My Background

Graduated in Geology - London 1978

Started out Mudlogging, then Wellsite Geology

Entered geological operations during the frenetic oil exploration in southern England, when and where the media thought would become a mini-Texas !

In the mid-80's when the North Sea bubble burst due to the oil price crash, I gravitated to Engineering Geology and participated in subsurface mapping areas of the Docklands for Canary Wharf development and London City airport, with access to many hundreds of shallow boreholes

Microsoft Windows was just emerging on the market at this time

Been in Operations Geology for as long as can remember !

“WORKING with SUBSURFACE DISCIPLINES and PROPORTIONALITY”

Spirit of my Talk

Not promoting a company nor its products

No specific case histories, but experience drawn from many

General observations and overview

Useful with an element of fun

Thought provoking

Poignant reminders

Time to reflect

Proportionality comes in many guises

Relative size or extent

Dimensions or scale

Comparable in size, rate of increase (growth)

Correct relationship between parts

A part considered with respect to the whole

Relationship between qualities and quantities

Without exaggeration

To adjust in relative amount or size

To cause to be harmonious in relationship of parts

Slide Presentation Road Map

A Sense of Proportionality

Awesome Sizes of Magnitude

Delusions of Scale and Volumetric Illusions

Not what it appears to be

Nature of Digital Use

Industry standard ? - Getting to grips with unit variation

Operations Geologists liaise with Petrophysicists, Geologists, Geophysicists, Reservoir Engineers, Drillers & Asset Managers

Working with these Subsurface Disciplines and Proportionality – some proportional characteristics

Ambiguities, Ambiguous and Quirky Terminology

Seeing the Bigger Picture

Acquisition, Handling and Transmission of Data

Is there such thing as too much information ? Can Digital systems Help or Hinder ?

Future challenges and where our industry is likely to benefit

Summary

A Sense of Proportionality

Sometimes, we struggle with proportionality, a sense of scale, priorities and value for money

Seems odd, but true examples:

- ❖ Driving miles to get a penny off a litre of supermarket fuel, when there's fuel just down the road
- ❖ Buying 3 food items for the price of 2 when the 3rd item will go off by the time I get to eat it. Anyway I only wanted one !
- ❖ Shopping, using a certain credit card to gain loyalty points, but lose out due to interest charged on late payment
- ❖ Missing out on the opportunity to appraise a discovery, when already have the rig on contract and on location
- ❖ Drill deeper (more rig time), but net gain as can run longer tool strings, reducing number of logging runs (less rig time)
- ❖ If a pair of quality safety boots cost twice as much as a cheap pair, but lasts 3 times as long, the quality pair is a better buy

-

Awesome Sizes of Magnitude……….rate of increase (growth)

Doubling pennies each square on a chessboard

If a penny is 1.5mm thick. How high would the pile be on the last (64^{th}) square ?

2^{63} = 9,223,372,036,854,775,808 pennies

8,646,911,285 miles high (over eight and a half billion)

i.e. 93 times the distance from earth to the sun

Awesome Sizes of Magnitude……….rate of increase (growth)

Investing 1 “penny” when the Romans invaded Britain in 55 B.C. at just 1% p/a

$$A = P(1+r)^t$$

A = money accumulated after t years, including interest

P = principal amount
r = annual rate of interest
t = years the amount is deposited

$$A = £0.01(1+0.01)^{2067}$$

With compound interest, the initial 1p investment would have grown to a staggering £8,556,174 (over eight and a half million pounds)

Awesome Sizes of Magnitude………atomic scale

If a strand of hair is 70 micrometres thick and a carbon

atom is 0.22 nano metres across (nm = billionth of a metre),

then the hair is 70 micrometers/ 0.22nm = 318,000 carbon atoms across

Scanning Electron Microscope image of hair

Awesome Sizes of Magnitude……….the infinitely small

Neutrinos, sub-atomic particles, are hard to detect as have a minute chance of interacting with mass. From the sun at the speed of light, most pass through Earth without touching any matter

Awesome Sizes of Magnitude………vast distances

Star Clusters within our galaxy 440 light years from Earth

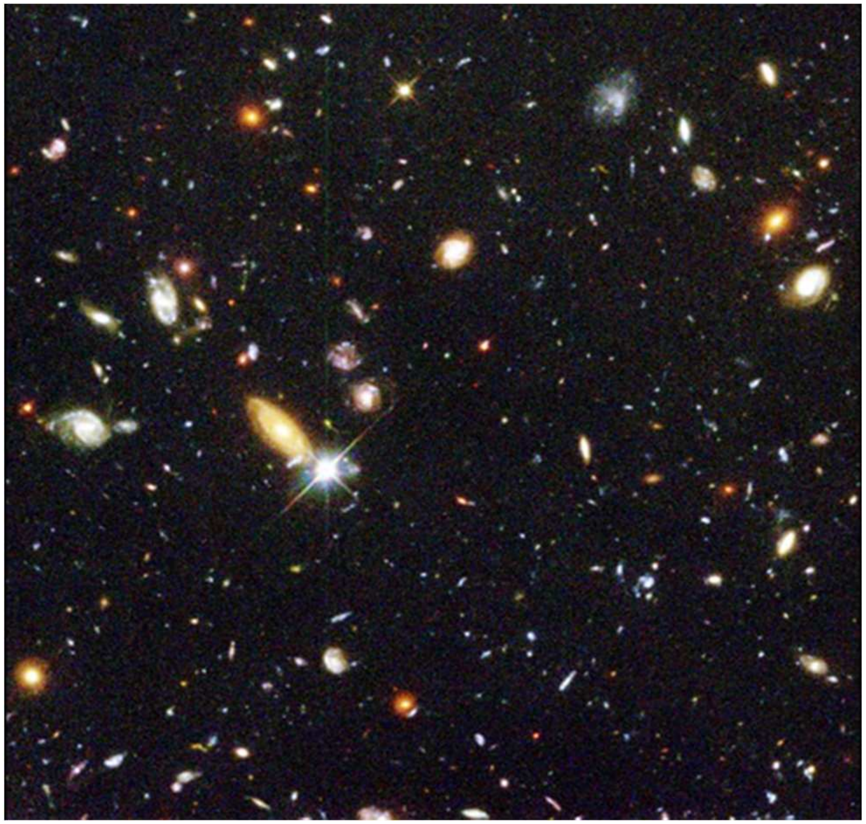
Light travels around the equator nearly 8 times a second

Awesome Sizes of Magnitude……….time and speed

Felix Baumgartner's supersonic freefall (at his initial rate of descent) would

have taken him 355 days - nearly a year to reach the speed of light

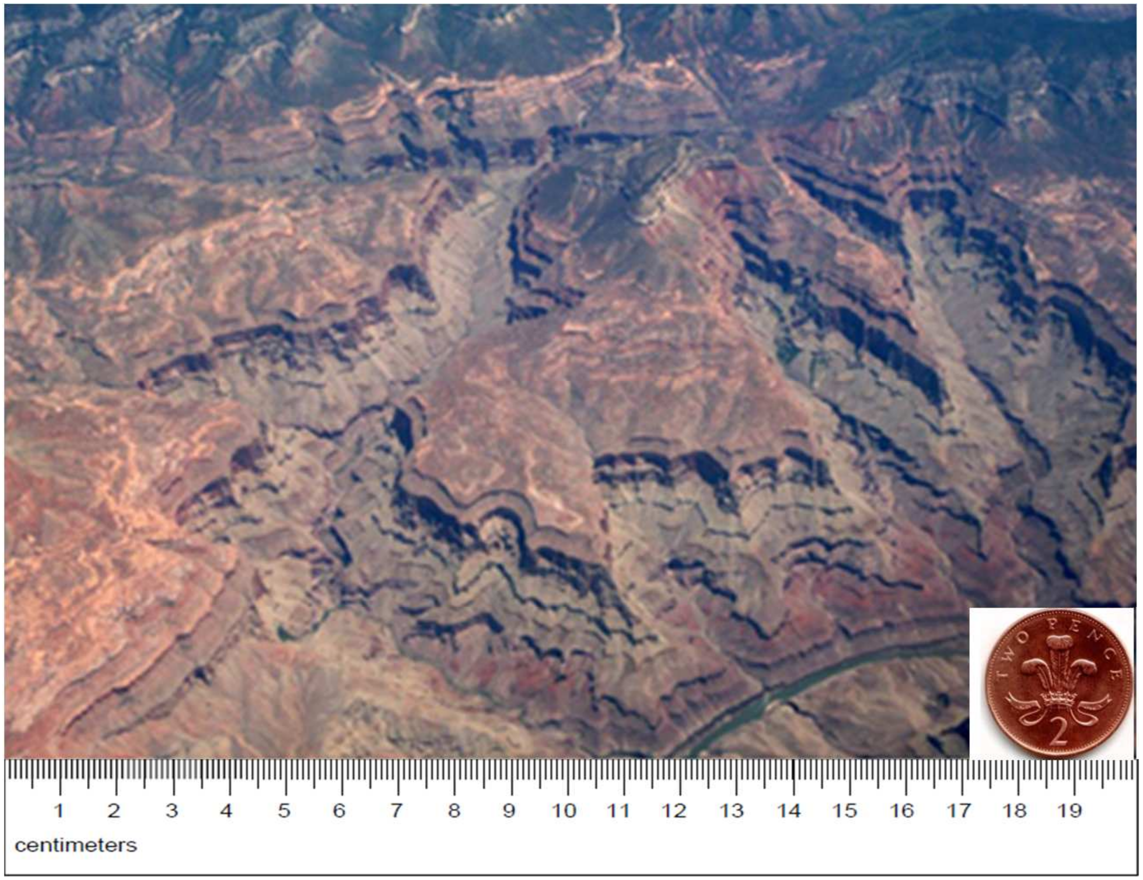
Awesome Sizes of Magnitude………universal dimensions



