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True Lies: Measuring Drilling and Completion Efficiency

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Understanding and measuring the true performance gap

- Efficiency analogies used in industry provide guidance
- Currently used measures in drilling are false (lies)
- Managers huge error focusing on NPT for measuring performance
    - deceiving themselves with false understanding (lies)
- Invisible Lost Time [ILT] is the true key to performing
- Understanding Technical Limit [TL] and Maximum Theoretical Performance [MTP]
- A true multi faceted drilling efficiency model
    - calculated, benchmarks, offsets, ….
- Case Studies show the impact
- Industry recommendations

Industry Efficiency Analogies – how do they measure?

- Manufacturing
  - efficiency is the ratio of the current productivity level to the best practice productivity level
- Lean Manufacturing
  - the percentage of planned production time that is truly productive
  - 100% represents perfect production
- Construction
  - input/output ratio based on quantitative and qualitative measurements
  - Bröchner 10 basic requirements relevant to drilling

Industry Efficiency Analogies – how do they measure?

Lean Manufacturing

100% - perfect production

85% - world class for discrete manufacturing

60% - typical for discrete manufacturers

40% - for companies starting to improve performance

Measures Currently In Use for Drilling

- Actual versus planned
  - Judgmental, tends to be relative to own performance
- Feet per Day / Cost per Foot
  - Different designs / well challenges, different contract rates
- Non Productive Times
  - Seduces managers to a false understanding
- Variety of detailed Key Performance Indicators (KPI's)
  - Lose track of overall performance
  - Waterbed effect – focus here causes negative change there
- Industry benchmark system
  - Valuable however primarily operator membership

Challenges:

- Varying well design
- Geological uncertainty
- Product quality

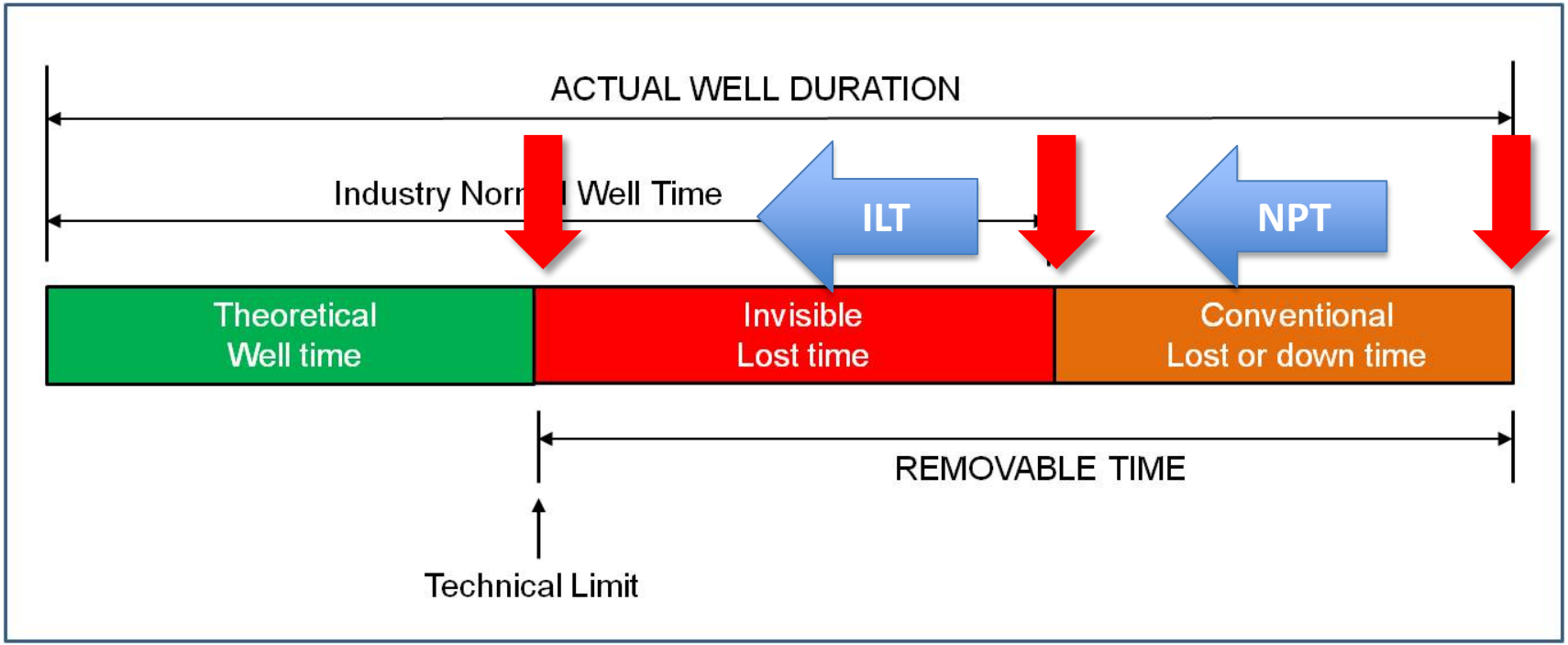
Balance measurement focus:

- Time reduction
- Functionality and quality
- Safety

The Fallacy of Non Productive Time as a Performance Measure

- Same well drilled faster with same NPT hours
  - NPT percentage increases
  - Higher true performance, lower NPT performance
- Drill slower to improve NPT % results
  - Negative driver of performance
  - Plan for NPT events
- Offshore NPT is chronic and stable at around 20%
  - NPT focus has not been effective to improve performance
- **Improving Productive Time (PT) bigger impact than reducing NPT**
  - **Operators have more control over PT than NPT**

True Value: Focus on Reducing Invisible Lost Time



True Value: Focus on Reducing Invisible Lost Time

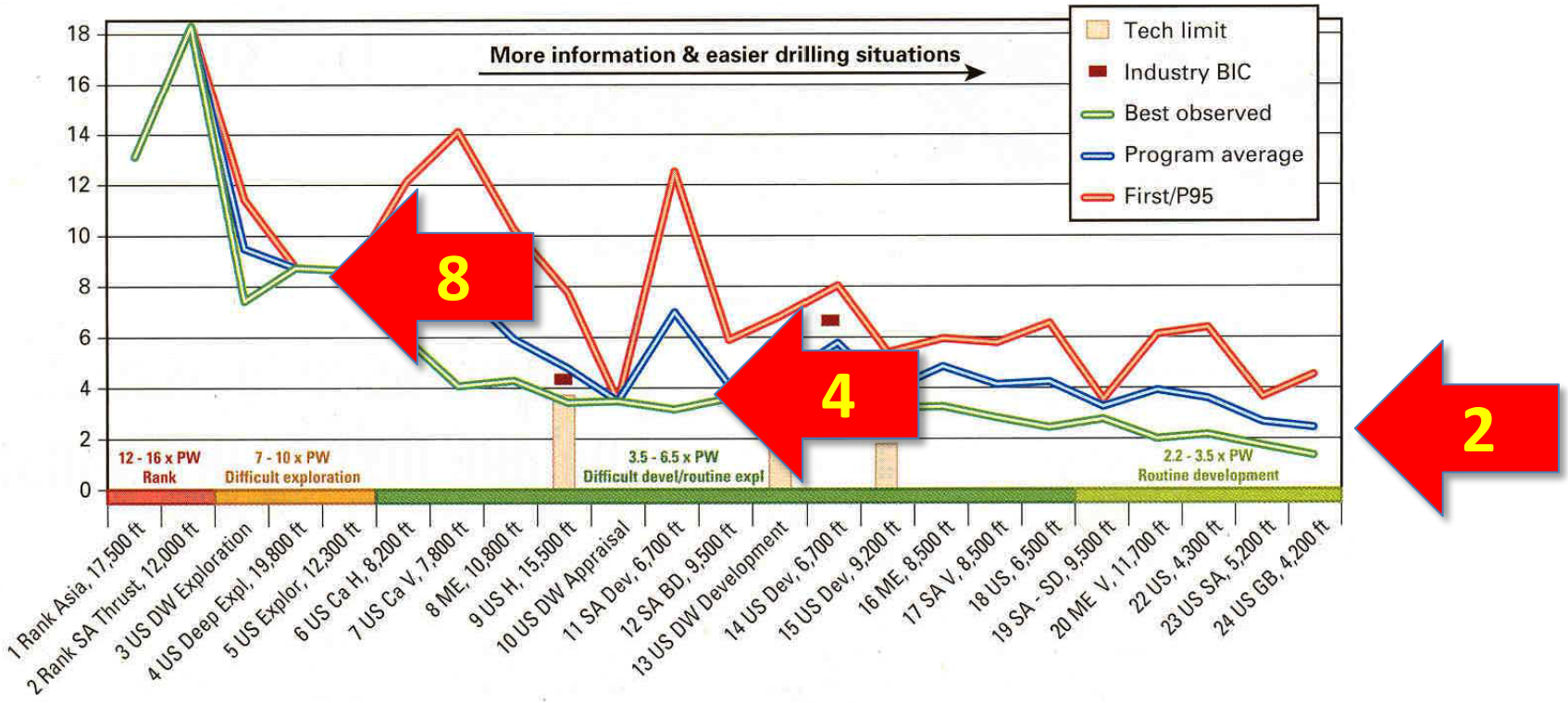
- ILT is caused by multiple sources, including:
  - Delayed off critical path activities
  - Planning on job not before
  - Planning includes inefficiencies not solutions
- Making ILT visible creates a valuable improvement opportunity

