# Cost Forecast & Capital Projects

## Beyond Cost Estimates

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Despite of extensive researches and studies by both industries & academic institution in past few decades, no convincing evidences are produced to aggregate the true root causes of megaprojects' failure.

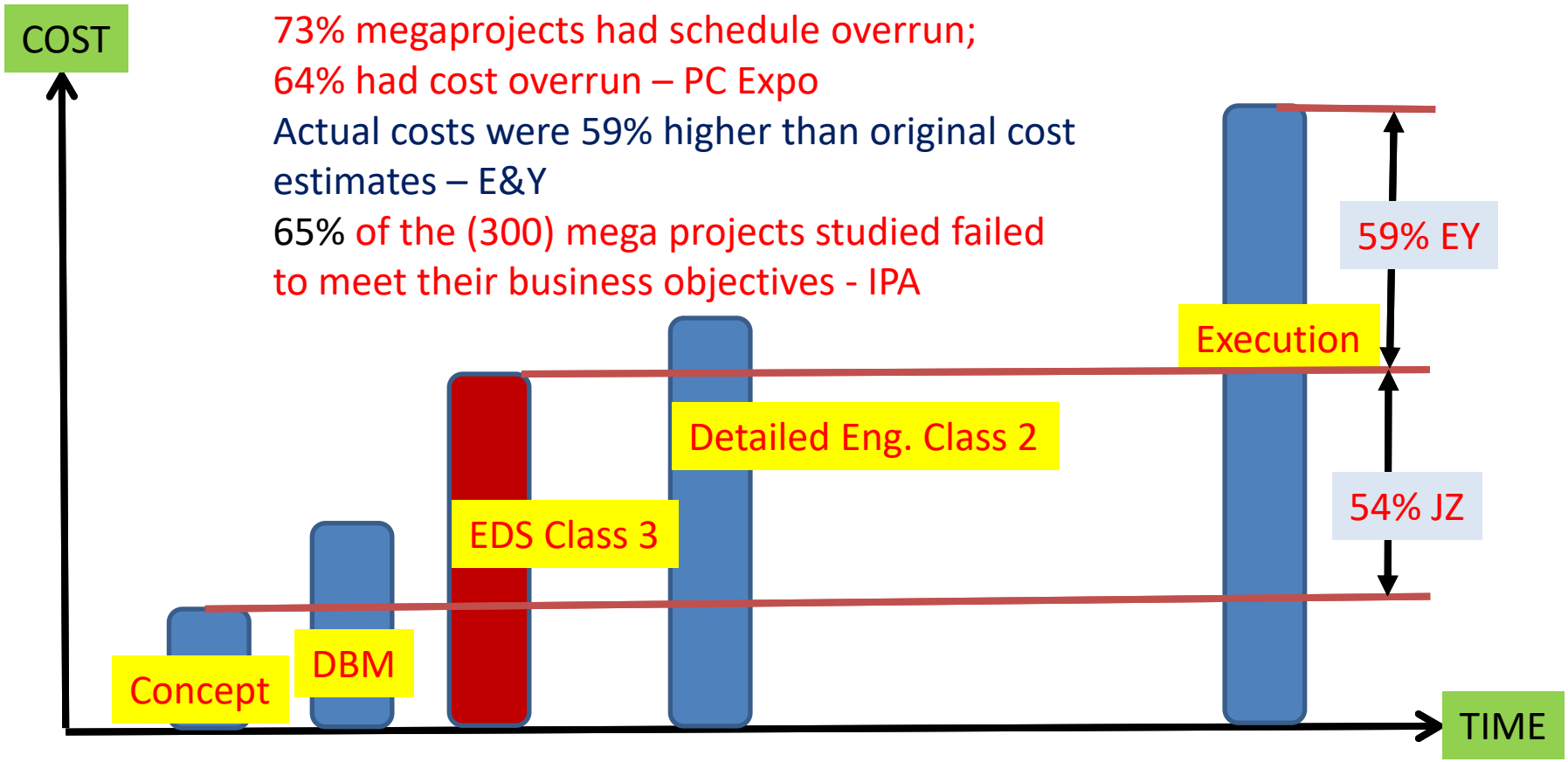
Because they are woven into the fabrics of an organization's culture, it is nearly impossible to generalize "generic" reasons why projects failed.

This presentation does not intend to analyse the root causes but investigates it from **cost forecast** lens.

# Capital Project Cost Escalation

## FACTS

73% megaprojects had schedule overrun;
64% had cost overrun – PC Expo
Actual costs were 59% higher than original cost estimates – E&Y
65% of the (300) mega projects studied failed to meet their business objectives - IPA




Dr. Flyvbjerg stated in his research that it is not uncommon for megaprojects to have Up to 100% cost overruns, measured from project initiation phase to final RFO.

# Muskrat Falls Project Inquiry - 2019

**100%** cost overrun of this public funded Megaproject in Newfoundland

## Political and Risk Influences

**Dr. Flyvbjerg (Oxford University) found the following for megaprojects**:

- **Megaprojects always involve the intersection of risk, democracy and power.** Political and regulatory authorities normally define parameters and goals to suit their own ends, but frequently forget the transparency concept in regulatory structures that affect the viability of a project.

- **Megaprojects cannot be planned and executed in a predictable world where cause-effect are evident**. Political interference and changing in governments make imperfect environments on executing megaproject developments.