Billions of galaxies each comprising billions of stars

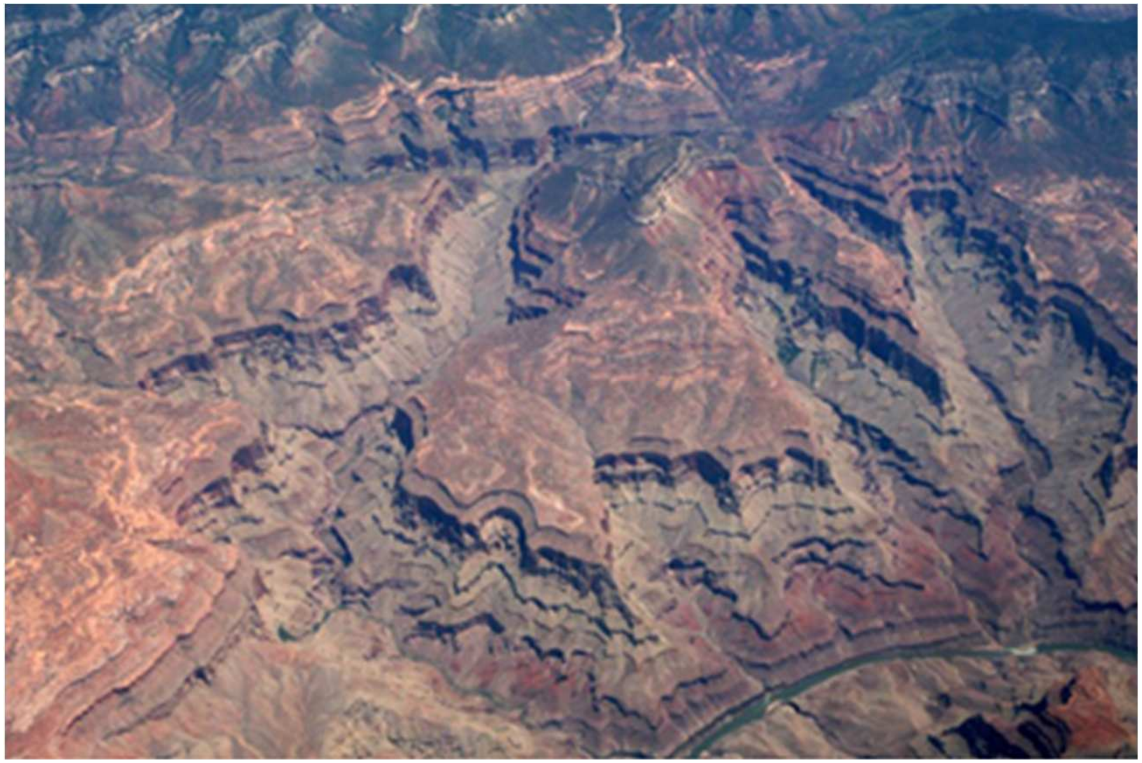
….. but the energy released by a falling snow flake on impact is greater than all light energy received by these distant galaxies since space exploration began !

Delusions of Scale



A slab of ironstone showing weathered surface

Delusions of Scale



10 kms

Actually, an aerial view of the Grand Canyon

Volumetric Illusions

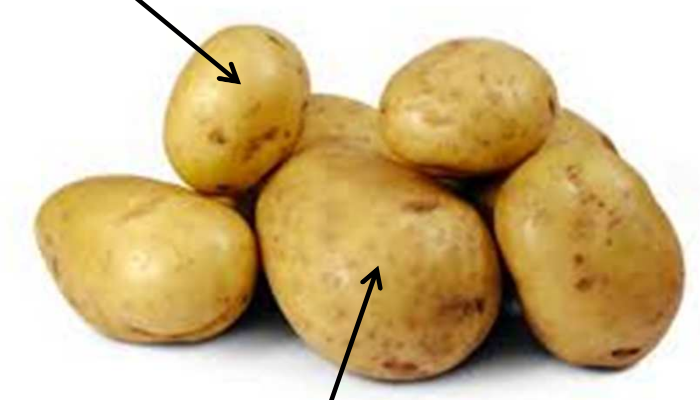
Barrel just 1.26 times taller, wider

Barrel just 2.15 times taller and wider

Barrel just 4.65 times taller and wider

Volumetric Illusions cont….

To minimise potato calories, choose this smaller one



This slightly larger spud may be 5 times the volume !

Not what it appears to be

Reservoir hydrocarbon volumes and recoverable reserves are not always **WYSIWYG**

“Hidden physics” play havoc, depending on:

Hydrocarbon Type:	Gas, Condensate or Oil
Fluid Character:	GOR and Volume Formation Factor
Reservoir:	Pressure, Temperature, Porosity and Sw
Formation N to G:	Ratio of sand to shale
Recovery Factor:	Formation Permeability and Fluid Viscosity (mobility)

-

Not what it appears to be cont….

Project economics are rarely **WYSIWYG**

Some **"Hidden factors" affecting project viability might be:**

Unknown variations in currency exchange rate

Predicting and applying a realistic discount figure

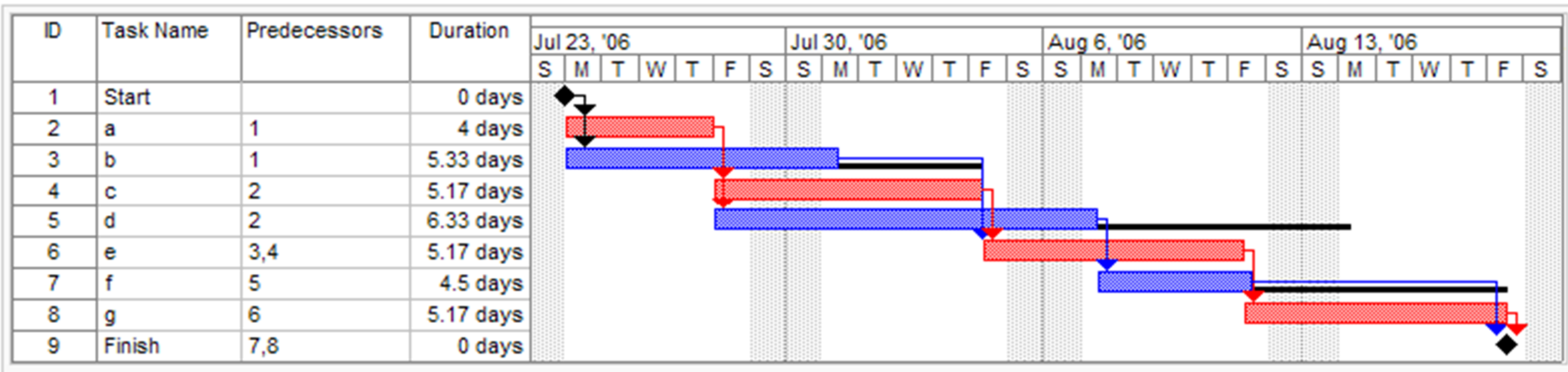
Commodity (hydrocarbons) prices subject to market forces

Unforeseen and uncontrollable events

-

Not what it appears to be cont….

A Gantt chart helps….but there are lurking uncertainties:



ID	Task Name	Predecessors	Duration
1	Start		0 days
2	a	1	4 days
3	b	1	5.33 days
4	c	2	5.17 days
5	d	2	6.33 days
6	e	3,4	5.17 days
7	f	5	4.5 days
8	g	6	5.17 days
9	Finish	7,8	0 days

Initial timing may be affected by external operational delays

Uncontrollable in-house delays

Late delivery of facilities or equipment failure

Alterations in plans due to changes in priority or unexpected budgetary restraints

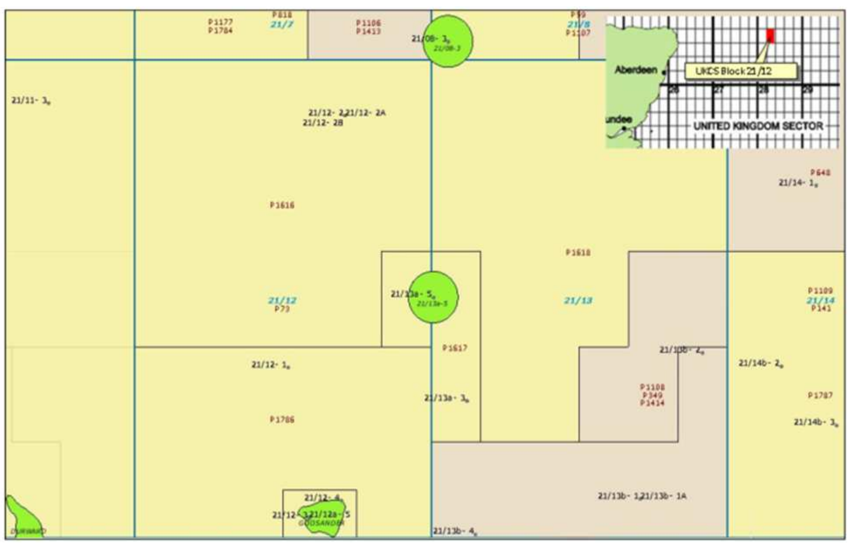
Rate determining steps, which will shift and can stretch timings

