Update
Error Model
Maintenance Group
Meeting

Sept 27th 2018
ISCWSA#48, Dallas, TX

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Speaker Information

- Andy McGregor

- Technical Director

- Angus Jamieson Consulting Ltd.

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Speaker Bio

- Introduction
  - Angus Jamieson Consulting Ltd.
  - 25 years in navigation and positioning
  - 12 years in wellbore survey
  - Inverness, Scotland
  - Specialized in survey algorithms, error modeling

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XCL Models

- Last year defined Rev5 of the error model

- Add long course length terms.

> Inc WtFn: MAX [Abs(Inc-IncPrev), T* (MD-MDPrev)]
>
> Az WtFn: MAX [Abs(Az-AzPrev), T* (MD-MDPrev) / sin(Inc)]

- To deal with situations with non-optimal survey spacings

- Early implementations showed some details to be clarified:
  - value for T, one source or two,
  - handling of vertical wells,
  - inc only models

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XCL Models

- **Revision 5 on hold**

- These functions do not operate as desired

- Good for regular long survey spacings

- Not so good for occasional missing surveys / irregular gaps
  - Do to nature of error model framework
  - Angular weighting functions means uncertainty after survey of interest

- Need to revise terms directly as position errors

- Jerry Codling to define the maths

- Small group to implement and resolve any issues

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Relative Correlations

- Supporting WPTS standard anti collision rule
    - Consider relative position between wells
    - Correlation of Geomagnetic Reference Terms
    - Depends on mag reference used – BGGM / HDGM / IFR etc

- Previous work quantified correlations, assessed impact

- Value case
    - potential impact of ~30% ellipse dimensions
    - wells can be closer when parallel
    - ensure not optimistic when coming towards each other

Relative Correlations

- Looking for manageable solution in software

- Algorithm defined
- Previous method required software to pick correlation value
- Latest thought to add new terms into error models

- Now to be written up
- Assessed by software teams
- Need to ensure that current terms are excluded

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DEC Term

Description	Code	Prop Mode	WtFn	IGRF	BGGM	HRGM	IFR1	IFR2
MWD: Declination - Global	DEC-G	G	AZ	0.43	0.36	0.3	0.15	0.15
MWD: Declination - Random	DEC-R	R	AZ	0.1	0.1	0.1	0.1	0.05
MWD: Declination Main Field Error	DEC-M	W	AZ	0.24	0.04	0.04	0.04	0.04
MWD: Declination Crustal Commission HD Models	DEC-CH	G	AZ	-	-	0.13	-	-
MWD: Declination Crustal Commission IFR Models	DEC-CI	G	AZ	-	-	-	0.13	0.13
MWD: Declination Crustal Omission Error	DEC-CO	G	AZ	0.36	0.3576	0.27	0.06	0.06
MWD: Declination - Random	DEC-R	R	AZ	0.1	0.1	0.1	0.1	0.05

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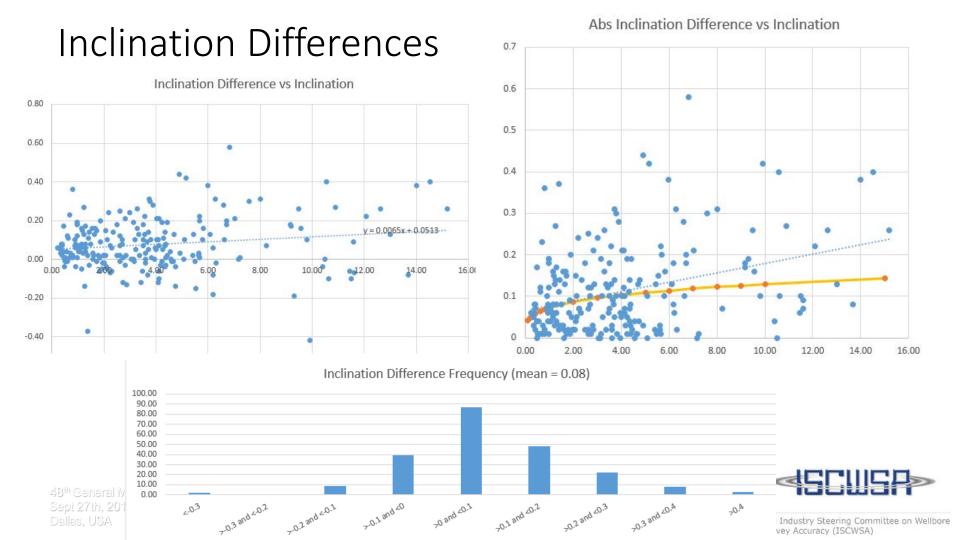Survey Accuracy (ISCWSA)

WITSML

- Total leading on WITSML format for transfer of error models

- Good progress

- Lot of detail generated

- Expecting to have a draft release this year

- Matching parallel work being done on P7

- WITSML will support real-time data transfer, P7 more focused on EOW and final archive of surveys.

- Details: scott.farmer@total.com

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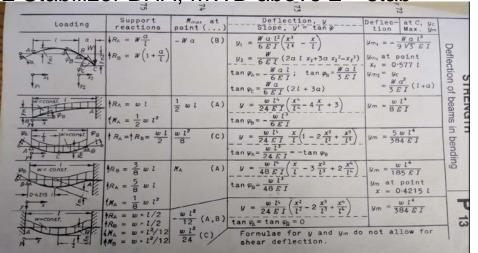
Revision of Misalignments

- Belief that current misalignments may be overly conservative

- Any changes to be evidence based

- Jerry Codling has being working on this and proposed:

- XYM3/4 term magnitudes increase to 0.3 deg and become random

- Seemed to fit available data better.

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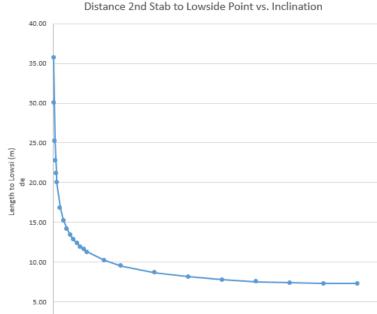- Now evaluated further data

- Sign of a low inclination sag

Inclination Differences

Inclination Difference vs Inclination

Abs Inclination Difference vs Inclination

Inclination Difference Frequency (mean = 0.08)

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Low Angle SAG Error

2 Stabilizer BHA, MWD above 2nd stab

Distance 2nd Stab to Lowside Point vs. Inclination

SAG Angle ≈ (Hole Size – Collar Size) / Length Stab to Lowside point

Deflection ≈ Weight.Length^4/384.EI

Angle ≈ (sin(inclination))^0.25

Gyro Error Model Issues

- Steve Grindrod develop model for Stockholm Precision

- Tool has three modes
    - Static – Gz Cont – Gxy Cont

- Complex mode changes and re-initialisation

- Model changes required?

- How closely does error model need to match

- Requires further data to assess

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