Well Risk Management and Automated Correction Platforms

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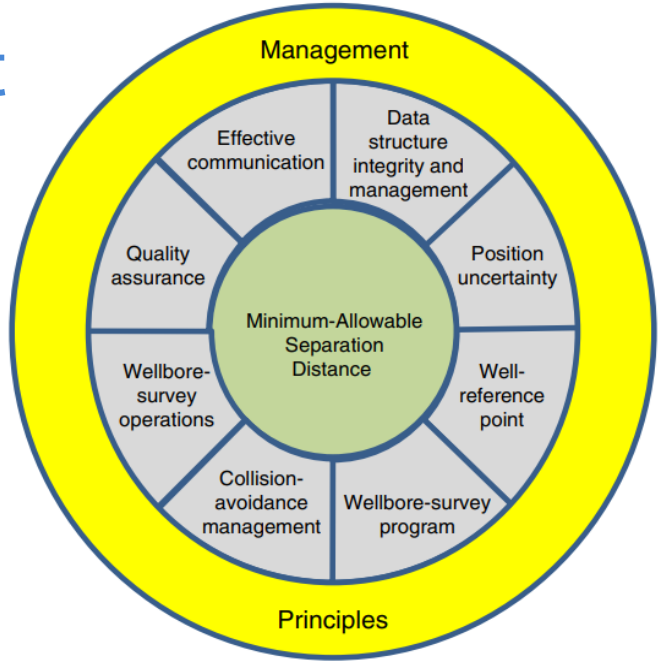
Agenda

- Well Construction Risk Management Overview
- Automated Survey Correction Platforms
  - During Execution Phase
  - Benefits and Concerns for other Risk Management Elements
- Summary

Well Construction Risk Management

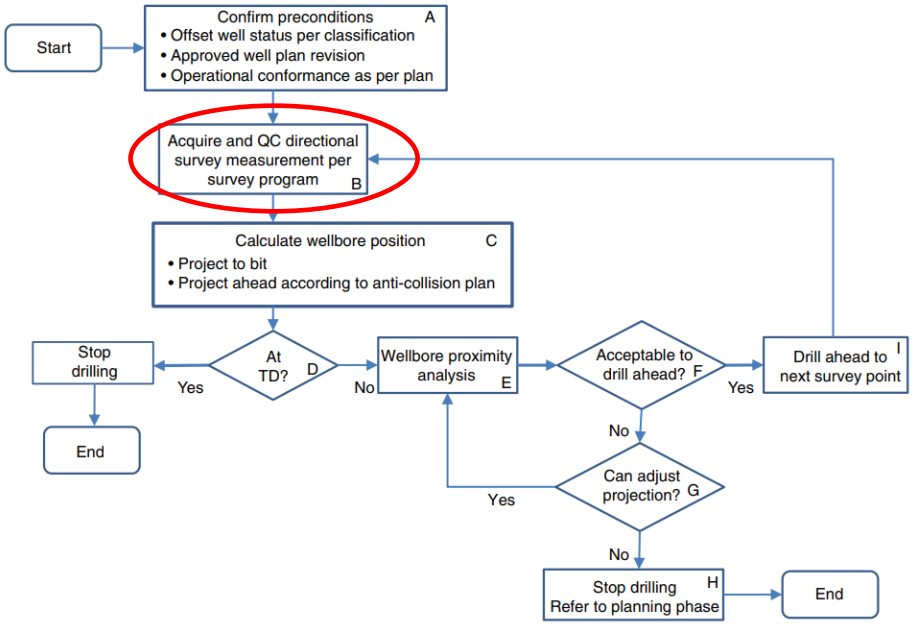
- Risk Management Structure important to maintain safe well construction practices
- Automated Survey Correction Platforms help with adherence to these elements but still have limitations



Well-Collision-Avoidance Management and Principles
Sawaryn, S. J. et. al.
SPE Drilling & Completion 33 (04): 335–350.
10.2118/184730-PA

Well Construction Phases

- Planning Phase
  - Creation of a Survey Program
    - Rigorously designed selection of survey instruments and running requirements to meet well objectives
- Execution Phase
  - QC directional survey measurement per survey program
  - Automated Survey Correction Platforms designed for this process



Well Construction Phase

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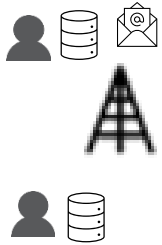
Survey QC