Nature of Digital Use

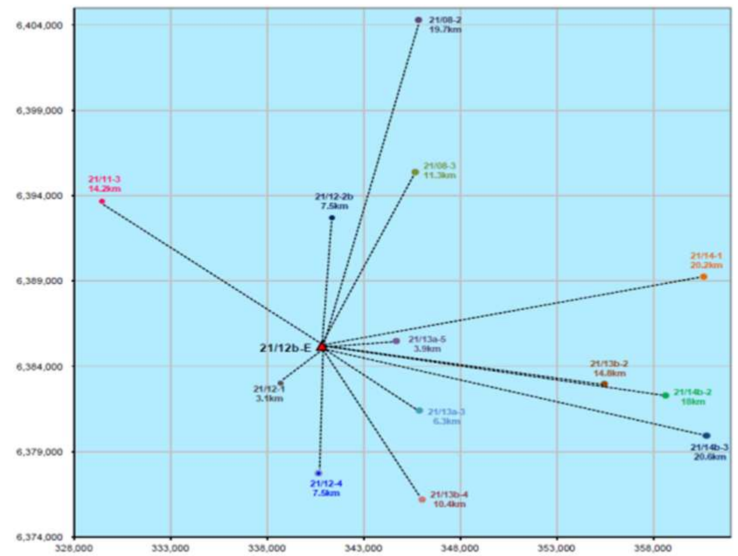
Acceptable error margin when dialling - none

Digital use is stronger when defining:

Blocks Quadrants



Distances & bearings of correlation wells



Nature of Digital Use cont….

Digital use is weaker when attempting to quantify quality such as:

Risk assessment, levels of uncertainty, data confidence, data filtering processes

- The level of risk is determined by entering the estimated probability and impact of a threat occuring in the Risk Matrix.
- Probability, Impact and Risk levels entered in the Risk Assessment should be the estimated levels before and after the proposed Control Measures have been implemented, ie.

Prob	Imp	Risk
before	before	before
after	after	after

- The estimation of risk will normally be subjective, and is determined by a team of experienced personnel.
- Further guidance on Risk Assessment Procedures is available from the STEA Department.

Risk Matrix

Low	E	M	M	L	L	L
	D	M	M	M	L	L
Severity	C	E	H	M	M	L
	B	E	H	H	M	M
High	A	E	E	H	H	M
		1	2	3	4	5
		High		Probability		Low

Acceptance Criteria expresses the level of Risk for the work task. The Risk Levels are calculated by utilising the probability rating x severity rating = Risk Level using the following ratings.

Probability Rating

1	Probable	Once or more in lifetime of single installation (experienced once during the course of drilling a well)
2	Remote	Once in the total lifetime of a number of installations (experienced once during the course of a drilling project)
3	Extremely remote	Possible in the total life of a number of installations (may be encountered once in a working lifetime)
4	Improbable	Unlikely in the working life of a number of installations
5	Extremely improbable	Not anticipated in the working life of a number of installations

Severity Rating

A	Catastrophic	Loss of installation or well, many fatalities. Extreme environmental impact.
B	Major	Possible loss of installation or well, or up to 6 fatalities. Major environmental impact.
C	Serious	Significant damage to installation or well or single fatalities. Moderate environmental impa
D	Minor	Minor damage or casualties. Minor environmental impact.
E	Negligible	No damage or casualties. No impact on the environment.

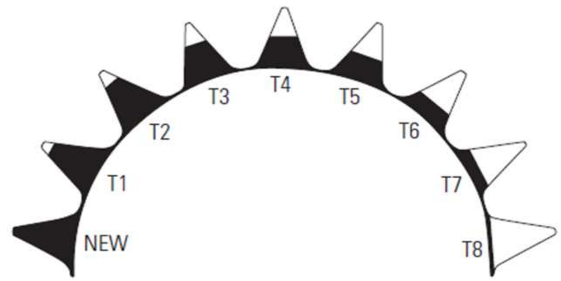
Risk Level

Low	Apply routine good industry practice and precautions.
Medium	Implement cost effective precautions with particular regard to safety. Ensure offshore crew are aware of the risks and control measures.
High	Identify and fully evaluate alternative options to avoid the risk. Identifv and implement control measures to reduce the risk to as low as is reasonablv

Nature of Digital Use cont….

Some aspects of bit wear grading are also subjectively classified using digits:

Cutting Structure Wear



Cutting Structure							
Inner Rows	Outer Rows	Dull Char.	Location	Bearings/Seals	Gauge	Other Dull Char.	Reason Pulled
1	2	3	4	5	6	7	8

1 Inner Cutting Structure

(All inner rows)

2 Outer Cutting Structure

(Gauge row only)
In columns 1 and 2, a linear scale from 0 to 8 is used to describe the condition of the cutting structure according to the following:

Steel Tooth Bits
A measure of lost tooth height due to abrasion and/or damage.

0 - No loss of tooth height
8 - Total loss of tooth height

Insert Bits
A measure of total cutting structure reduction due to lost, worn and/or broken inserts.

0 - No lost, worn and/or broken inserts

3 Dull Characteristics

(Use only cutting structure related codes)

BC - Broken Cone*
BT - Broken Teeth
BU - Balled Up
CC - Cracked Cone*
CD - Cone Dragged*
CI - Cone Interference
CR - Cored
CT - Chipped Teeth
ER - Erosion
FC - Flat Crested Wear
HC - Heat Checking
JD - Junk Damage
LC - Lost Cone*
LN - Lost Nozzle
LT - Lost Teeth
NO - No Dull Characteristic
NR - Not Rerunnable
OC - Off Center Wear
PB - Pinched Bit
PN - Plugged Nozzle/Flow Passage

4 Location

Roller Cone
N - Nose Row
M - Middle Row
G - Gauge Row
A - All Rows

Cone #
1
2
3

5 Bearings/Seals

Non-Sealed Bearings
A linear scale estimating bearing life used
0 - No life used
8 - All life used, i.e., no bearing life remaining

Sealed Bearings
E - Seals effective
F - Seals failed
N - Not able to grade

8 Reason Pulled or Run Terminated

BHA - Change Bottom Hole Assembly
CM - Condition Mud
CP - Core Point
DMF - Downhole Motor Failure
DP - Drill Plug
DSF - Drill String Failure
DST - Drill Stem Test
DTF - Downhole Tool Failure
FM - Formation Change
HP - Hole Problems
HR - Hours on Bit
LIH - Left In Hole
LOG - Run Logs
PP - Pump Pressure
PR - Penetration Rate
RIG - Rig Repair
TD - Total Depth/Casing Depth
TQ - Torque

Industry standard ? - Getting to grips with unit variation

Mud Loggers' Total Gas recorded in UNITS of gas, but rig personnel may be more familiar with %

Deadly H_2S gas alarm levels set proportionally in ppm, not insensitive % volumes in air

MW, PP, FIT, OBG and FG can be expressed in EMW ppg, kPa/m, g/cc or psi/ft

Although Geophysicists talk of TWT in millisecs, others may only identify depth with ft or m

ROP plotted in ft/hr or mins/ft, **OR** m/hr or mins/m

Temperatures recorded in ^oC or ^oF

-

Industry standard ? - Getting to grips with unit variation cont……..

Beware ! GR scale may not be the more usual 0-150 API units

Resistivity log scale on two, three or four cycles. Care needed if making well comparisons

Neutron Porosity and Density plotted on a “sandstone matrix” or “limestone matrix”

Datum co-ordinates - which spheroid was used ?….Geographic and UTM conversions

MSL or LAT ?

True North, Grid North or Magnetic North ?

We’re seeing some standardisation in the industry, but archives are often in other units, scales, grids and different formats.   If labelling is clear, then these differences are just minor inconveniences which can be converted - avoiding disasters !

-

Getting to grips with significant digits and the decimal place (d.p.)

Initial recording often to 1 d.p. but in FWR, may be “rounded” to a whole digit e.g. Temp, Press, ROP

Hole size caliper relevant to 1 d.p. which has a major impact on annulus volume calculations

Certain well depths for casing shoes, geological tops, well TD to nearest foot or 1 d.p. in metres

Core length measurements to one decimal inch, where 10” = 1ft

Reservoir sandstone average thickness and N:G in whole digits

Significance is relevant. Quoting a well as producing 2,500.7 bbls/d would be pointless !
…..because if gauges were accurate to 0.1%, there would still be an error of +/-2.5bbls/d
It would be splitting hairs if not atoms !

