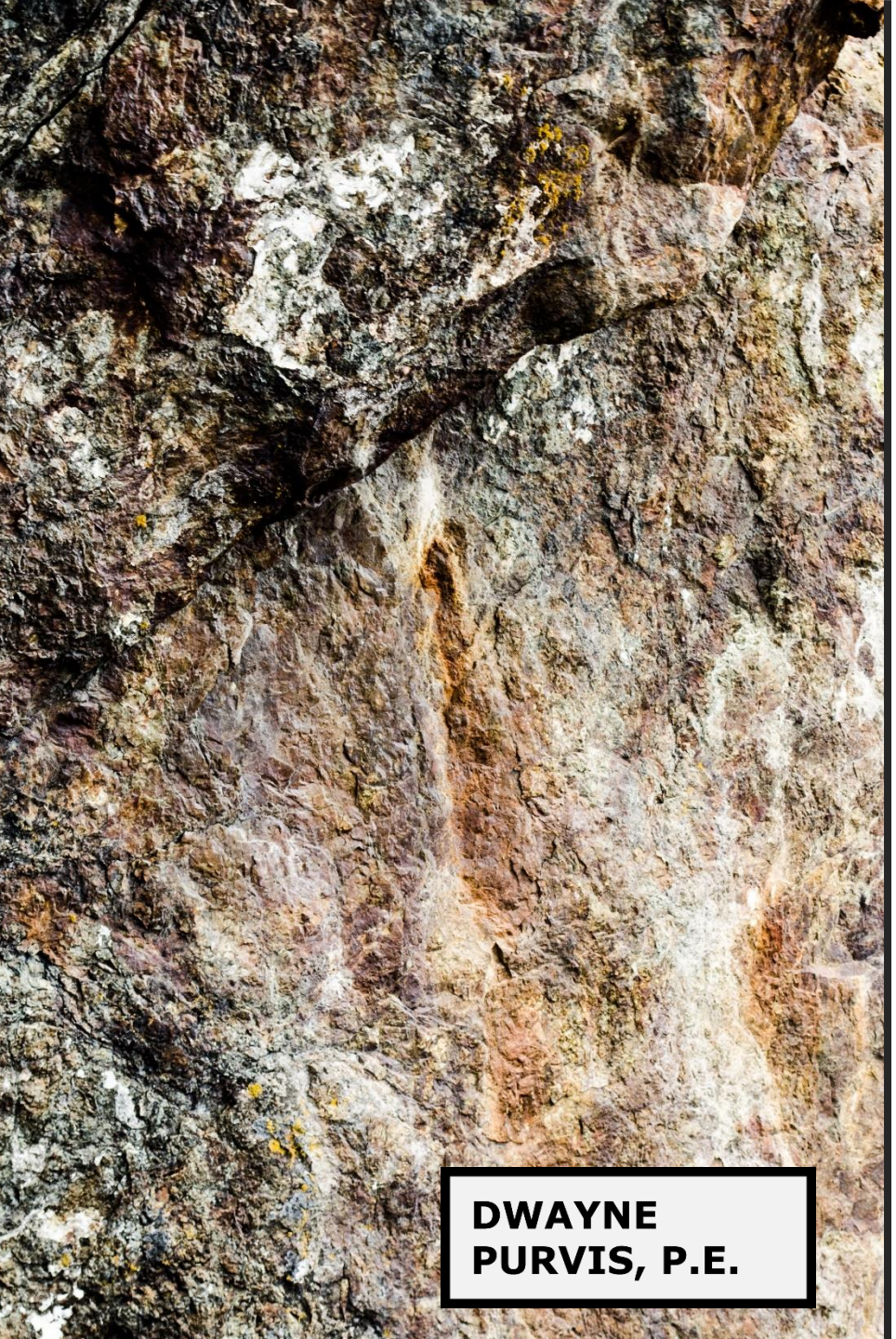
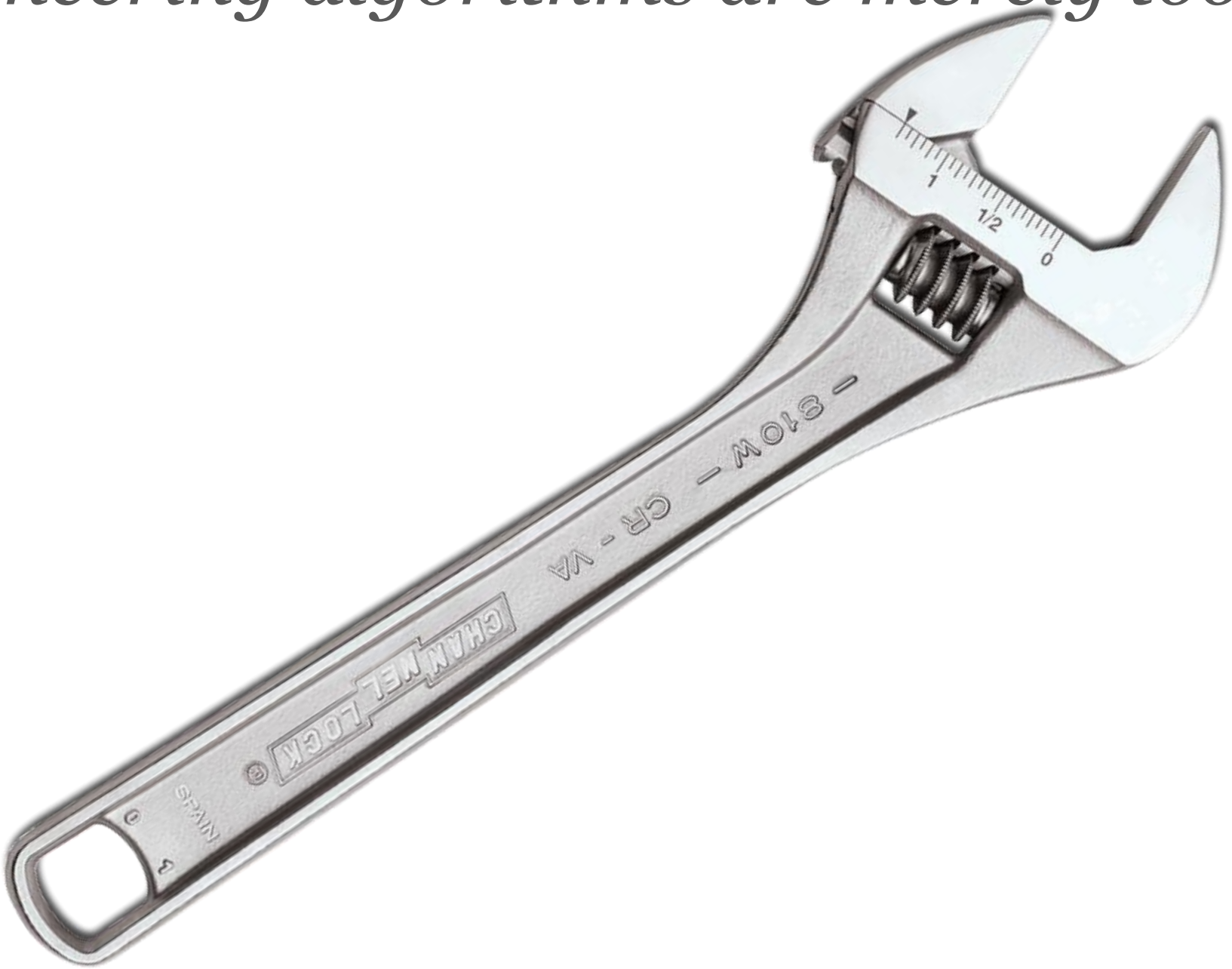


