IADC / SPE 178850
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
• Caused by multiple sources, including:
   Delayed off critical path activities
   Planning on job not before
   Planning includes inefficiencies

• Visible ILT creates a valuable improvement opportunity

• Issue for ILT is defining the reference time to determine the gap

True Value: Focus on Reducing Invisible Lost Time

ACTUAL WELL DURATION

Industry Normal Well Time

ILT

NPT

Theoretical Well time

Invisible Lost time

Conventional Lost or down time

REMOVABLE TIME

Technical Limit

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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

More information & easier drilling situations

Tech limit
Industry BIC
Best observed
Program average
First/P95

12 - 16 x PW
7 - 10 x PW
3.5 - 6.5 x PW
2.2 - 3.5 x PW

Rank
Difficult exploration
Difficult devel/routine expl
Routine development

1. Rank Asia 17,500 ft
2. Rank SA Thrust 12,000 ft
3. US DW Exploration
4. US Deep Explo col 8,800 ft
5. US Expol 12,300 ft
6. US Ca H 8,200 ft
7. US Ca V 7,800 ft
8. ME 16,800 ft
9. US H 15,500 ft
10. US DW Appraisal
11. US Dev 6,700 ft
12. SA BD 8,500 ft
13. US DW Development
14. US Dev 6,700 ft
15. US Dev 8,200 ft
16. ME 8,500 ft
17. SA V 5,500 ft
18. US 8,500 ft
19. SA - SD 9,500 ft
20. ME 8,500 ft
21. US 3,400 ft
22. US SA 5,700 ft
23. US SA 5,700 ft
24. US SB 4,200 ft
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

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Maximum Theoretical Performance
Depth vs. Time - 3,500m Development Well

- Maximum Theoretical Performance
- Routine Development
- Difficult Development
- Best well drilled

Case Studies of MTP Applications
Mid East Land Drilling – Dayrate, High Complexity
Case Studies of MTP Applications

Deep Offshore Far East Drilling - Appraisal

Maximum Theoretical Performance
5,100 m well - seabed zero

MD [m]

Time [d]

MTP

Deepwater Appraisal

Difficult Deepwater Exploration

Best well drilled

Deepwater Exploration

Appraisal

5,100 m well - seabed zero

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70
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

Maximum Theoretical Performance
9,700 ft single lateral well

- MTP
- Routine Development
- Difficult Development
- Best well drilled

MD [Ft] vs Time [d]
Case Studies of MTP Applications

USA Land – “Super” Performance Drillers

Public reported data estimation

Maximum Theoretical Performance
15,000 ft ‘S’ shaped well

- Routine Development
- Difficult Development
- Best well drilled

MD [Ft]

Time [d]
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
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Thank You / Questions

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