When Uncertainty is not uncertain

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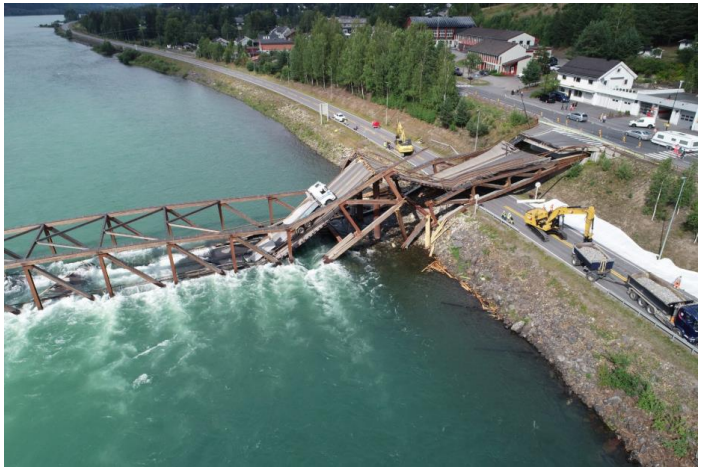
Gross Error vs Uncertainty

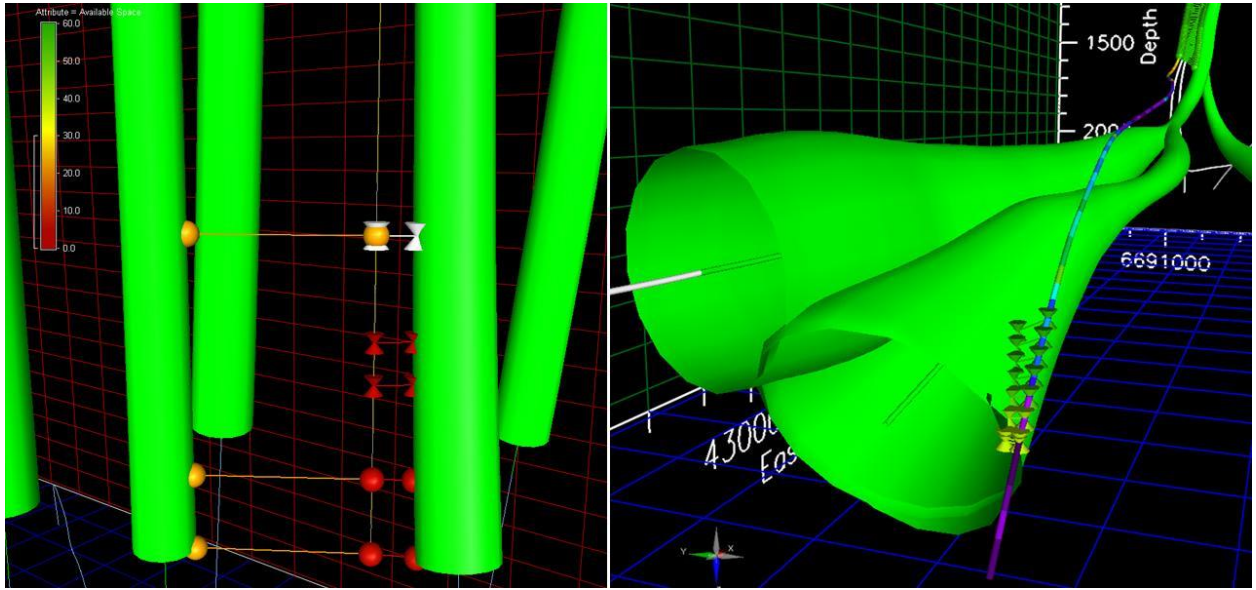
Uncertainty is the *small, expected wiggle* around a correct calculation.
Gross error is a *big blunder that makes the calculation wrong in the first place.*



Gross Error vs Uncertainty

Incident:	Sleipnar A Platform
Year:	1991
What Failed:	Concrete tricell/ballast chamber walls cracked during ballast test and the hull sank.
The Gross Error (Simple arithmetic slip):	"**Decimal point moved one place left / forgot a carry**" → stresses came out ~47% too small → walls designed ~40–50% too thin for real pressure. (Investigation found FE/NASTRAN model underestimated shear stresses by ~47%, leading to insufficient wall thickness.)
Consequence:	Platform hull sank during test; multi-billion NOK loss, major schedule impact; no fatalities.
Typical uncertainty (%) vs gross error magnitude:	**Typical uncertainty**: concrete strength & self-weight ~±5–15%.
	Gross error: −47% in stress prediction → order-50% under-design.