If a reservoir fluid mobility test is high at 800 mD/cP, there’s no need for any decimal places
But, if very low at 6.3 mD/cP, the d.p. may be very relevant

Sandstone porosity (Φ) sufficient to whole digit as %, sometimes more pertinent to quote a range

-

Ambiguities, Ambiguous and Quirky Terminology

How often seen written +/- 2,500bbl/d, when really mean 2,500 bbls/d +/-   a massive difference !

Date written as 04/01/12 or 01/04/12   Is that 4th January or 1st April ? (fooled you !)

Sands described as “unconsolidated” whereas actually mean poorly cemented

If a flow check shows a well not to be flowing, then misleading to report it anything other than “static” (seen written “-ve” for not flowing)

We talk about operating in **ANGER** - not angry as in road rage

……but put into action for real (i.e. not a mere test exercise)

Chopper pilots refer to remaining flight distance as “miles-to-**RUN**” – no thanks, I’ll stay seated !

-

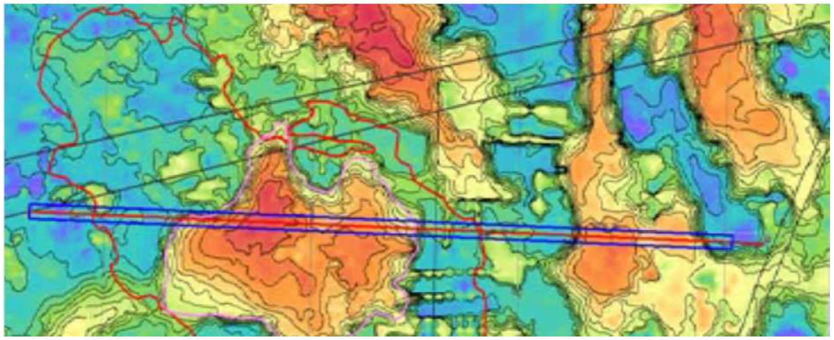
Ambiguities, Ambiguous and Quirky Terminology cont….

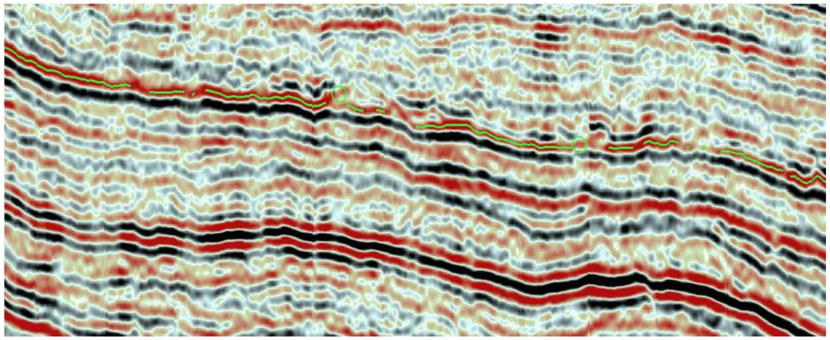
Data transmission speed quoted as 512 or 1024 kbps….

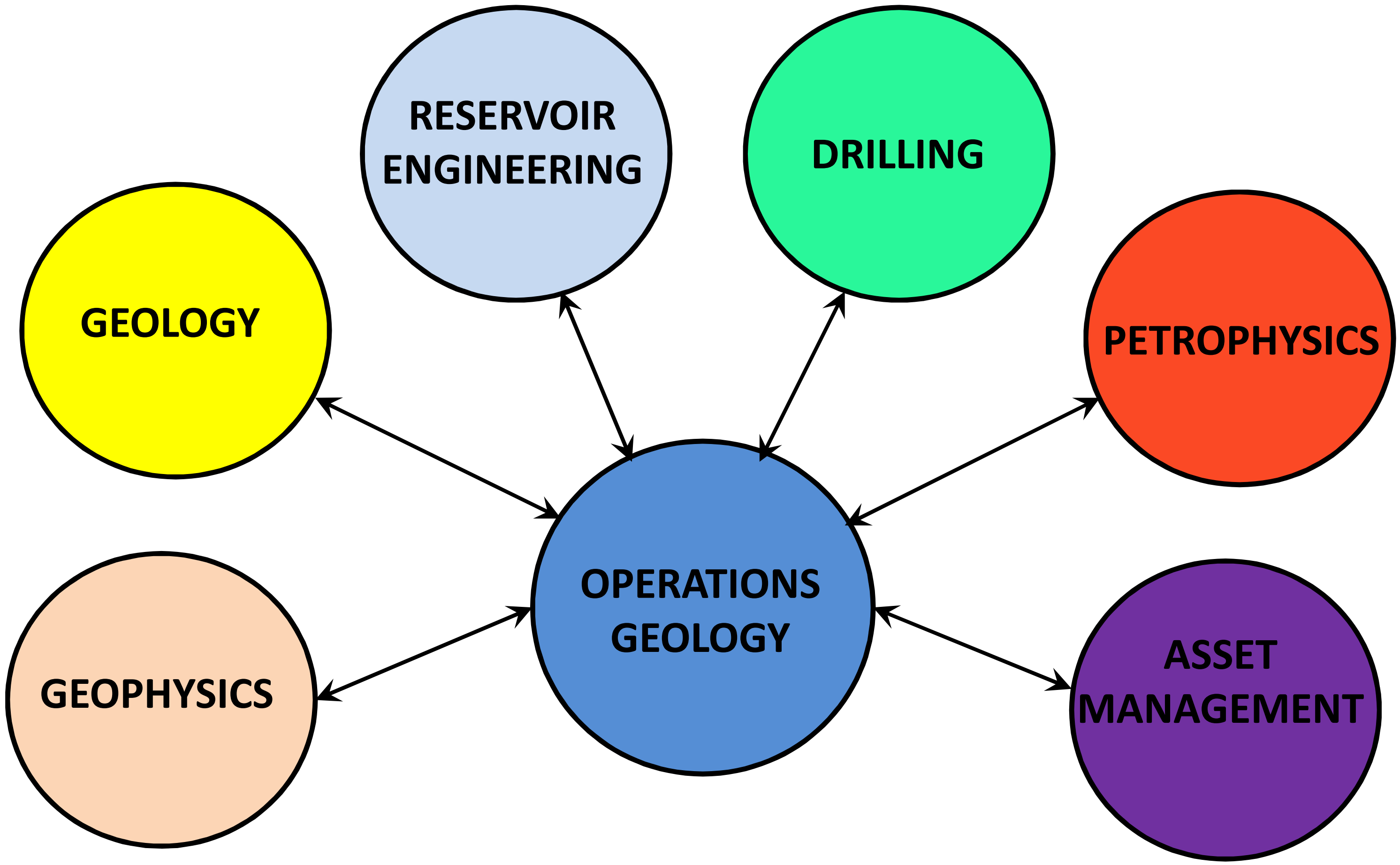
….electrical signals travel at same speed, it's the number of lanes that allow greater data volume transfer - bandwidth

Interpolated seismic lines referred to as "arbitrary lines" – in reality anything but ! .....

….they are carefully selected lines between chosen mapped points where software generates "in-between" seismic sections







WELL PHASES

PLANNING DRILLING COMPLETION PRODUCTION

Collaboration is key to success

Working with Subsurface Disciplines and Proportionality – COMMUNICATIVE

A quote from John Donne (1572-1631) “No man is an Island”

Everyone benefits from good communications:

We don’t thrive when working in isolation from each other and may go off on a tangent

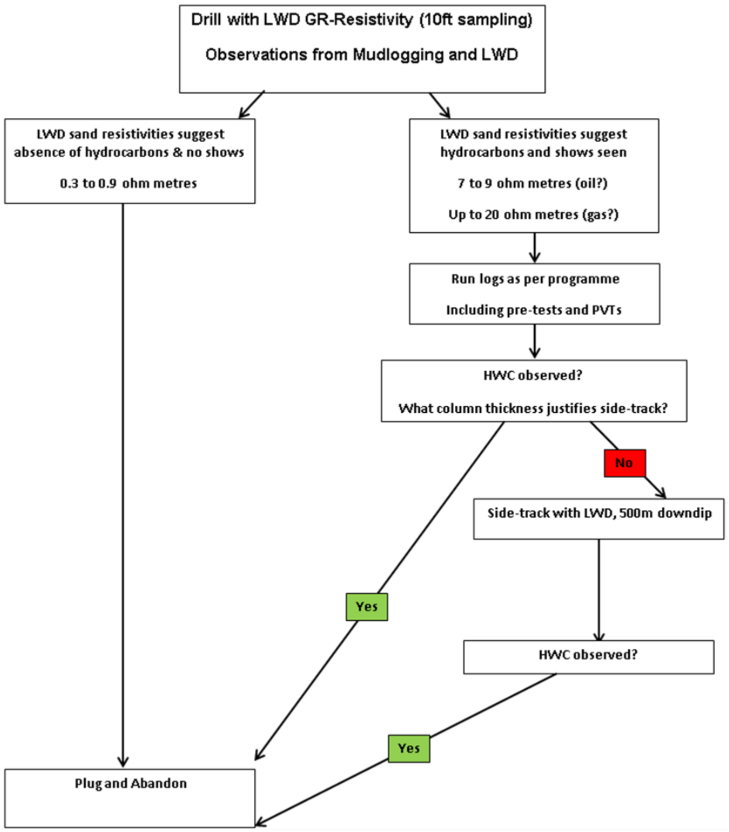
“Great minds think alike”, or not as the case may be – at least problems are worked on together

By talking technical and sharing ideas, how often have you answered your own question ?