- **Issue for ILT is defining the reference time to determine the gap from current performance**

Technical Limit and Maximum Theoretical Performance

- Challenge = Calculate well drilling /completion times in a systematic, consistent and non-emotional manner
- Technical Limit offers a solution
  - Estimated time to drill theoretical well from flawless execution
  - Aggressiveness is function of the team
- Maximum Theoretical Performance is the solution
  - Minimum time calculated from physical factors
  - Perfect Well Calculation with Perfect Well Ratio
  - Aggressiveness is function of the calculation

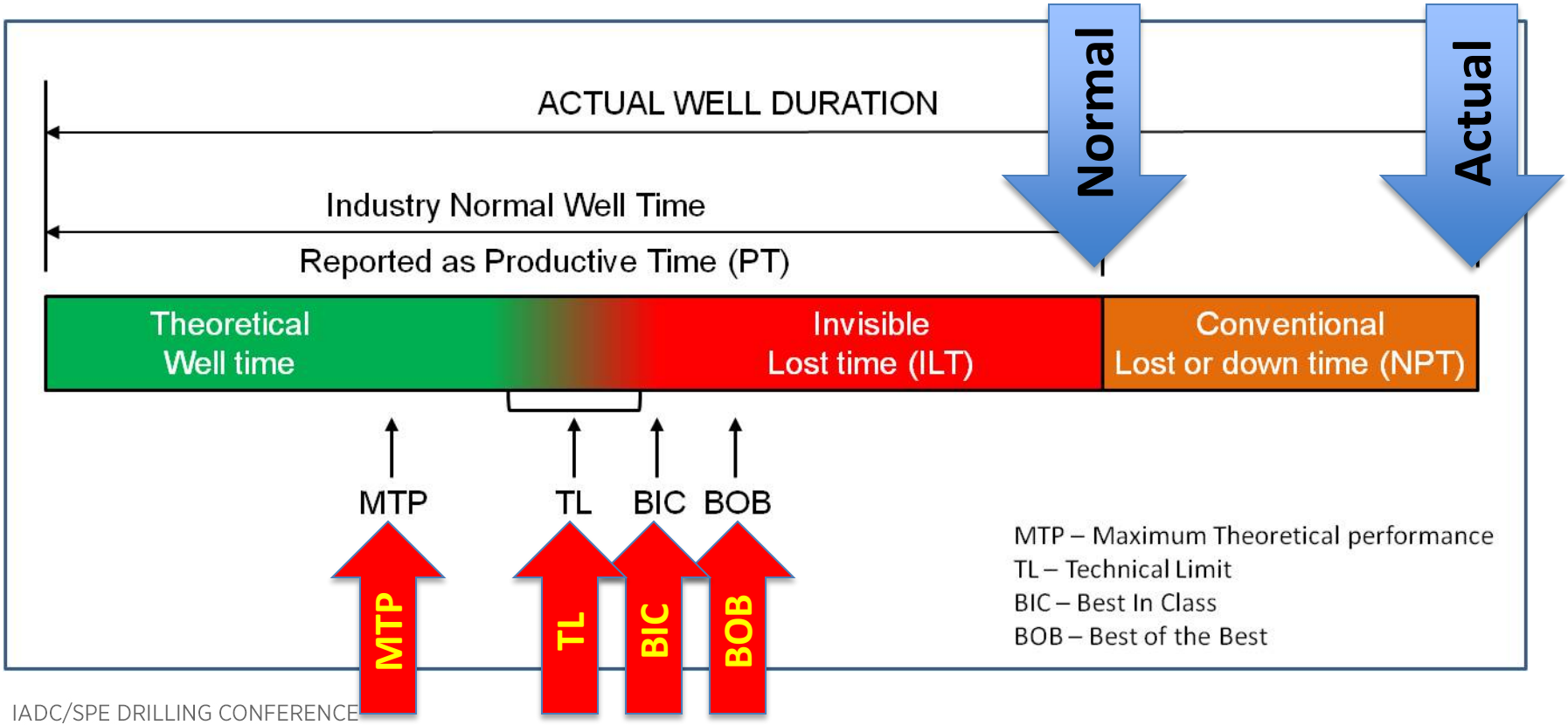
Perfect Well Ratio for various well types



