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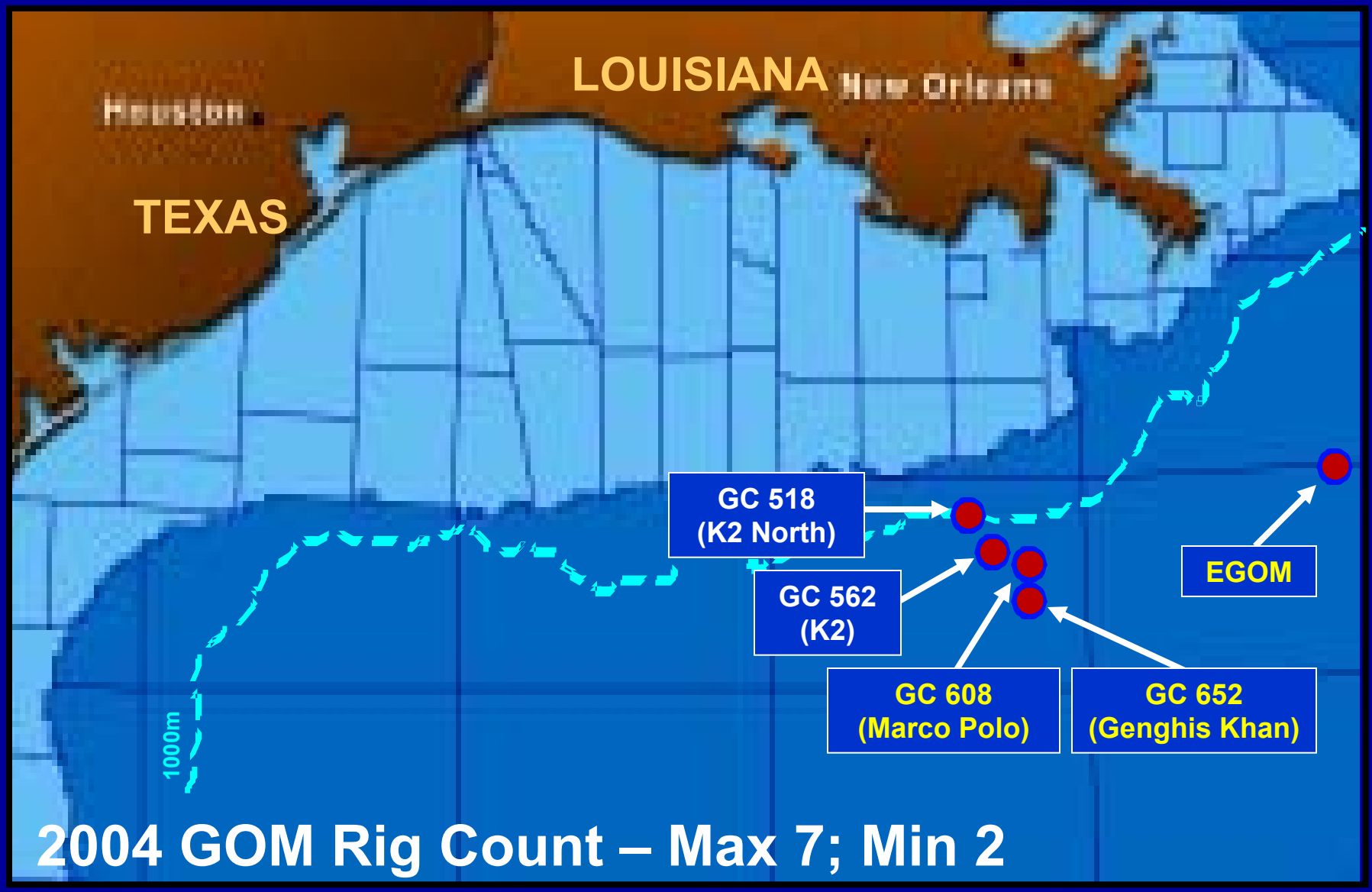
And special thanks to The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) for their contribution to the program.

"Lessons Learned from Integrated Analysis of GOM Drilling Performance "

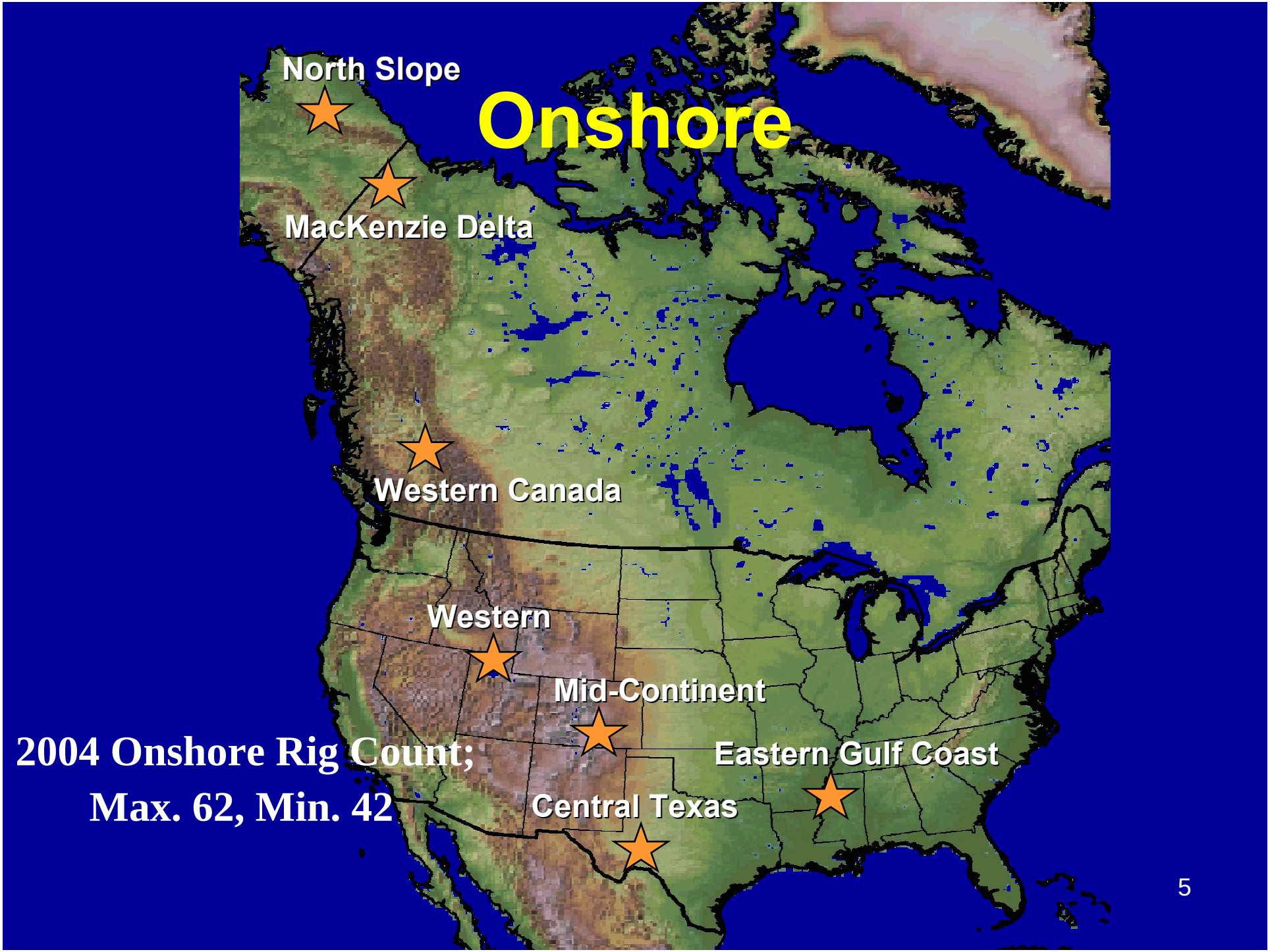
Presented by Robert A. Meize,
WWDWO Drilling Manager
Anadarko Petroleum Corporation

Presentation Summary

- Company Overview
- Drilling Data Analysis Implications
- Conventional Drilling Data Analysis
- “New-and-improved” Analysis
- Actual Results
- Conclusions