EOU: Probability ≠ Truth



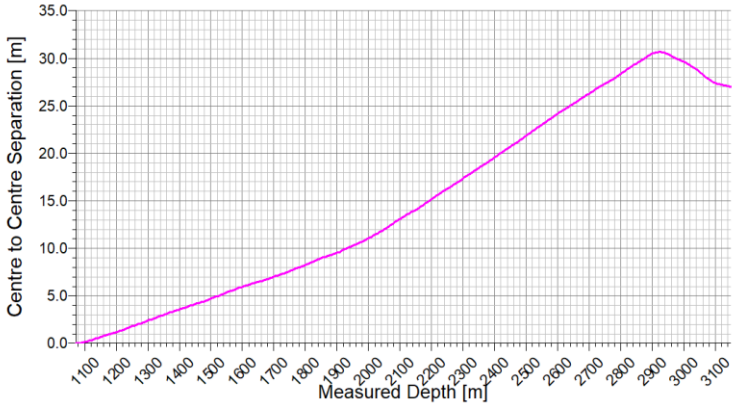
- EOU = statistical uncertainty model derived from ideal assumptions.
- Represents probability, not actual position
- Cannot replace survey QA/QC
- Precision still matters despite geology uncertainty

Uncertainty vs Gross Error

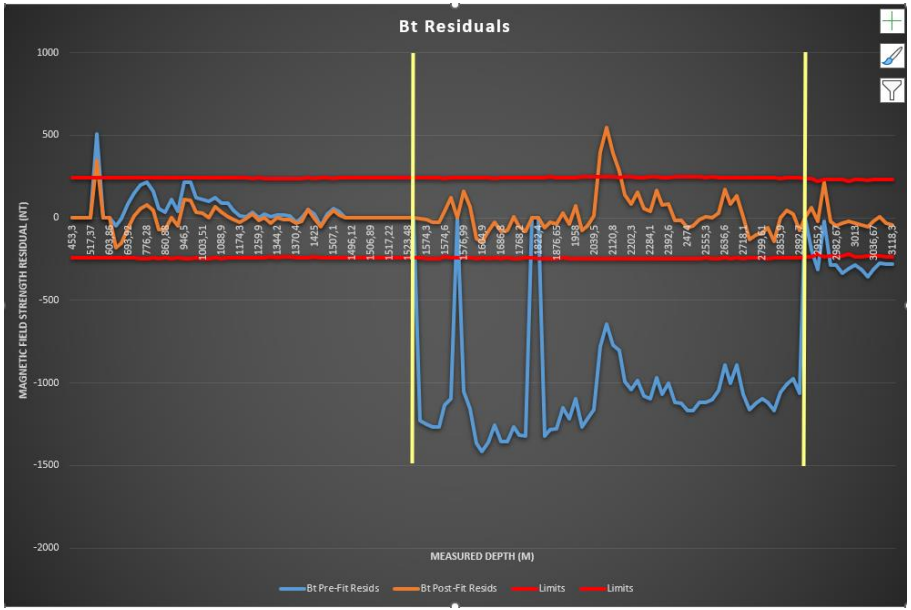
Blue: Planned Trajectory in the DP
Red: Posted Trajectory while drilling
Pink: Gross/Systematic error removed

