Rethinking an Industry Recommended Practice:
Lessons being Learned from Monograph 5 (Type Well Profiles)

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Introduction – SPEE Monographs

SPEE Monograph 3, "Guidelines for the Practical Evaluation of Undeveloped Reserves in Resource Plays"

- Published 2010
- Set forth methods for determining proved areas within a resource play, along with methods for estimating per-well reserves for undeveloped locations within those proved areas

SPEE Monograph 4, "Estimating Ultimate Recovery of Developed Wells in Low-Permeability Reservoirs"

- Published 2016
- Presented and discussed several different methods of forecasting on a by-well basis

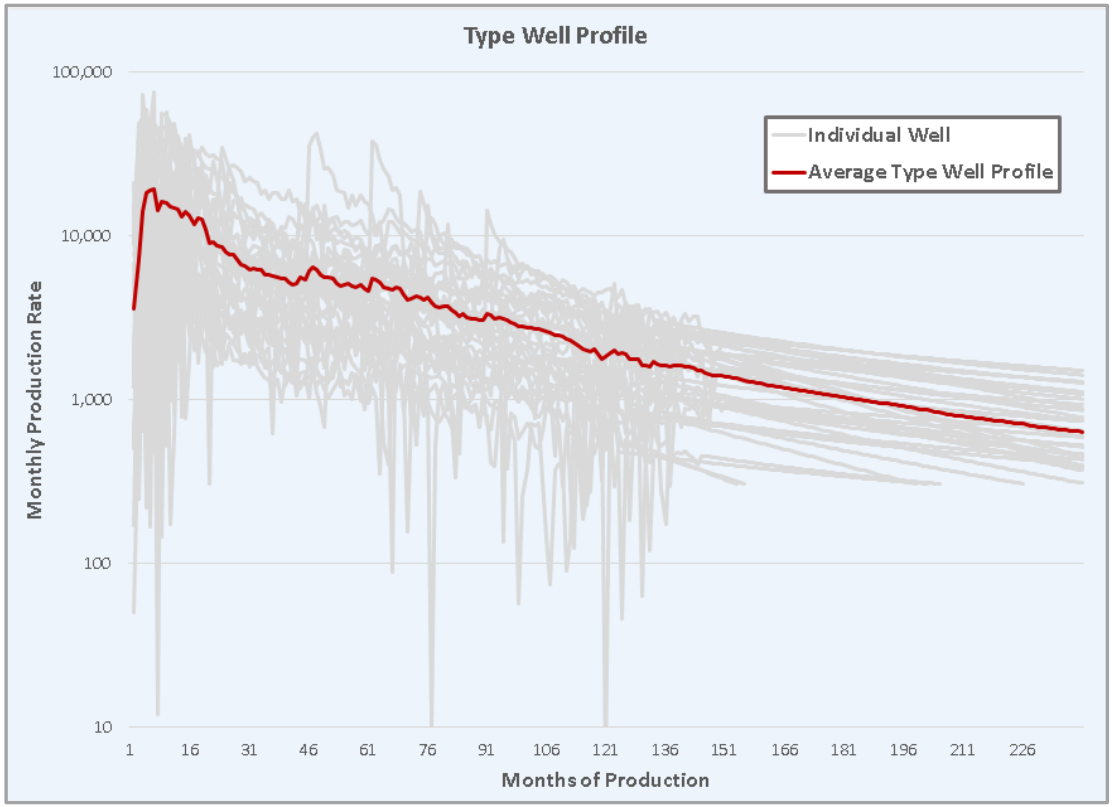
SPEE Monograph 5, "A Practical Guide to Type Well Profiles"

- Published 20?? – Work in progress
- A recommended practices guideline for the evaluation engineer to perform type well analysis, as well as, a guideline for assessing the reliability of type well profiles

Introduction – Monograph 5

Type Well Profiles (TWP)

- Estimated production profile for a typical well in a reservoir of interest
- Utilization of historical well performance from analogous wells