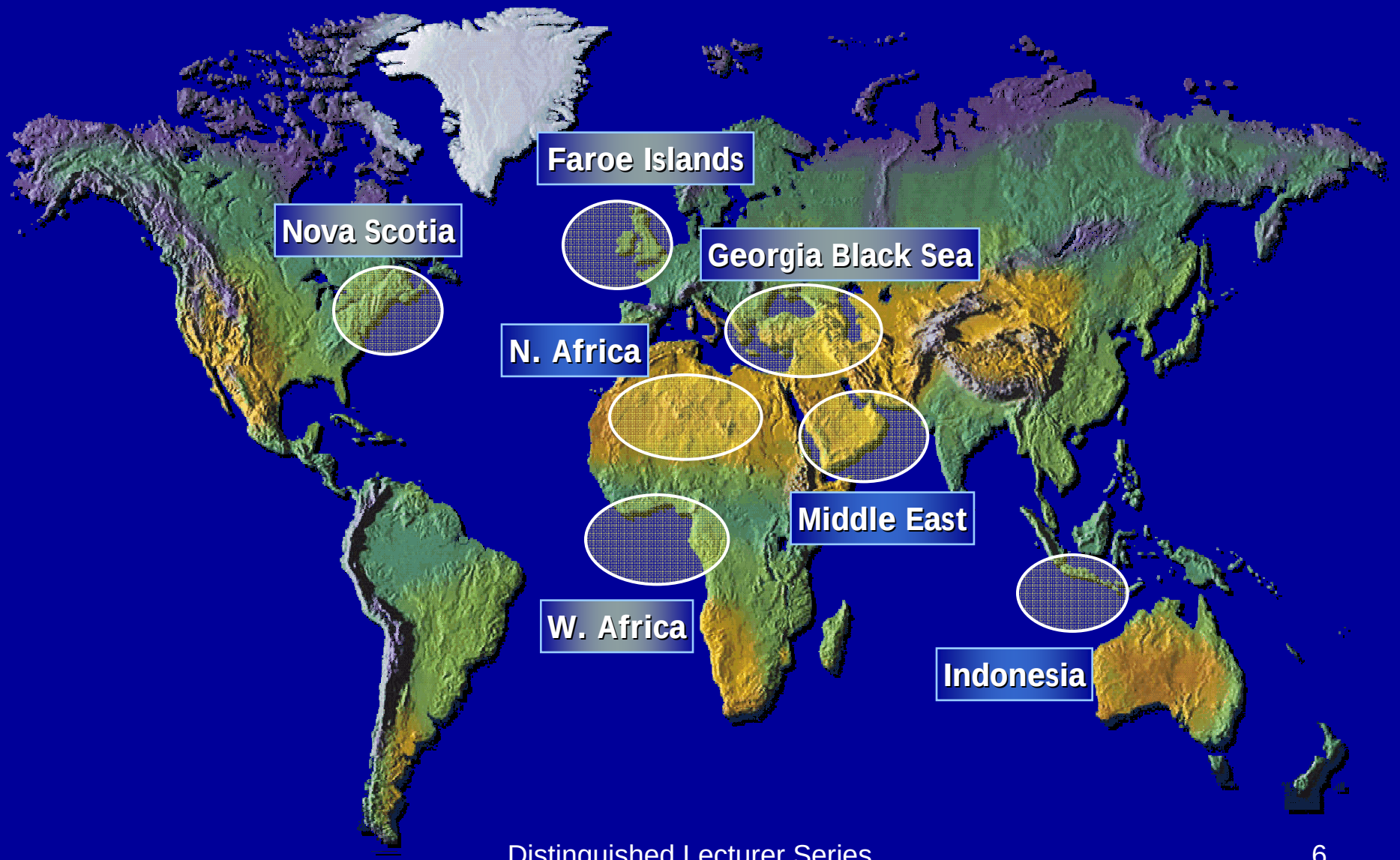


2004 GOM Rig Count – Max 7; Min 2



2004 Onshore Rig Count;
Max. 62, Min. 42

International



Study Objectives

- Stimulate industry discussion
- Present summary data to management and industry peers
- Benefits of *state-of-the-art* drilling analysis
  - efficiency
  - knowledge retention and transfer
  - problem identification

Drilling Analysis ….

- On par with other disciplines?
- What resources committed to collecting and storing data?
- How much analysis needed for improvement?

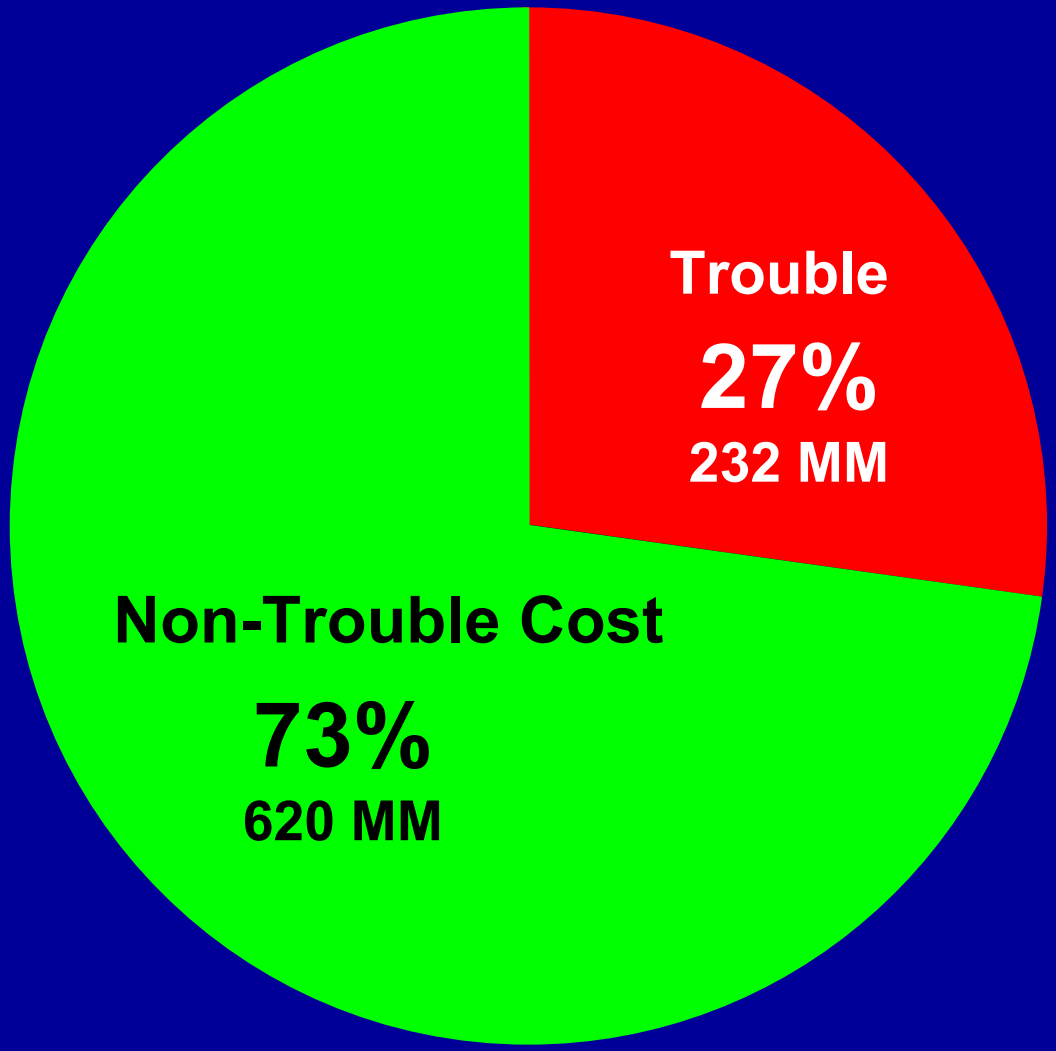
Drilling Challenges and Opportunities

- Wellbore Designs for Different Areas
- Project Management – All Disciplines
- Implementation
- Technology Development & Transfer
- Lowering Cost / ft