-

Working with Subsurface Disciplines and Proportionality – IMAGINATIVE

Can't plan for every situation, lateral thinking helps - imagining a range of different possible scenarios



A Decision Tree helps

Working with Subsurface Disciplines and Proportionality – TECHNICAL CONFLICTS

Geoscientists are often up against: **Is it nice-to-have or absolutely essential ?**

Plan with sufficient engineering contingency, or go with the bare minimum ?

Smooth well trajectories facilitate running well completions but can cost more rig time to achieve

Drilling fluid loss prevention (LCM) can cause unwanted higher skin, impairing well PI

LWD in preference to wireline logging ? – unobservable drilling mud invasion effects

Reaming for additional LWD data may aggravate poor hole conditions

-

Working with Subsurface Disciplines and Proportionality – COMPROMISES

Technical conflicts or different objectives may necessitate operational compromises

To achieve unshared objectives, subsurface disciplines may have to make sacrifices

Strive to maximise data capture within the well AFE

Minimum data acquisition to meet well / appraisal objectives and problem solving

Prudent to acquire as much information as possible while rig on location – may be last chance !

With vision, even a compromised, fuller data capture programme can avoid regrets

-

Working with Subsurface Disciplines and Proportionality – CONFIDENCE

Different confidence levels within subsurface disciplines may arise because……..

….archive data reliability has proved to be poor – once bitten, twice shy !

….there's uncertainty if factual and interpreted information is mixed

….there are different levels of knowledge and experience from team members

….lack of trust in others ability and competence

….data found to be flawed - which is actually worse than useless

-

Working with Subsurface Disciplines and Proportionality – COHERENCE

Subsurface disciplines working together, are more likely to be successful

Collaborating geoscientists will produce more fruitful work

Being united and gelling makes for better and harmonious team work

Sharing ideas to arrive at “near” unanimous data acquisition objectives

More likely to win approval and be granted project funds if speaking with one voice !

-

Working with Subsurface Disciplines and Proportionality – SUITABILITY

“Horses for Courses”

It helps to be familiar with how much and what data is needed

Knowing what format is most appropriate

Working with a large operator with many global fields ?   **OR…….**
a small operator with a “one-off” exploration well

Are partners involved or 100% WI ? - a matter of operational scale

-

Working with Subsurface Disciplines and Proportionality – HT

Are you “using a Sledge Hammer to Crack a Nut” ?

Perhaps closer to home….“a geological hammer to open a geode”

Working with Subsurface Disciplines and Proportionality – HT

If today's technology was available during early '70s, may not have deployed so many platforms

New / reprocessed seismic data with higher resolution, aids mapping accuracy and raises confidence

Modern drilling and completion technology reduces the number of development wells needed, by using long reach targeted horizontals and more refined perforating intervals

Subsea templates used instead of platforms – smaller footprint and lower costs

Working with Subsurface Disciplines and Proportionality – CRUDE ECONOMICS

Formation or reservoir evaluation is usually a small proportion of the whole well AFE, a little price to pay to gather sufficient geological data

Scrimping on data acquisition saving pounds, then later go and blow £1,000s !

There really are cost benefits of data acquisition, transmission and storage

-

Working with Subsurface Disciplines and Proportionality – TARGETS

How realistic was the target ?

If exceeded, was it due to high performance or was the target set too low ?

If not met, was it because it was genuinely unattainable or set much too high ?

In reality, missing the bull's eye would probably have been a result of both factors

-

Working with Subsurface Disciplines and Proportionality – TIME

TIME is relative

There’s no **TIME** like the present

TIME and MOTION: this method really improves and upgrades work systems

TIME is money

-

Working with Subsurface Disciplines and Proportionality – EFFICIENCY

“A Stitch in **TIME** Saves Nine”

Being proactive and gathering data early on can avoid costlier acquisition later in **TIME**

Hesitation is likely to cause missed opportunities – however, not advocating knee jerk reactions !

The expression “Killing two birds with one stone” is apparent here, when operating efficiently

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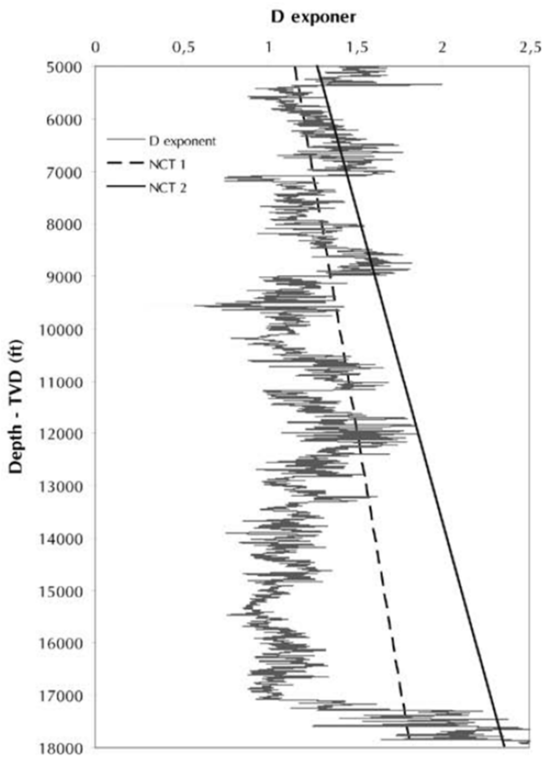
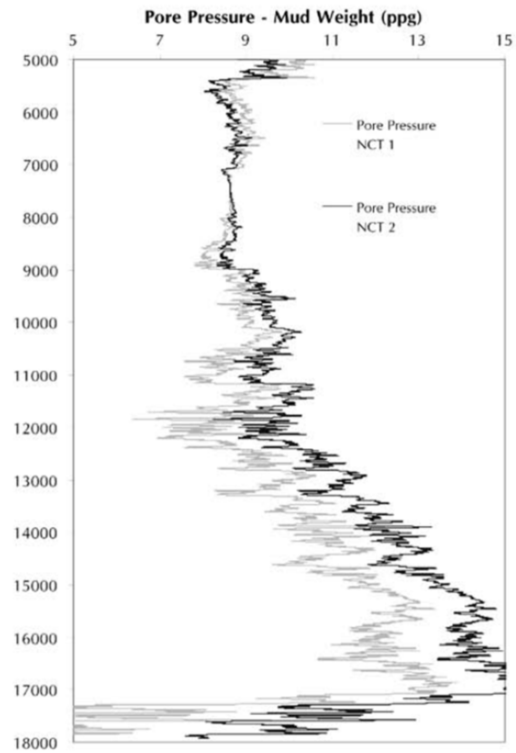
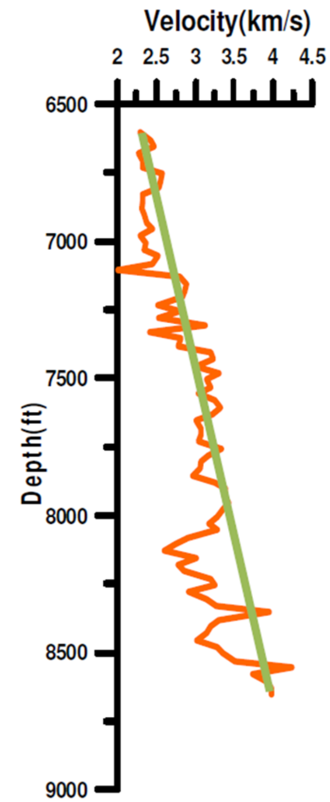
Working with Subsurface Disciplines and Proportionality – USING TRENDS







Was past data good? Or was it the result of a one-**TIME** event influenced by unique circumstances

An absolute number itself doesn't necessarily reveal the picture. Making comparisons with **TIME** when analysing an incoming data stream, aids meaningful identification

Trends can smooth out anomalous data and reduce the impact of unique occurrences which may lead to poor or ineffective decision making

An established and accepted trend can be used as a predictive tool

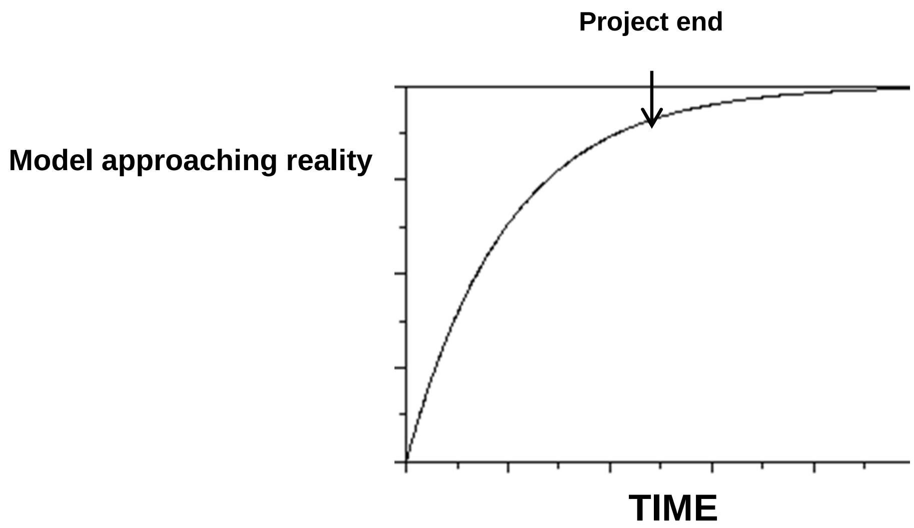
-

Working with Subsurface Disciplines and Proportionality – USING MODELS

Initial geological and reservoir models rarely perfectly match the real world

With **TIME**, as models are updated with field data, they approach geological and reservoir reality

Only after an infinite number of wells have been drilled or a reservoir produced to exhaustion, will reiterated final models approach 100% perfection !