The Engineer as Craftsman

OKC Section SPEE

January 24, 2019

Engineering algorithms are merely tools



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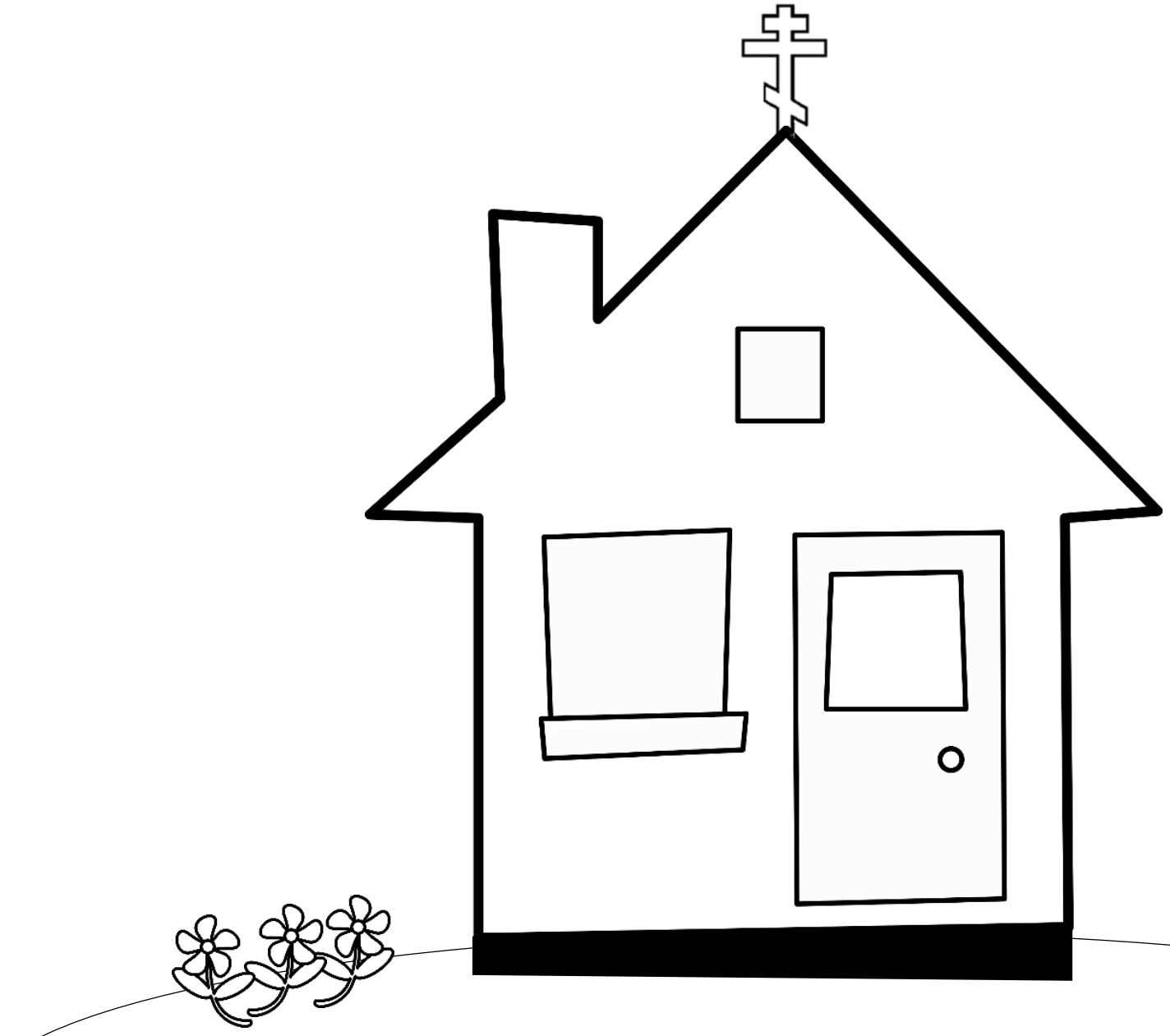
Channel Lock.com