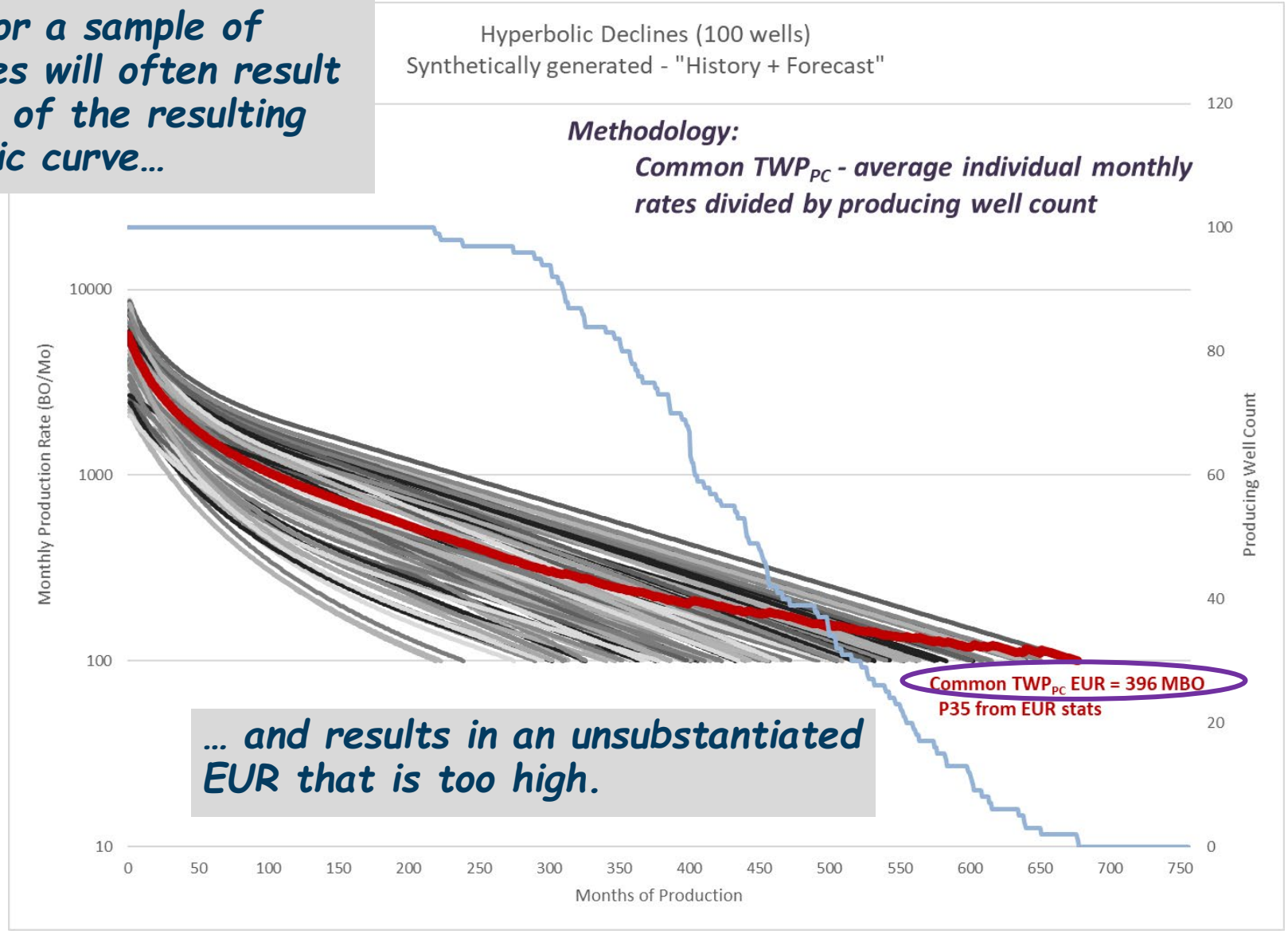


Finding the Right Tool in the Toolbox

The purpose of this monograph is to be a recommended practices guideline for the evaluation engineer to perform type well analysis, focusing first on public or easily obtained data, and then enhancing the reliability by supplementing detailed or proprietary data as necessary. The monographs gives due consideration to the "fit for purpose" confidence level to be achieved. Secondly, this monograph serves as a guideline for assessing the reliability of type well profiles.

One Common Approach

Common TWP_{PC} for a sample of hyperbolic declines will often result in over curvature of the resulting average hyperbolic curve…