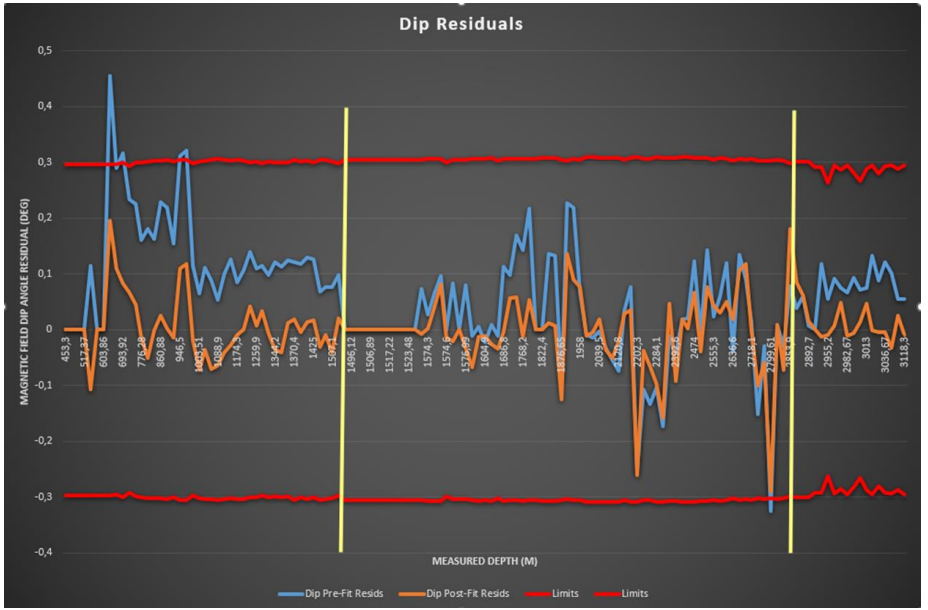
65° <Inc <71°

275 <Azm<270°



Systematic/Gross Error





MSA solutions

The chosen set of parameters yields a numerically degenerate solution

Parameter Estimates:

	BxB	ByB	BzB/AMI	BxS	ByS	BzS
	nT	nT	nT	--	--	--
Estimate:	-31,9352	-56,4317	704,6316	-0,03634	-0,03471	0
Limit:	210	210	496,5884	0,0048	0,0048	0,0048
Unc (1s):	18,37555	16,9769	1023,67	0,010741	0,010448	0,0016

The chosen set of parameters yields a numerically degenerate solution

Parameter Estimates:

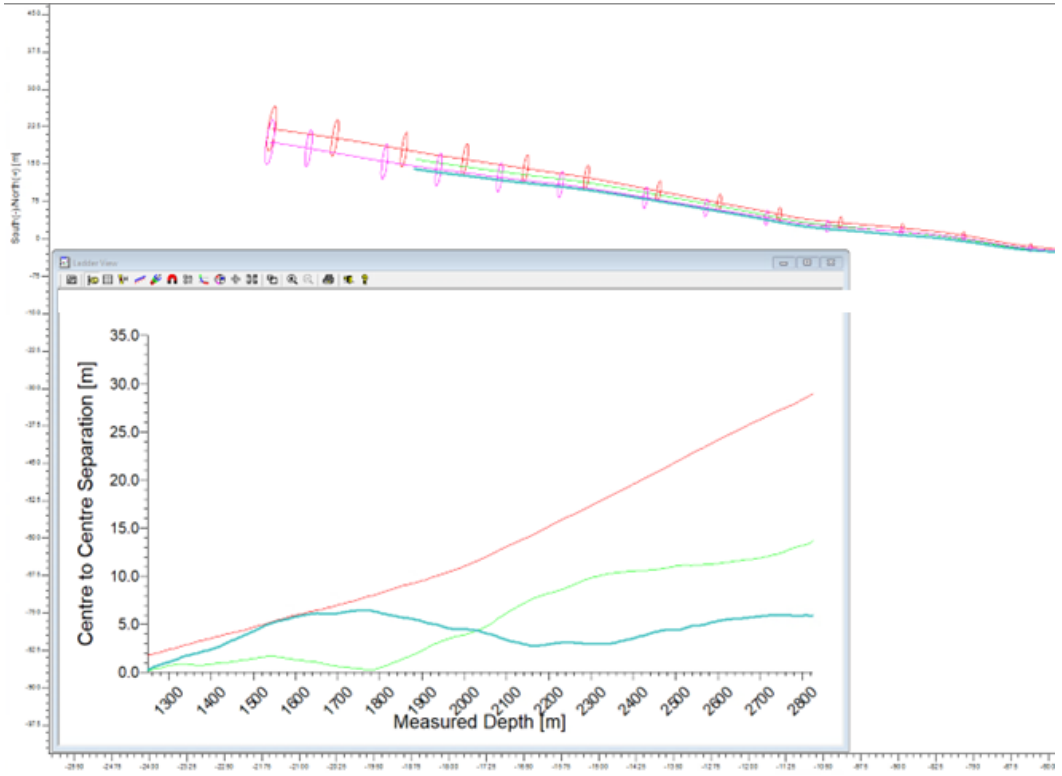
	BxB	ByB	BzB/AMI	BxS	ByS	BzS
	nT	nT	nT	--	--	--
Estimate:	0	0	642,7884	-0,03566	-0,03443	0
Limit:	210	210	496,5884	0,0048	0,0048	0,0048
Unc (1s):	70	70	1064,856	0,010741	0,010448	0,0016

