COAA

Performance Metric Formulas and Definitions

Performance Metric Category: COST

Metric: ***Project Cost Growth***	**Formula:** $\frac{\text{Actual Total Project Cost - Initial Predicted Project Cost}}{\text{Initial Predicted Project Cost}}$
Metric: ***Delta Cost Growth***	**Formula:** | Cost Growth |
Metric: ***Project Budget Factor*** *(Contractor data only)*	**Formula:** $\frac{\text{Actual Total Project Cost}}{\text{Initial Predicted Project Cost +Approved Changes}}$
Metric: ***Delta Budget Factor****(Contractor data only)*	**Formula:** | 1- Budget Factor |
Metric: ***Phase Cost Factor*** *(Owner data only)*	**Formula:** $\frac{\text{Actual Phase Cost}}{\text{Actual Total Project Cost}}$
Metric: ***Phase Cost Growth*** *(Owner data only)*	**Formula:** $\frac{\text{Actual Phase Cost – Initial Predicted Phase Cost}}{\text{Initial Predicted Phase Cost}}$

Definition of Terms

Actual Total Project Cost:

- Owners –
  - All actual project cost from front end planning through startup
  - Exclude land costs but include in-house salaries, overhead, travel, etc.
- Contractors – Total cost of the final scope of work.

Initial Predicted Project Cost:

- Owners – Budget at the time of Project Sanction.
- Contractors – Cost estimate used as the basis of contract award.

Actual Phase Cost:

- All costs associated with the project phase in question.
- See the Project Phase Table in Appendix C for phase definitions.

Initial Predicted Phase Cost:

- Owners – Budget at the time of Project Sanction.
- Contractors – Budget at the time of contract award.
- See the Project Phase Table in Appendix C for phase definitions.

Approved Changes:

- Estimated cost of owner-authorized changes.

CII/ COAA Benchmarking& Metrics
Revise Nov 16th, 2007

COAA

Performance Metric Category: SCHEDULE

Metric: ***Project Schedule Growth***	**Formula:** Actual Total Proj. Duration - Initial Predicted Proj. Duration / Initial Predicted Proj. Duration
Metric: ***Delta Schedule Growth***	**Formula:** **| Schedule Growth |**
Metric: ***Project Schedule Factor*** *(Contractor data only)*	**Formula:** Actual Total Project Duration / Initial Predicted Project Duration + Approved Changes
Metric: ***Delta Schedule Factor****(Contractor data only)*	**Formula:** **| 1- Schedule Factor |**
Metric: ***Phase Duration Factor*** *(Owner data only)*	**Formula:** Actual Phase Duration / Actual Overall Project Duration
Metric: ***Total Project Duration***	Actual Total Project Duration (weeks)
Metric: ***Phase Schedule Growth*** *(Owner data only)*	**Formula:** Actual Phase Duration – Initial Predicted Phase Duration / Initial Predicted Phase Duration

Definition of Terms

Actual Total Project Duration:
(Detailed Engineering through Start-up)

- Owners – Duration from beginning of detailed engineering to turnover to user.
- Contractors - Total duration for the final scope of work from mobilization to completion.

Actual Overall Project Duration:
(Front End Planning through Start-up)

- Unlike Actual Total Duration, Actual Overall Duration also includes time consumed for the Front End Planning Phase.

Actual Phase Duration:

- Actual total duration of the project phase in question. See the Project Phase Table in Appendix C for phase definitions.

Initial Predicted Project Duration:

- Owners – Predicted duration at the time of Project Sanction.
- Contractors - The contractor's duration estimate at the time of contract award.

Approved Changes

- Estimated duration of owner-authorized changes.

CII/ COAA Benchmarking& Metrics

Revise Nov 16th, 2007

COAA

Performance Metric Category: SAFETY

Metric: ***Lost Time Frequency (LTF)***	**Formula:** $\frac{\text{Total Number of Lost Time cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Medical Aid Frequency (MAF)***	**Formula:** $\frac{\text{Total Number of Medical Aid Cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***First Aid Frequency (FAF)***	**Formula:** $\frac{\text{Total Number of First Aid Cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Total Recordable Injury Frequency (TRIF)***	**Formula:** $\frac{\text{Total Number of Recordable Cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Total Injury Frequency (TIF)***	**Formula:** $\frac{\text{Total number of all injury or illness cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Restricted Work Frequency (RWF)***	**Formula:** $\frac{\text{Total Number of Restricted Work Cases x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Lost Time Severity Rate (LTSR)***	**Formula:** $\frac{\text{Total Number of Lost Time Workdays x 200,000}}{\text{Total Site Work-Hours}}$
Metric: ***Total Severity Rate (TSR)***	**Formula:** $\frac{\text{Total Number of Recordable Lost Time Cases and all Restricted Work Cases x 200,000}}{\text{Total Site Work-Hours}}$

Performance Metric Category: SAFETY (cont.)