Drilling Efficiency Model provides alternative time references

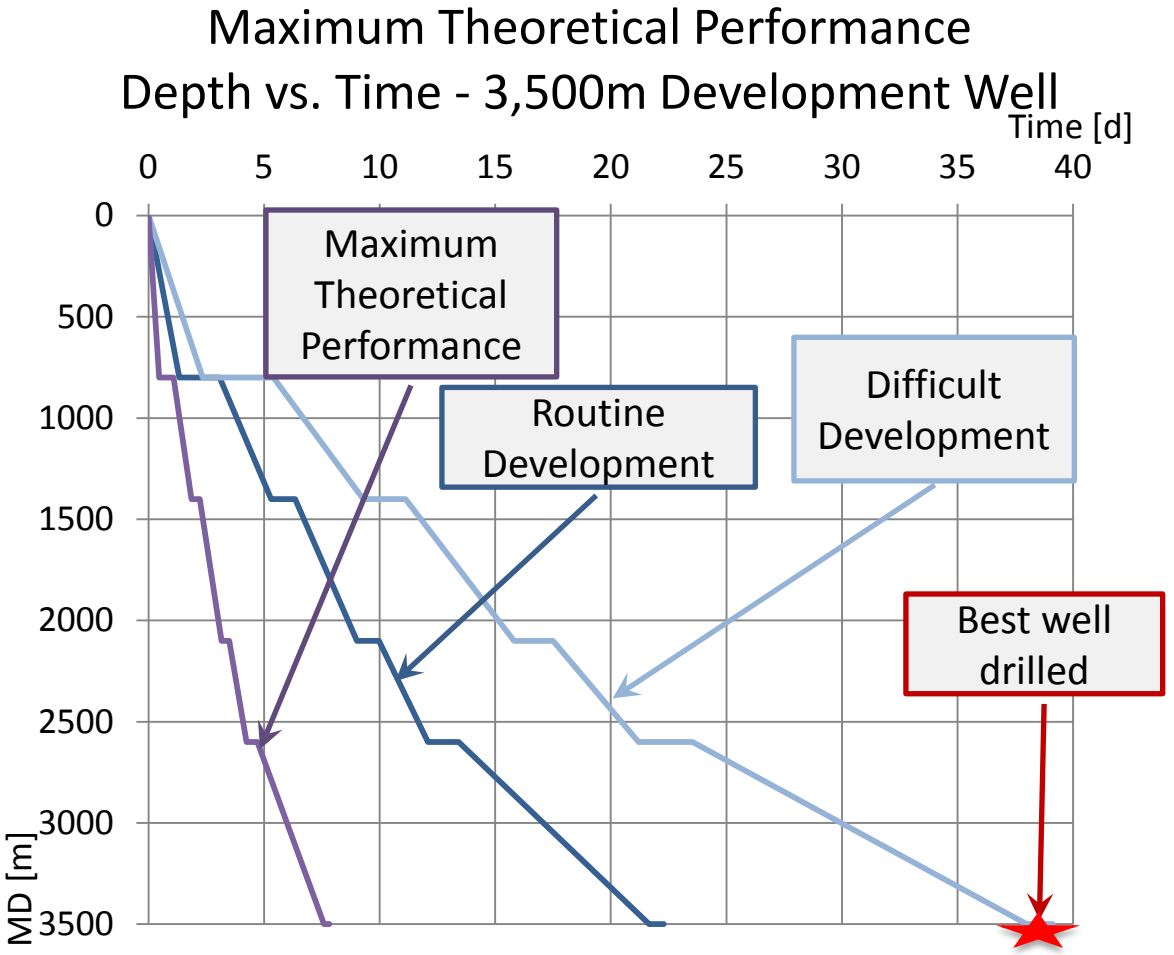
- Best of the Best (BOB) - Internal
  - measure of best component performance
- Best in Cass (BIC) – Benchmarking
  - comparison to other companies
- Technical Limit (TL) – Theoretical Times
  - developed from analysis and team estimates
- Maximum Theoretical Performance (MTP) – Calculated
  - physics of the drilling, perfect operations
  - weighted to reflect difficulty of operating environment