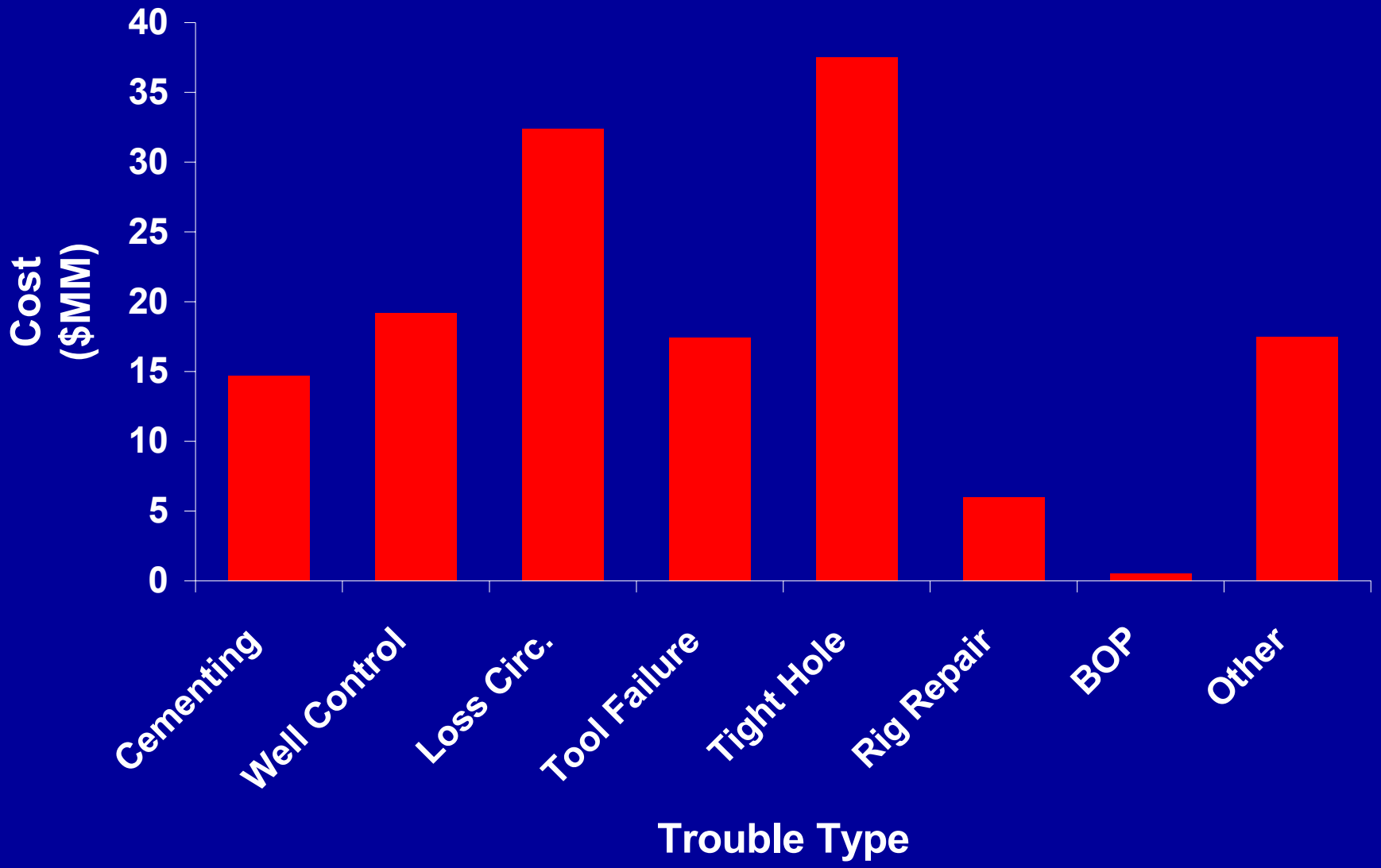
Motivation and Justification

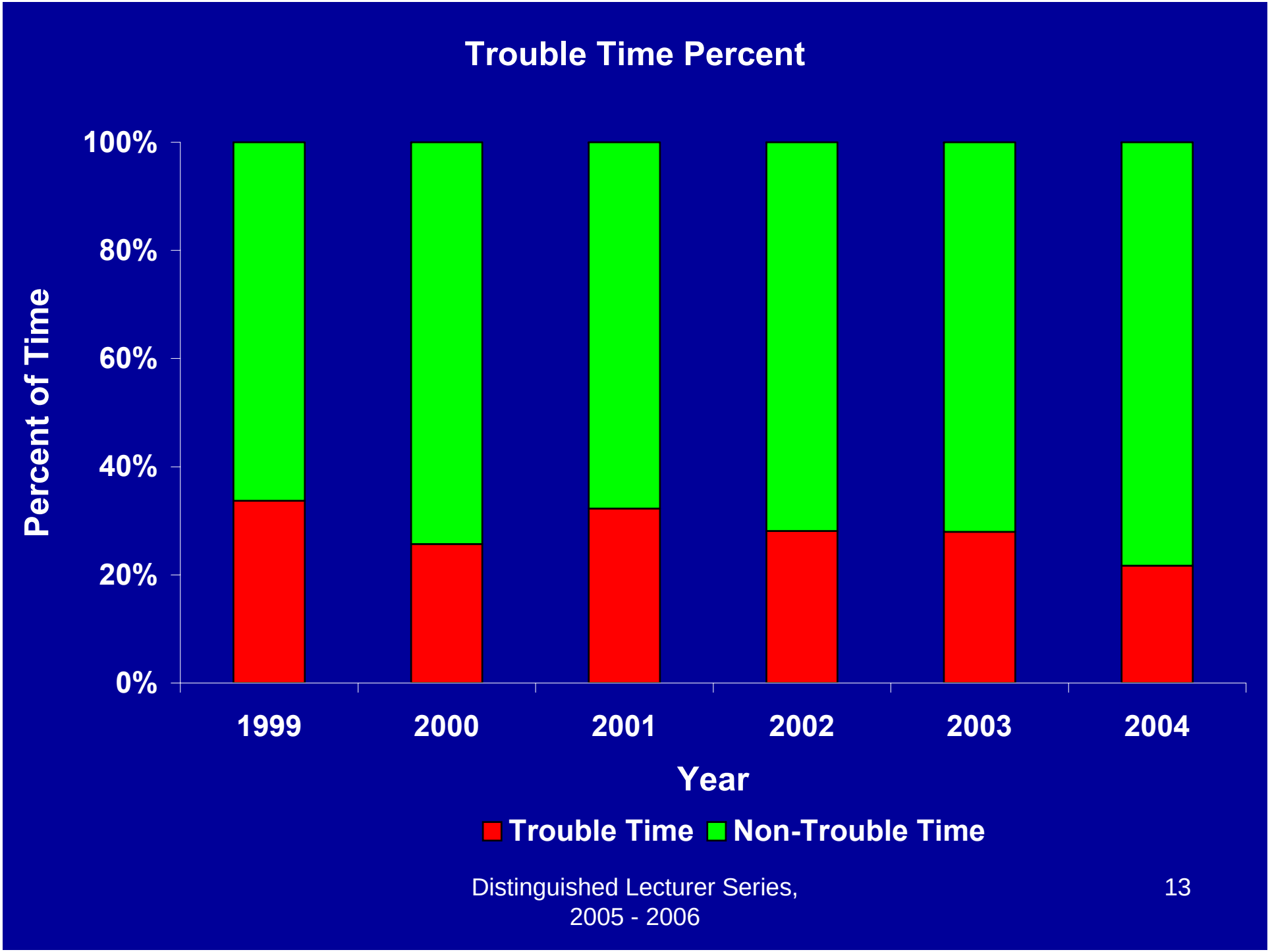
- Industry spends $MM's collecting/storing data
- 35% + corporate capex spent on drilling
- Individual well costs often determine economics
- Cost/benefit of drilling studies
- Trained personnel necessary for maximum benefit.
- Drilling Data Mgmt ≤ $1MM/yr

Percentages of Total and Non-Trouble Drilling Costs
SPUD Through Evaluation
APC 1999 – 2004



1999 - 2004 APC
Drilling Trouble Cost




Trouble Time Percent
100%
80%
60%
40%
20%
0%
Percent of Time
1999
2000
2001
2002
2003
2004
Year
Trouble Time
Non-Trouble Time

