



SPE/IADC-173148

Well Cost Estimation and Control

Advanced Methodologies for Effective Well Cost Management

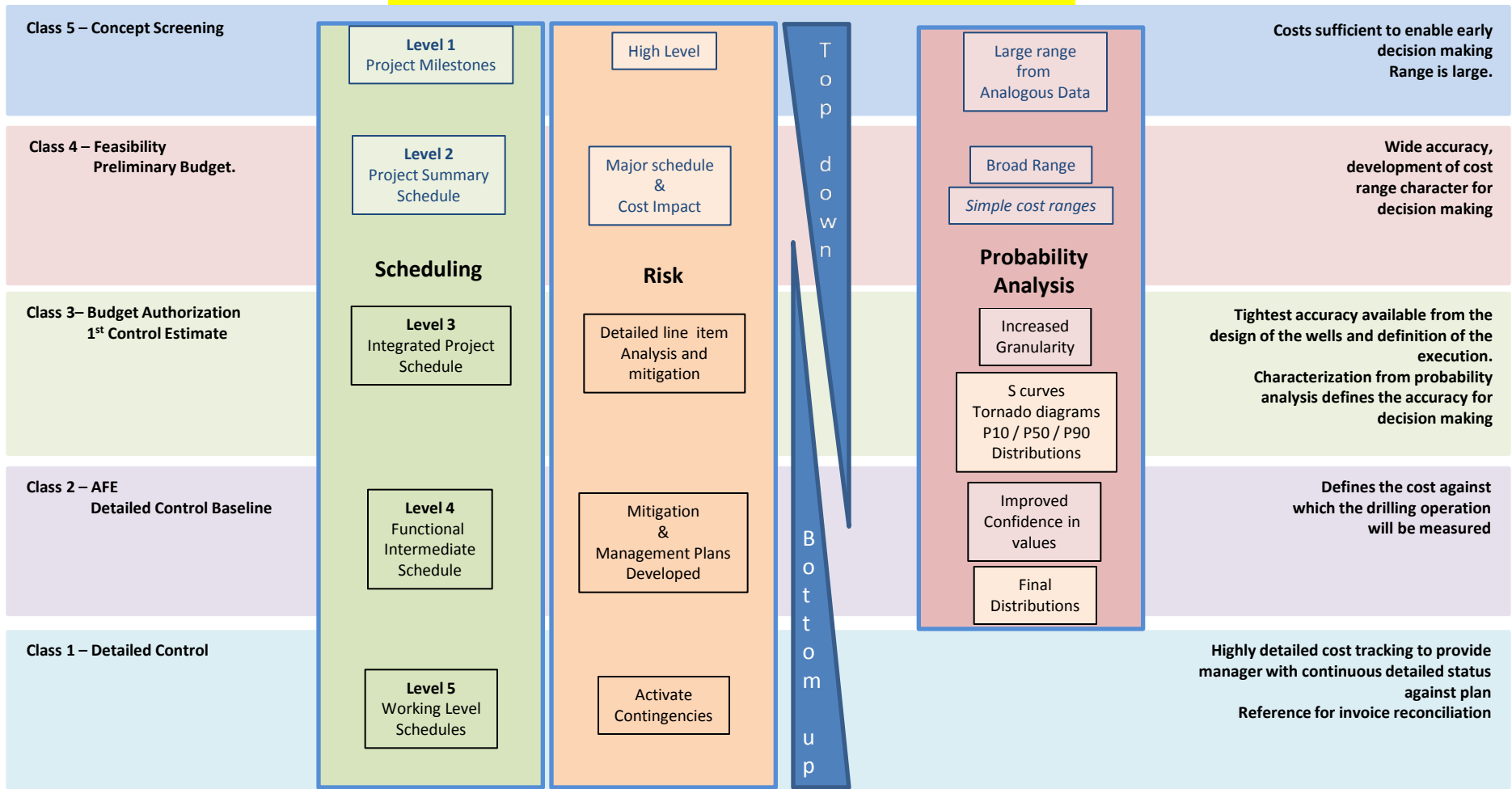
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Significant improvement in well cost estimation and control is required

- Effective well cost estimation and control is critical
- Many poor practices across drilling industry
- Classification of costs provides a foundation
- Linkage to schedule, uncertainty and risks drives the outcome
- Probabilistic estimation has value typically not seen
- Effective well cost estimation and control workflow
- Time to do it right
 - Drilling & Completion Cost Estimation and Control Framework



Why does the industry need to improve?