design

synthesis

analysis

accumulation & reduction

data

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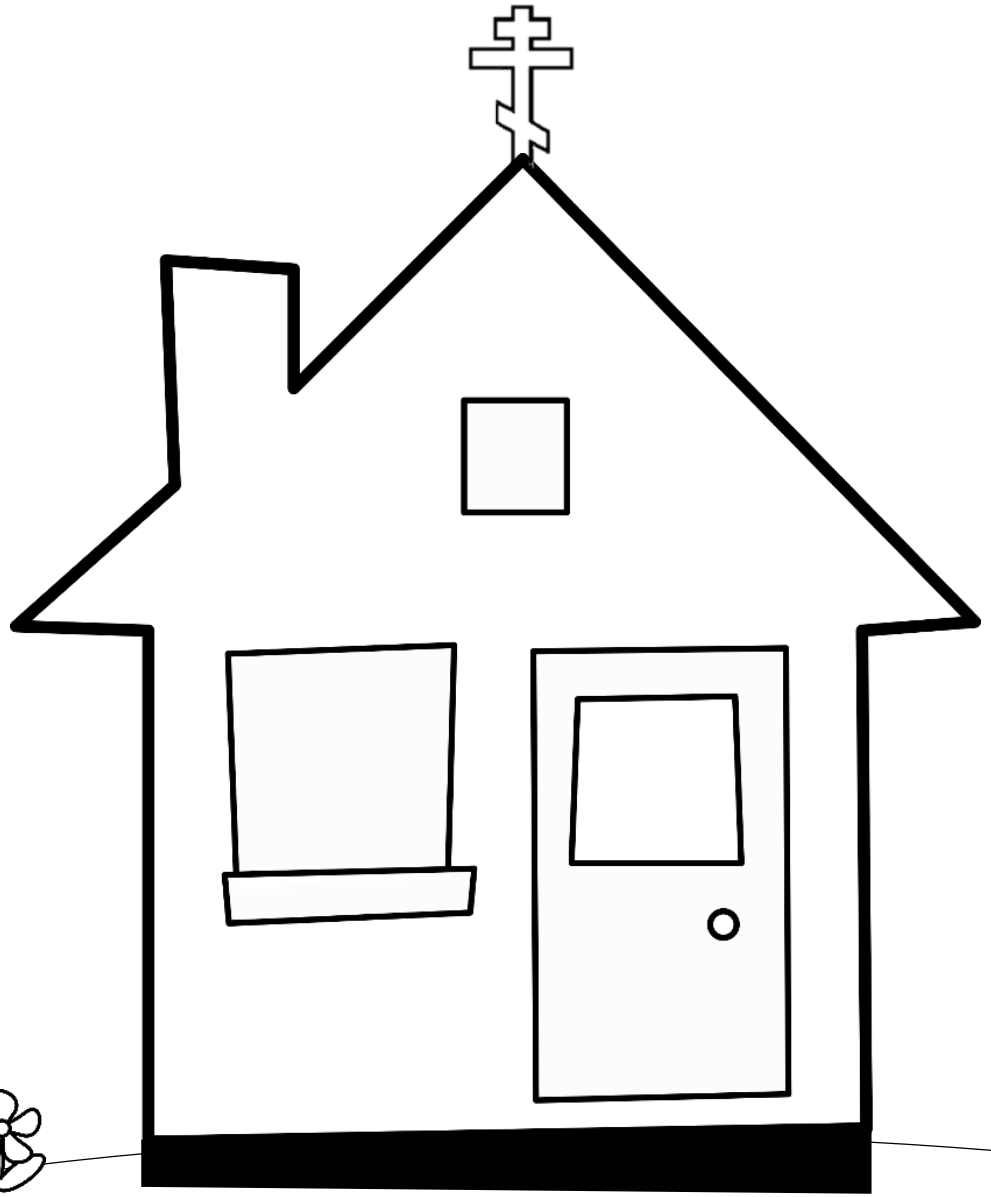
quality. . .

timely

reliable
for decision at hand

transferable



design

synthesis

analysis

accumulation & reduction

data

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Our foundation and raw material is. . .

data

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Our foundation and raw material is. . .

data

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

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Public data downloads are invaluable. . .

vendors

DrillingInfo

IHS

TGS

Oseberg

Lasser

Welldatabase

regulatory agencies

what it is

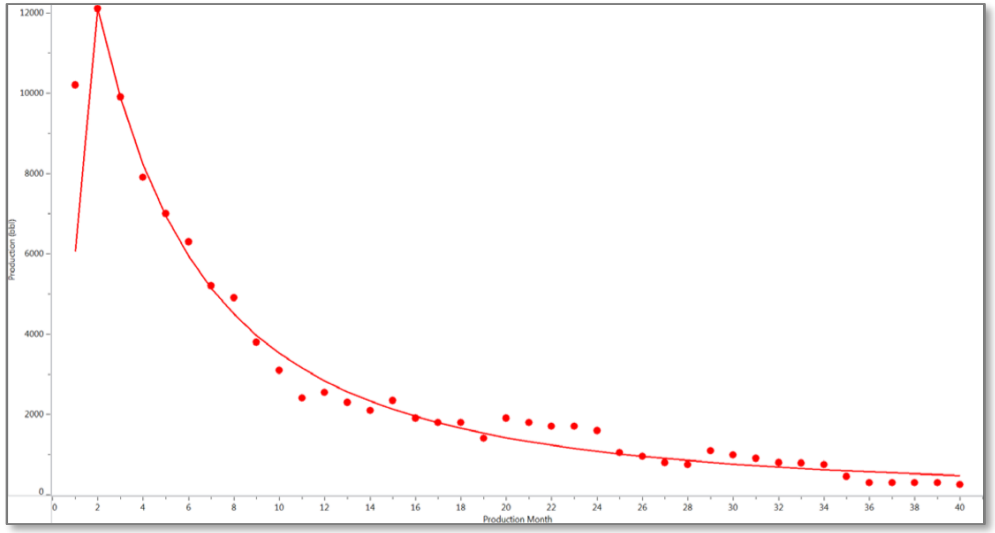
header data

monthly volumes

well test rates

what is emerging

different methods of allocation



DrillingInfo white paper, July 2017

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. . .but badly needing an overhaul

what it is

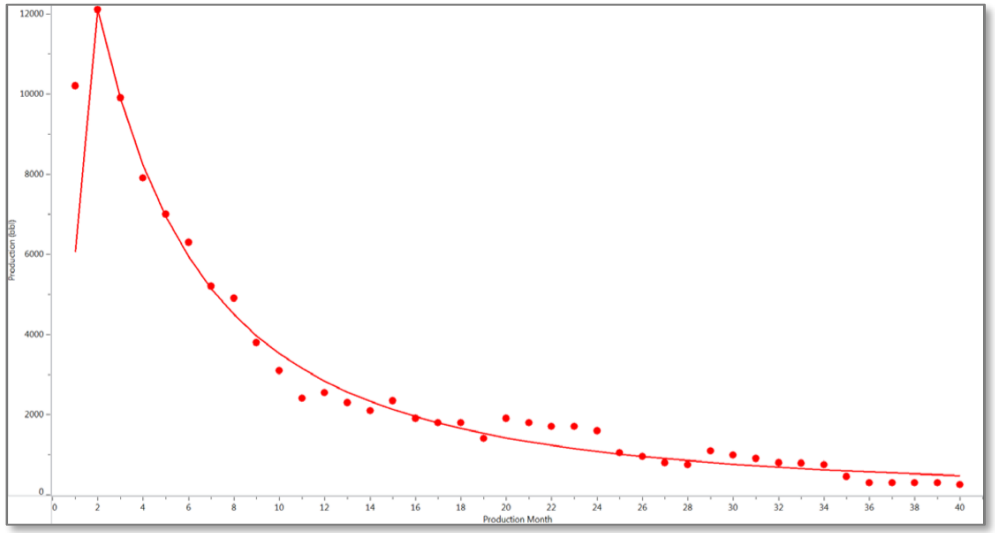
header data

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

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Treasuries of public data extend well beyond production. . .