- **Megaprojects undertaken in emerging economies**, for example, face poor prospects for more transparent stakeholder involvement, efficient and effective public sector risk analysis, and government bodies in emerging economies often **lack the institutional capacity and depth to perform proficient risk assessments**

# Things could Go Wrong

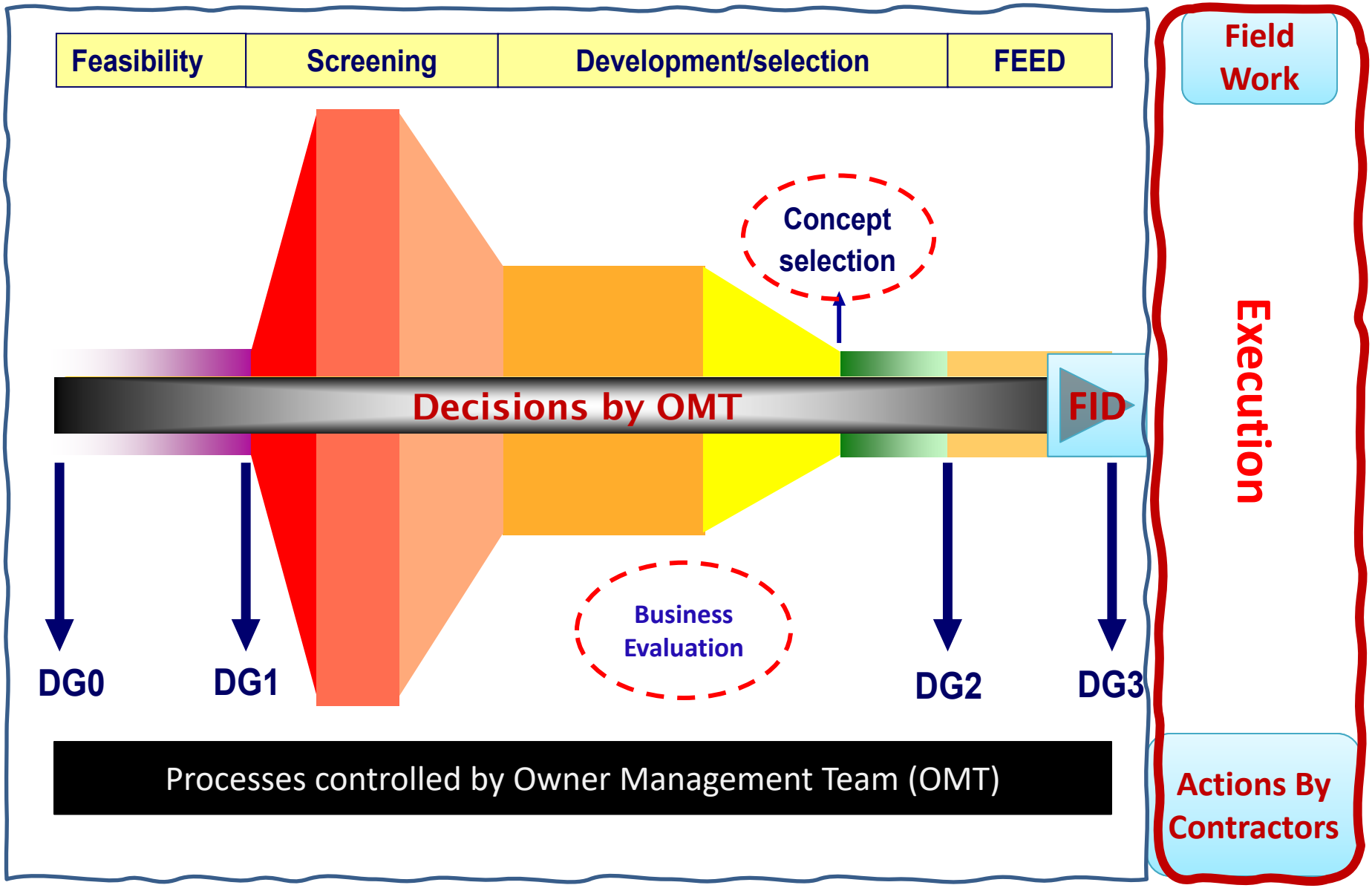
For any megaproject, the following could happen, due to its intricacy, multidisciplinary interfaces, complexity and unpredictability:

- Major Accidents or Incidents causing a Fatality or Injuries
- Prolonged schedule (extension or delay) beyond the plan
- **Cost over-run from its FID Approval (**this is a Topic at Global Level**)**
- Staff or labor-force High Turn-over Ratio or Higher Attrition
- Underperformance of awarded construction contractors
- And so on ….