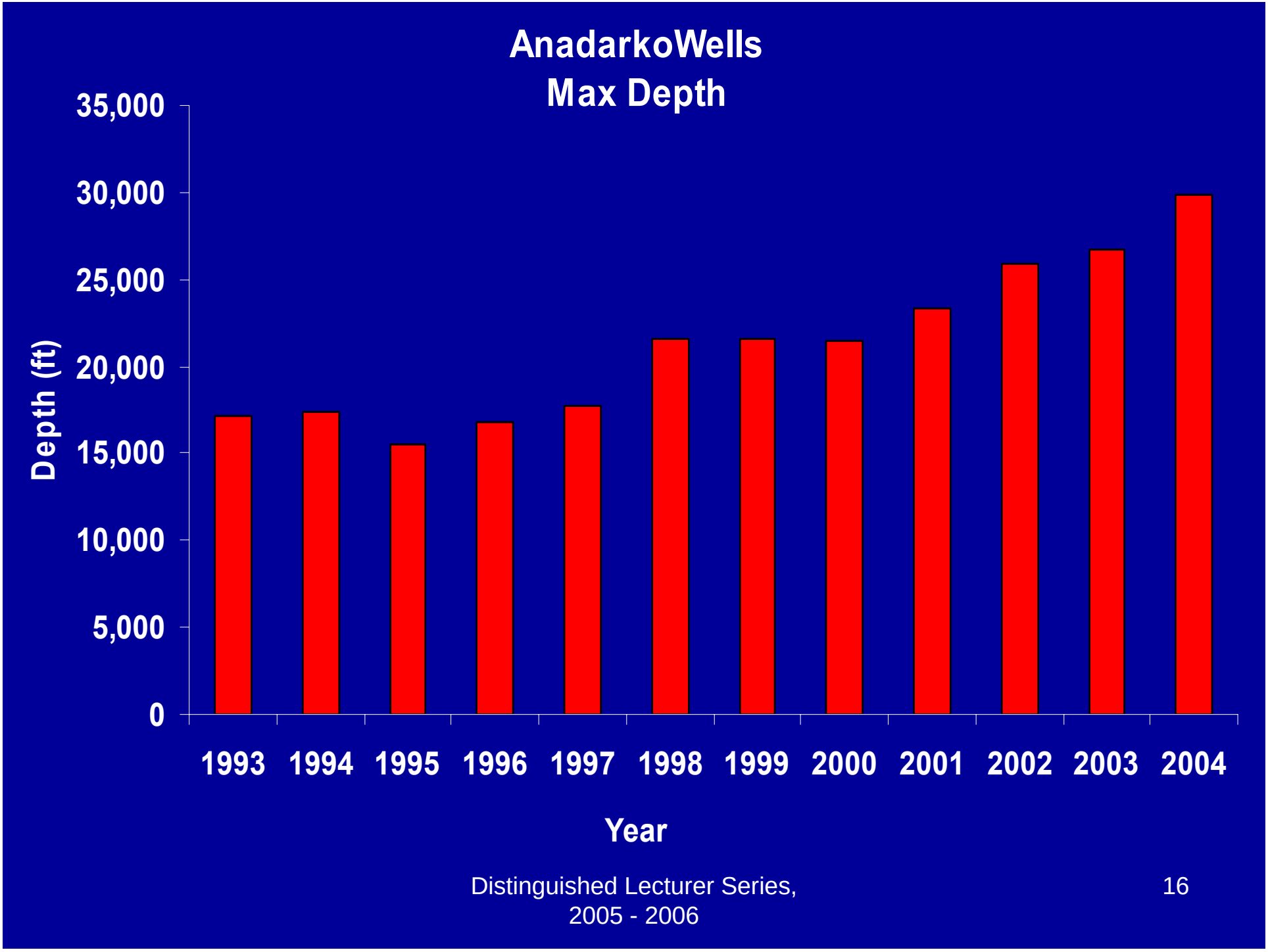
Trouble Time Analysis Lessons Learned

- Drilled too far, took kick
- Weak formation or close tolerance to frac gradient
- Lost circulation
- Tight hole/packing-off
- Casing/cementing problems

Lessons Learned Number One

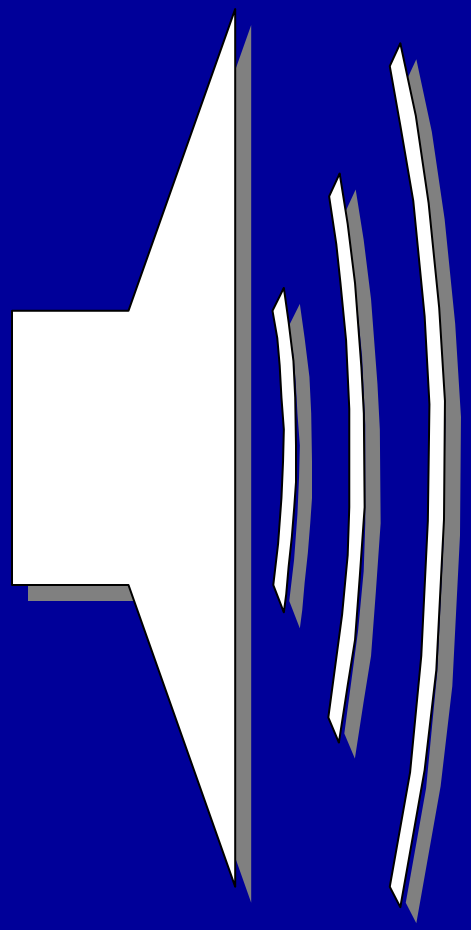
"Enemy of Good is Perfect"

- **Don't "push" casing points**
- **Casing point selection & pore pressure interpretation is critical**
- **Add 1 or 2 contingency strings**
- **Once wellbore starts losing mud, set pipe.**


AnadarkoWells
Max Depth
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Depth (ft)
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year

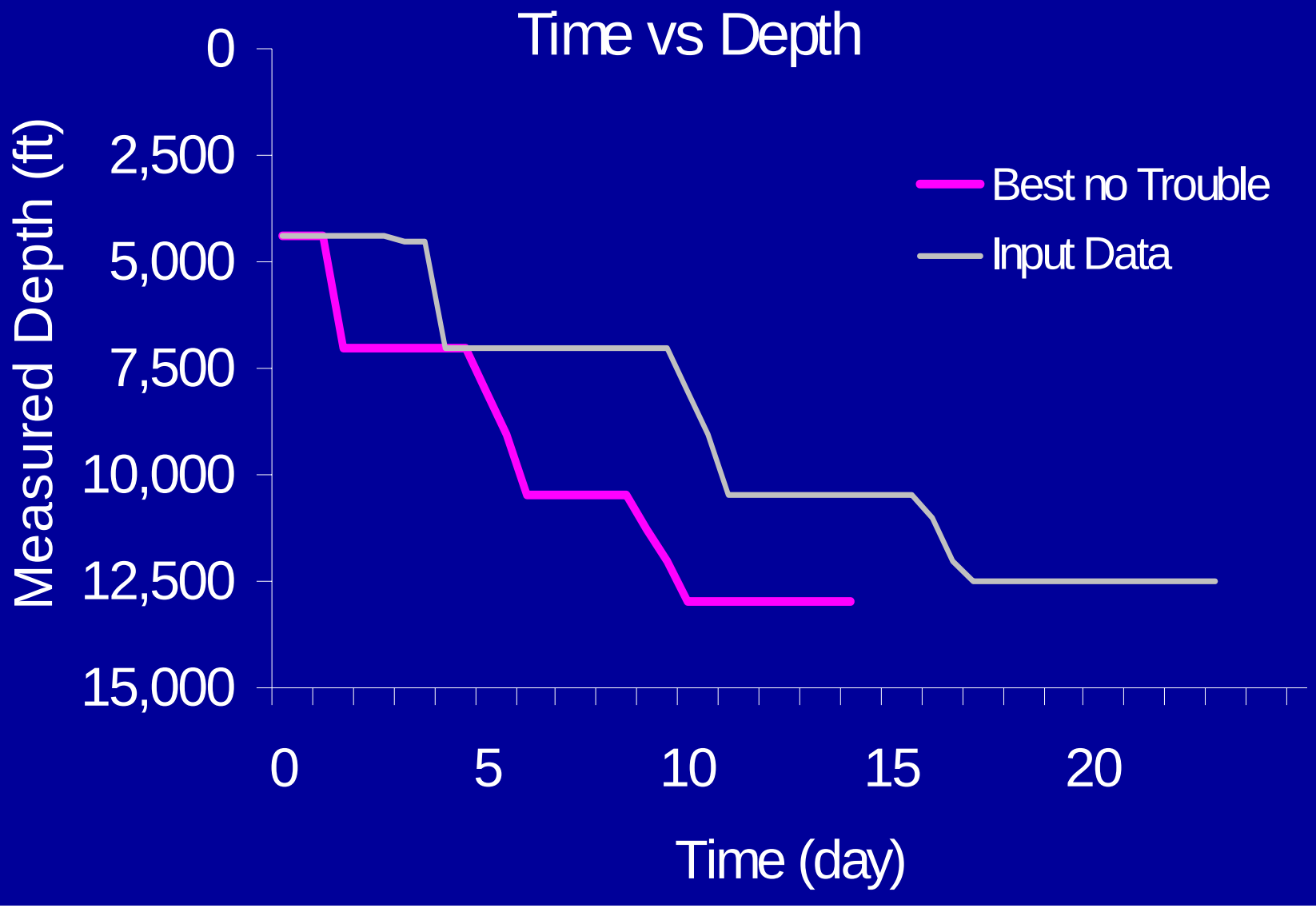
CONTINUOUS DRILLING IMPROVEMENT …

BEST COMPOSITE COST-BCC
BEST COMPOSITE TIME-BCT
(Combined best cost & time from existing wells in a field)