MD (m)		BxB	ByB	BzB/AMI	BxS	ByS	BzS
0	1800	0	0	0	-0,035	-0,035	0
1800	2040	0	0	0	-0,03	-0,03	0
2040	2892	0	0	0	-0,026	-0,026	0

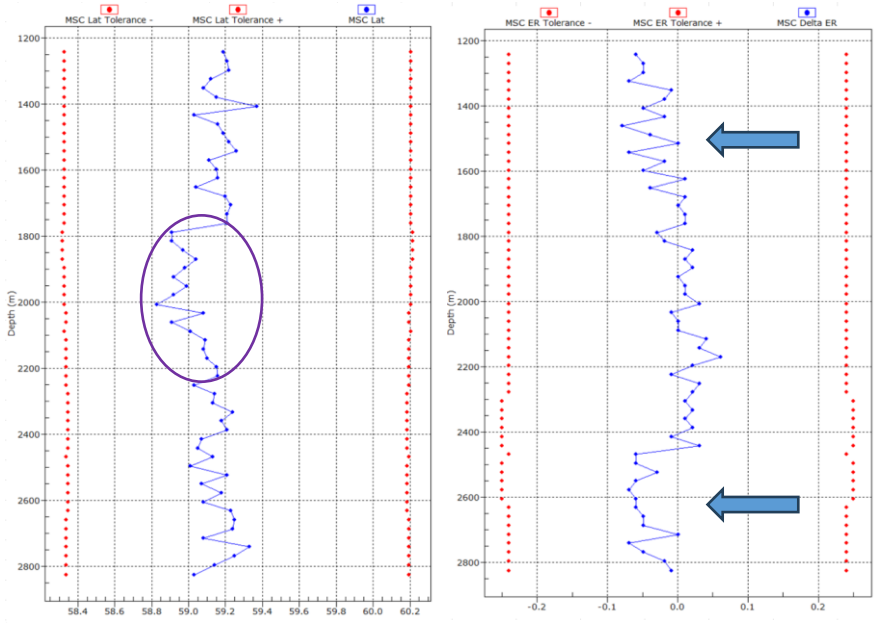
Running a gyro

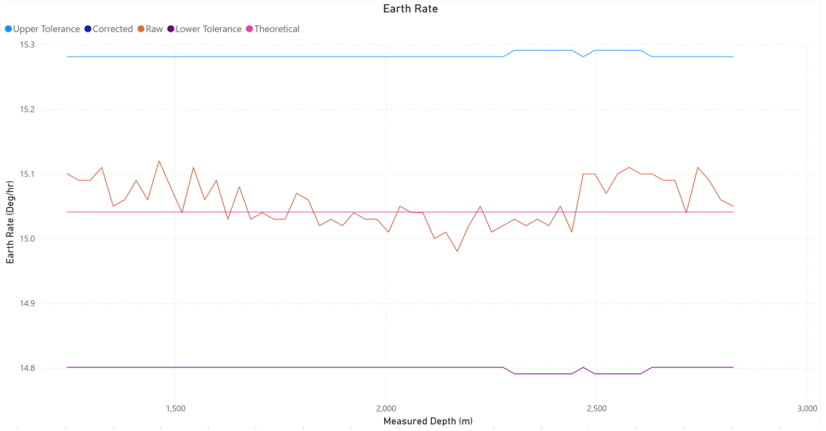
Red: Posted Trajectory while drilling
Pink: Gross/Systematic error removed
Green: Initial Gyro

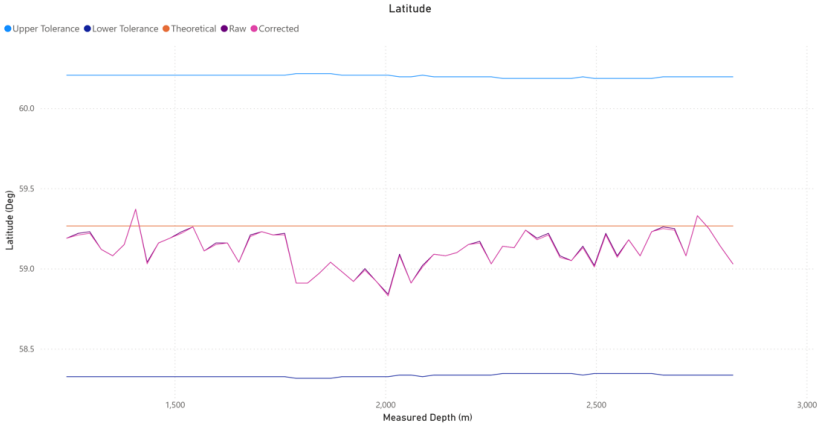
Turquoise: Gyro post bias/systematic error removed