Of course, models are always "right" with the available data to hand !

Working with Subsurface Disciplines and Proportionality – RISK

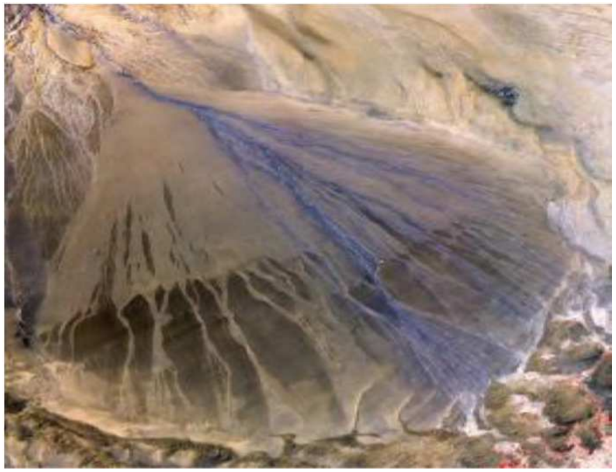
Working with proportionality has associated **RISKS**…..

…..whether being struck by lightning or exploring for hydrocarbons

Working with Subsurface Disciplines and Proportionality – RISKY ANALOGUES

When using “obvious” analogues but without being systematic, we may fail to see fundamental differences that render them inappropriate for modelling.

Using present day visibly active geological processes to understand past systems is useful but limited. Contemporary geological settings are not necessarily identical to past systems, and there’s a **RISK** of conflating challenges. So, rather than illuminating a Jurassic or Palaeocene system, present ones can “muddy the waters” so to speak !



A classic example is where depositional analogues are imprecise

Seeing the Bigger Picture

Three stone cutters each cutting a block of stone in a quarry replied to the question

“What are you doing”?

First stone cutter said “I’m cutting stone”

Seeing the Bigger Picture cont….

Second stone cutter said “I’m cutting stone for a wall”

Seeing the Bigger Picture cont….

Third stone cutter, the happiest, said “I’m building a cathedral”

Seeing the Bigger Picture cont….

All were doing the same job, but each replied differently

Each knew how to do the job but the 3rd stone cutter:

Knew not just how and what to do, but knew why

Viewing the whole and not just its part

Seeing a vision, a sense of the bigger picture

Having the ability to see significance in work, beyond the obvious

Realising a legacy will live on, whether in the stone of a cathedral, or in the impact made on others

Seeing the Bigger Picture cont….

Which of the three stone cutters are we ?

In all fairness though:

Other team members may be party to more information than us and so see the bigger picture

It’s easier to be critical than creative and prudent not to step on anyone’s toes !

-

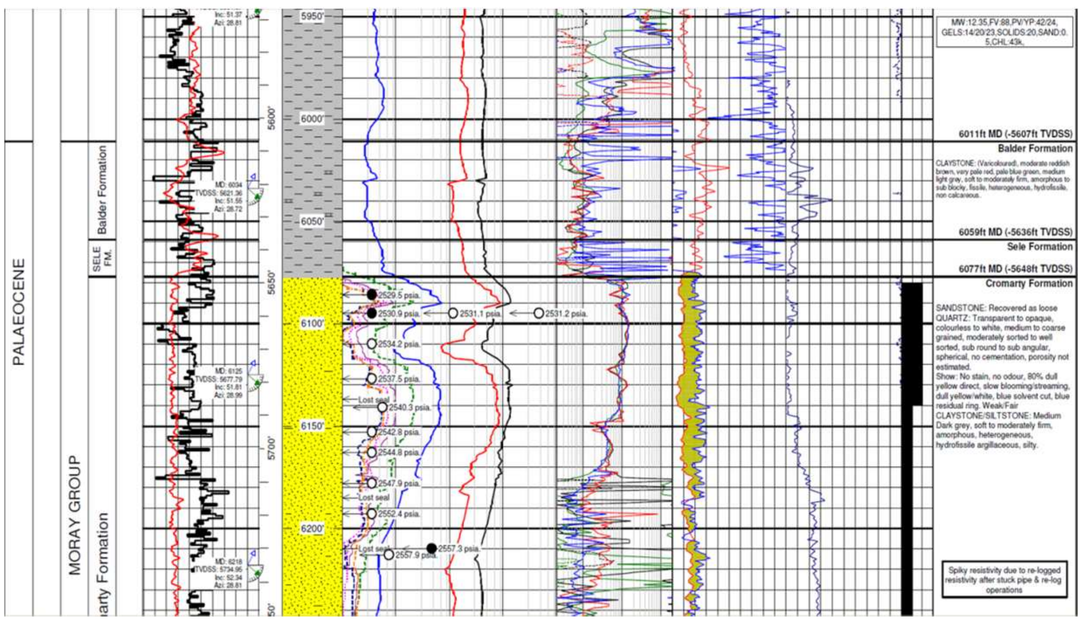
Acquisition and Presentation of Data

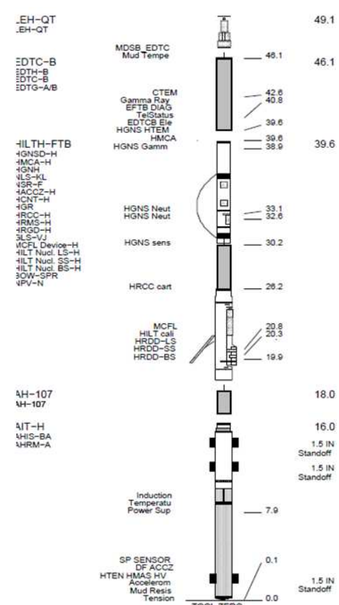
Rarely can operations be slowed for collecting data. It’s important to select and prioritise data acquisition with appropriate time-scanning