The Clark Society

TCU MARY COUTS BURNETT LIBRARY

literature

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

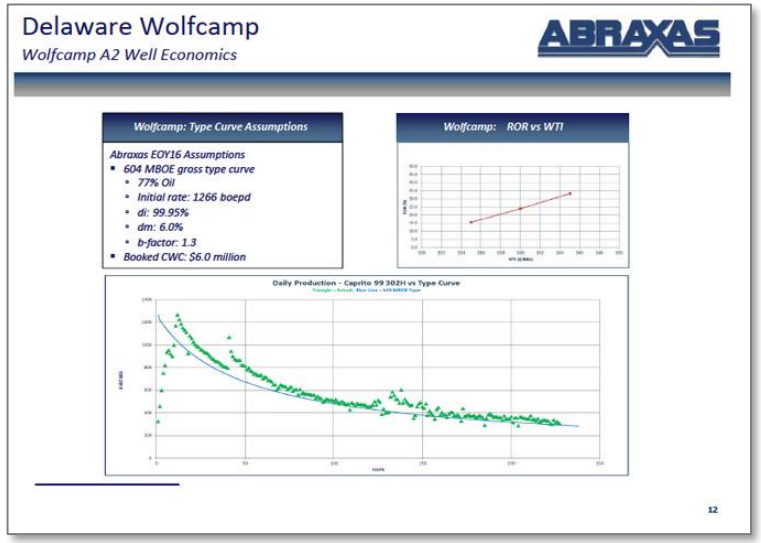
docFinder database

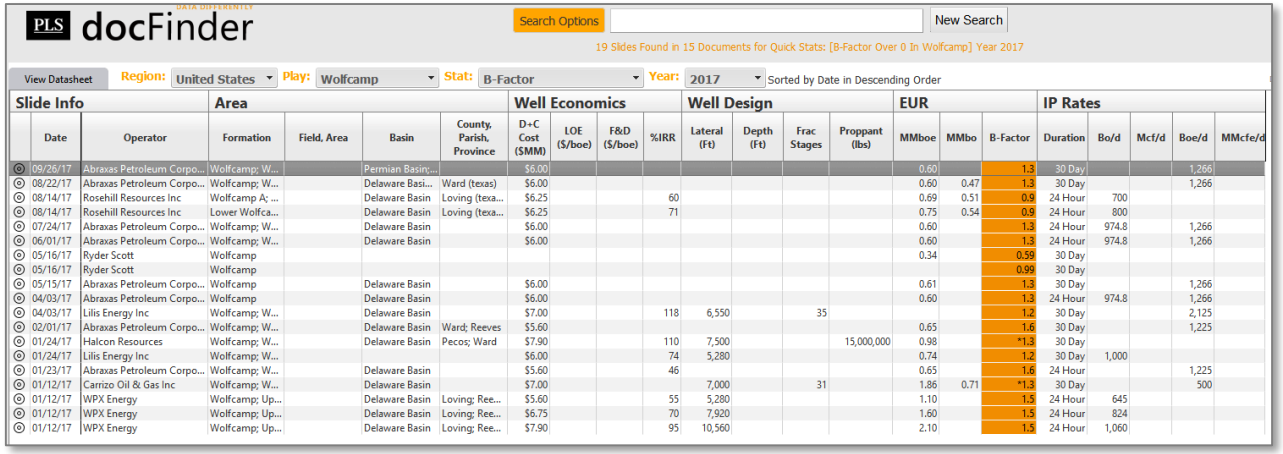
- geology, costs, recovery, etc.
- b-factor database

log libraries

- before about 1990

DI Plus LAS files





Slide Info		Area				Well Economics				Well Design				EUR			IP Rates				
Date	Operator	Formation	Field, Area	Basin	County, Parish, Province	D+C Cost ($MM)	LOE ($/boe)	F&D ($/boe)	%IRR	Lateral (Ft)	Depth (Ft)	Frac Stages	Proppant (lbs)	MMboe	MMbo	B-Factor	Duration	Bo/d	Mcf/d	Boe/d	MMcfe/d
09/26/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Permian Basin;...		$6.00								0.60		1.3	30 Day			1,266	
08/22/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Delaware Basi...	Ward (texas)	$6.00								0.60	0.47	1.3	30 Day			1,266	
08/14/17	Rosehill Resources Inc	Wolfcamp A; ...		Delaware Basin	Loving (texa...	$6.25			60					0.69	0.51	0.9	24 Hour	700			
08/14/17	Rosehill Resources Inc	Lower Wolfca...		Delaware Basin	Loving (texa...	$6.25			71					0.75	0.54	0.9	24 Hour	800			
07/24/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Delaware Basin		$6.00								0.60		1.3	24 Hour	974.8		1,266	
06/01/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Delaware Basin		$6.00								0.60		1.3	24 Hour	974.8		1,266	
05/16/17	Ryder Scott	Wolfcamp												0.34		0.59	30 Day				
05/16/17	Ryder Scott	Wolfcamp														0.99	30 Day				
05/15/17	Abraxas Petroleum Corpo...	Wolfcamp		Delaware Basin		$6.00								0.61		1.3	30 Day			1,266	
04/03/17	Abraxas Petroleum Corpo...	Wolfcamp		Delaware Basin		$6.00								0.60		1.3	24 Hour	974.8		1,266	
04/03/17	Lilis Energy Inc	Wolfcamp; W...		Delaware Basin		$7.00			118	6,550		35				1.2	30 Day			2,125	
02/01/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Delaware Basin	Ward; Reeves	$5.60								0.65		1.6	30 Day			1,225	
01/24/17	Halcon Resources	Wolfcamp; W...		Delaware Basin	Pecos; Ward	$7.90			110	7,500			15,000,000	0.98		*1.3	30 Day				
01/24/17	Lilis Energy Inc	Wolfcamp; W...				$6.00			74	5,280				0.74		1.2	30 Day	1,000			
01/23/17	Abraxas Petroleum Corpo...	Wolfcamp; W...		Delaware Basin		$5.60			46					0.65		1.6	24 Hour			1,225	
01/12/17	Carrizo Oil & Gas Inc	Wolfcamp; W...		Delaware Basin		$7.00				7,000		31		1.86	0.71	*1.3	30 Day			500	
01/12/17	WPX Energy	Wolfcamp; Up...		Delaware Basin	Loving; Ree...	$5.60			55	5,280				1.10		1.5	24 Hour	645			
01/12/17	WPX Energy	Wolfcamp; Up...		Delaware Basin	Loving; Ree...	$6.75			70	7,920				1.60		1.5	24 Hour	824			
01/12/17	WPX Energy	Wolfcamp; Up...		Delaware Basin	Loving; Ree...	$7.90			95	10,560				2.10		1.5	24 Hour	1,060			