DD and DD Software System



MWD Hand Surface System

Manual Data Transfers
High Risk of Gross Errors
Multiple “Definitive” Data Sets

Drilling Engineer and DE Software

- **Confirm Surface Location and Reference Values**
- **Quality check based on target Instrument**

cking for drillstring
ncertainties

tations if available

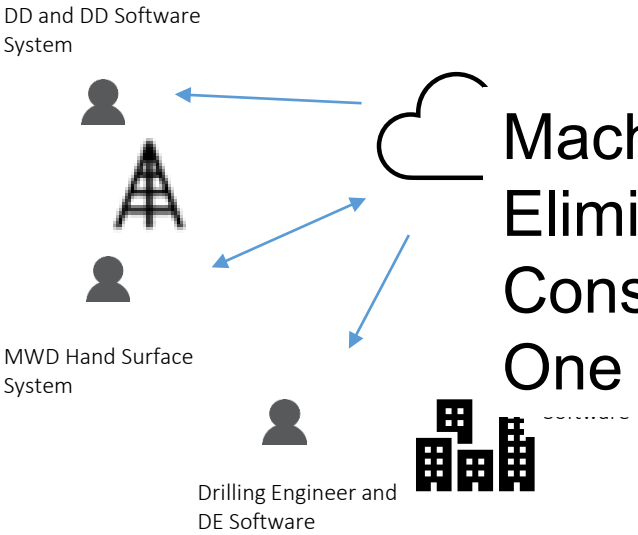
l BHA tendencies

with survey stations

- **Provide back final QC’d stations**
- **Done in Batches – Takes 5-45 minutes**

- **Surface Location and Global Reference Values from Well Plan**
- **Compare downhole station with Field Acceptance Criteria set by service provider**
- **Escalate if questions**

Survey QC - Automation



Machine to Machine Data Transfer
Eliminate Gross Errors
Consistent Results
One Definitive Data Set

- **Automatic QC software initiated: surface location, well plan, BHA and survey program entered**
- **Surveys streamed to software, for each station:**

Instrument

drillstring
ities
f available
ndencies with

actual trajectory

- **Make final QC'd station available**
- **Each station done in ten seconds**

Survey QC Benefits and Concerns

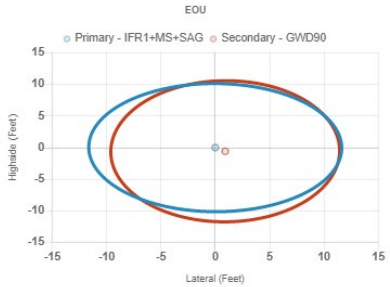
- Automated Platforms allow internal and external QC methods
  - Internal Checks, as described in SPE 103734 by Ekseth et al…
  - External Checks
    - Run RIP and Chi^2 tests when data available
    - Compare multiple sensor packages
    - Independent reference verification
  - Does not replace the need to acquire overlapping surveys or proper surveying procedure

RIP Test Results

Inclination Difference	Pass
Azimuth Difference	Pass

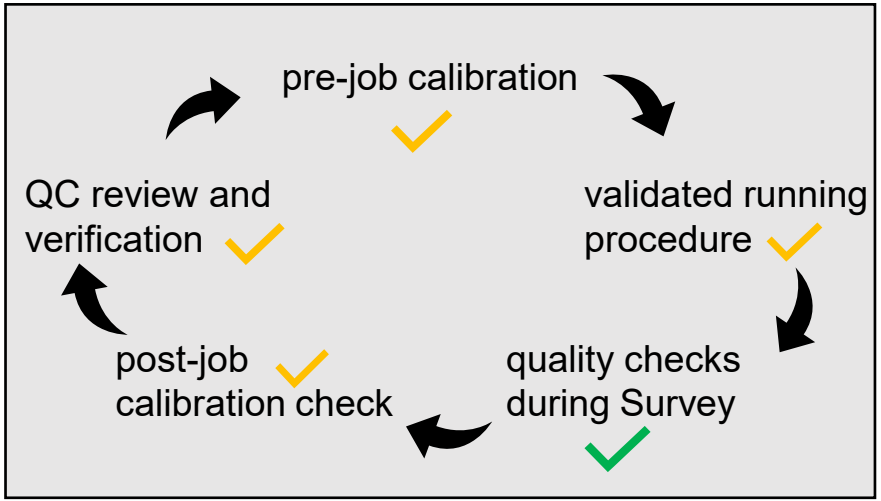
Chi² Test Results

Inclination Difference	Pass
Azimuth Difference	Pass
NEV Difference	Pass
HLA Difference	Pass