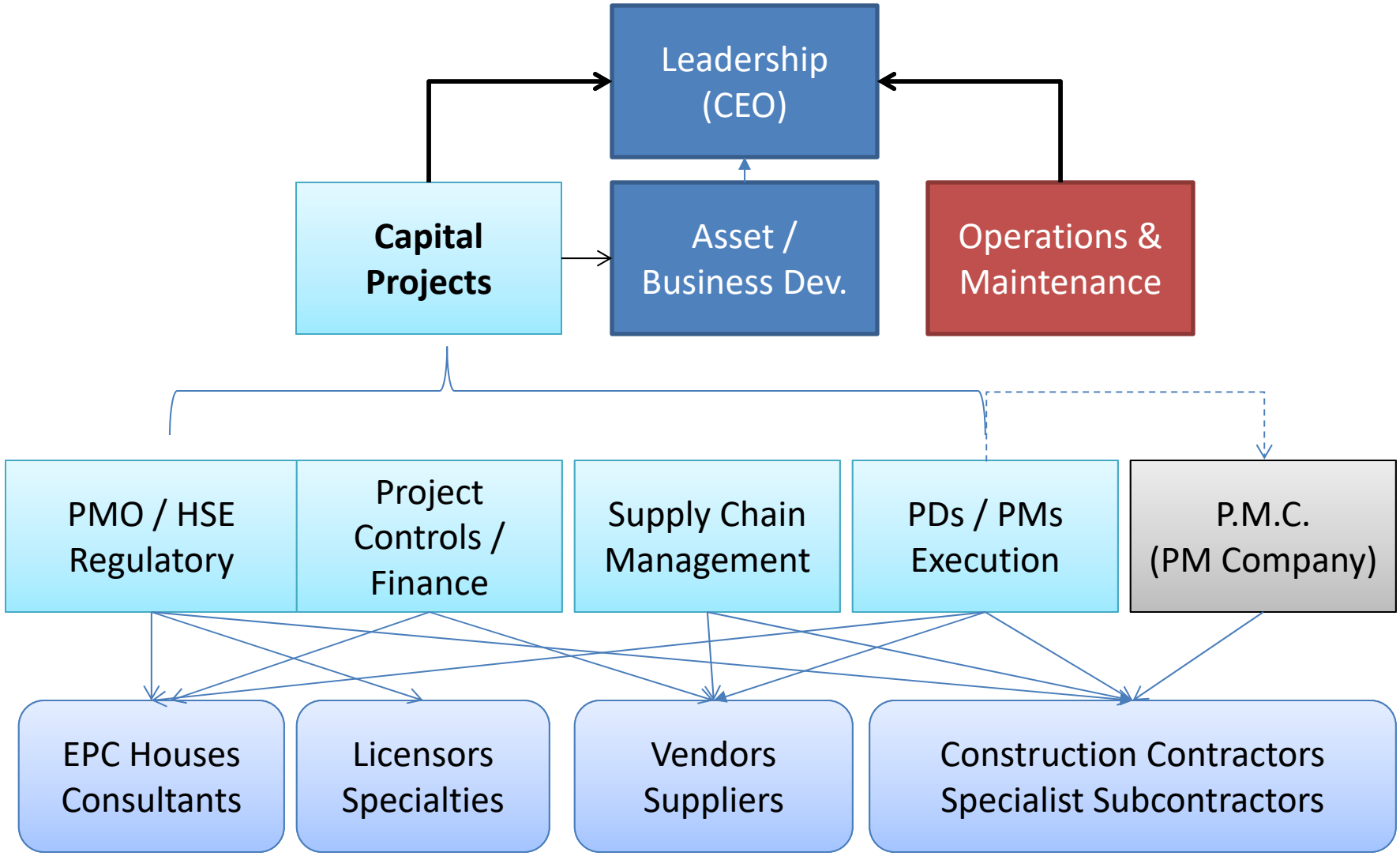
Unfortunately, Not all companies are well prepared / equipped to proactively handle such **risks in advance,** most of them, however, only take reactive approach.

But many owner operating companies also have “modernized” their project management process, strengthened their core leadership, enhanced staff’s competences and capabilities, all are well prepared to **cope with and proactively tackle such risk events.**

# Project Decisions – By OMT



# Project Organizational Structure




* Note communication chaos from OMT function teams is the Cash for contractors.

## Cost Proportions

To manage a megaproject, OMT and relevant owner internal supporting functions typically takes between 5% and 10% of Total Installed Costs (TIC), depending upon the types of contracts with EPC and GCC contractors.

Up to 10% project cost is for front end and detailed engineering.
**Up to 80% project costs are spent by suppliers and contractors.**

**Hence it is extremely crucial for an OMT to have:**

- Strict and disciplined financial rules and practices for expenditures;
- Clear roles ad responsibilities of Owner's Delegation of Authority;
- Effectuated contractual clauses, terms and conditions, addendum;
- Efficient field change management process for approvals & records;
- Realistic & agreeable performance baseline cost estimate & schedule;
- Timely **Total Cost Forecasting with proven Technique & Competence** .

## Forecasting EAC

**An early warning of cost overruns can be detected through cost forecast process which includes Change Management and EAC:**

- Prequalify and hire competent contractors to execute projects with skills and experiences and report EAC periodically;
- Use customized lump-sum or fixed fee conversion contracting model to hold contractors accountable for total EAC;
- Increase in-house competence to estimate cost & schedule baseline, monitor progress, manage risks, control changes & forecast EAC frequently;
- Hire temporary seasoned PM / PMC professionals to manage megaprojects professionally with EAC as target;

**Cost Estimator:** An approximation of the probable cost of a product, program, or project, computed based on available information before the work starts. (***Cost Estimator***)

**Cost Forecaster:** Based on the work completed and costs expended at any given time, a cost forecaster determines the values of the remaining activities and estimates the probable final costs (TIC) to complete such activities in consideration of productivities, change management and initial inadequacy of information using the established work process to adapt cost planning to constantly changing circumstances. (***Cost Engineer***)

## Cost Estimate to Create a "Baseline"

**Definition**:

A cost estimate is the **prediction** of the **probable** costs of a project, of a given and documented **scope**, to be completed at a **defined location** and **point of time** in the future.

**Characteristics**:

- Involves assumptions, exclusions and uncertainties
  hence, some level of error (never being right)
- Involves probabilities of over or under running
  hence, ranges of costs (never a single number)
- Involves a given and defined scope of work
  hence, possible scope creep (never assume frozen)
- Involves risks and quantitative risk analysis
  hence, contingency necessary (never enough)