Drilling Efficiency Model provides alternative time references



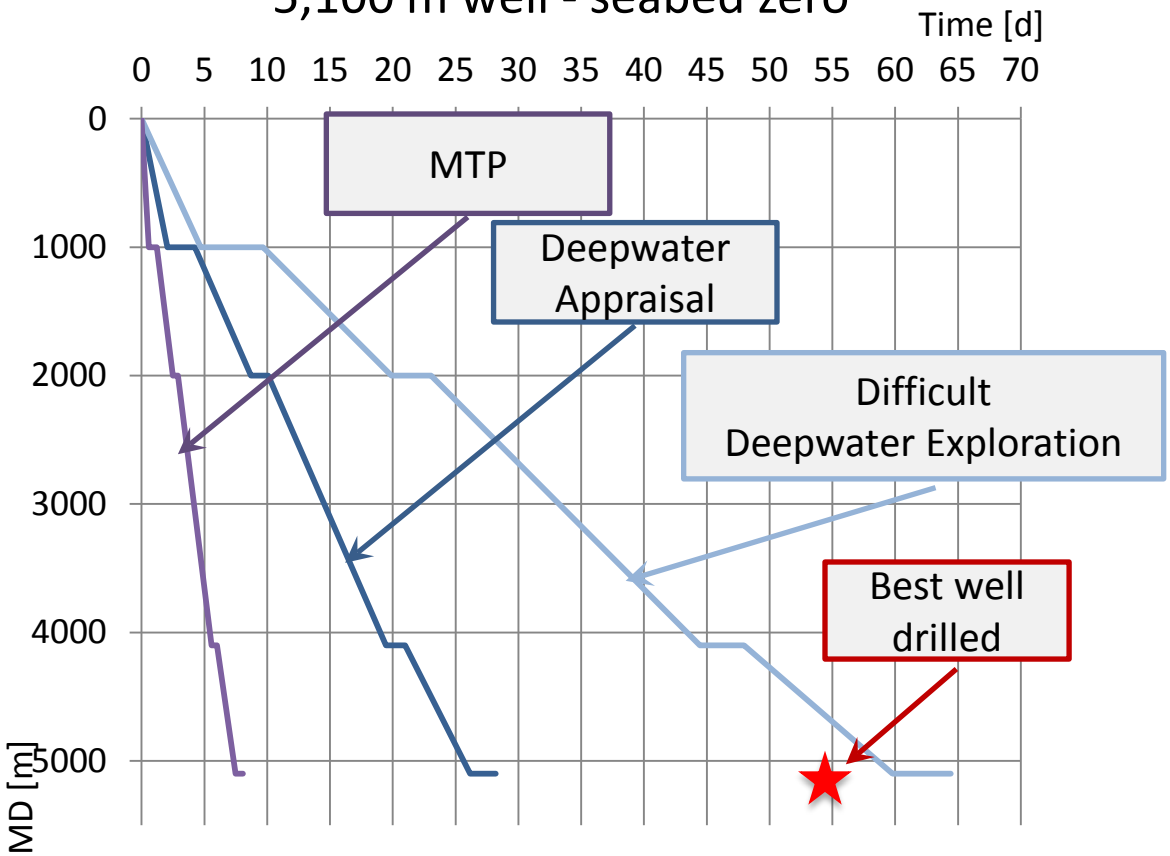
Case Studies of MTP Applications