- Well feasibility costs drive the economic analysis
 - leading to a decision to implement a project.
- Drilling budget and AFE define a significant component of the expenditure of an operating company.
- Actual well costs define the expenditure made
 - provide reconciliation to the invoiced quantities.

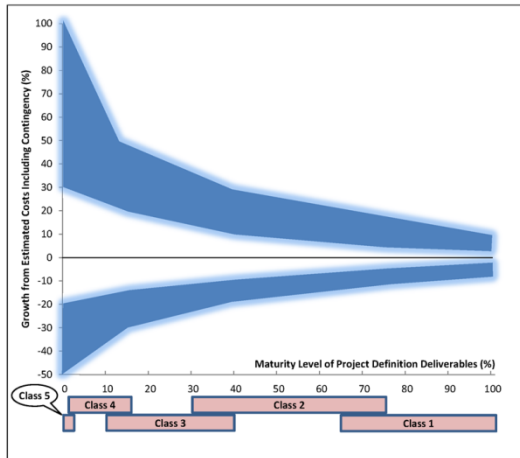


Poor practices are prevalent

- Deterministic estimates used when uncertainty and risk prevail
- Wrong people make the estimate
- Estimators lack a defined system and training
- Contingency is a fixed percentage (often 10%)
- Probabilistic estimating is misapplied through lack of understanding
- AFE variances after overruns occurred

Cost classes follow a standard

- Defined by AACEI and DOE
- Logical stages that match well design / programming
- Creates consistency with facilities and FDP



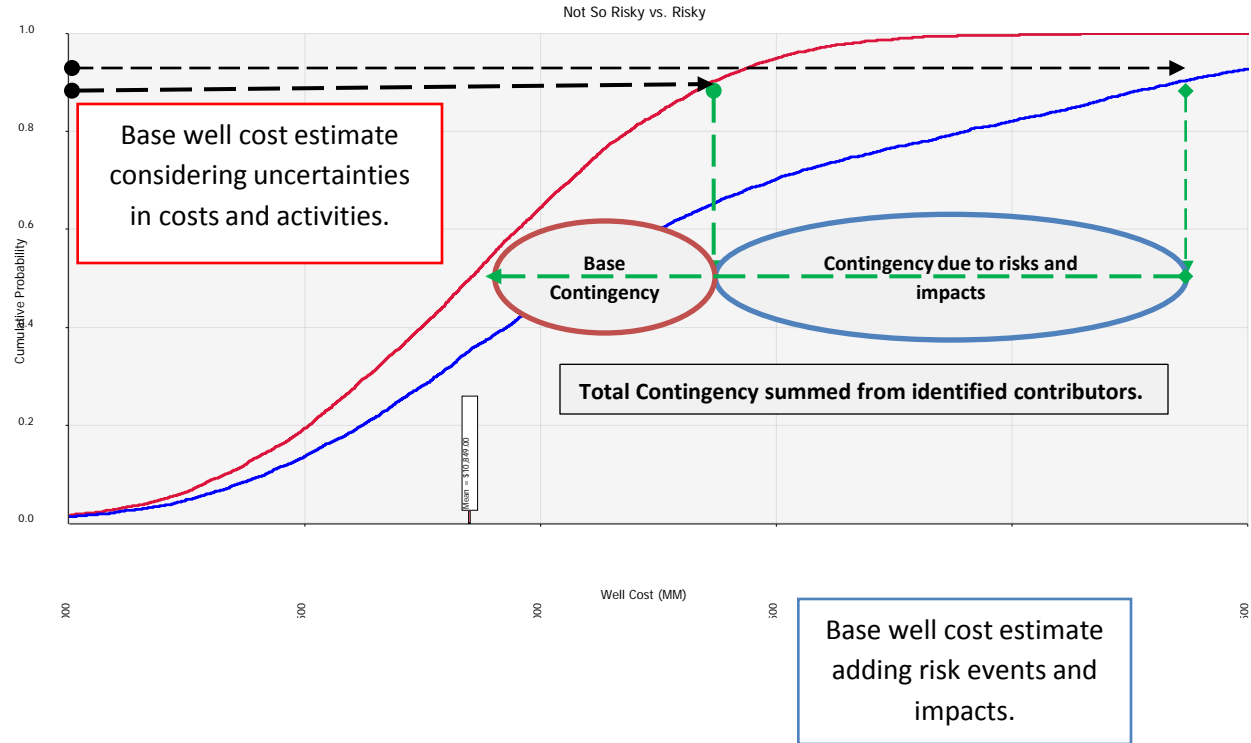
Estimate Class (definition)	Project Definition	End Usage	Methodology	Expected Accuracy range
Class 5 (0 – 2%)	Very low Limited effort Quick preparation	Concept Screening	Analogy, judgment, factoring, modeling	+30 to +100% -20 to -50%
Class 4 (2 – 15%)	Low	Feasibility / study Preliminary budget approval / gate approval	Probabilistic	+20 to +50% -15 to -30%
Class 3 (10 – 40%)	Medium	Budget authorization or control Support full funding. 1 st control estimate	Semi detailed unit cost Probabilistic for risk / uncertainties	+10 to +30% -10 to -20%
Class 2 (30 – 70%)	High	AFE Detailed control baseline Expenditures will be reported against this	Detailed unit cost Probabilistic for risk / uncertainties	+5 to +20% -5 to -15%
Class 1 (50 – 100%)	Complete	Detailed Control Current control estimate	Detailed unit cost Deterministic with contingencies	+3 to +15% -3 to -10%

