50% |
| 11 | Instrumentation Materials (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 6.50% | 16.50% |
| 12 | Electrical Labor (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 9.50% | 17.50% |
| 13 | Electrical Materials (Inside Battery Limits - ISBL & Outside Battery Limits OSBL) as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 7.00% | 18.50% |
| 14 | Overall Major Equipment (M.E.) cost multiplier to obtain Total Installed Cost (TIC). | 3 | 5.5 |
| 15 | Buildings & Structures as a percentage of Major Equipment (M.E.) cost, excludes Major Equipment setting. | 4.80% | 11.30% |
| 16 | Off sites scope percentage of Total Installed Cost of Facility | 15.00% | 30.00% |

| # | DESCRIPTION | MATERIAL COST | M-H'S | HOURLY RATE | LABOR COST | TOTAL COST |
|---|---|---|---|---|---|---|
| | **CONTINUED** | | | | | |
| 28 | Field In-Directs | | | | | 12,665,926 |
| **29** | **ENGINEERING / EPC SERVICES** | | | | | |
| 30 | Detailed Design | | | | | 3,476,005 |
| 31 | PM / PC / Procurement | | | | | 1,087,088 |
| 32 | HO Support | | | | | 563,860 |
| 33 | Start Up / Commissioning | | | | | 276,000 |
| 34 | Engineering Fee | | | | | 575,890 |
| 35 | Misc. items | | | | | 86,082 |
| 36 | Engineering / EPC Services | | | | | 6,064,925 |
| 36 | Contingency / Mgmt. Reserve | | | | | 3,000,000 |
| **36** | **TOTAL PROJECT COST** | | | | | **81,302,865** |

# Cost / Man-hour Model (7)

## 1.50 MILLION TON PER YEAR USA GULF COAST ETHYLENE FACILITY

| # | COST CATEGORIES | QTY | UOM | MATERIAL | M-H'S | M-H RATE | LABOR COST | TOTAL |
|---|---|---|---|---|---|---|---|---|
| **1** | **MAJOR EQUIPMENT (M.E.)** | | | | | | | |
| 2 | Columns c/w trays | 74 | EA | 411,083,852 | 43,475 | 44.90 | 1,951,952 | 413,035,803 |
| 3 | Drums / Vessels | 70 | EA | 23,248,825 | 36,650 | 44.90 | 1,645,523 | 24,894,348 |
| 4 | Pumps | 103 | EA | 20,507,850 | 18,837 | 44.90 | 845,744 | 21,353,594 |
| 5 | Compressors / Fans / Blowers | 26 | EA | 112,070,264 | 137,319 | 44.90 | 6,165,348 | 118,235,613 |
| 6 | Heat Exchangers | 96 | EA | 24,444,292 | 17,404 | 44.90 | 781,394 | 25,225,685 |
| 7 | Tanks | 7 | EA | 17,045,486 | 3,890 | 44.90 | 174,664 | 17,220,150 |
| 8 | Material Handling | 4 | EA | 19,115,295 | 4,914 | 44.90 | 220,629 | 19,335,924 |
| 9 | Water Treatment | 11 | EA | 5,889,824 | 2,594 | 44.90 | 116,443 | 6,006,267 |
| 10 | Miscellaneous Equipment | 20 | EA | 65,495,758 | 20,953 | 44.90 | 940,737 | 66,436,494 |
| 11 | Electrical Equipment | 30 | EA | 17,654,253 | 7,849 | 44.90 | 352,393 | 18,006,646 |
| 12 | Instrumentation Devices (Tagged) | 5,670 | EA | 20,703,120 | 176,085 | 44.90 | 7,905,864 | 28,608,984 |
| 13 | Freight | | ALLOW | 22,718,782 | - | | | 22,718,782 |
| 14 | Vendor Assistance | | ALLOW | 1,827,224 | - | | | 1,827,224 |
| 15 | Total Major Equipment (M.E.) | | | 761,804,823 | 469,970 | | 21,100,691 | 782,905,514 |
| 16 | Removals / Demolition | | ALLOW | 8,955,009 | 79,950 | 41.56 | 3,322,762 | 12,277,771 |
| 17 | Site Earthmoving / Improvements | 1,230,000 | CY | 35,175,206 | 799,500 | 41.56 | 33,227,620 | 68,402,826 |
| 18 | Piling | 6,150 | LF | 8,846,992 | 159,900 | 41.56 | 6,645,524 | 15,492,516 |
| 19 | Buildings | 61,500 | SF | 8,846,992 | 239,850 | 41.56 | 9,968,286 | 18,815,278 |
| 20 | Concrete | 86,100 | CY | 47,332,250 | 186,550 | 41.56 | 7,753,111 | 55,085,361 |
| 21 | Refractory / Fireproofing | - | ALLOW | 6,423,583 | 7,995 | 41.56 | 332,276 | 6,755,859 |
| 22 | Structural Steel / Platforms | 9,225 | TON | 38,829,629 | 319,800 | 41.56 | 13,291,048 | 52,120,677 |
| 23 | Piping systems | 799,500 | LF | 221,753,872 | 3,997,500 | 41.56 | 166,138,099 | 387,891,971 |
| 24 | Insulation | - | ALLOW | 53,220,460 | 63,960 | 41.56 | 2,658,210 | 55,878,670 |