DEPT	ROPA	BWAV	RSAV	TAAV	SPPA	FIPA	FOAV
ft	fph	klb	rpm	f-p	psig	gpm	gpm
1043.0000	113.9600	8.0386	89.9181	3009.0000	1828.7650	1093.0117	0.0000
1044.0000	115.8033	11.7197	90.2887	2841.6001	1773.7931	1094.3818	0.0000
1045.0000	129.9851	11.6497	90.5077	2991.6001	1557.0026	1102.1276	0.0000
1046.0000	234.3378	12.3123	89.5551	2965.2000	1279.3081	1112.1492	0.0000
1047.0000	46.9554	12.9885	89.9842	3197.8999	1291.3936	1094.0215	0.0000
1048.0000	193.0103	11.1248	89.8790	3247.0000	1280.6199	1096.8851	0.0000
1049.0000	256.6509	9.7016	89.4629	3405.1001	1319.0558	1092.5410	0.0000
1050.0000	169.4269	11.8991	89.6677	3964.7000	1469.6141	1084.0381	0.0000
1051.0000	69.2451	12.2800	89.6032	4138.7002	[illegible]	1087.4186	0.0000
1052.0000	54.3058	11.8065	88.8199	3707.6379	[illegible]	1092.3079	0.0000
1053.0000	61.7186	11.5234	92.8158	4716.4316	[illegible]	1093.7621	0.0000
1054.0000	82.9011	11.9183	91.2171	4348.7529	[illegible]	1093.7273	0.0000
1055.0000	51.0035	13.0619	78.2694	4272.2773	[illegible]	1092.6658	0.0000
1056.0000	280.1978	11.4000	79.5664	4705.5703	[illegible]	1090.9164	0.0000
1057.0000	46.4188	9.4000	70.2128	4301.3306	1832.3882	1091.3911	0.0000
1058.0000	158.1312	8.7000	83.8023	6604.6616	1833.8694	1089.8759	0.0000
1059.0000	366.7613	12.1000	83.8539	[illegible]	1831.1270	1092.2465	0.0000
1060.0000	172.5235	10.2000	84.2557	[illegible]	1831.7865	1090.7902	0.0000
1061.0000	232.9264	10.7000	83.6685	[illegible]	1831.9525	1091.4178	0.0000
1062.0000	355.4042	10.4000	84.9135	[illegible]	1846.9323	1092.3433	0.0000
1063.0000	400.2195	11.3000	84.9416	[illegible]	1834.2483	1088.0920	0.0000
1064.0000	372.6384	14.2000	85.2887	4594.5723	1835.2587	1094.4487	0.0000
1065.0000	357.1404	12.8000	85.0454	4753.2803	1827.6333	1092.1389	0.0000
1066.0000	360.9202	11.5000	[illegible]	4832.2588	1841.4122	1089.8304	0.0000
1067.0000	280.2198	10.4000	[illegible]	4820.3423	1836.5564	1093.4183	0.0000
1068.0000	207.1949	11.1000	[illegible]	5182.7671	1835.4006	1091.4709	0.0000
1069.0000	130.0231	9.4000	[illegible]	5210.3799	1836.3589	1091.4036	0.0000
1070.0000	322.6289	9.9000	[illegible]	5767.9902	1836.5073	1089.4012	0.0000
1071.0000	288.1166	7.6000	84.4546	5709.6489	1830.4780	1092.1776	0.0000
1072.0000	287.0937	8.3000	85.3003	4599.1270	1846.3046	1089.6389	0.0000
1073.0000	349.0155	[illegible]	84.7217	4286.0088	1835.0471	1092.4852	0.0000
1074.0000	217.5718	[illegible]	84.4454	5106.9424	1837.6226	1092.4796	0.0000
1075.0000	228.8955	[illegible]	84.8687	4895.3623	1842.9705	1091.4568	0.0000
1076.0000	280.1316	[illegible]	84.8527	4320.8550	1833.2542	1092.8413	0.0000
1077.0000	198.1483	[illegible]	85.2501	4029.5122	1842.9253	1090.6906	0.0000
1078.0000	171.6578	6.9000	85.1457	4101.5342	1839.6738	1090.9197	0.0000
1079.0000	211.5813	7.5000	84.8948	4041.6042	1832.9720	1092.7444	0.0000
1080.0000	138.8744	7.1000	85.3388	3873.3755	1841.7880	1091.6589	0.0000
1081.0000	355.4397	8.4000	85.2673	3968.4902	1840.9579	1091.7662	0.0000
1082.0000	283.5473	7.9000	85.0299	3900.9553	1841.3821	1091.3547	0.0000
1083.0000	238.9330	6.4000	85.4435	3754.4448	1841.9169	1092.1544	0.0000
1084.0000	273.4572	6.9000	84.9856	3945.5869	1840.3776	1091.2992	0.0000
1085.0000	262.2697	7.2000	85.0659	3841.9312	1845.5765	1092.4729	0.0000
1086.0000	102.4903	6.1000	85.3458	3623.7771	1839.6147	1091.2505	0.0000
1087.0000	238.1813	8.9000	84.8684	3839.0615	1845.0671	1092.3298	0.0000
1088.0000	80.0735	9.4000	85.2222	3372.3225	1843.5518	1091.4344	0.0000
1089.0000	252.7134	7.5000	85.0665	3597.2961	1838.4609	1091.1940	0.0000
1090.0000	229.5897	6.2000	84.9232	3546.6584	1854.0068	1091.4872	0.0000

TIME scanned data stream

Pictures say a thousand words – Composite logs and logging tool string diagrams

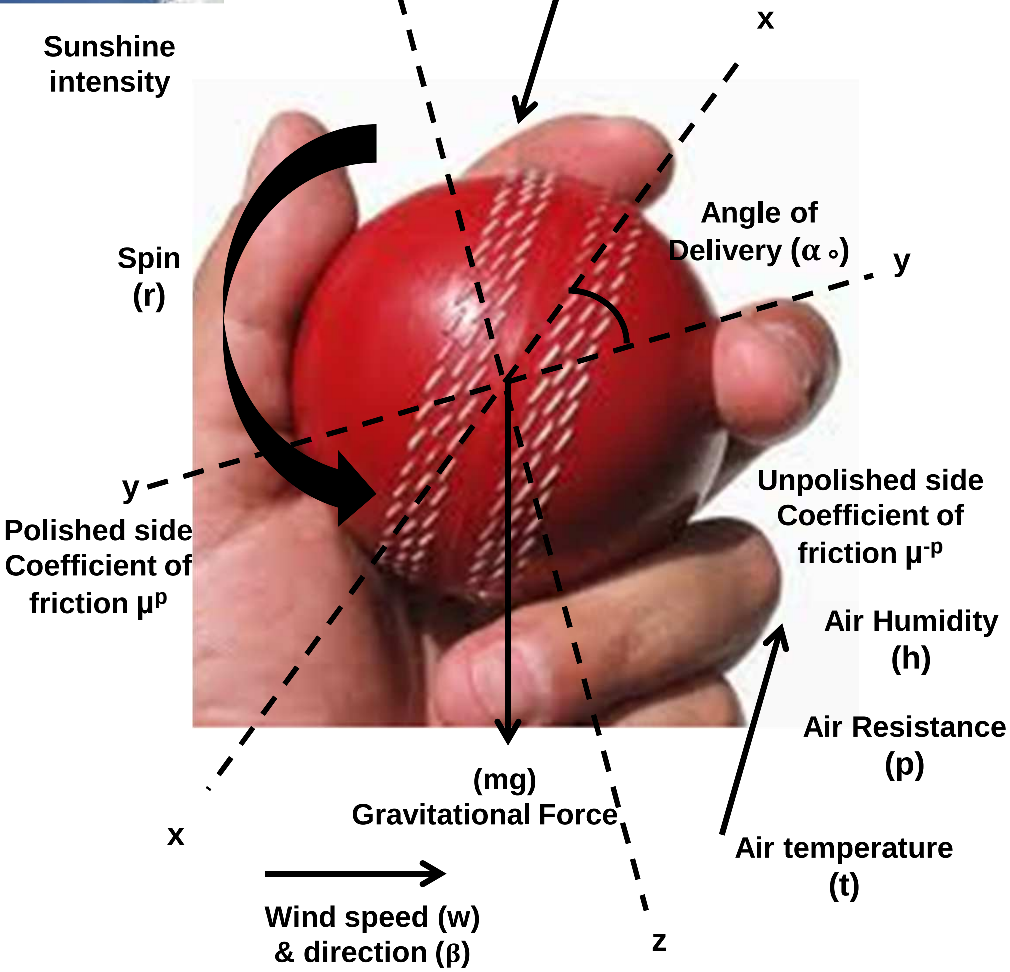




Handling and Transmission of Data

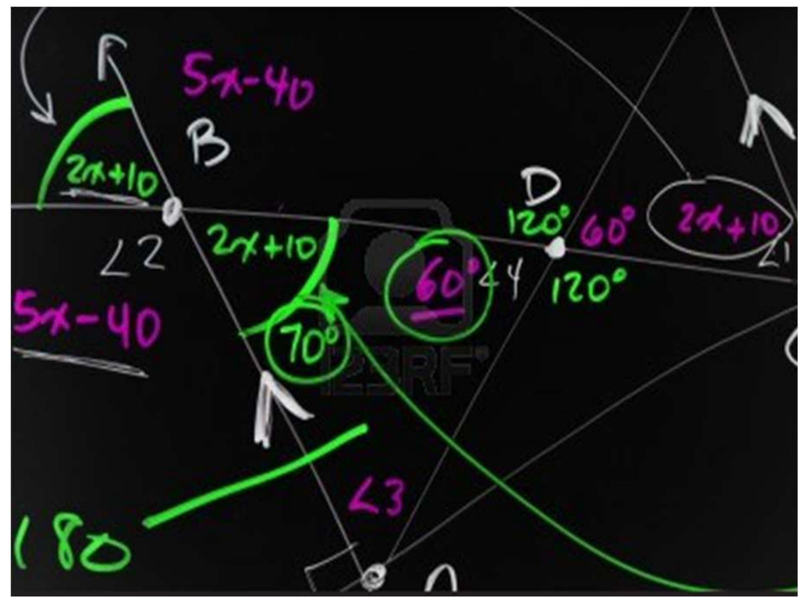
“Batched-to-town” data loaded into software onshore is being replaced by website based systems which receive live streamed rig data fed directly into the software application….BUT often up against contesting for highways to the server…...

… which may seem more like a maze !



Is there such a thing as too much information ?

