The Engineer as Craftsman

OKC Section SPEE
January 24, 2019
Engineering algorithms are merely tools
data
accumulation & reduction
analysis
synthesis
design

data
data
accumulation & reduction
analysis
synthesis
design
accumulation & reduction
data
timely
for decision at hand
reliable
transferable
quality...
Our foundation and raw material is...
Our foundation and raw material is...

- production tests, volumes
- flowing pressures
- build-up pressures
- open hole logs
- mud logs
- cased hole logs
- core analysis
- special core analysis
- reservoir fluid studies
- fluid properties correlations
- drilling and operations
- history, configuration
- contracts, operating costs,
capital costs
Public data downloads are invaluable. . .

### Vendors
- DrillingInfo
- IHS
- TGS
- Oseberg
- Lasser
- WellDatabase

### What it is
- Header data
- Monthly volumes
- Well test rates

### What is emerging
- Different methods of allocation

DrillingInfo white paper, July 2017
...but badly needing an overhaul

**what it is**
- header data
- monthly volumes
- well test rates

**what is emerging**
- different methods of allocation

**what it should be**
- complete test info
- commodity sales price
- lease NRI
- allocated & unallocated data
- or data on allocation quality
- perhaps LOE data from *ad valorem* appraisal

[Graph showing data trend]
Treasuries of public data extend well beyond production. . .

**literature**
- papers via university library
- reference volumes, monographs
- state geologic surveys

**docFinder database**
- geology, costs, recovery, etc.
- b-factor database

**log libraries**
- before about 1990

**DI Plus LAS files**
...even into proprietary and laboratory data

**RRC**
- wellfiles online
- field rules hearings
- waterflood survey

**Core Lab**
- consortia studies
- relative permeability database
- core database

**GeoMark Research**
- PVT database
- oil geochem
- gas analyses
- water analyses
- source rock analyses
- all or subset

[geomarkresearch.com/database-products/](geomarkresearch.com/database-products/)
Some tools are better than others
Generic tools are powerful. . .

Excel  for tables
Spotfire  for graphs
Tableau  for simple & unique calculations
for data analysis of any kind
...but not universal

When all you have is a hammer, everything looks like a nail.

-Abraham Maslow (paraphrase)
Few methods for determining reserves

preferable to use multiple methods
<table>
<thead>
<tr>
<th>vendors</th>
<th>what it is</th>
<th>what is emerging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petra</td>
<td>two dimensional</td>
<td>three dimensional</td>
</tr>
<tr>
<td>Transform</td>
<td>log images</td>
<td>LAS images</td>
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<td>Geographix</td>
<td>single-user</td>
<td>high resolution</td>
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<td>NeuraSection</td>
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<td>Surfer + Strater</td>
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<td>ARCgis/Qgis</td>
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<td>Petrel</td>
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<td>RMS (Roxar)</td>
<td></td>
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<tr>
<td>GOCAD</td>
<td></td>
<td></td>
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<tr>
<td>ReservoirGrail</td>
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Volumetrics, mapping and cross-sections needs step change

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<th>what it should be</th>
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<tr>
<td>two dimensional</td>
<td>three dimensional</td>
<td>fully LAS</td>
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<tr>
<td>log images</td>
<td>LAS images</td>
<td>fully three dimensional</td>
</tr>
<tr>
<td>single-user</td>
<td>high resolution</td>
<td>available to other users</td>
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<tr>
<td></td>
<td></td>
<td>manual control of contouring</td>
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<td></td>
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<td>save maps</td>
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Decline Curve Analysis also needs a step change in vendors, what it is, and what is emerging.

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<thead>
<tr>
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<tbody>
<tr>
<td>PHDwin</td>
<td>rate-time, rate-cum</td>
<td>map interface</td>
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<tr>
<td>ARIES</td>
<td>two phase</td>
<td>alternative decline models</td>
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<td>Value Navigator</td>
<td>deterministic</td>
<td>probabilistic volume forecasting</td>
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<td>PEEP</td>
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<td>MOSAIC</td>
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<td>BetaZi</td>
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<td>DI</td>
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<td></td>
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Decline Curve Analysis also needs a step change

what it should be
integrated map interface
Fetkovich (log-log)
NPI and other methods
transient hyperbolic model
database and graphs of
  + all historical data
  + all inputs/outputs
NGL by default
Measure twice

Check results
Rate Transient Analysis seems static, needs more use

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<td>forecast only volumes</td>
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<td>Topaze</td>
<td>“straight-line analysis”</td>
<td>. . .</td>
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<td>Sahara</td>
<td>“model” type curves</td>
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<td>simulation</td>
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Rate Transient Analysis seems static, needs more use