| # | PROJECT COMPONENT / UNIT AREA | SF | $ COST | SF $ COST FOR WORK O-S PRODUCTION FACILITY | COST PER SF |
|---|---|---|---|---|---|
| | CONTINUED | | | | |
| 4 | S/T | | 99,398,233 | | 401.55 |
| 15 | Detailed Design + Fee 10.3% of # 14 | 247,535 | 10,238,018 | | 41.36 |
| 16 | CM + Fee 5% of # 14 | 247,535 | 4,988,000 | | 20.15 |
| 17 | Owner Costs 3.9% of # 14 | 247,535 | 3,846,980 | | 15.54 |
| 18 | S/T | 247,535 | 118,471,231 | | 478.60 |
| 19 | CONTINGENCY / OWNERS RESERVE FUNDS | 247,535 | 10,544,786 | | 42.60 |
| 20 | PROJECT FUNDING TARGET | 247,535 | 129,016,017 | | 521.20 |

# Cost / Man-hour Model (21)

## LARGE SCALE CELL CULTURE MANUFACTURING BENCHMARKS BASED ON 5 COMPLETED / PLANNED FACILITIES (2 FLOORS) 2020 COST BASIS IN EURO'S WESTERN EUROPE LOCATION

| | SCOPE INCLUDES: | CONSTRUCTION CATEGORY SPLIT | % SPLIT |
|---|---|---|---|
| A | Cell Culture Production Area | Site Work / UG Utilities | 4.3 |
| B | Cell Harvesting Area | Concrete / Masonry | 8.6 |
| C | Cell Purification Area | Struct Steel / Mezz | 5.7 |
| D | Prep Area / Bulk Filling Area | External Wall / Roof | 5.8 |
| E | Clean Utilities Area | Internal Finishes | 11.7 |
| F | Clean Warehouse Building | Production Equipment | 26.1 |
| G | Labs / QA/QC Area | Process / Utility Piping | 21.5 |
| H | Offices / Cafeteria / Reception | Elec / Instr | 11.9 |
| I | Site work / Parking Areas/ Landscaping | Insulation / Painting | 4.4 |
| | | | 100.0 |

| # | DESCRIPTION | 30,000 LITRE 2 BIO REACTORS | 60,000 LITRE 4 BIO REACTORS | 90,000 LITRE 4 BIO REACTORS |
|---|---|---|---|---|
| 1 | Site Work +/- 20% | 10 Acres / SF | 15 Acres / SF | 20 Acres / SF |
| 2 | Offie / Admin / Cafeteria | 35,000 | 70,000 | 105,000 |
| 3 | Labs QA /QC | 24,000 | 48,000 | 72,000 |
| 4 | Manufacturing | 70,000 | 140,000 | 210,000 |
| 5 | Warehouse | 20,000 | 40,000 | 60,000 |
| 6 | Utility Bulding | 12,000 | 24,000 | 36,000 |
| 7 | TOTAL SF | 161,000 | 322,000 | 483,000 |
| 8 | Cost of Facility in Euro's per SF | 2,481 | 2,368 | 2,255 |
| 9 | Cost of Facility in Euro's per M2 | 26,690 | 25,477 | 24,264 |
| 10 | FACILITY % SPLIT | | | |
| 11 | Site Work, Office, Admin. Labs | 33.3 | 33.3 | 33.3 |
| 12 | Manufacturing | 41.3 | 41.3 | 41.3 |
| 13 | Clean Warehouse | 4.3 | 4.3 | 4.3 |
| 14 | Utility Bulding | 5.2 | 5.2 | 5.2 |
| 15 | Detailed Design | 10.4 | 10.4 | 10.4 |
| 16 | Construction Management | 5.5 | 5.5 | 5.5 |
| 17 | TOTAL | 100 | 100 | 100 |
| 18 | EPC Duration | 21 / 26 months | 26 / 29 months | 32 / 38 months |
| 19 | Construction Peak Workforce | 325 | 500 | 750 |
| 20 | Production Admin Staff | 110 | 165 | 235 |