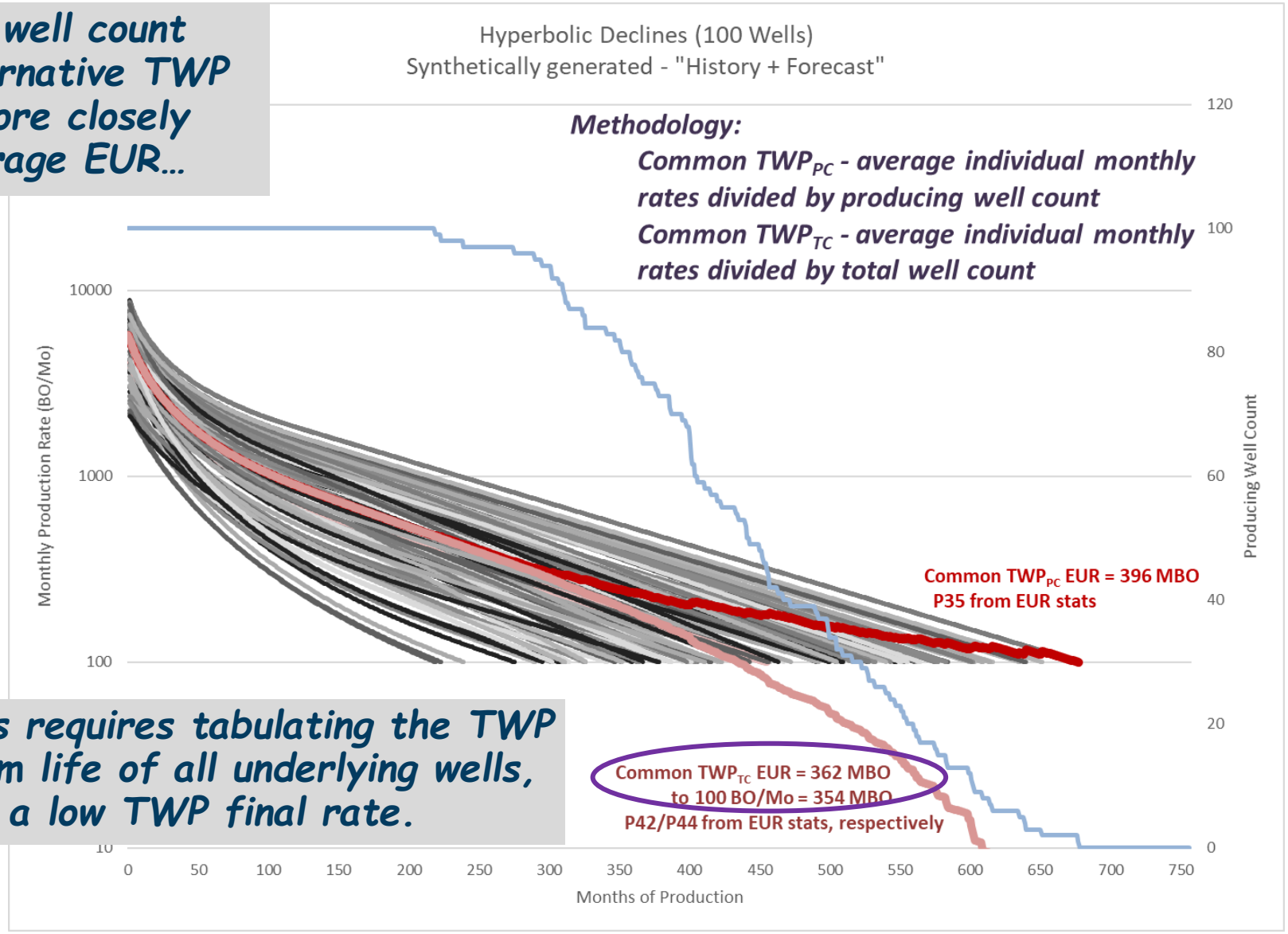


EUR Stats:

P90 = 188 MBO
P50 = 332 MBO
Mean = 365 MBO
P10 = 585 MBO
P10/P90 Ratio = 3.11

Simple Adjustment to the Common Approach

Using a constant well count results in an alternative TWP (TWP_{TC}) which more closely matches the average EUR…



EUR Stats:

P90 = 188 MBO
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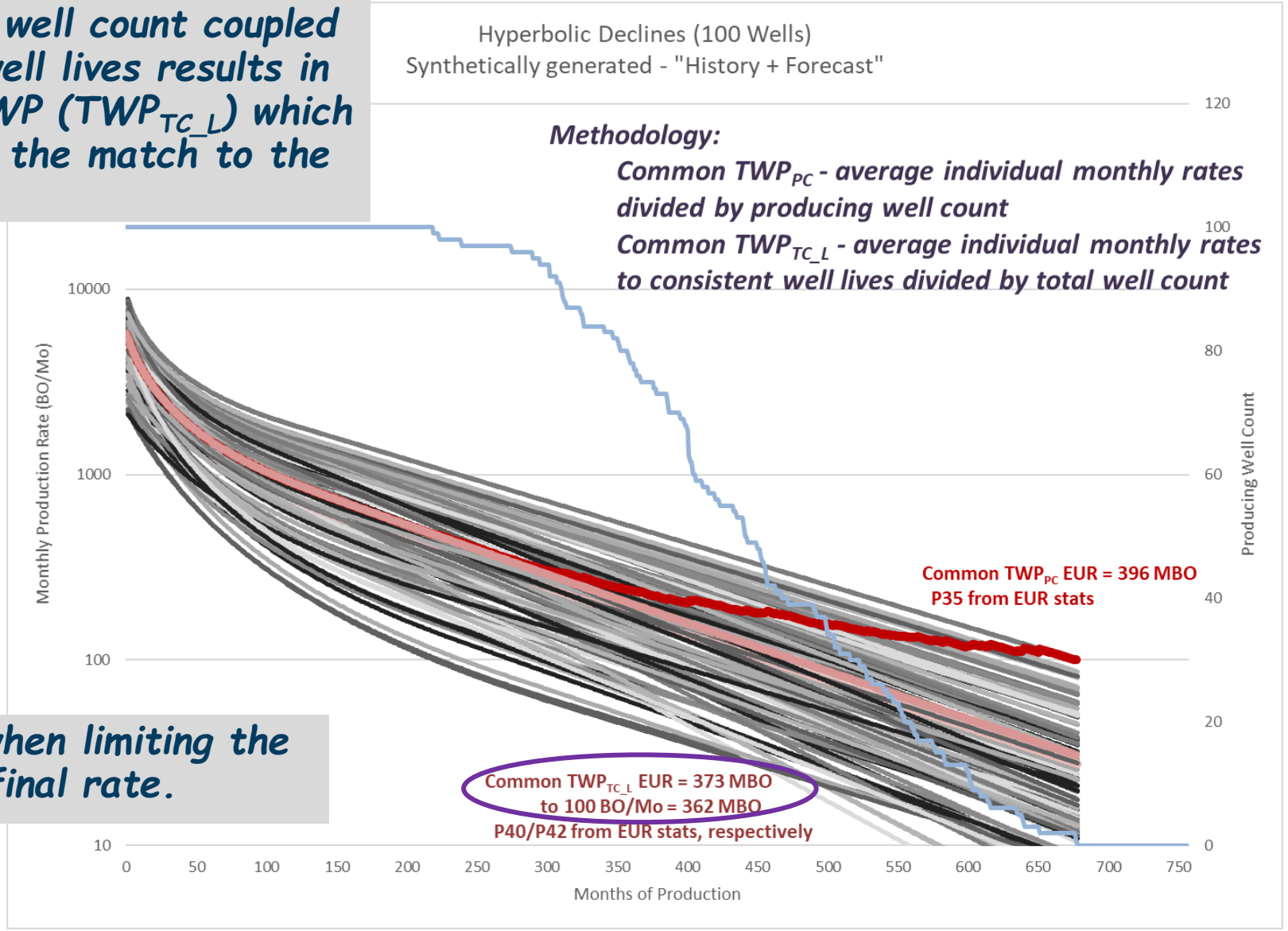
P10 = 585 MBO
P10/P90 Ratio = 3.11

… although this requires tabulating the TWP to the maximum life of all underlying wells, which leads to a low TWP final rate.

Another Adjustment to the Common Approach

Using a constant well count coupled with consistent well lives results in an alternative TWP (TWP_{TC_L}) which further improves the match to the average EUR…



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… particularly when limiting the resulting TWP final rate.

The Parameterized Method

- Based upon the aggregation of decline parameters rather than monthly production rates
- Must first forecast each analog well from the start of production to develop decline parameters for the entire curve
  - Use a common parameter template for each analog well
  - Flexibility to choose the appropriate combination of decline parameters
- Aggregate like parameters via statistical analysis to determine each element to be used in the TWP
- Check: Perform statistical analysis of the individual analog well EURs to determine the Best Estimate EUR

Typical Decline Parameters
Time to Peak Rate
Peak Rate (IP)
Initial Decline Rate
Linear Flow Hyperbolic Exponent
Transition Hyperbolic Exponent
BDF Hyperbolic Exponent
Terminal Exponential Decline Rate

Workflow Overview

Identify

Purpose

Area of Interest

Data Integration

Data Refinement

Data QC & Diagnostics

Identify Determinants of Performance

Analog Identification & Selection

Validation

QA/QC

Bias Consideration

Uncertainty Analysis

Analysis

Determine TWP Construction Method

Preparation of TWPs

Application

Ideal vs Reality

Identify

- Purpose dependent analysis
- Identify minimal data necessary for analysis
- Consider complications
- Account for practicalities
- Availability of additional data to enhance reliability of analysis

Managing Bias

Validation

- Potential for multiple types of data bias to influence the outcome
- Mitigation may be necessary to eliminate or greatly reduce error associated with bias

Specific Types of Bias

Validation

- Selection Bias
- Forecast Bias
- Normalization Bias
- Population Bias
- Survivor Bias
  - Vintage Bias
  - Performance Bias

Validation

Validation

- Validate use of appropriate analog set
- Validate results with diagnostics and hind-casting
- Clear documentation of assumptions and methodology

Uncertainty

Validation

- Characterize the certainty level of data analysis prior to application

- Elements impacting Uncertainty
  - Individual well forecasts
  - Sample representative of the population
  - Program Size

Reinventing the Wheel

- Too often engineers across an organization reinvent the wheel
- Ensure standards are met
- Consistency of technique
- Flexibility to allow for "fit for purpose"

Questions

Thank you!

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