Definition of Terms

- **Lost Time Days**: Equals the number of scheduled work days away from work as a result of an occupational injury or illness, disabling injury or illness which prevents a worker from reporting to work on next regularly scheduled.
- **Medical Aid Case**: Any occupational injury or illness requiring medical treatment administered by a physician, not including first aid treatment
- **First Aid Case**: Any one time treatment which does not require medical care or further medical aid e.g. minor scratches, cuts, burns, splinters.
- **Recordable Case**: A work event or exposure that is the discernable cause of an injury or illness or of a significant aggravation to a pre-existing condition. A recordable case requires medical aid, restricted work in relation to either medical aid or lost time, or fatality.
- **Total number of all injury or illness cases**: Equals the number of lost time (LT) cases, medical aid (MA) cases, first aid (FA) cases and the number of restricted work cases for lost time (RWLT), medical aid (RWMA) and first aid (RWFA).
- **Total Number of Restricted Work Cases**: Equals the number of restricted work lost time cases, restricted work medical aid cases and restricted work first aid cases.
- **Lost Time Case**: Lost Time cases are the result of an occupational injury or illness including any disabling injury which prevents a worker from reporting to work on his/her next regularly scheduled.
- **Restricted Work Case**: Includes restricted work lost time cases, restricted work medical aid cases and restricted work first aid cases.
- **Restricted Work Days**: Equals the number of scheduled work days that the worker was unable to work their regular duties as a result of an injury or illness as defined in restricted work.
- **Total Number of Recordable Lost Time Cases and all Restricted Work Cases**: Includes the number of lost workdays plus the number of restricted work days for all lost time, medical aid and first aids.

Performance Metric Category: CHANGES

Metric: ***Scope Change Cost Factor***	**Formula:** Total Cost of Scope Changes / Actual Total Project Cost
Metric: ***Project Development Change Cost Factor***	**Formula:** Total Cost of Project Development Changes / Actual Total Project Cost

Definition of Terms

- Total Cost of Scope Changes: Total cost impact of scope and project development changes.
- Total Cost of Project Development Changes: Total cost impact of project development changes.

Actual Total Project Cost:

- Owners –
  - All actual project cost from front end planning through startup
  - Exclude land costs but include in-house salaries, overhead, travel, etc.
- Contractors – Total cost of the final scope of work.

Performance Metric Category: REWORK

Metric: ***Total Field Rework Factor***	**Formula:** Total Direct Cost of Field Rework / Actual Construction Phase Cost

Definition of Terms

- Total Direct Cost of Field Rework: Total direct cost of field rework regardless of initiating cause.
- Actual Construction Phase Cost: All costs associated with the construction phase. See the Project Phase Table in Appendix C for construction phase definition.

CII/ COAA Benchmarking& Metrics

Revise Nov 16th, 2007

COAA

Construction Productivity and Total Installed Unit Cost (TIUC)
Metrics Categories and Breakouts

Concrete

- **Total Concrete**
  - **Slabs** (CM)
    - On-Grade (CM)
    - Elevated Slabs/On Deck (CM)
    - Area Paving (CM)
  - **Foundations** (CM)
    - < 4 CM
    - 4 – 15 CM
    - 15 –38 CM
    - ≥ 38 CM
  - **Concrete Structures** (CM)

Structural Steel

- **Total Structural Steel** (MT)
  - Structural Steel (MT)
  - Pipe Racks & Utility Bridges (MT)
  - Miscellaneous Steel (MT)

Instrumentation

- **Loops** (Count)
- **Devices** (Count)