# Re-casting Estimate as basis for Forecasting

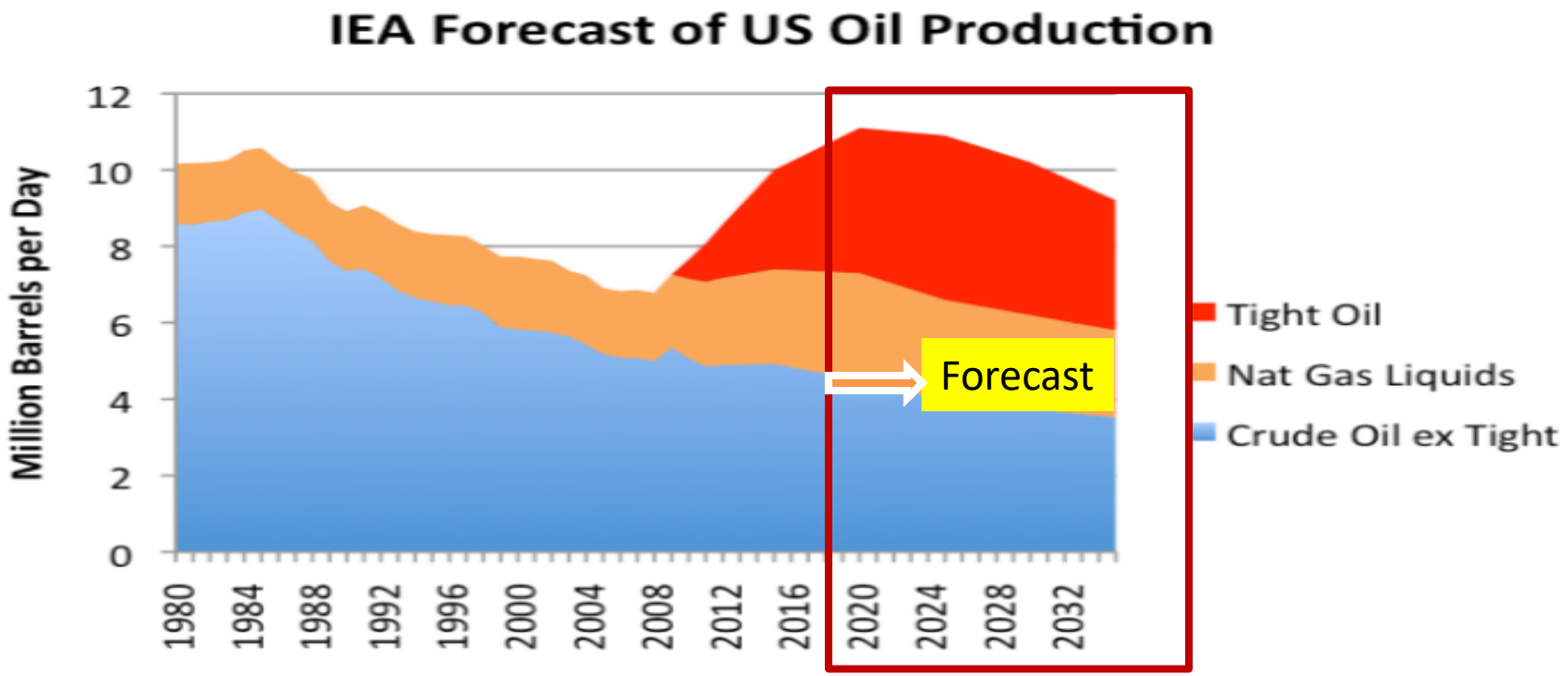
| Code of Accounts | Field Labour | | Bulk Mat'ls | Subcontracts | Offsite Fabs. | Other | AFE Budget |
|---|---|---|---|---|---|---|---|
| | Hours | x $1,000 | x $1,000 | x $1,000 | x $1,000 | x $1,000 | x $1,000 |
| **Project Direct Costs** | 416,667 | 50,000 | 20,000 | 10,000 | 5,000 | 5,000 | 90,000 |
| Process Equipment | | | | | | | *0* |
| Civil and Structure | | | | | | | *0* |
| Piping and Fittings | | | | | | | *0* |
| Electrical & Control Systems | | | | | | | *0* |
| **Project Indirect Costs** | 166,667 | 20,000 | 2,500 | 5,000 | 0 | 2,500 | 30,000 |
| Construction Management (Site) | | | | | | | *0* |
| Field Services (Roads, Facilities) | | | | | | | *0* |
| **Engineering and Project Management** | 53,846 | 7,000 | 500 | 500 | 0 | 2,000 | 10,000 |
| **TOTAL TIC** | **637,179** | **77,000** | **23,000** | **15,500** | **5,000** | **9,500** | **130,000** |

**AFE Budget** is based on the approved cost estimate including necessary contingency and escalation; the total budget is then allocated to WBS per company COA for cost management.

It is the responsibility of either Project Controls Manager or the senior cost engineer to re-case the approved cost estimate (i.e. AFE) into appropriate and manageable code of accounts at the start of the project execution.

## Concept of Forecasting

**Forecasting** is the process of making predictions of the future based on past and present data and most commonly by analysis of trends. A commonplace example might be estimation of some variable of interest at some specified future date.
Prediction is a similar, but more general term.

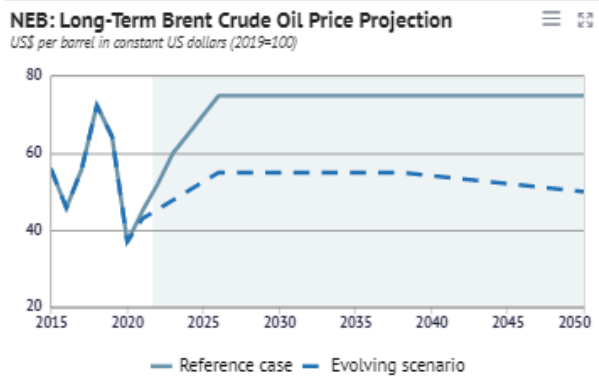


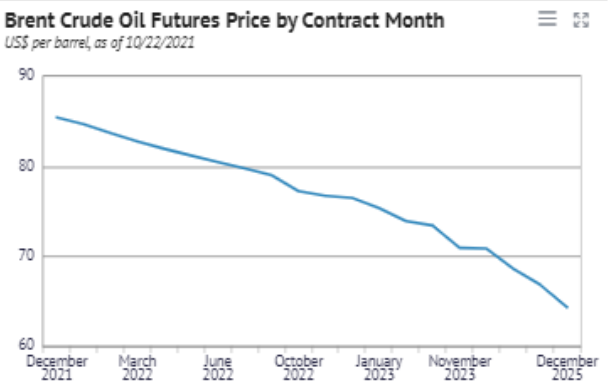
# Forecast is an Art or Sciences

Forecast is an obligation, everyone does it.

Using the education, knowledge, experience and with the assistance of statistical data, you are obliged to predict future outcomes (of both personal & business).

