

The Systematic Application of Root Cause Analysis to Failures of Intelligent Well Completions, to determine the Causes

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ABSTRACT

When a producing well fails, the engineering team needs to diagnose the failure quickly, in order to determine the best course of remedial action. This is particularly important with an early-life failure when other wells are still being installed using the same design, raising legitimate concern that the failure may be repeated in those other wells. In practice, diagnosis of a failure when evidence is incomplete, and even inconsistent, can lead to conflicting or incorrect conclusions. A systematic method of root cause analysis forces the discussion to converge on a useful outcome. This case study illustrates the use of such a method, using a fault-tree structure, to analyze failures in two subsea multizone intelligent completions.

The objectives of the analysis were to -

- understand the failures as fully as possible;
- determine what steps are needed to prevent the failures from recurring on subsequent installations;
- determine what other tests may be useful to help understand the problem.

The work started by collecting and reviewing the evidence (written reports, and links to knowledgeable people), and defining the symptoms of failure. Then Fault Trees were constructed from all the potential failure modes that fit the symptoms of failure (32 in total for the first well, 48 for the second well). These were used in a structured workshop session to review all those potential failure modes. Those that did not fit the evidence were discarded, leaving just 4 Possible Causes by a process of elimination.

Extra tests were identified to confirm each Possible Cause, providing further elimination. A structured comparison to find analogues in other similar projects provided further insight. Finally, further characterisation tests and other actions were identified to help avoid future failures. Specific recommended actions (30 in total) were identified to address the Possible Causes and so prevent the failures from recurring on subsequent installations.

The study showed that a systematic application of root cause analysis, using fault trees as the underlying structure, can be very effective in focusing engineering effort on resolving the important issues and avoiding time-wasting distractions.