Piping

- **Small Bore (2-1/2" & Smaller)** (LM)
  - Carbon Steel (LM)
  - Stainless Steel (LM)
  - Chrome (LM)
  - Other Alloys (LM)
  - Non Metallic (LM)
- **Inside Battery Limits (ISBL)** (LM)
  Large Bore (3" & Larger) (LM)
  - Carbon Steel (LM)
  - Stainless Steel (LM)
  - Chrome (LM)
  - Other Alloys (LM)
  - Non Metallic (LM)
- **Outside Battery Limits (OSBL)** (LM)
  Large Bore (3" & Larger) (LM)
  - Carbon Steel (LM)
  - Stainless Steel (LM)
  - Chrome (LM)
  - Other Alloys (LM)
  - Non Metallic (LM)
- **Heat Tracing Tubing (LM)**

Electrical

- **Total Electrical Equipment** (Each)
  - Panels and Small Devices (Each)
  - Electrical Equipment below 1kV (Each)
  - Electrical Equipment over 1kV (Each)
- **Conduit** (LM)
  - Exposed or Above Ground Conduit (LM)
  - Underground, Duct Bank or Embedded Conduit (LM)
- **Cable Tray** (LM)
- **Wire and Cable** (LM)
  - Control Cable (LM)
  - Power and Control Cable below 1kV (LM)
  - Power Cable above 1kV (LM)
- **Transmission Line** (LM)
  - High Voltage above 25kV (LM)
- **Other Electrical Metrics**
  - Lighting (Each)
  - Grounding (LM)
  - Electrical Heat Tracing (LM)

Equipment

- **Pressure Vessels (Field Fab.& Erected)** (Each), (MT)
- **Atmospheric Tanks (Shop Fabricated)** (Each), (MT)
- **Atmospheric Tanks (Field Fabricated)** (Each), (MT)
- **Heat Transfer Equipment** (Each), (MT)
- **Boiler & Fired Heaters** (Each), (MT)
- **Rotating Equipment** (Each), (HP)
- **Material Handling Equipment** (Each), (MT)
- **Power Generation Equipment** (Each), (kW)
- **Other Process Equipment** (Each), (MT)
- **Modules & Pre-assembled Skids** (Each), (MT)

Insulation

- **Equipment**
  - Insulation Equipment (SM)
- **Piping**
  - Insulation Piping (ELM)

Offsite Modules

- **Pipe Racks** (MT)
- **Process Equipment Modules** (MT)
- **Building** (SM)

Scaffolding

- **Scaffolding Work-Hours**
  - Percentage estimated WH/ total direct hours
  - Percentage Actual WH/ total direct hours

$$\textbf{Construction Productivity Unit Rate} = \frac{\textbf{Direct Work-Hours}}{\textbf{Installed Quantity}}$$

$$\textbf{Productivity Deviation Factor} = \frac{\textbf{Actual Productivity Rate}}{\textbf{Estimated Productivity Rate}}$$

$$\textbf{Cost Deviation Factor} = \frac{\textbf{Actual TIUC}}{\textbf{Estimated TIUC}}$$

CII/ COAA Benchmarking& Metrics

Revise Nov 16th, 2007

COAA

Engineering Productivity Metrics Categories and Breakouts

Concrete

- **Total Concrete (CM)**
  - Total Slabs (CM)
    - Ground and Supported Slab (CM)
    - Area Paving (CM)
  - Total Foundations (except Piling) (CM)
    - Foundation (<4CM) (CM)
    - Foundation (≥4CM) (CM)
  - Concrete Structures (CM)
  - Total Piling (Each)

Structural Steel

- **Total Steel (MT)**
  - Combined Structural Steel / Pipe Racks & Utility Bridges (MT)
    - Structural Steel (MT)
    - Pipe Racks & Utility Bridges (MT)
  - Miscellaneous Steel (MT)

Electrical

- **Total Electrical Equipment** (Each)
  - Electrical Equipment 600V & Below (Each)
  - Electrical Equipment Over 600V (Each)
- **Conduit**
  - Conduit (LM)
  - Conduit (Number of Runs)
- **Cable Tray** (LM)
- **Wire & Cable**
  - Wire & Cable (LM)
  - Wire & Cable (Number of Terminations)
- **Other Electric Metric**
  - Lighting (Each Fixtures)
  - Electrical Heat Tracing (LM)