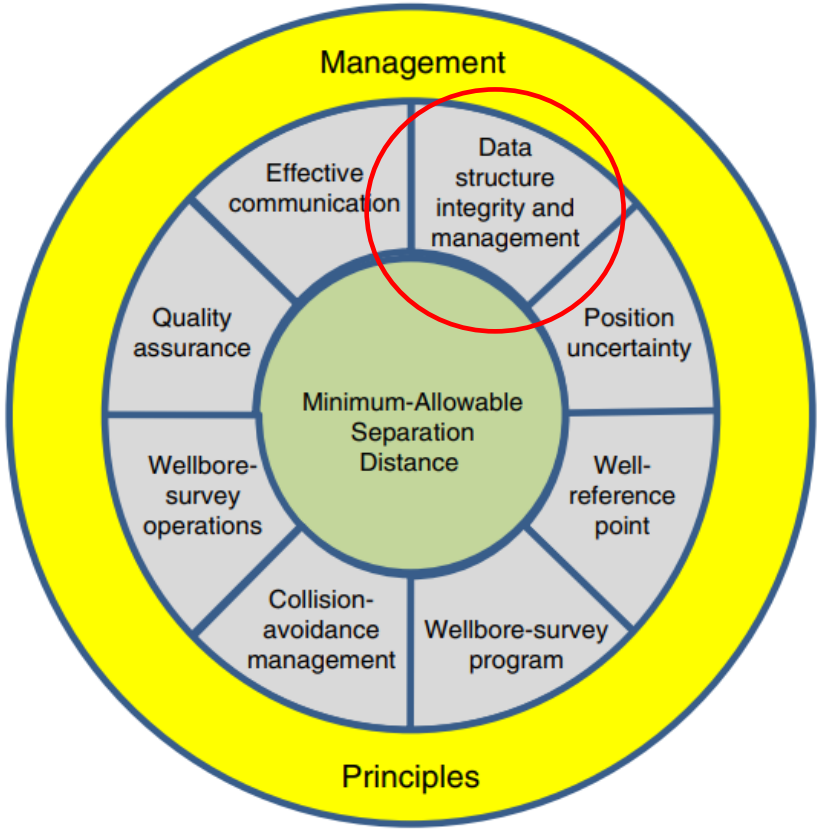
Survey Quality Control Loop – Automation Limitations

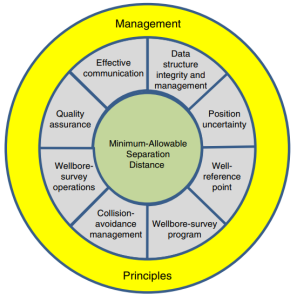
- Calibrations and checks still required
  - Automated platform can help in tracking tool performance over multiple wells
- Running procedures still require validation
  - Automated algorithms can indicate potential issues, but cannot fully verify
- Verification still required
  - Automated Platform helps in standardizing and simplifying Reports
  - Allow machine-to-machine transfers



Data Structure

- Automated Platfo ansfer
  - via API or WITS
- Can adhere to Ma protocols and formats
  - Pre-sanitized d
- QA/QC reports a
  - "6-axis data" f ions
  - Critical importa in MSD
  - Allows later su





Position Unce

Point

- Confirm internal a
  programs targete
- Well Reference P
  - Setting up well
    - If API is use
      - Ideally,
        officiall
    - If manually
    - Automated
      - Confirr
      - Confirr

urvey

ce software or manually.