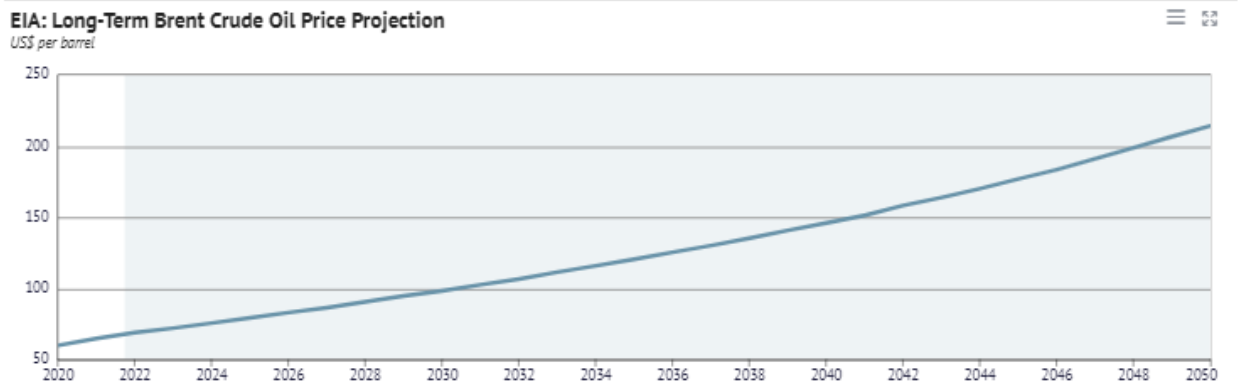
No right or wrong forecast untill it is proven.




| Year | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| Reference | 55.81 | 45.79 | 55.87 | 72.47 | 64.35 | 37.00 | 45.00 | 52.00 | 60 |
| Evolving | 55.81 | 45.79 | 55.87 | 72.47 | 64.35 | 37.00 | 43.00 | 45.40 | 4 |

| | December 2021 | January 2022 | February 2022 | March 2022 |
|---|---|---|---|---|
| 2021 Oct 22 | 85.46 | 84.69 | 83.70 | 82.79 |

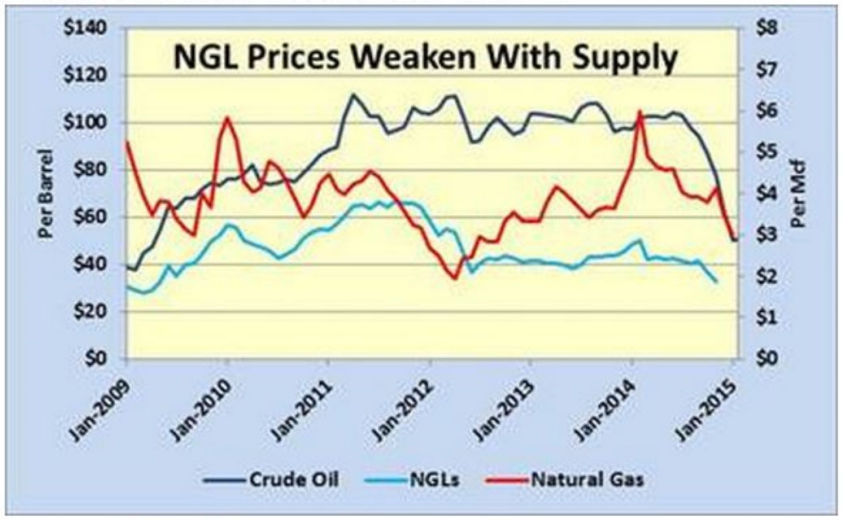



| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 | 2036 | 2037 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| nom $/b | 59.93 | 64.69 | 68.86 | 72.01 | 75.53 | 79.24 | 83.03 | 86.48 | 90.51 | 94.65 | 98.29 | 102.56 | 106.52 | 111.48 | 115.85 | 120.47 | 125.41 | 130.16 |