Probabilistic estimation is a powerful tool

- Most effective method to incorporate uncertainties & risks
 - quantified
 - graphically displayed
- Transparent method to view through class development
- P90 provides a logical contingency funding level
- Methodologies exist to correctly apply Monte Carlo simulation
 - Distribution types for time / cost variances
 - Roll up to limited summed activities / costs

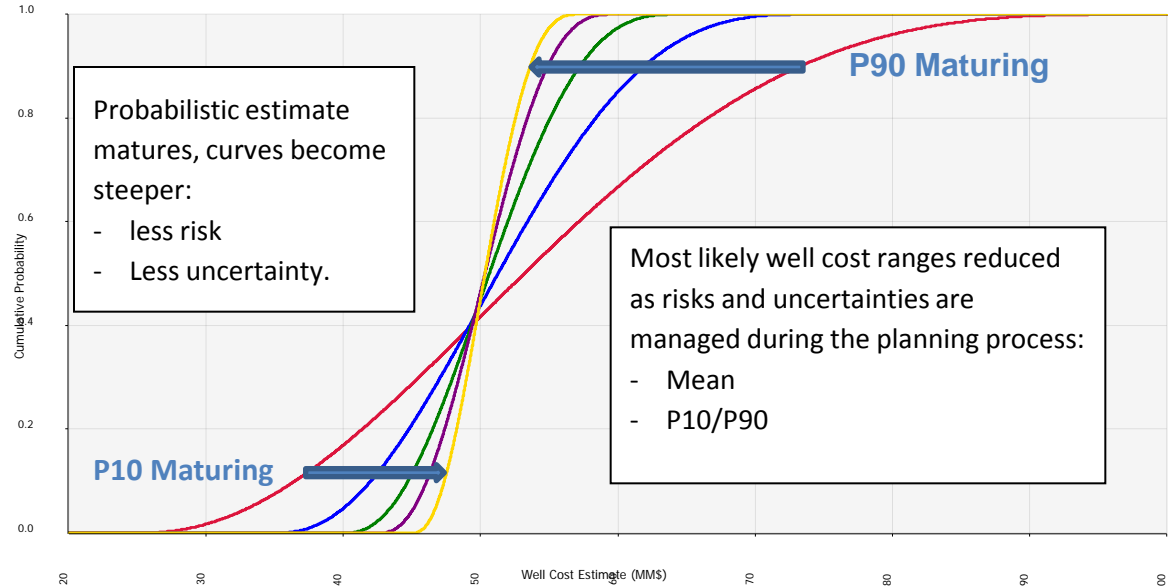
“S” Curve development for a well

- View the effects of uncertainties
- View the effects of risks
- Define the contingency based on transparent logic