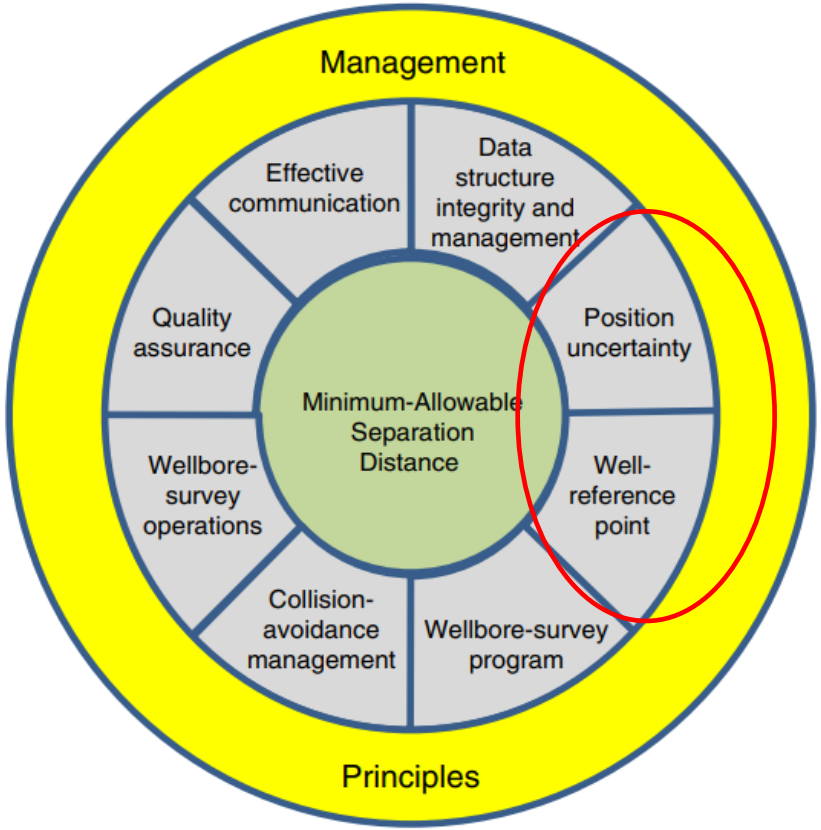
source

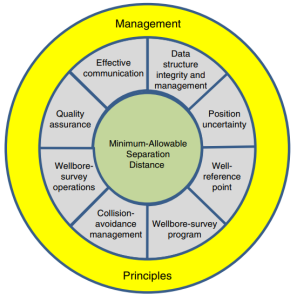
lanning software which has been

ndently

ngitude with a cross check

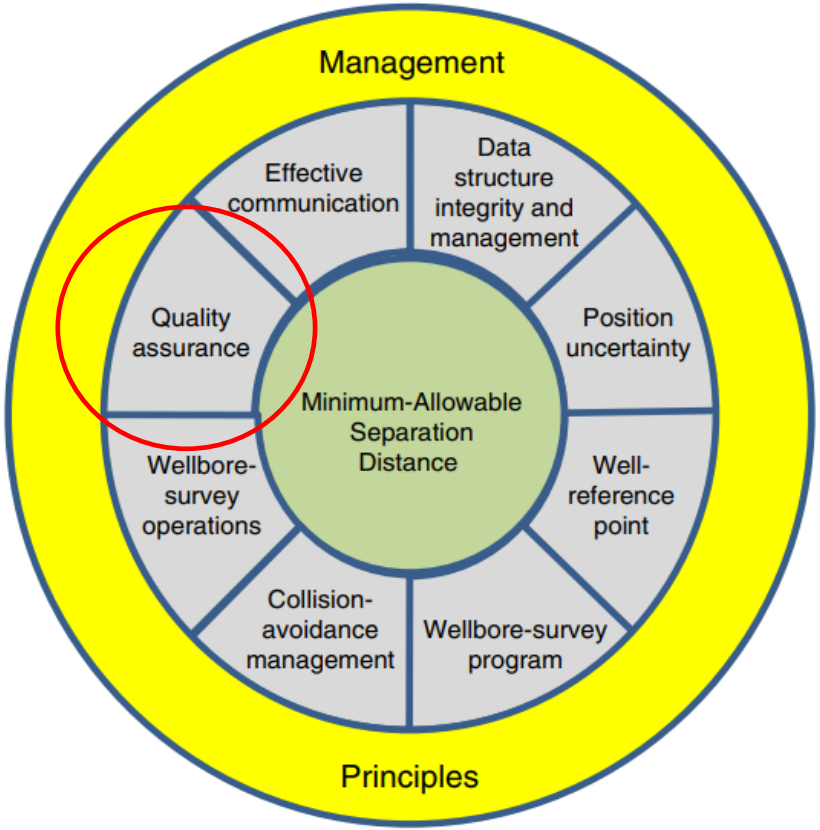
alculation

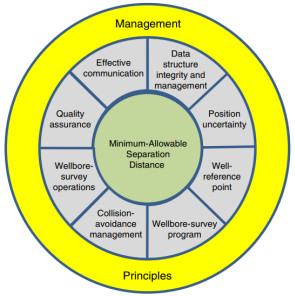




Quality Assura

- Automated Platfo
  - Software locks
    - Surface Lo
    - Crustal Mo
    - Printable re
- Automated Platfo
  - Important to ha
    checked regul
  - Can increase t
    - See SPE 7





ce

by Nicholas Zachman

expectations that are

update cycles

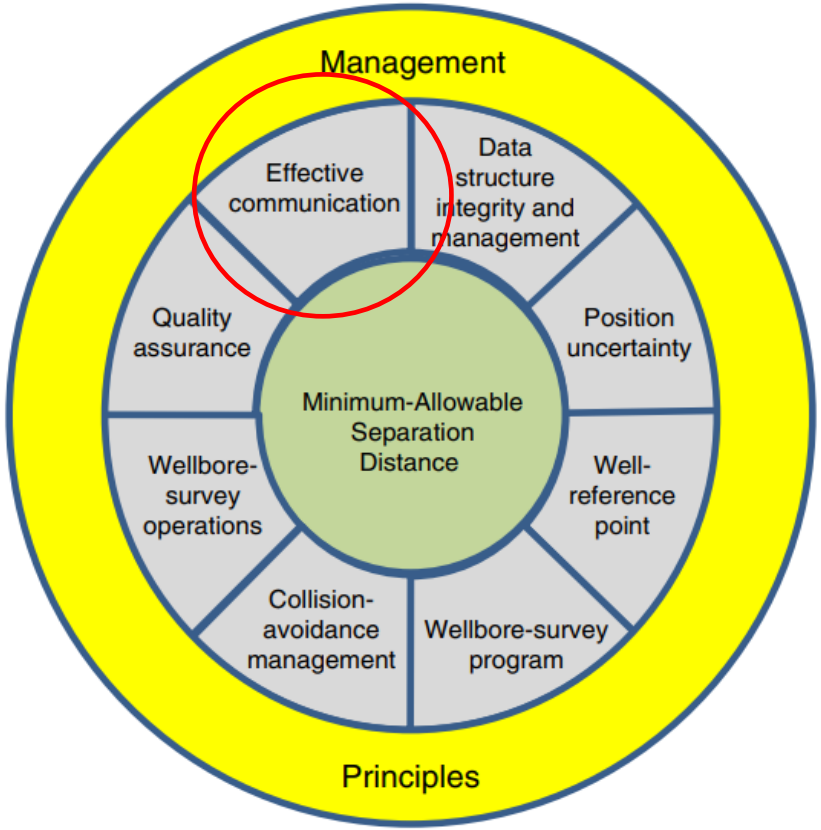
afety-Important Software

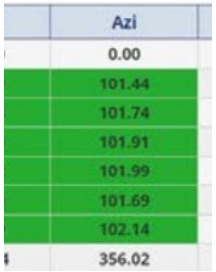
Effective Com

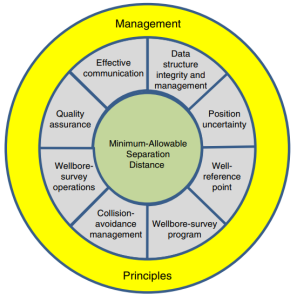
- Clear user interfa

FAC Raw	MD (ft)	INC
G B Dip	1,968.79	30.471
G B Dip	2,061.17	32.623
G B Dip	2,154.1	34.793
G B Dip	2,246.72	37.064

- Enable easy esca
  - Automated Alg
  - Chat functions
  - Ease Manager







varning systems.
mmunication channels.

Automated Platform Summary

- Potential Benefits
  - Fast, reliable, and clear confirmation of adherence or failure to survey program
  - Easy access to survey expert analysis
  - Minimize manual data transfers, minimize potential data entry errors
  - Clear audit trail
- Potential Concerns
  - Fewer experienced people
  - Black box concern – no understanding of underlying process.
  - Complacency in execution
  - Increase audit requirements

Questions?