# Forecasting Is A Gamble

**The admonition to economists: forecast often but only gives a price with no date, or a date with no price.**

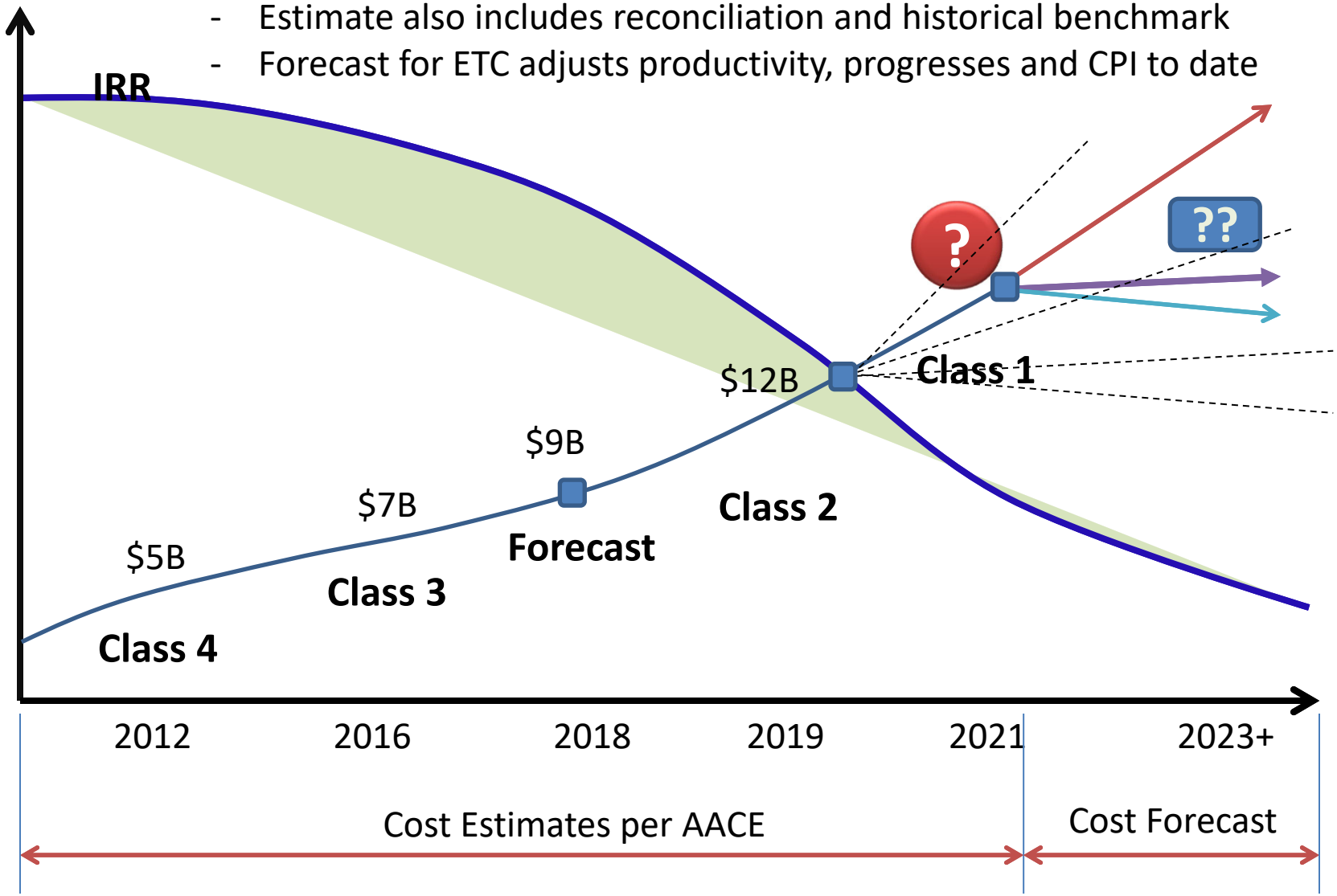
**Example: "**The incentive to continue drilling for NGL-rich natural gas may ease with sustained lower crude oil prices. – Feb. 2015"




Source: EIA, PPHB

# Estimate vs Forecast

- Forecast can be equally reliable and convincing if done properly
- Estimate also includes reconciliation and historical benchmark
- Forecast for ETC adjusts productivity, progresses and CPI to date