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. . .even into proprietary and laboratory data

RRC

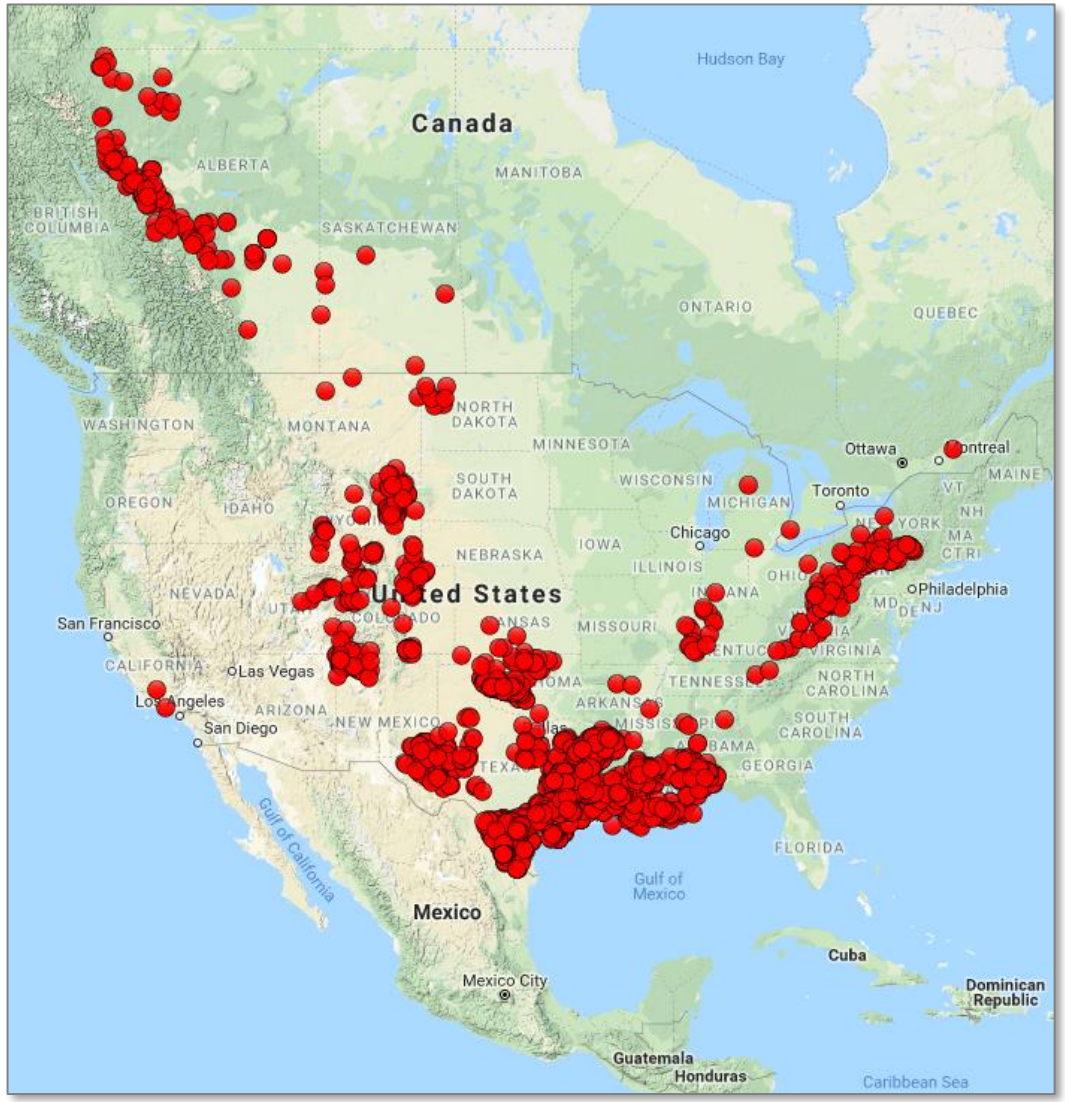
- wellfiles online
- field rules hearings
- waterflood survey

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



corelab.com/irs/data-management
geomarkresearch.com/database-products/

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Some tools are better than others

URREAprofessionaltools.com
WILDEtool.com

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Generic tools are powerful. . .

Excel	for tables for simple & unique calculations
Spotfire	for graphs for data analysis of any kind
Tableau	

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. . .but not universal

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

-Abraham Maslow (paraphrase)

Wikipedia.org "Law of the instrument"