Gyro Plots

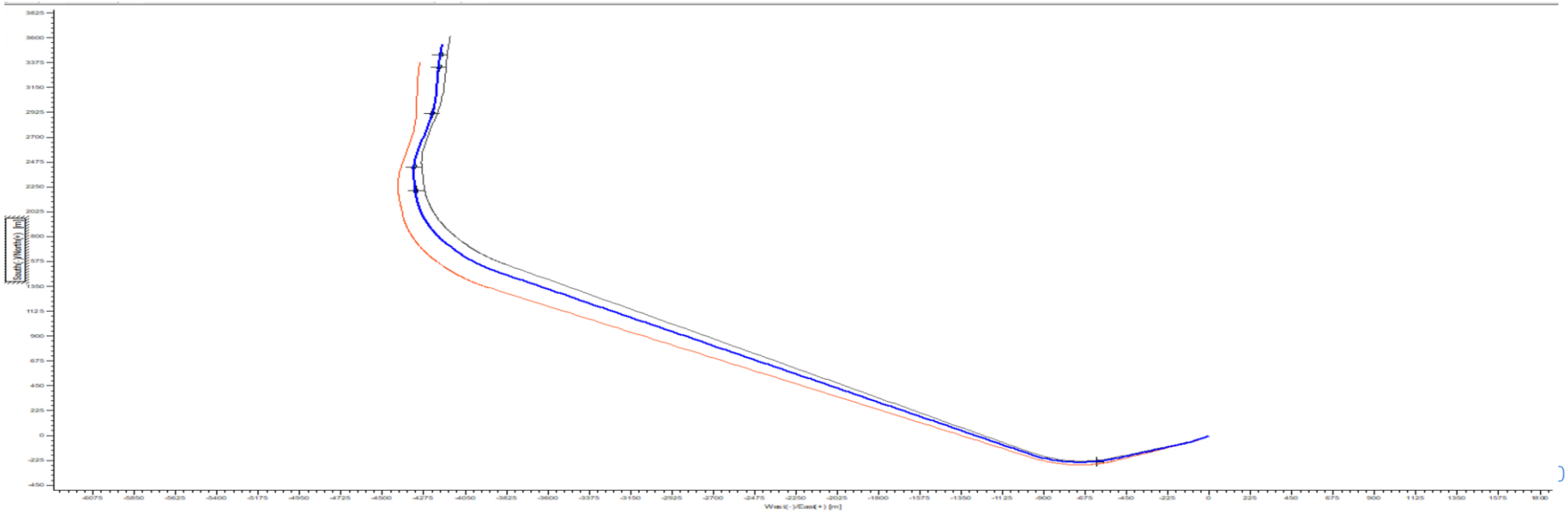

MSC Lat Tolerance -
MSC Lat Tolerance +
MSC Lat
Depth (m)
MSC ER Tolerance -
MSC ER Tolerance +
MSC Delta ER
Depth (m)


Earth Rate
Upper Tolerance
Corrected
Raw
Lower Tolerance
Theoretical
Earth Rate (Deg/hr)
Measured Depth (m)


Latitude
Upper Tolerance
Lower Tolerance
Theoretical
Raw
Corrected
Latitude (Deg)
Measured Depth (m)

Worst case scenario – when planning a trajectory

- It's not EOU
- Back engineering the planned trajectory



Data delivery

- MWD:
  - Parameter Estimates
  - Limit
  - Uncertainty 1σ
  - Plots BT, DipResidual and GT residual
  - Raw angles both inc and azimuth with clearly stating if GT/BT/Dip Pass or fail
  - Corrected angles and the difference between corrected and raw angels.
  - Include check shots and rejected surveys for documentation
- Gyro
  - Full Calibration report
  - MD vs Toolface
  - Plots Lat raw and corrected vs depth and Earth rate vs Depth – also all data associated with these plots
  - Raw data values, MSC solution