# Forecasting Technique – Trending Method

**Deterministic Approach**

BAC

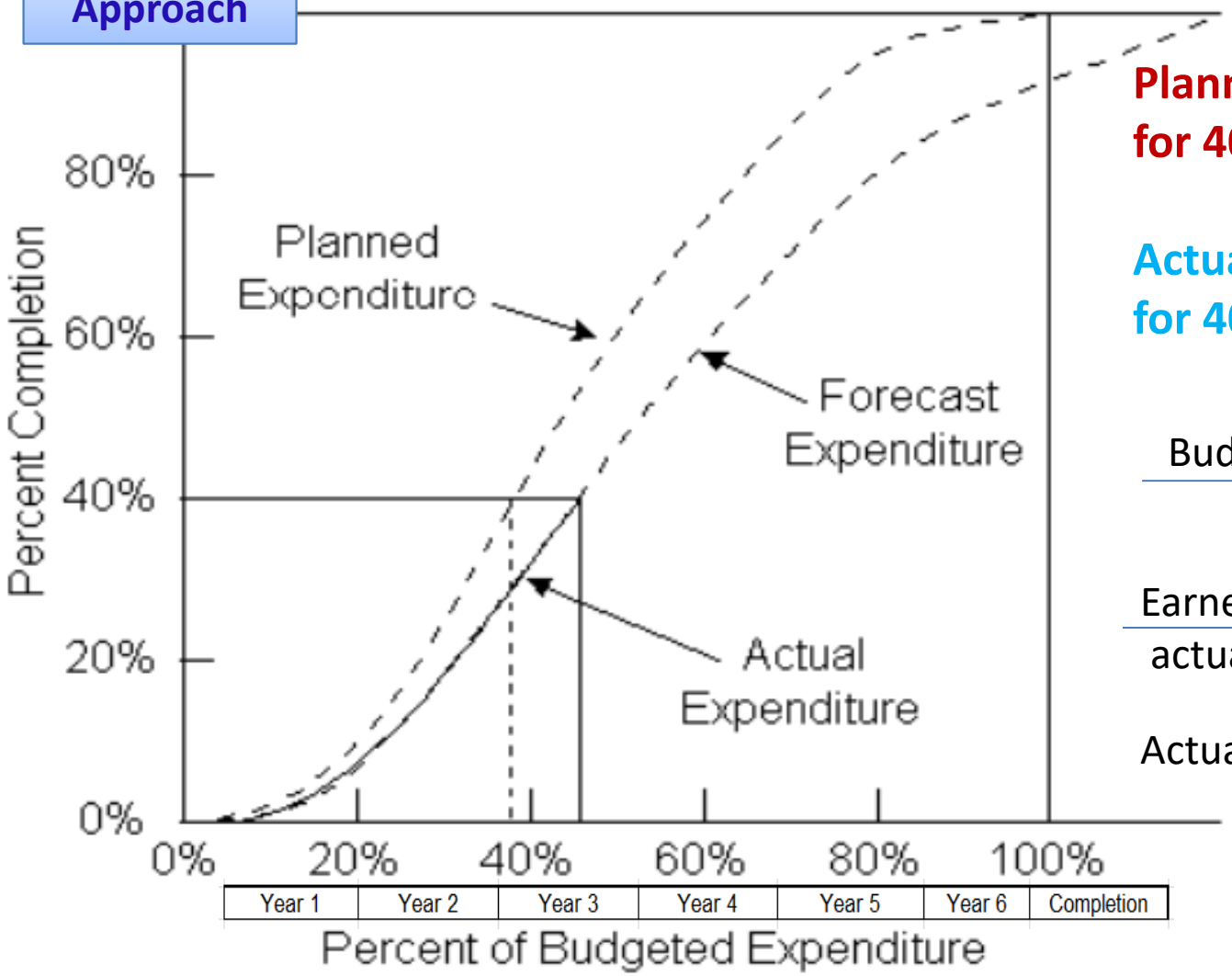
VAR

EAC

| **Major Project Cost Categories** Canadian Dollars x $1,000 | Approved AFE Budget | Approved Changes | Pending / Potential Trends | Percent of Complete | Final Forecast (EAC) |
|---|---|---|---|---|---|
| | A | B | C | D / (A+B) | A+B+C |
| **Project Direct Costs** | 90,000 | 6,000 | 9,000 | 35.42% | 105,000 |
| Field labour Costs (onsite) | *40,000* | *5,000* | *2,000* | *22.2%* | *47,000* |
| Total Subcontracted Work (Contracts) | *20,000* | *0* | *5,000* | *40.0%* | *25,000* |
| Bulk Materials (procured) | *10,000* | *0* | *2,000* | *40.0%* | *12,000* |
| Total Fabricated Work (offsite) | *20,000* | *1,000* | *0* | *57.1%* | *21,000* |
| **Project Indirect Costs** | 30,000 | 1,000 | 7,500 | 38.71% | 38,500 |
| Construction Management (Site) | *5,000* | *1,000* | *2,500* | *33.3%* | *8,500* |
| Field Services (Roads, Facilities) | *25,000* | *0* | *5,000* | *40.0%* | *30,000* |
| **Engineering and Project Management** | 10,000 | 1,000 | 500 | 45.45% | 11,500 |
| **TOTAL Project Cost** | **130,000** | **8,000** | **17,000** | 36.96% | **155,000** |

# Forecasting Technique – Earned Value

**Performance Approach**




**Planned 38% of budget for 40% progress**

**Actually 45% of budget for 40% progress**

$$\frac{\text{Budget - EV}}{\text{CPI}} = \text{ETC}$$

$$\frac{\text{Earned Value (EV)}}{\text{actual cost (AC)}} = \text{CPI}$$

Actual % x Budget = EV

## An Alternative Forecasting Technique

**An Alternative** method is proposed herein to forecast project time and cost at completion (EAC) and/or at any given time horizon.

The method, based on Monte Carlo Simulation, is designed to *overcome limitations of current applications* of earned value method (EVM – based on historical performance without seeing the future improvements) in forecasting project cost and durations.

The **Monte Carlo Simulation** is based on probabilistic process and it enables the user to assess the uncertainty associated with forecasted project activities (i.e. cost and duration) at project completion so that appropriate corrective actions (i.e. extra costs and time) can be forecasted, when needed.

# Forecasting Technique – Monte Carlo

CAT. | BAC | AC | RISK | EAC | VAR

| Major Cost Component Groupings | Cost Estimate 10-Oct-08 | Incurred as of 10-Oct-08 | Risk Exposure 10-Oct-08 | Total Forecast 10-Oct-08 | Contingency Variance |
|---|---|---|---|---|---|
| Equipment & Bulk | 87,908 | 40,000 | 47,908 | 87,908 | 0 |
| Fabrication / Moduls | 77,415 | 10,000 | 67,415 | 77,415 | 0 |
| Field construction | 499,896 | 50,000 | 449,896 | 499,896 | 0 |
| Engineering | 62,000 | 40,000 | 22,000 | 62,000 | 0 |
| Owner Costs | 104,257 | 15,000 | 89,257 | 104,257 | 0 |
| **Subtotal** | **$831,476** | **$155,000** | **$676,476** | **$831,476** | **$0** |
| Risked Contingency (P70) | 101,267 | 0 | 98,020 | 98,020 | -3,247 |
| Risk Register Contingency (P70) | 0 | 0 | 20,387 | 20,387 | 20,387 |
| Rare Event Contingency (P70) | 0 | 0 | 2,739 | 2,739 | 2,739 |
| Risked Escalation (P70) | 0 | 0 | 43,163 | 43,163 | 43,163 |
| **Subtotal** | **$101,267** | **$0** | **$164,309** | **$164,309** | **$63,042** |
| **GRAND TOTAL** (Estimated P70) | **$932,743** | **$155,000** | **$840,784** | **$995,784** | **$63,042** |
| Risked Estimate Contingency (P50) | $101,267 | 0 | 86,368 | 86,368 | -14,899 |
| Risk Register Contingency (P50) | $0 | 0 | 18,435 | 18,435 | 18,435 |
| Rare Event Contingency (P50) | $0 | 0 | 1,064 | 1,064 | 1,064 |
| Risked Escalation (P50) | $0 | 0 | 42,934 | 42,934 | 42,934 |
| **Subtotal** | **$101,267** | **$0** | **$148,801** | **$148,801** | **$47,534** |
| **GRAND TOTAL (Estimated P50)** | **$932,743** | **$155,000** | **$825,277** | **$980,277** | **$47,534** |

## Key Advantages (Riscor Crystalball):

1. It allows PMT to focus on improving “future activities and cost items” using historical project performance benchmarks in the past;

2. It considers past actual site productivity and factors them into contractors’ future performances (for remaining work);

3. It timely adjusts supply chains’ purchasing prices by forecasting future commodity pricing range using the most current market price index;

4. It combines estimate-specific line-item variability with project-wide systemic risk events generating a consolidated holistic project risk profile;

5. It generates final project estimate at completion (EAC, or Forecast) from overarching and holistic project-wide portfolio view-point instead of cost-code based approach;

6. It considers indirect cost impacts on overall project for probable construction time / schedule delay and builds into the cost forecast.

7. It identifies key cost and schedule drivers hence applying mitigation measures in advance of risks’ occurrence or undertaking consequential cost impacts.