# Cost / Man-hour Model (24)

## LIGHT INDUSTRIAL / MANUFACTURING FACILITY - 22' HIGH
## BRUNSWICK - GEORGIA USA - OPEN SHOP CONSTRUCTION -
## 11 MONTH CONSTRUCTION SCHEDULE
## 125,000 SF - 7 ACRES SITE
## 2023 COST BASIS: OPEN SHOP LABOR:

| # | DESCRIPTION | AREA | COST PER SF | $ TOTAL | REMARKS |
|---|---|---|---|---|---|
| 1 | General Conditions / Preliminaries | 125,000 | 7.45 | 931,250 | Trailers, Storage, Superintendent , Site Engineer |
| 2 | Incoming utilities / Ponds / Well | 125,000 | 3.64 | 455,000 | Water, Gas, Electricity , Sewer |
| 3 | Site Works | 125,000 | 4.61 | 576,250 | Tree removal, site strip, new entrance road |
| 4 | Foundations | 125,000 | 5.33 | 666,250 | 9" thick spread footers & ground beams |
| 5 | Slab on Grade | 125,000 | 6.85 | 856,250 | 6" SOG (Polished) c/w 9" stone |
| 6 | Superstructure | 125,000 | 12.53 | 1,566,250 | Metal siding, Structural steel, bar joist. mezz floor, windows |
| 7 | Exterior Closure | 125,000 | 7.23 | 903,750 | PC tilt up walls & brickwork |
| 8 | Roofing | 125,000 | 6.23 | 778,750 | 6" Insulation & EPDM membrane c/w gutters |
| 9 | Interior Construction (partitions, flooring, ceilings. painting & insulation) | 125,000 | 7.87 | 983,750 | Partitions, 4 offices / conference area, break room & toilets |
| 10 | Mechanical / HVAC | 125,000 | 9.64 | 1,205,000 | Pumps, piping, chillers, compressor & roof top AHU's & ductwork |
| 11 | Electrical / Security | 125,000 | 7.68 | 960,000 | 1600 A service CCTV, O/S lighting, security systems, card swipes |
| 12 | Trollies, Fork lifts, Racks, Loading Docks | 125,000 | 4.23 | 528,750 | |
| 13 | Minor items | 125,000 | 0.88 | 110,000 | |
| **14** | **S/T** | | **84.17** | **10,521,250** | |
| 15 | Detailed Design / Project Management | 125,000 | 7.77 | 971,250 | A/E services |
| 16 | Contractors O/H & P | 125,000 | 4.73 | 591,250 | |
| 17 | Parking Area / Landscaping / Fencing | 320,000 | 1.87 | 598,400 | |
| **18** | **TOTAL PROJECT COST** | **125,000** | **98.54** | **12,682,150** | |

# Cost / Man-hour Model (26)

**CANDY BAR / CHOCOLATE SNACKS PRODUCTION FACILITY**
**244,360 SF 24 ' HIGH MANUFACTURING FACILITY IN PENNSYLVANIA USA**
**185,400 PRODUCTION / PACKAGING / SHIPPING**
**23,600 SF ADMIN / OFFICE AREA TOTAL BUILDING FOOTPRINT 244,360 SF**
**16 ACRE SITE - 64 OPERATIONAL STAFF**
**64 OPERATIONS STAFF**
**2023 COST BASIS**