Mid East Land Drilling – Dayrate, High Complexity



Case Studies of MTP Applications

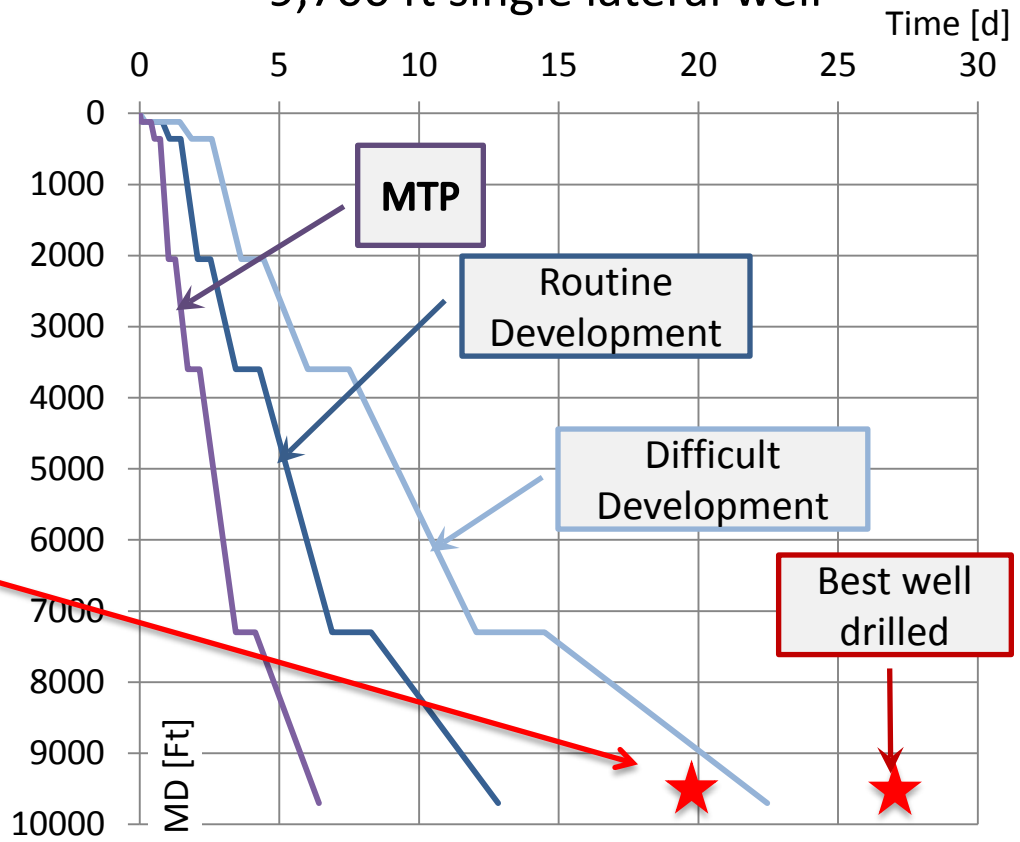
Deep Offshore Far East Drilling - Appraisal