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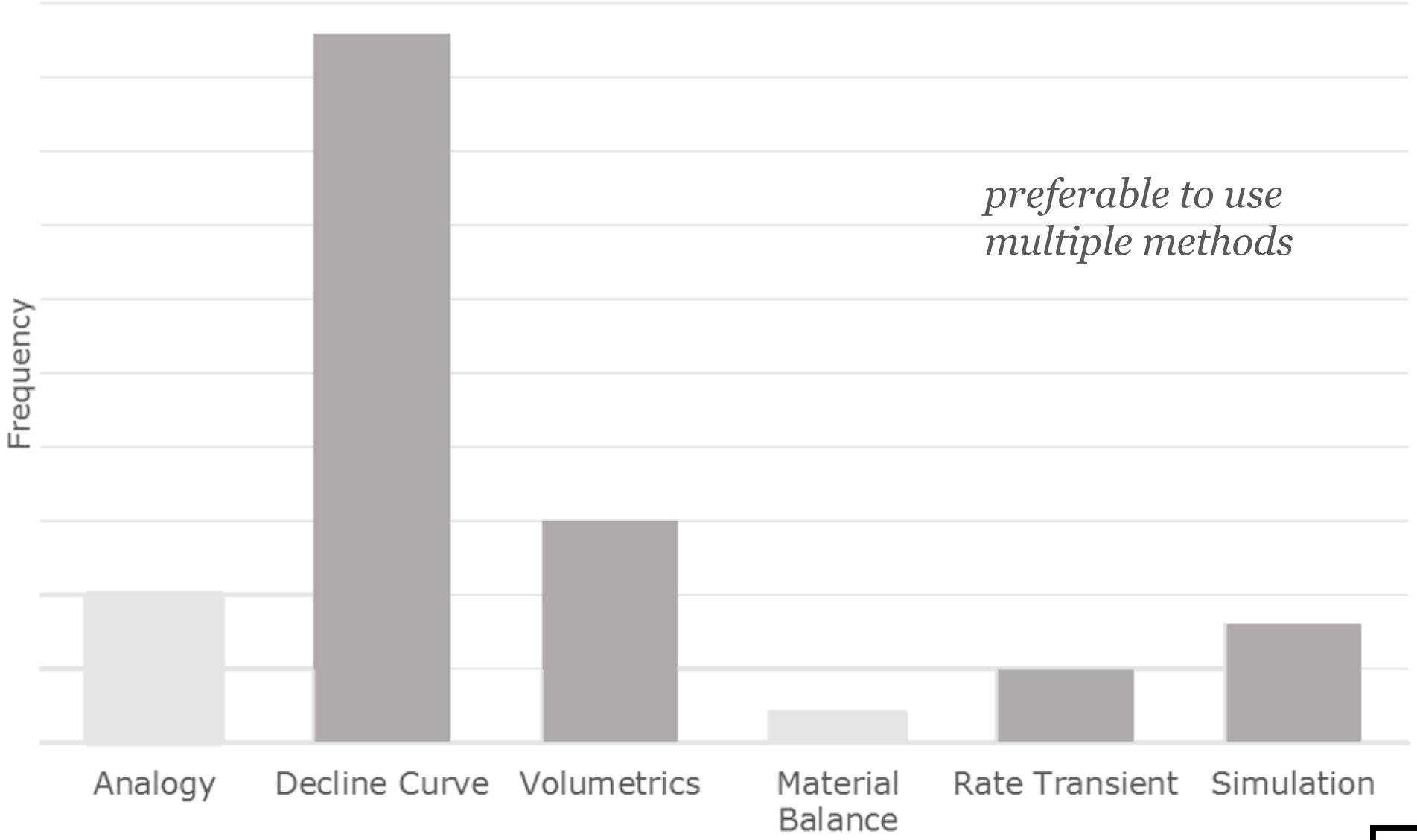
Few methods for determining reserves



preferable to use multiple methods

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Volumetrics, mapping and cross-sections needs step change

vendors	***what it is***	***what is emerging***
Petra	two dimensional	three dimensional
Transform Geographix NeuraSection	log images	LAS images
Surfer + Strater ARCgis/Qgis	single-user	high resolution
Petrel RMS (Roxar) GOCAD		
ReservoirGrail		

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Volumetrics, mapping and cross-sections needs step change

what it is	***what is emerging***	***what it should be***
two dimensional	three dimensional	fully LAS
log images	LAS images	fully three dimensional
single-user	high resolution	available to other users
		manual control of contouring
		save maps

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Decline Curve Analysis also needs a step change

vendors

PHDwin
ARIES

Value Navigator

PEEP
OGRE
PowerTools

MOSAIC
QuickDecline
DeclinePlus

what it is

rate-time, rate-cum

two phase

deterministic

what is emerging

map interface

alternative decline models

probabilistic volume forecasting

PetroVisual

BetaZi
DI
Value Navigator

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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

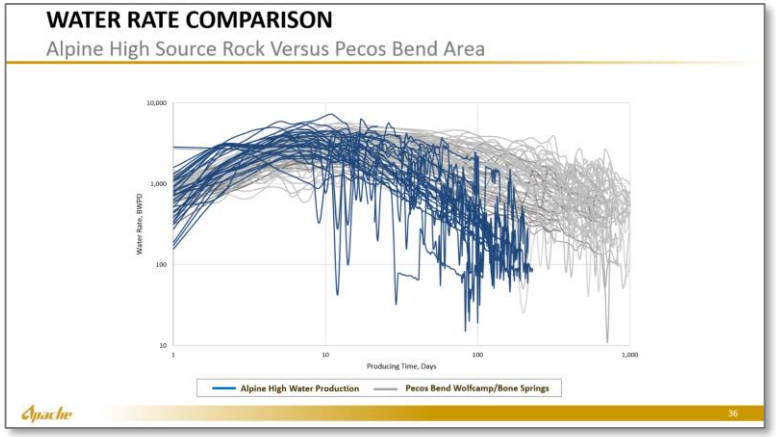
transient hyperbolic model

database and graphs of

+ all historical data

+ all inputs/outputs

NGL by default



Apache Corporation investor presentation, March 26, 2018
PetroVisual.com

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Measure twice

Check results

EmpireLevel.com
HomeDepot.com

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Rate Transient Analysis seems static, needs more use

vendors	***what it is***	***what is emerging***
Harmony	forecast only volumes	. . .
Topaze	“straight-line analysis”	
Sahara	“model” type curves	
	simulation	

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Rate Transient Analysis seems static, needs more use

what it is	***what is emerging***	***what it should be***
forecast only volumes	. . .	integration with economics
“straight-line analysis”		used more often!
“model” type curves		
simulation		

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Simulation needs application for line engineers