| # | DESCRIPTION | $ COST / SF | TOTAL SF | TOTAL $ COST |
|---|---|---|---|---|
| 1 | General Conditions / Site Establishment | 15.08 | 244,360 | 3,685,376 |
| 2 | Site work incl ponds, well & roads | 9.35 | 244,360 | 2,283,727 |
| 3 | Concrete work | 25.52 | 244,360 | 6,235,640 |
| 4 | Masonry | 9.36 | 244,360 | 2,286,843 |
| 5 | Metals & Mezz floor | 12.46 | 244,360 | 3,043,931 |
| 6 | Woods / Plastic | 4.80 | 244,360 | 1,173,233 |
| 7 | Thermal / Roof System | 4.81 | 244,360 | 1,174,577 |
| 8 | Doors / Windows | 5.09 | 244,360 | 1,243,120 |
| 9 | Finishes / Gypsum walls- Painting | 3.19 | 244,360 | 779,875 |
| 10 | Specialties | 1.44 | 244,360 | 352,086 |
| 11 | Equipment (Building) | 0.84 | 244,360 | 205,629 |
| 12 | Furnishings | 1.05 | 244,360 | 255,539 |
| 13 | Special Construction | 0.65 | 244,360 | 133,970 |
| 14 | Dock Levelers | 0.86 | 244,360 | 210,895 |
| 15 | Piping / HVAC / Fire Protection | 38.60 | 244,360 | 9,432,052 |
| 16 | Electrical / Controls | 24.92 | 244,360 | 6,333,994 |
| **17** | **S/T** | **158.91** | **244,360** | **38,830,466** |
| 18 | Production – Manufacturing Equipment, Tanks, Kettles, Mixers, Kneaders, Spindle Mills, Ovens / Molders, Melters, Coating Tunnels, Cooling Tunnels, & Cold Rooms | 274.60 | 244,360 | 67,100,828 |
| 19 | Packaging Equipment / Wrappers/ Fork Lifts | 29.92 | 244,360 | 7,310,396 |
| **20** | **S/T** | **304.51** | **244,360** | **74,411,224** |
| 21 | Detailed Design | 41.78 | 244,360 | 10,209,972 |
| 22 | Construction Management | 19.59 | 244,360 | 4,787,807 |
| **23** | **S/T** | **61.38** | **244,360** | **14,997,778** |
| **24** | **TOTAL** | **524.80** | **244,360** | **128,239,468** |

**ADDITIONAL SCOPE ITEMS**

- Owner Engineering / Construction Oversight $543,600
- Gatehouse / Weighbridge / Incoming Road $26,760
- Fencing $53,450
- Parking for 85 Cars & 20 Trucks $234,600
- Utility Building / Storage Sheds / Warehouse 6,000 SF $275,940
- Landscaping – Sprinkler Systems $267,600

# Cost / Man-hour Model (2)

**TYPICAL ARCHITECTURAL / ENGINEERING / CONSTRUCTION MANAGEMENT FEES FOR A $10 - $50 MILLION GENERAL CONSTRUCTION PROJECT (SHOPPING CENTER - MALL / HOTEL / OFFICE BUILDING / CORPORATE HEADQUARTERS): NOTE THE FOLLOWING VALUES ARE PERCENTAGES OF THE TOTAL INSTALLED COST OF COMPLETED PROJECT (EXCLUDING LAND PURCHASE AND ANY SIGNIFICANT SITE DEMOLITION COSTS). SEE FOLLOWING LIST FOR COUNTRY SPECIFIC APPLICATIONS.**

| # | DISCIPLINE | LOW RANGE % | HIGH RANGE % |
|---|---|---|---|
| 1 | Architect Fee | 3.25 | 7.50 |
| 2 | Structural Engineer Fee | 0.90 | 1.75 |
| 3 | Mechanical, Electrical & Plumbing (MEP services) Fee | 1.35 | 2.25 |
| 4 | Cost Consultant / Quantity Surveyors / Cost Planners Fee | 0.35 | 0.75 |
| 5 | Landscape Architect Fee | 0.10 | 0.25 |
| 6 | Acoustical Engineer Fee | 0.00 | 0.10 |
| 7 | Other Consultants (Traffic, Fire Protection, BMS etc.) Fee | 0.00 | 0.15 |
| 8 | Construction Management (excludes General Conditions / Division 1 / Preliminaries) Fee | 2.50 | 6.00 |

**NOTE:**
the above percentages can vary significantly, items that can influence these percentages include:
- For revamp or alteration type work the high range % could increase by as much as 50%
- Complexity of the required facility
- Sophistication of specified materials and equipment
- Requirement to use owners design standards and specification. (i.e. Federal or local government funded project or a major Fortune 500 company that is continually building facilities around the world - utilizing an in-house Corporate Engineering Group)
- Sub surface ground conditions
- Competitive bid – possibly 4 – 6 other A/E firms proposing on the project. Single source bid or negotiated bid by A/E firm
- Involvement of client during the detailed design and construction effort
- Future tenant fit out requirements
- Business climate (boom or bust period)
- Future repeat work with Owner