Piping

- **Total Piping (LM)**
  - Small Bore (2-1/2" and Smaller) (LM)
  - Large Bore (3" and Larger) (LM)
  - Engineered Hangers and Supports (Each)
- **Heat Tracing Tubing (LM)**

Instrumentation

- **Loops** (Count)
- **Tagged Devices** (Each)
- **I/O** (Count)

Equipment (Individual Design and Total Quantity)

- **Total Equipment (Each)**
  - Pressure Vessels (Each)
  - Atmospheric Tanks (Each)
  - Heat Transfer Equipment (Each)
  - Boiler & Fired Heaters (Each)
  - Rotating Equipment (Each)
  - Material Handling Equipment (Each)
  - Power Generation Equipment (Each)
  - Other Process Equipment (Each)
  - Vendor-Designed Modules & Pre- Assembled Skids (Each)

Engineering Productivity = $\dfrac{\text{Direct Design-Hours*}}{\text{IFC Quantity**}}$

* Per Design Component

** IFC (Issued for Construction)

Project Phase Definition Table

Project Phase	Start/Stop	Typical Activities & Products	Typical Cost Elements
Front End Planning Typical Participants: • Owner Personnel • Planning Consultants • Constructability Consultant • Alliance / Partner	**Start: Single project adopted and Formal project team established** **Stop: Project Sanction**	• Options Analysis • Life-cycle Cost Analysis • Project Execution Plan • Appropriation Submittal Pkg • P&IDs and Site Layout • Project Scoping • Procurement Plan • Arch. Rendering	• Owner Planning Team Personnel Expenses • Consultant Fees & Expenses • Environmental Permitting Costs • Project Manager / Construction Manager Fees • Licensor Costs
Detail Engineering Typical Participants: • Owner Personnel • Design Contractor • Constructability Expert • Alliance / Partner	**Start: Contract award to engineering firm** **Stop: Release of all approved drawings and specs for Construction (or last package for fast-track)**	• Drawing & spec. preparation • Bill of material preparation • Procurement Status • Sequence of operations • Technical Review • Definitive Cost Estimate	• Owner Project Management Personnel • Designer Fees • Project Manager / Construction Manager Fees
Procurement Typical Participants: • Owner personnel • Design Contractor • Alliance / Partner	**Start: Procurement plan for engineered equipment** **Stop: All major equipment has been delivered to site**	• Vendor Qualification • Vendor Inquiries • Bid Analysis • Purchasing • Expediting • Engineered Equipment • Transportation • Vendor QA/QC	• Owner project management personnel • Project Manager / Construction Manager fees • Procurement & Expediting personnel • Engineered Equipment • Transportation • Shop QA / QC
Note: The demolition / abatement phase should be reported when the demolition / abatement work is a separate schedule activity (potentially paralleling the design and procurement phases) in preparation for new construction. Do not report the demolition / abatement phase if the work is integral with modernization or addition activities.			

Project Phase Table (Cont.)

Project Phase	**Start/Stop**	Typical Activities & Products	Typical Cost Elements
Construction Typical Participants: • Owner personnel • Design Contractor (Inspection) • Construction Contractor and its subcontractors	**Start: Commencement of foundations or driving Piles** **Stop: *Mechanical Completion***	• Set up trailers • Procurement of bulks • Issue Subcontracts • Construction plan for Methods/Sequencing • Build Facility & Install Engineered Equipment • Complete Punchlist • Demobilize construction equipment • Warehousing	• Owner project management personnel • Project Manager / Construction Manager fees • Building permits • Inspection QA/QC • Construction labour, equipment & supplies • Bulk materials (including freight) • Construction equipment (including freight) • Contractor management personnel • Warranties
Start-up / Commissioning Note: Does not usually apply to infrastructure or building type projects Typical Participants: • Owner personnel • Design Contractor • Construction Contractor • Training Consultant • Equipment Vendors	**Start: *Mechanical Completion*** **Stop: Custody transfer to user/operator (steady state operation)**	• Testing Systems • Training Operators • Documenting Results • Introduce Feedstocks and obtain first Product • Hand-off to user/operator • Operating System • Functional Facility • Warranty Work	• Owner project management personnel • Project Manager / Construction Manager fees • Consultant fees & expenses • Operator training expenses • Wasted feedstocks • Vendor fees