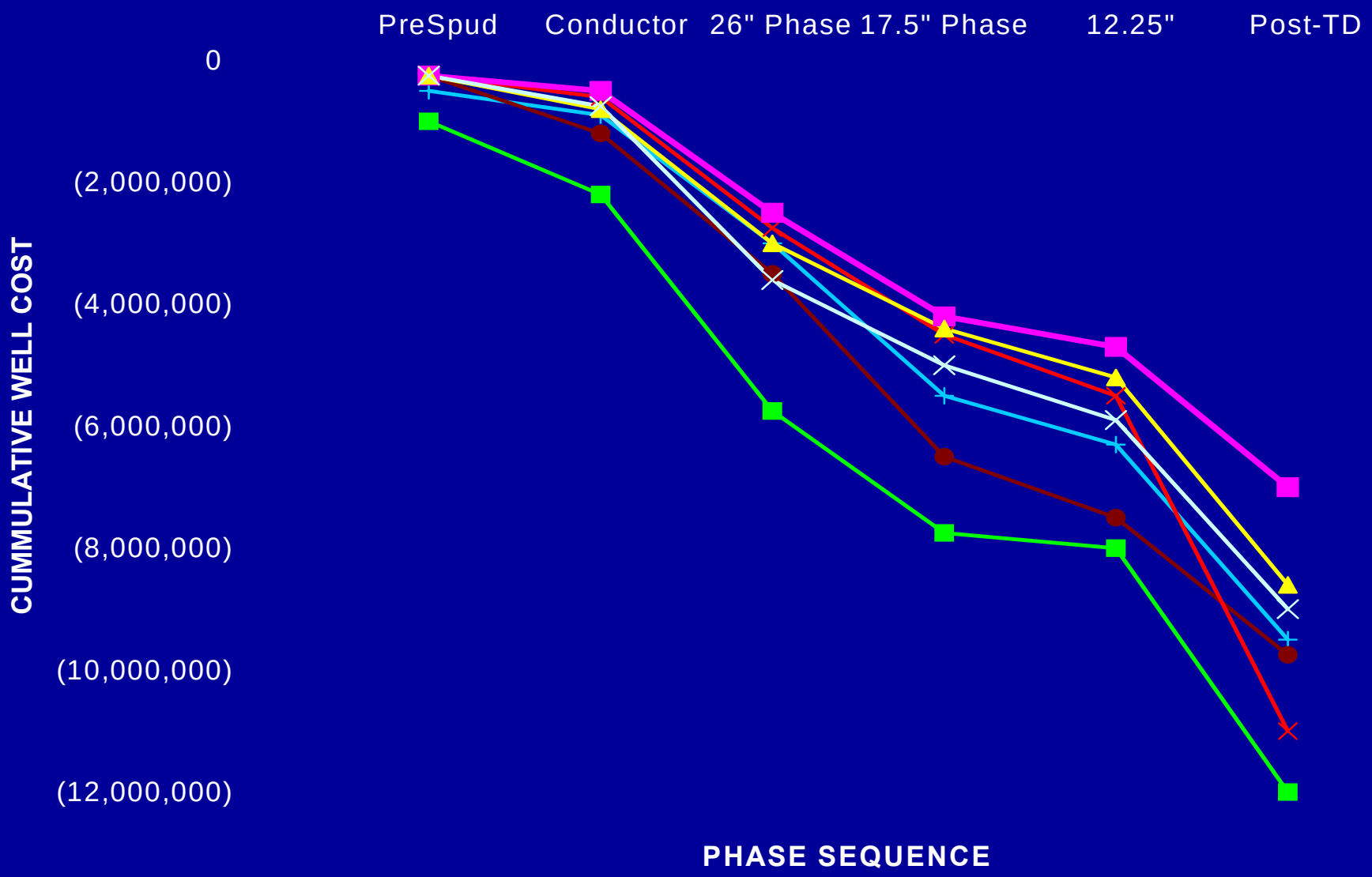


17" HOLE SECTION	EXAMPLE BCT ACTIVITIES	Best Hrs.	FROM WELL(S)
	Make Up BHA & TIH	5.5	GOM Wells 2&5
	Drill out Shoe/Cement	2.5	GOM Well 4
	Leak off Test	1	GOM Wells 5&6
	Drilling Ahead	43	GOM Well 3
	Circ/Condition Mud	7.5	GOM Well 2
	Short Trip	0	GOM Wells 1&2
	Rig Service	0.5	GOM Well 4
	Trip out of Hole	6	GOM Well 5
	Run 13-3/8" Casing	16.5	GOM Wells 1,3,6
	Circ.& Cmt. Casing	5.0	GOM Wells 3&4

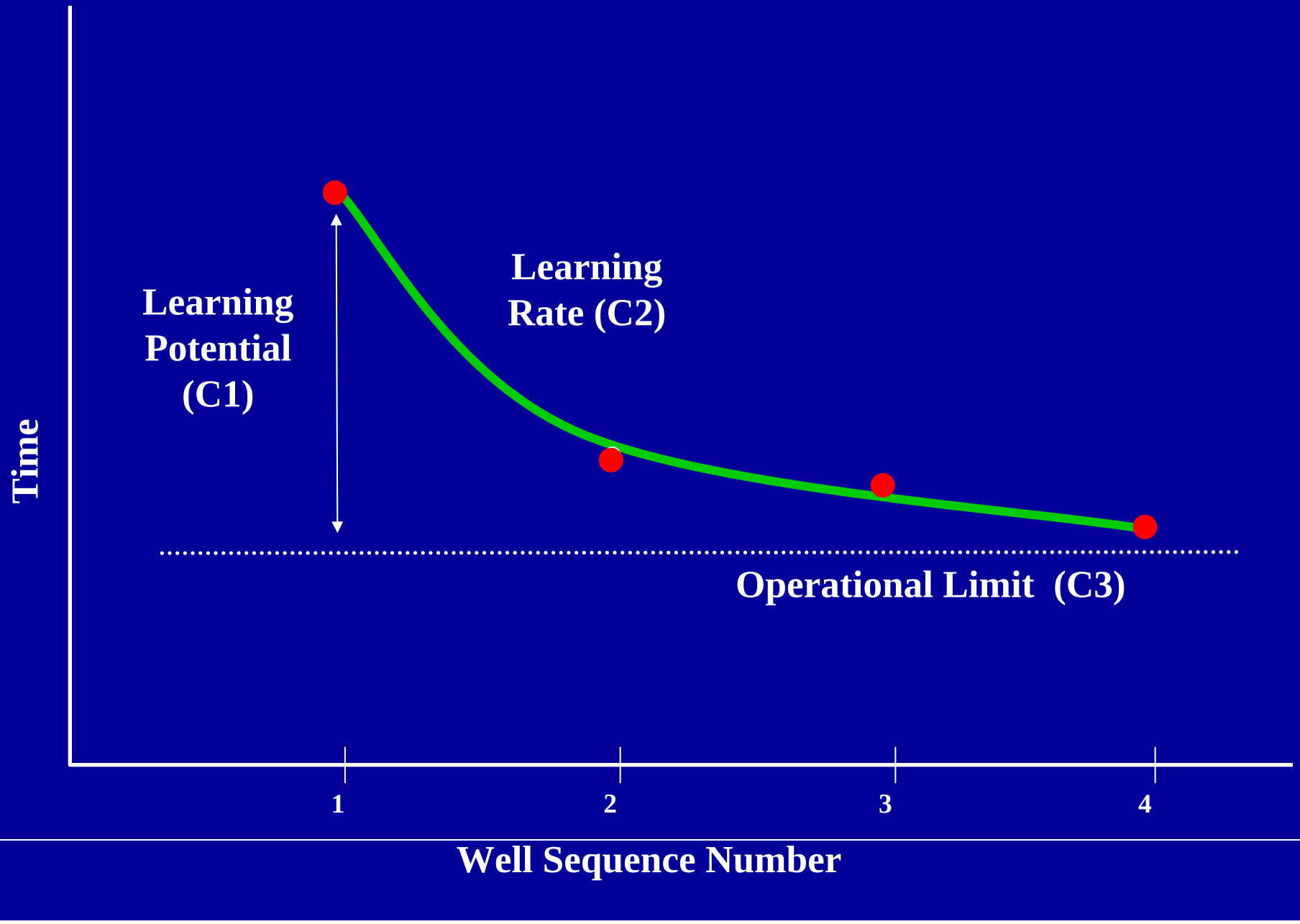
Deepwater Well Times,18-23 days with the BCT (pink curve ~15 days)



Deepwater Drilling Costs with BCC - Uppermost (Pink) Curve



The Drilling Learning Curve



Learning Curve Analysis

tn = C3 + C1*exp [(1-n)C2]; …… (Eq.1)

tn is time to drill the nth well; *C1, C2, C3* are defined in the literature as the *learning potential, learning rate & operational limit.*

BCT (~15 days) < C3 (~20 days); C2 from 0.4 to 0.8 shows "good performance" and C2 > 0.8 indicates excellent performance;

Note: C2=0.7 results in 50% C1 in 2nd well.

