AI-Assisted Well Integrity Analysis System

Introduction

Well integrity failures — such as Macondo (2010) — show that critical risks are buried across thousands of unstructured well reports. No existing tool triangulates drilling, cement, and pressure data by depth across the full well lifecycle.

Objective

Develop an AI tool to ingest well PDF reports, extract depth-indexed integrity events, assign structured risk codes, and enable cross-phase correlation — from drilling to abandonment and CO2/H2 repurposing.

Methodology

INGEST

PDF well reports loaded into a Python desktop app, text extracted page-by-page (PyMuPDF)

ANALYZE

Tool processes text in 3-page chunks.
Assigns:
- event code (X=losses, A=kick, SP=stuck pipe, CJ=cement, PT=pressure test)
- measured depth
- Risk flag (CRITICAL/HIGH/MEDIUM/LOW)
- Root cause

VISUALIZE

Events exported to Excel (FACT_Events schema)
Loaded into PowerBI
Depth risk profile + pressure timeline charts

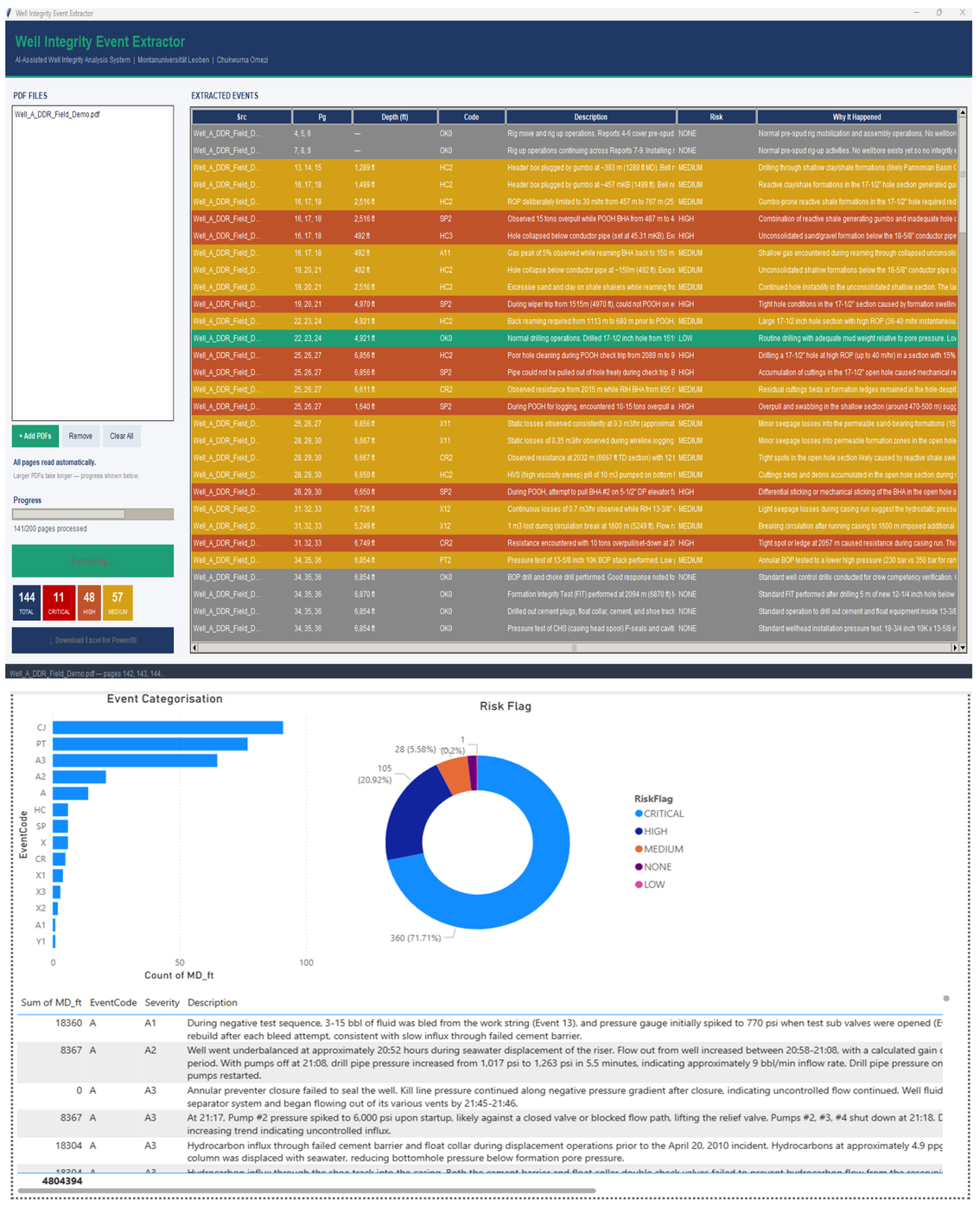
Results

Demo ▶ [Launcher] [Py-App]

200-page field DDR processed in full: 172 events extracted (8 CRITICAL, 52 HIGH, 75 MEDIUM). Color-coded risk table + Excel export for PowerBI generated in <15 minutes.

Validation: Macondo Well (BP, 2010)

4 public reports (BP, National Commission, Transocean Vol I & II) processed: 502 events extracted — 360 CRITICAL, 105 HIGH, 28 MEDIUM. Risk flags cluster at 18,200–18,360 ft, matching the forensic failure zone.



Roadmap and Next Steps:

- Expand variables: pore pressure, formation type, mud type, drill rate, bit type, rotation speed
- Cross-well correlation to identify depth-pattern recurrence
- Integrate geological and completion data

Limitation: analysis quality depends on data availability from operators.

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Research Interests:

- Well integrity analysis across the full well lifecycle
- AI-assisted document analysis and data extraction
- Drilling engineering, cementing
- Well abandonment/repurposing
- PowerBI dashboards for petroleum engineering data

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