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<td>integration with economics</td>
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<td>“straight-line analysis”</td>
<td>. . .</td>
<td>used more often!</td>
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Simulation needs application for line engineers

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<tr>
<td>Eclipse</td>
<td>single well or full field</td>
<td>multiprocessor, GPU and CPU</td>
</tr>
<tr>
<td>IMEX</td>
<td>mostly 1970s</td>
<td>modern code</td>
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<tr>
<td>tNavigator</td>
<td>+ FORTRAN code</td>
<td>backwards compatibility</td>
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<tr>
<td>VIP</td>
<td>+ command line flat file</td>
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<tr>
<td>SENSOR</td>
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<td>+ REXCEL</td>
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<tr>
<td>+ TecPlot</td>
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<tr>
<td>+ PetroStreamz</td>
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<tr>
<td>Merlin</td>
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Simulation needs application for line engineers

what it should be

tool for line engineers
+ smaller and cheaper
+ modern software
+ database driven
+ extensive correlations and auto-fill
+ easy I/O
+ workflow management
The job is not done, until it is cleaned up.
Reservoir engineering forms the capstone (synthesis)
Reservoir Engineering forms the capstone

A good engineer is at least a decent geologist.

-Bruce Archinal
Cognitive bias

When it comes to assessing risk, humans often fail to make rational decisions because our brains take mental shortcuts that prevent us making the correct choice. Since the 1960s behavioural scientists and psychologists have been researching these failings, and have identified and labelled dozens of them. Here are some that can cause havoc when it comes to assessing risks in business.

- ANCHORING EFFECT
  - “The first test seemed OK. So we need to look any more?”

- AVAILABILITY HEPERISTIC
  - “I saw something very similar to this on LinkedIn. We need to take it seriously.”

- BANDWAGON EFFECT
  - “The whole department knows there’s no problem here.”

- BELIEF BIAS
  - “I didn’t quite follow your argument but the conclusion seems right.”

- BLIND SPOT BIAS
  - “Let’s ignore Sarah’s views on this one. She’s biased.”

- CLUSTERING ILLUSION
  - “This is the second week in a row that this has happened. There must be a problem.”

- CONFIRMATION BIAS
  - “We did loads of simulations. Most of them showed there’s no problem.”

- COURTESY BIAS
  - “The last time we discussed this the meeting lasted for hours. Let’s move on.”

- ENDOWMENT EFFECT
  - “I know it will cost a fortune to fix but it cost us £15,000. We can’t just throw it away.”

- GAMBLER’S FALLACY
  - “The conveyor belt broke three times last month, it’s pretty unlikely it’ll happen again.”

- HYPERBOLIC DISCOUNTING
  - “Let’s just get the deal done ASAP.”

- ILLUSION OF VALIDITY
  - “This worked fine in the factory in Korea, it should work fine here.”

- ILLUSION OF LIKELIHOOD
  - “Looks like we’re running out of time to discuss this.”

- OSTRICH EFFECT
  - “We made a good call on that one.”

- POST-FACTOR RATIONALISATION
  - “Our competitors are only doing well because their products are cheap.”

- REACTIVE DEVALUATION
  - “If it ain’t broke - don’t fix it.”

- RISK COMPENSATION
  - “Dave from tech is worried - but frankly the tech team are always pessimists.”

- STATUS QUO BIAS
  - “Now we’ve got the new equipment we can cut the time spent on maintenance.”

- STEREOTYPING
  - “Assuming a person has characteristics because they’re a member of a group.”

**ORIGIN**
The academic origins of bias were first introduced by psychologists James Tenopy and Daniel Kahneman in the early 1970s. Their research paper Judgement Under Uncertainty: Heuristics and Biases, published in 1974, was based on the 1920s work of a psychologist named Edward Thorndike. The book has provided the basis of almost all current theories of decision making and psychology. Several decades later, Kahneman was awarded a Nobel Prize in Economics in 2002 after further developing the ideas and applying them to economics.

**IMAGE**
VisualCapitalist.com
Even engineers are not rational

Intelligence will be used in the service of the neurosis.

-Sigmund Freud
Treat yourself and ideas with tactical distrust

We made a searching and fearless moral inventory of ourselves.

- Alcoholics Anonymous, Step 4

“How can we test this theory?”
+ parallel
+ perpendicular
+ possibilities
Wisdom is a matter of probabilities, not possibilities

Five measures of risk assessment
1. probability of success
2. ratio of win to loss
3. absolute win
4. absolute loss
5. sense of control of the outcome
Thank You!

www.dpurvisPE.com