Cloud cover

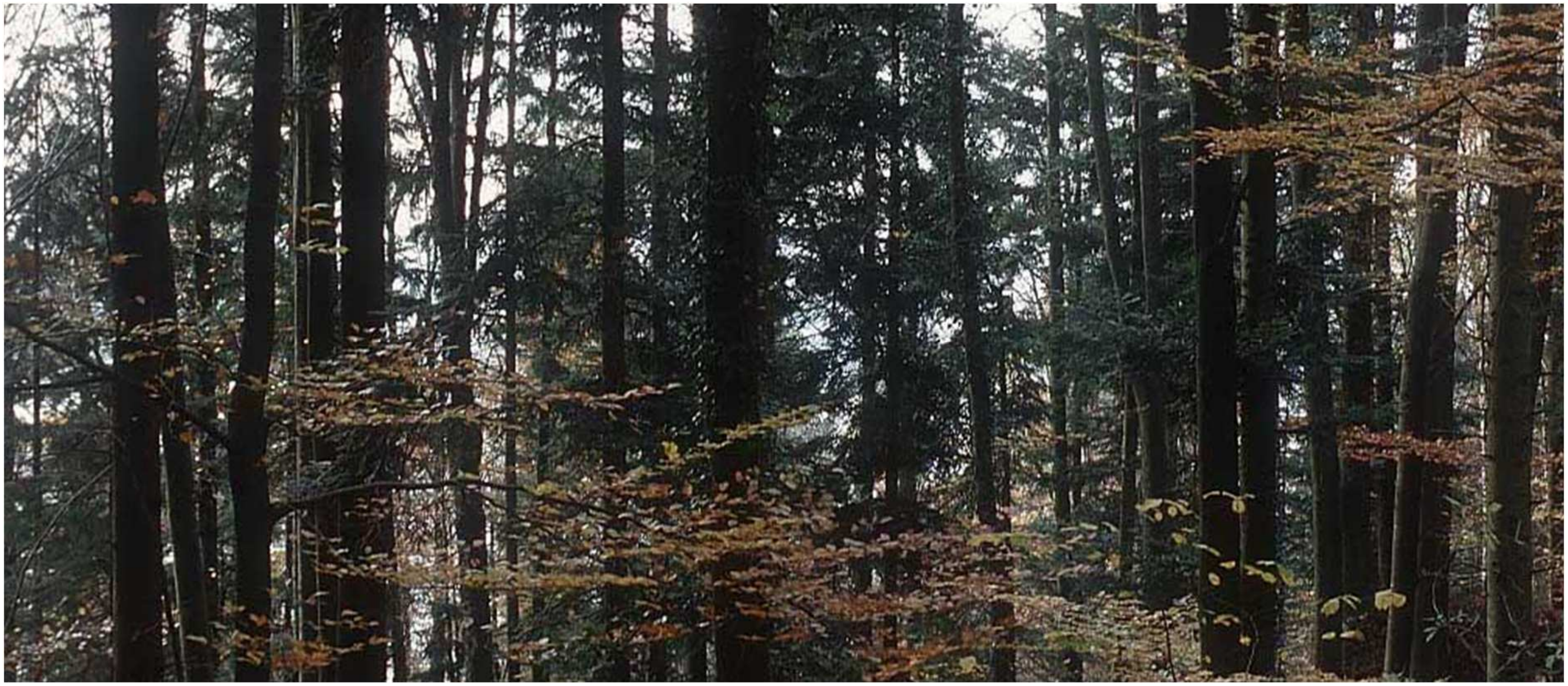


$$\text{Lateral displacement} = \mu^{-p} \sin\alpha \pm \mu^{p} \sin\beta - 2rp/tpw^{2} \sin\frac{1}{2}(\alpha \pm \beta) \cos\frac{1}{2mgh}(\alpha \mp \beta)$$

Trying to explain swing using mathematical analysis

Is there such a thing as too much information?

Sometimes we can't see the wood for the trees and are unable to understand what’s important because we’re giving too much attention to detail



Digital Systems can Hinder

In the myriad demands of today, we can become numb to numbers

Copy Paste Syndrome – can allow errors to creep in unnoticed

Are we in danger of overload to properly digest and interpret ?

Too easy to cc everyone on everything – making it difficult to prioritise and organise workload

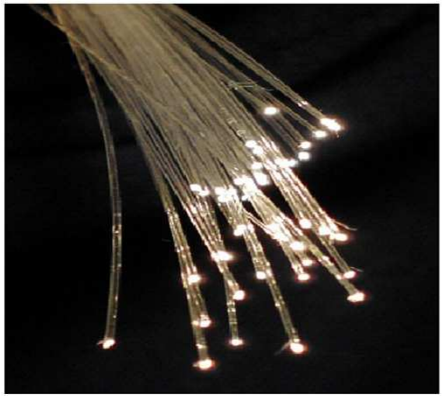
When a WSG, digital systems could be distractive – diverting attention, removing finger off the pulse

Digital technology is a tool and shouldn't be allowed to dictate our work so we become slaves to it…
...........we must remain in control and be masters of our destiny

Tail wagging the dog comes to mind !

Future challenges and where our industry is likely to benefit

Fibre Optics (FO) Provide Technological Advantages:



Technologically speaking “small is beautiful” rather than “bigger is better”

Increasing use of nanotechnology in oilfield materials – lighter, smaller footprint

FO enables larger data volume delivery at higher resolution and higher sensitivity measurements plus wider bandwidths, replacing existing electrical communications for well monitoring and tubular integrity

FO can transmit a continuous data stream rather than “snap shots” of data and can render 3D images in real time

FO can operate in harsher physical environments >400°C and vibration with greater reliability

-

Future challenges and where our industry is likely to benefit cont….

A country, where you can phone to resolve a technical problem with your computer !

Would proportionate use of FO help here ?

Future challenges and where our industry is likely to benefit cont….

Apps in the Digital Oilfield…..

….providing Computations

Designing well drilling and completion programmes which need physical inputs such as:

Hole sizes, ROPs, WOB, well surveys, depths, pipe & tubular internal and external diameters, geological formation, temperatures and pressures

….helping to monitor Rig Operations

Enabling remote well site data access.
Collating rig data into a central database in order to make comparisons with actual and expected trends such as pore pressure, temperature, ROPs etc.

….helping to monitor Well Productions

Again, enabling remote well site data access – monitoring well test data and compare with expected production profiles

Future challenges and where our industry is likely to benefit cont….

Data storage capacity is massive. Easier to search, access and retrieve information

How often than not, **data quality** is more important than quantity

Clearer electronic filing and data labelling (categorisation) is essential

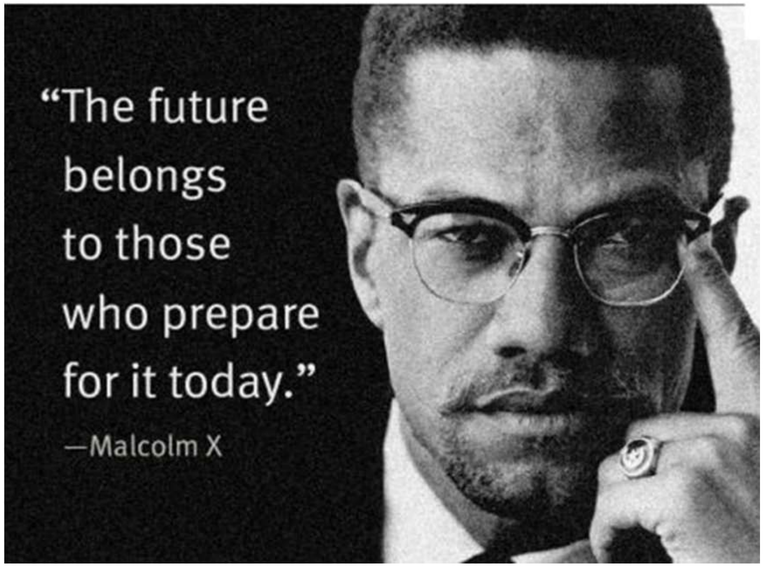
One of the biggest challenges we face is being swamped….. **DATA OVERLOAD**

Future challenges and where our industry is likely to benefit cont….

There can be reluctance to introduce or trial new technologies as don’t wish to be a guinea pig

But someone has to be first on the starting block…….

….so take advantage and keep ahead of the game by using emerging technology



SUMMARY - How Digital Technology developments may improve the Oil Industry

My spin, is that **Digital Technology** can only fulfil its potential in the oilfield when:

There’s good collaboration between subsurface disciplines and operators with service providers

A shared sense of proportionality

It is applied appropriately and with practicality

It is used as a tool to improve efficiency and data reliability (raising data confidence)

There’s continuous investment, particularly in training

Everyone is onboard together with latest in technology

There’s more industry standardisation

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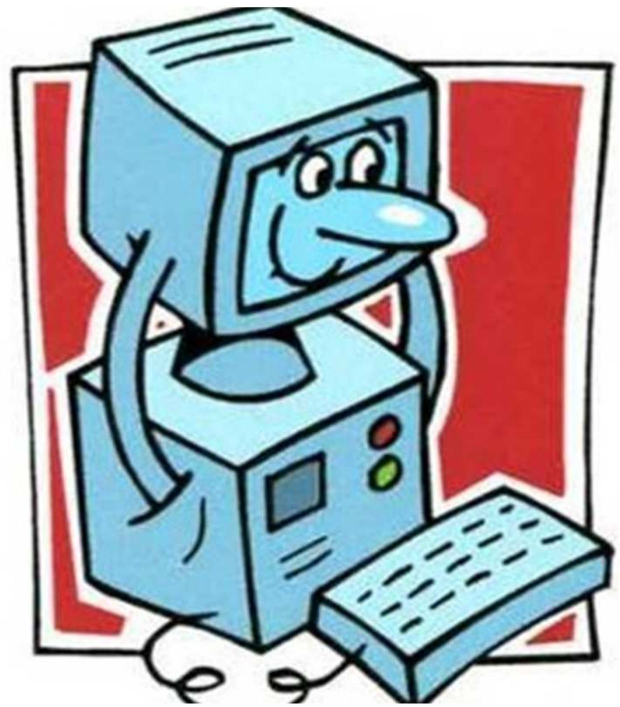
Stone Age man

Iron Age man

Hydrocarbon man

Mobile Phone man



In future, we may be remembered as Homo–Digital–Sapiens

If so….would that be proportionate ?