vendors

Eclipse

IMEX

tNavigator

VIP

SENSOR

+ REXCEL
+ TecPlot
+ PetroStreamz

Merlin

what it is

single well or full field

mostly 1970s

+FORTRAN code

+command line flat file

what is emerging

multiprocessor, GPU and CPU

modern code

backwards compatibility

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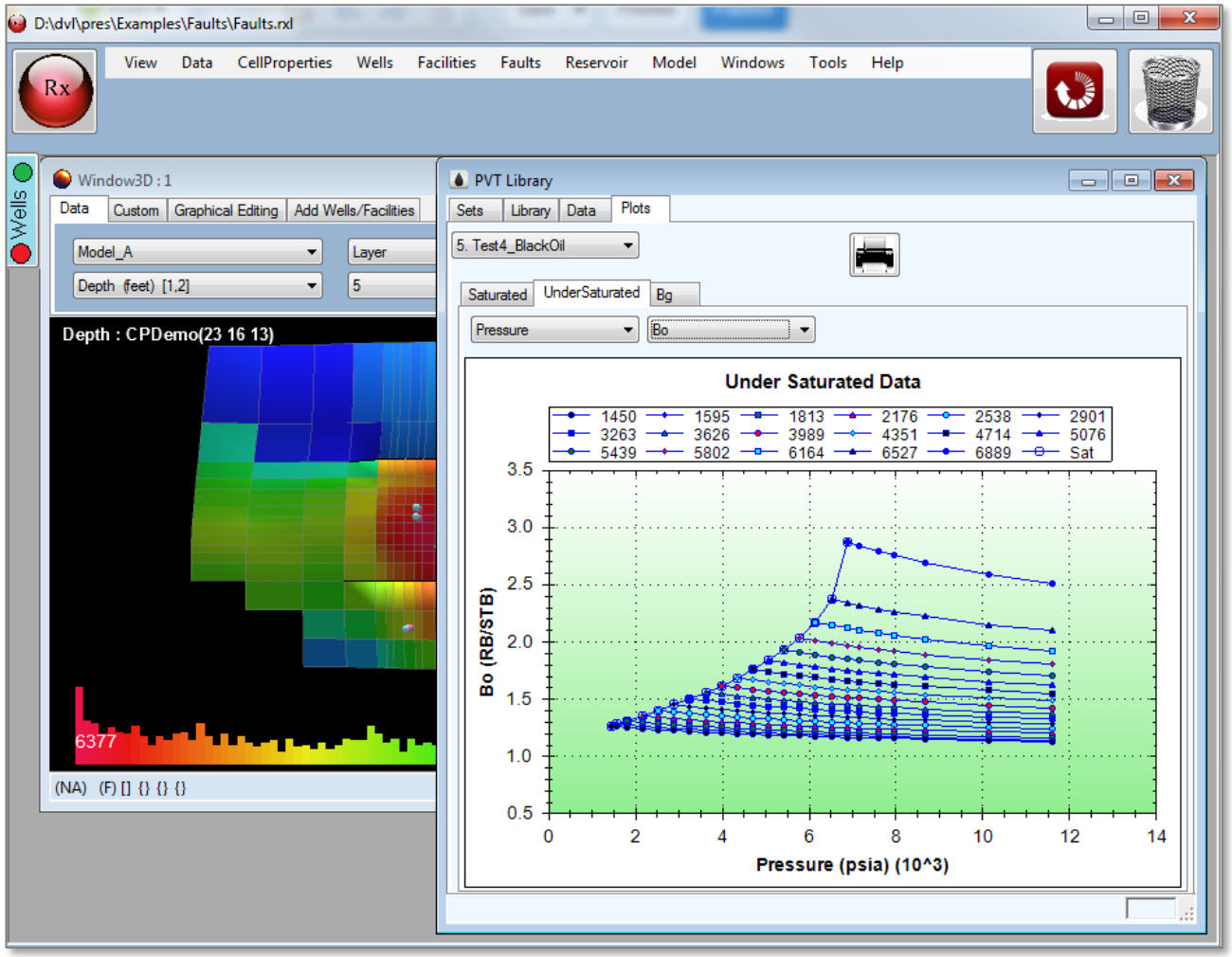
Simulation needs application for line engineers

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



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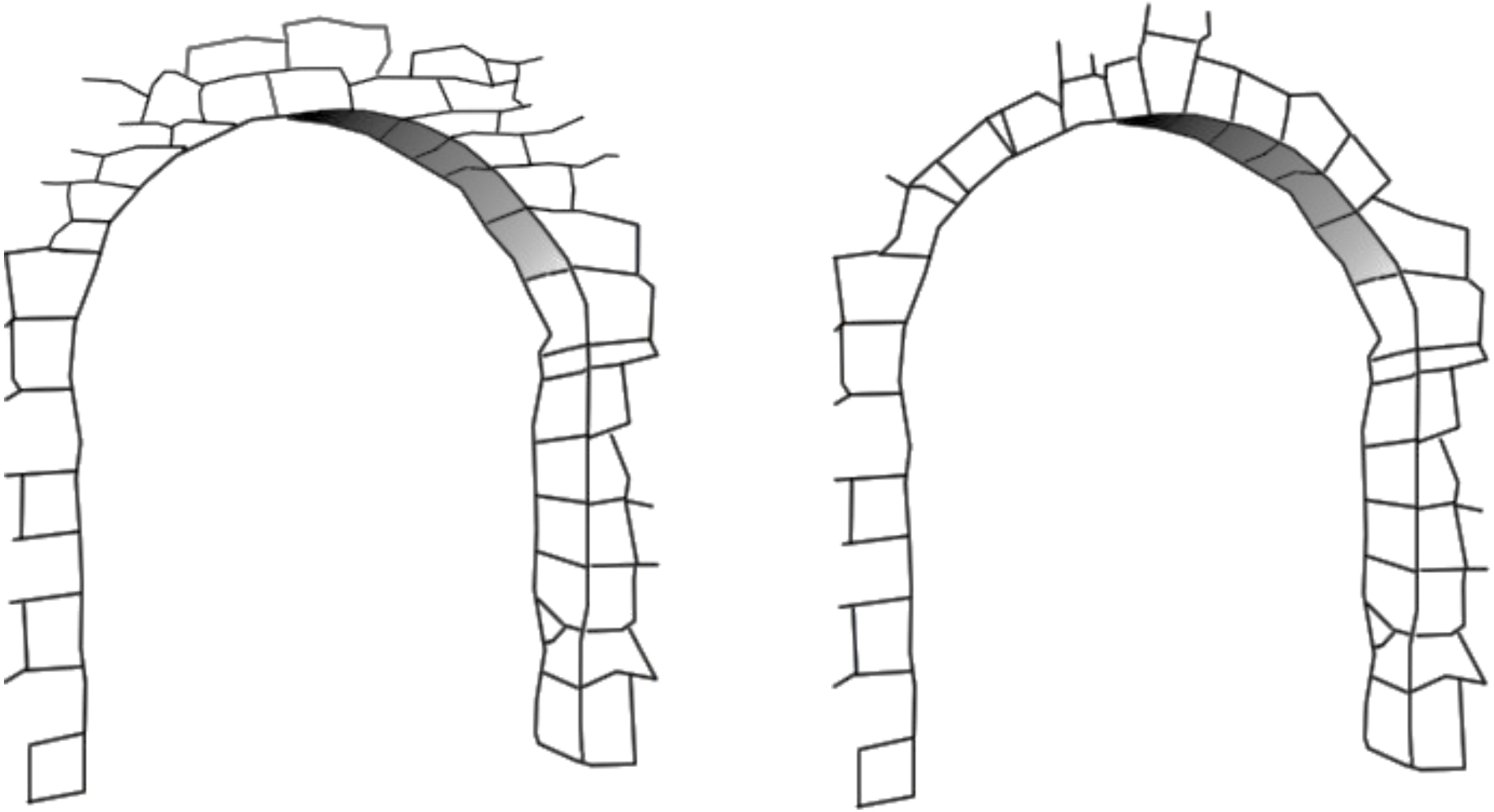
The job is not done,
until it is cleaned up
Pixabay.com