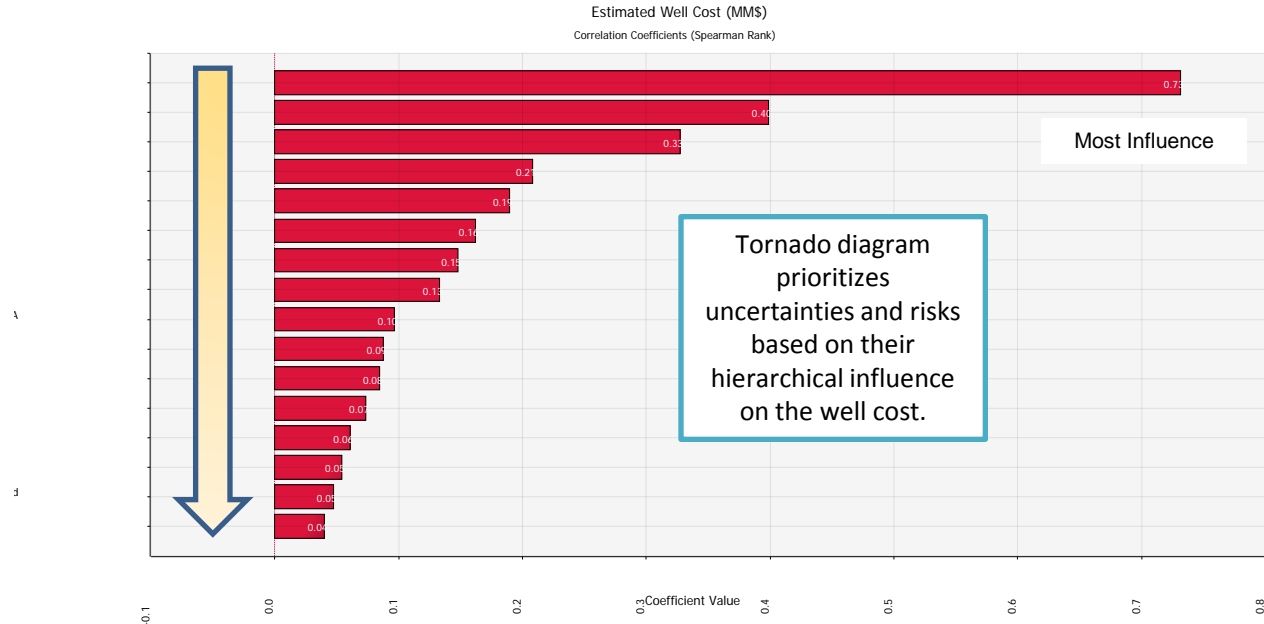
Maturing the cost estimate effect on “S” curve

- Maturing the cost estimate alters the probability profile
- Later cost estimates ought to fit within earlier cost estimates unless the scope has changed



Tornado diagrams rank the sources of uncertainty

- Visually identify most influence
- Identify opportunities to invest to reduce



Well cost estimation and control can be improved significantly through adopting an effective workflow

- Design a suitable well cost template
 - Activity based costing
- Define responsibility – Drilling Department
- Adopt the cost classes
- Link to schedule and risk management
- Distinguish Exploration / Appraisal from Development well cost cycle

Recommendations and Conclusions

- Develop a well cost estimation and control process based on best practice
- Follow the class levels
- Integrate schedule and risk into cost estimation
- Assign competent resources
- Apply probabilistic methods in a competent manner
- The cost ranges are the ranges – do not make them up

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Thank You / Questions

John de Wardt