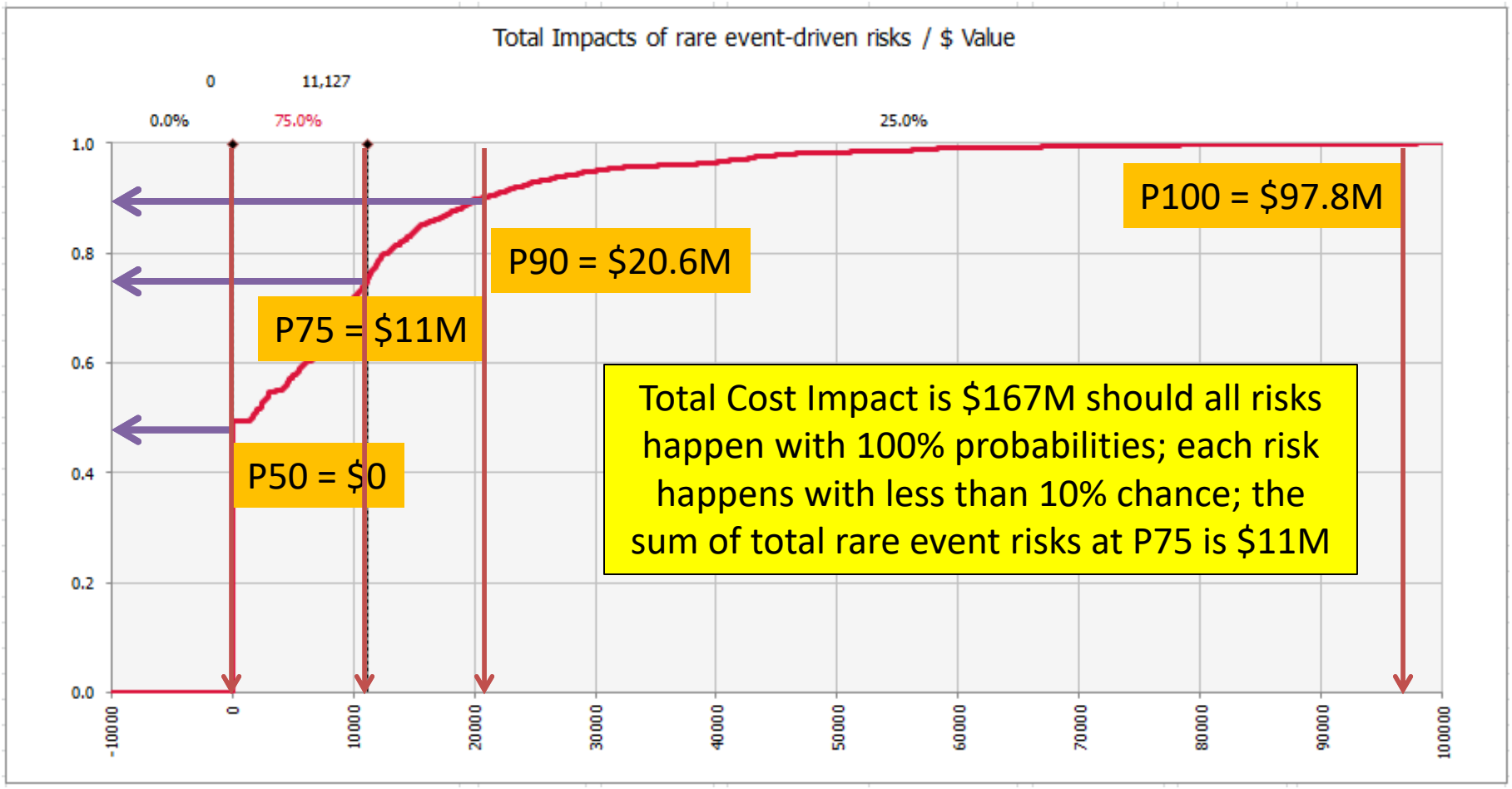
## Project-wide Systemic Risks – in EAC

Systemic risks may have profound negative impacts on project objectives but are intangible, invisible, elusive and inherent to an organization's culture, not only difficult to identify but also hard to be included in risk assessment such as

- Owner company's culture (operation oriented vs. project oriented)
- Project leadership style (Laissez-faire vs. autocratic leaders)
- Maturity of PM systems, processes and tools (developed vs. developing)
- Market conditions & assumptions (labor, materials, escalation, etc.)
- Optimism biases for major project's complexity and challenges
- Suitability of Organizational Structure and Competences of PMT
- Relationship with Contractors and Commercial Compensations
- Stakeholder Relations and Communication with Communities
- Oppositions, Protests, Climate Change & Regulatory Compliances

Traditional cost forecast techniques would **NOT** consider or include the systemic risks into final project cost or schedule forecasts, this is a major **FLAW,** and it is about the time to have a paradigm shift in Project Controls practice.

# Black Swans – out of EAC




The Management and Strategic Risk Reserve is the simulation result of residual risks and rare-event driven risks. It is not a part project contingency but an additional reserve.

## To be Successful in Forecasting EAC

### Owner Project Controls Team:

- Must have holistic and strategic visions of project's cost entirety
- Must manage overarching project costs with central planning
- Must get ready to be onsite and verify actual progress for CPI
- Must thoroughly understand the dynamics of "productivity"
- Must be the cohesive core of all fragmented project cost elements

### Contractors Project Controls Team:

- Keep experienced and competent key PC members on frontline
- Have a robust project change management systems & process
- Document every changes and have owner timely sign them
- Be cognizant with business "Relationship" and Claim Readiness
- Review cost & schedule forecasts periodically with owner team

# THANK YOU, from Riskcore Team

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**OUR EXPERTISE:** To focus on specialty and niche skills by working with competent & experienced professionals collaborating as a team

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***Specializing in Quantitative Risk Analysis of Capital Cost Estimates Supported By Proprietary RISCOR™ Monte Carlo Simulation Model***

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