Reservoir engineering forms the capstone (synthesis)



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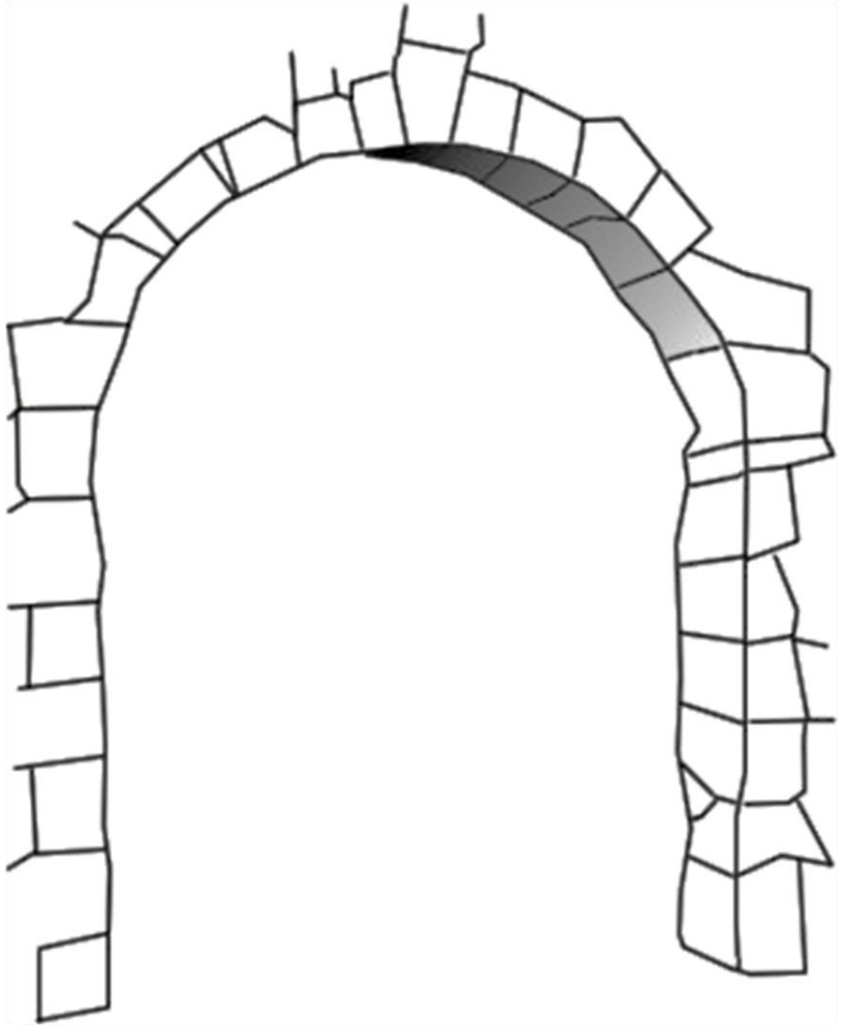
Wikimedia.org

Reservoir Engineering forms the capstone



A good engineer is at least a decent geologist.

-Bruce Archinal

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Wikimedia.org

Cognitive bias

● Social ● Financial ● Failure to estimate ● Short-termism

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

ORIGIN

The notion of cognitive biases was first introduced by psychologists Amos Tversky and Daniel Kahneman in the early-1970s. Their research paper, 'Judgment Under Uncertainty: Heuristics and Biases', in the Science journal has provided the basis of almost all current theories of decision-making and heuristics. Professor Kahneman was awarded a Nobel Prize in 2002 after further developing the ideas and applying them to economics.

ANCHORING EFFECT
Relying too much on the initial piece of information offered when making decisions

"The first test seemed OK. Do we need to look any more?"

AVAILABILITY HEURISTIC
Overestimating the importance and likelihood of events given the greater availability of information

"I saw something very similar to this on LinkedIn. We need to take it seriously"

BANDWAGON EFFECT
Uptake of beliefs and ideas increases the more that they have already been adopted by others

"The whole department knows there's no problem here"

BELIEF BIAS
Basing the strength of an argument on the believability or plausibility of the conclusion

"I didn't quite follow your argument but the conclusion seems about right"

BLIND SPOT BIAS
Viewing oneself as less biased than others

"Let's ignore Sarah's views on this one. She's biased"

CLUSTERING ILLUSION
Erroneously overestimating the importance of small clusters or patterns in large data

"This is the second week in a row that this has happened. There must be a problem"

CONFIRMATION BIAS
Focusing on information that only confirms existing preconceptions

"We did loads of simulations. Most of them showed there's no problem"

COURTESY BIAS
Giving an opinion/conclusion that is viewed as more socially acceptable so as to avoid causing offence/controversy

"The last time we discussed this the meeting lasted for hours. Let's move on"

ENDOWMENT EFFECT
The tendency for people to ascribe more value to things merely because they already own/have them

"I know it will cost a fortune to fix but it cost us £15,000. We can't just throw it away."

"The conveyor belt broke three times last month. It's pretty unlikely it'll happen again."

GAMBLER'S FALLACY
Believing that future probabilities are altered by past events, when in fact they are unchanged

"Let's just get the deal done ASAP"

HYPERBOLIC DISCOUNTING
Preferring a smaller, sooner payoff over a larger, later reward

"This worked fine in the factory in the Korea, it should work fine here"

ILLUSION OF VALIDITY
Overestimating our ability to make accurate predictions, especially when data appears to tell a coherent "story"

"Looks like we've run out of time to discuss this"

OSTRICH EFFECT
Avoiding negative financial information by pretending it doesn't exist

"We made a good call on that one"

POST-PURCHASE RATIONALISATION
Tendency to retroactively ascribe positive attributes to an option one has selected

"Our competitors are only doing well because their products are cheap"

REACTIVE DEVALUATION
Devaluing an idea because it originated from an adversary or opponent

"Now we've got the new equipment we can cut the time spent on maintenance"

RISK COMPENSATION
Taking bigger risks when perceived safety increases; being more careful when perceived risks increases

"If it ain't broke - don't fix it"

STATUS QUO BIAS
Preferring the current state of affairs over change

"Dave from tech is worried - but frankly the tech team are always pessimists"

STEREOTYPING
Assuming a person has characteristics because they are a member of a group

RACONTEUR

Even engineers are not rational

Intelligence will be used in the service of the neurosis.

-Sigmund Freud

Hermann Rorschach via Wikimedia.org

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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

Hermann Rorschach via Wikimedia.org

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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*

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Pexels.com

Thank You!

www.dpurvisPE.com

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