Case Studies of MTP Applications

Mid East Land Drilling – Lump Sum Project Managed

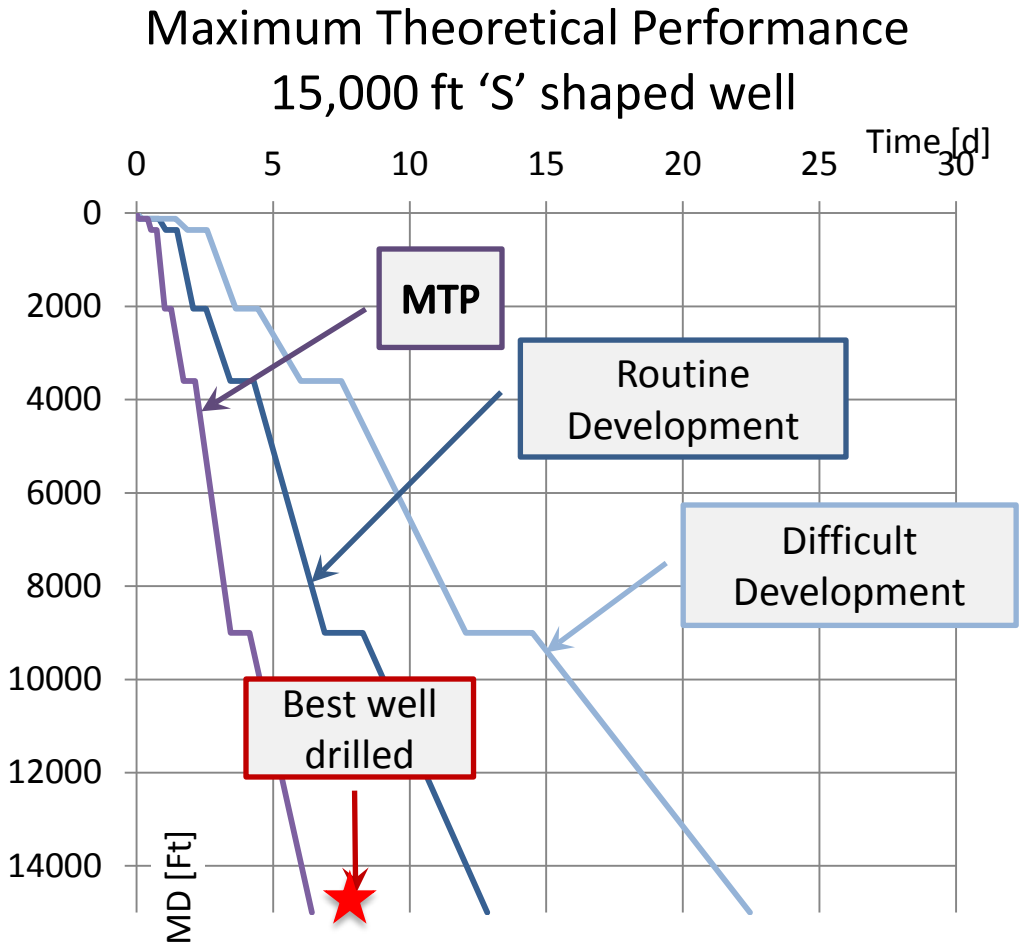
Phase 1:Lean Drilling™ Program Improvement = 26% well to well across 4 rigs



Case Studies of MTP Applications

USA Land – "Super" Performance Drillers

Public reported data estimation



True Drilling Efficiency is in the Doldrums

- Challenging environment for drilling (wells and logistics and security)
  - 20% aiming for 24%
- Deeper offshore has very low true efficiencies
  - 14% aiming for 28 % (a doubling)
- Lump sum operations affected by start up challenges
  - 24% jumped to 32% with a target of 75%
- USA tight gas achieved 78%
  - Estimated improvements total to 90%
- Offshore Thailand is effectively 100%
  - Off critical path well to well
- USA Colorado basin is effectively 100%

Recommendations

- Do **NOT** justify being a poor performer – True Lies
- Understand that calculating MTP shows what is truly possible
    - applying performance ratios for well types shows hurdles to cross
    - performance ratios show % efficiency that is possible in well types
- Aggressive targets expose large performance deficiencies
    - challenge is to motivate drilling team to address deficiencies
- Use the structured method for BOB, BIC, TL and MTP
    - educate engineers, operations and **managers** to the meaning, purpose and value of each

True efficiency has very high value in current business climate

- Shale / tight gas driller performance gains contributed to lower oil / gas prices
- Drilling performance is a competitive advantage for hydrocarbon development
- High drilling performance required for economic approval

Conclusions

- Crisis drives step change performance
    - The true crises is here!
- MTP and MTP with well ratios is non emotional and definitive
- True 90% to 100% performance is possible
    - 90% “operational” efficiency may only be 25% true drilling efficiency = asleep at the switch
- NPT alone as a management tool is detrimental to true performance improvement

Acknowledgements

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Thank You / Questions

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