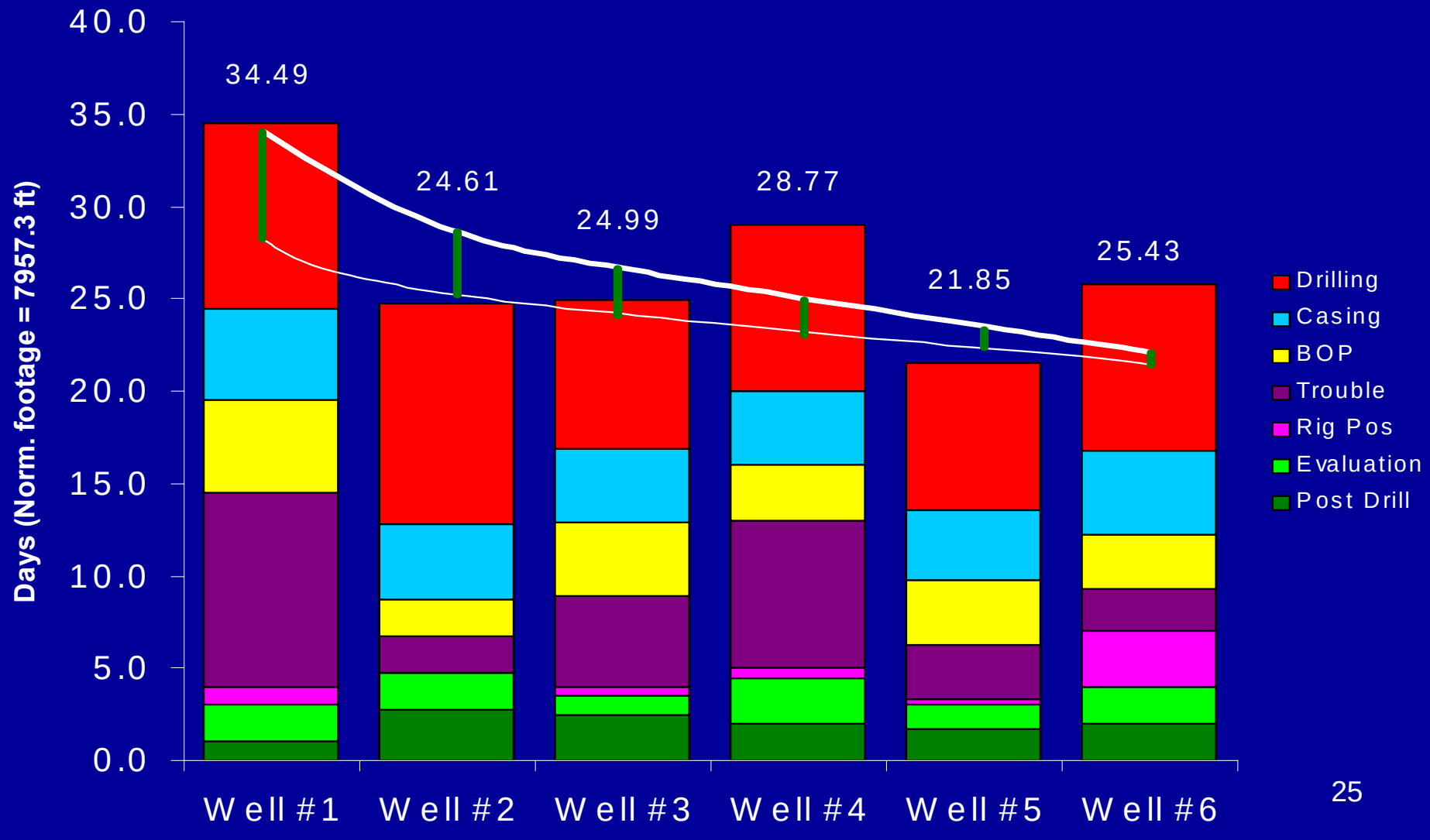
Lessons Learned Number Two

“Measure twice, cut once”

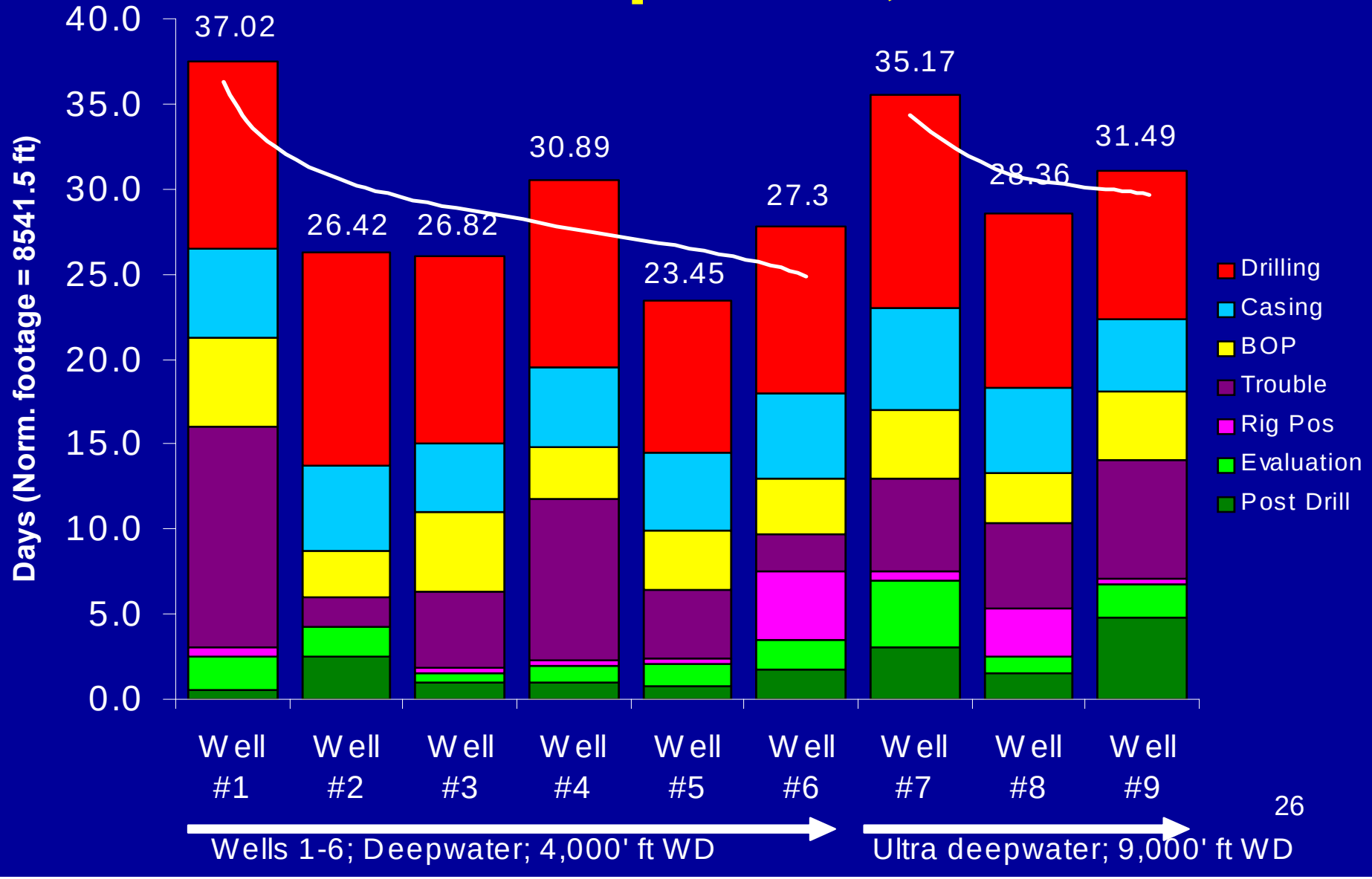
- **Review all available data**
- **Seek best performance in all phases of operations**
- **Repeat things that work well**

Cajun Express

Deepwater Drilling Economics - Improved C1 Level ➔ $5.96MM

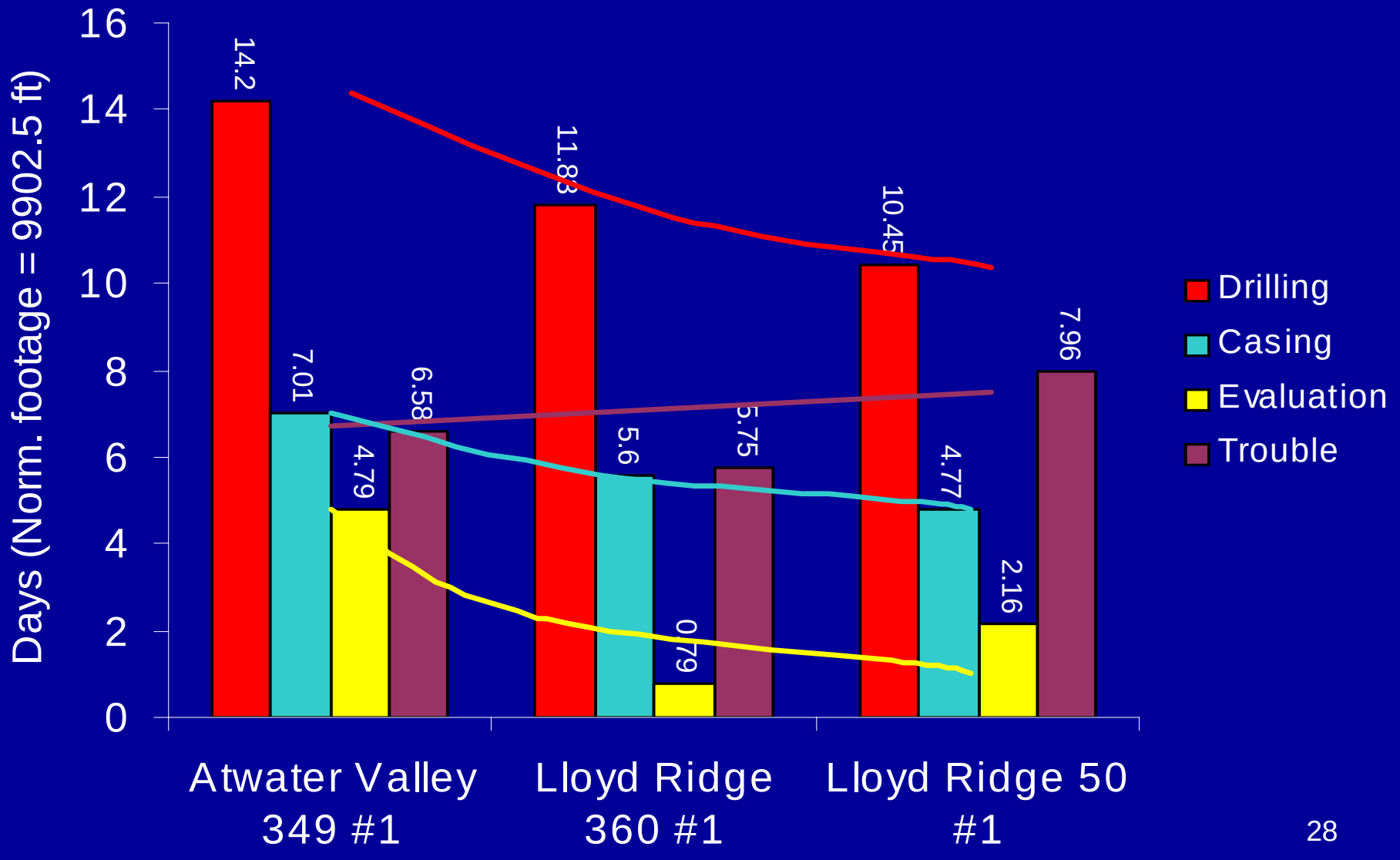


Lessons & Solutions from ~4000 ft WD to Ultra-deepwater, 9000 ft WD

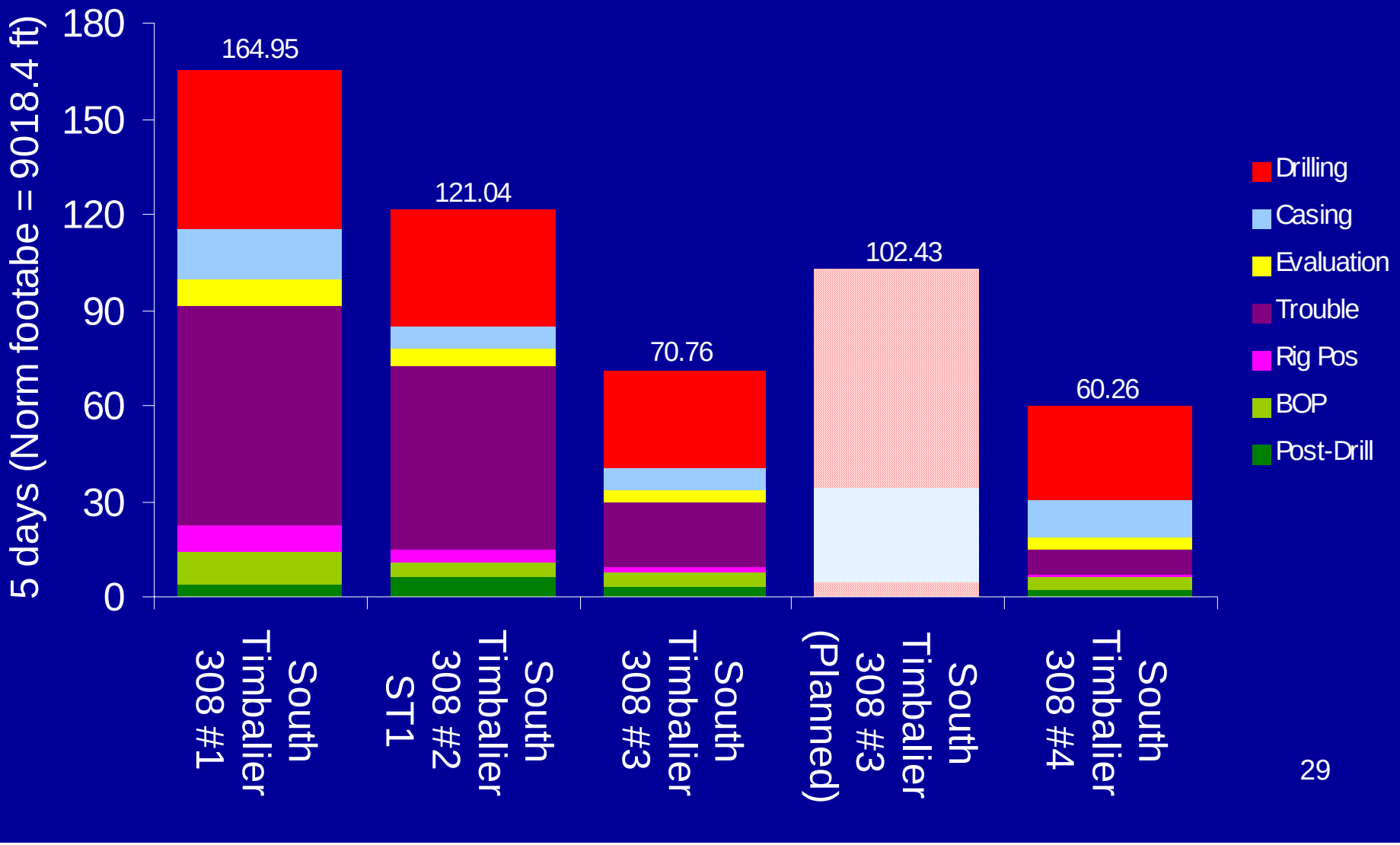


Millennium

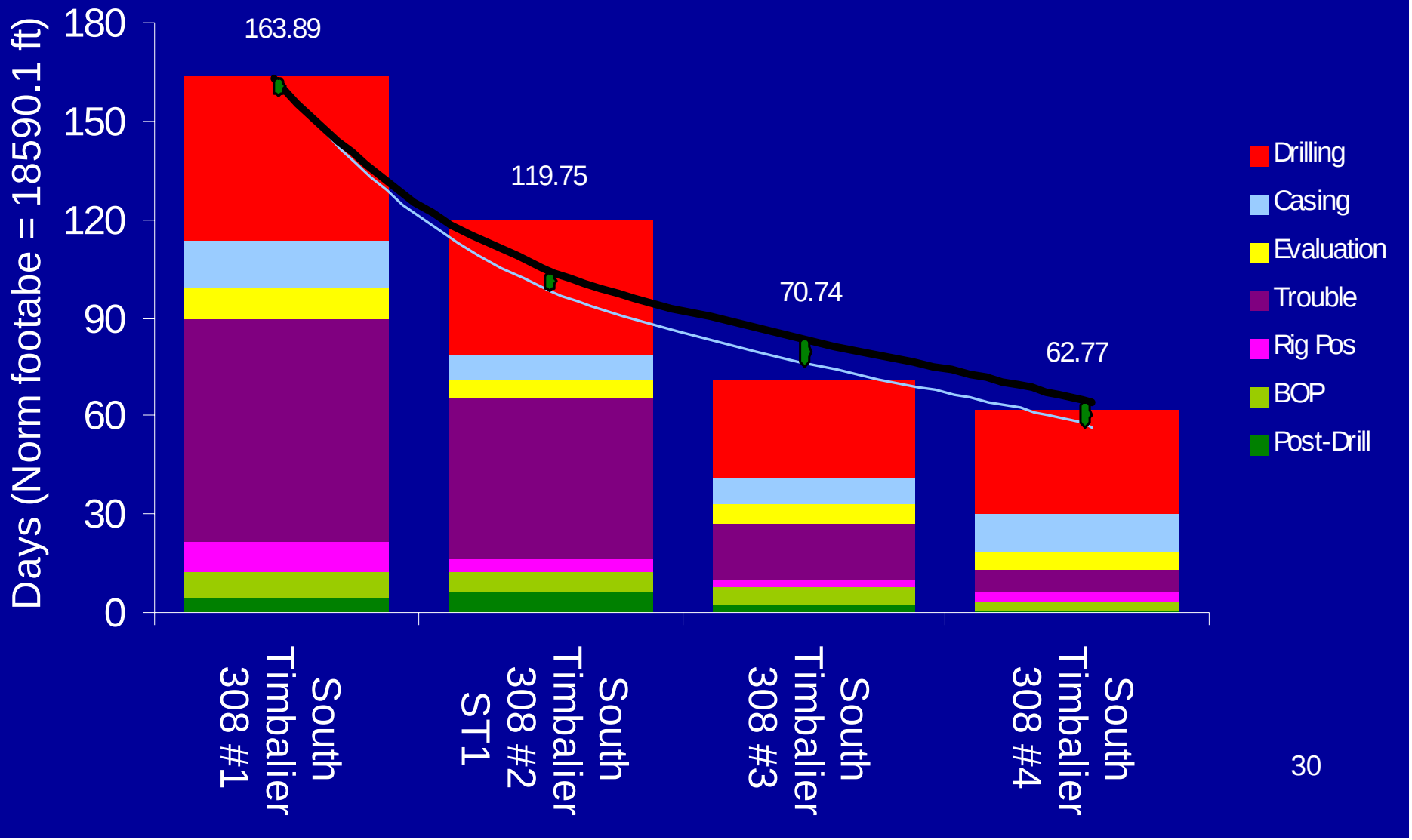
ULTRA-DEEPWATER LEARNING; Curves Separated by Drlg. Operation



Subsalt S. Timbalier; AFE estimate for Well #3 based on previous performance



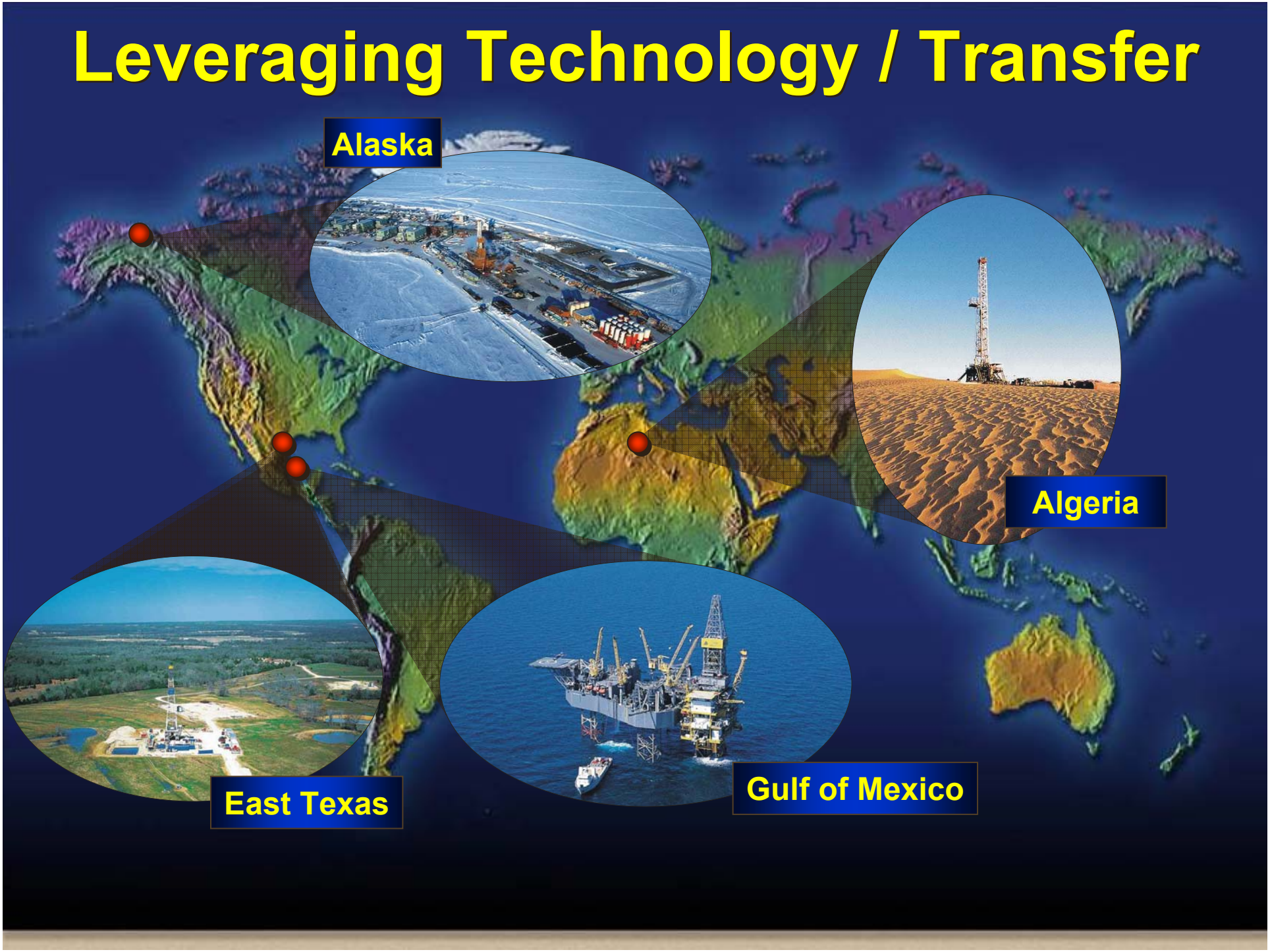
S. Timbalier Learning Analysis; C2 = 0.8 ➔ Excellent Learning



Top Five Time & Money Savers

1. Marker beads on surface casing cementing
2. BOP test against 20” & 13-5/8” casing
3. Bit run retrievable wear bushing
4. Use cement stinger on 9-5/8” production to set TA plugs
5. Utilize same rig & crew on consecutive wells

Leveraging Technology / Transfer



Traditional Analysis

The Future

Summary and Conclusions

- There are computer-assisted tools available for drilling data analysis
- Proper utilization can set new benchmarks for drilling performance
- Facilitate lessons learned, problem identification and areas for improvement
- Requires technical skills to interpret and utilize the data
- Senior management support is essential.

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