Reducing Well Control Incidents
A Case for Automation

Mark Gillard
Technical Manager

Agenda

- Introduction
- Data Analysis
- Why Automation?
- Automated Well Control
  - Human Factors
  - Reducing Influx Size
  - Cost Benefits
- Automated Well Control System
- Q&A

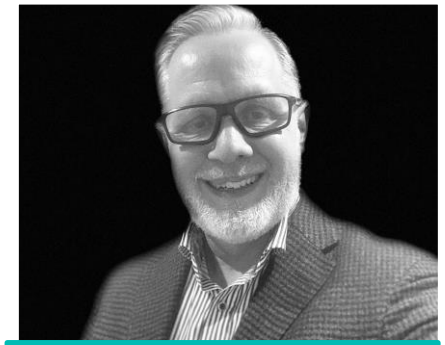
Meet Our Team

Bryan Atchison

Managing Director

Senior executive with long-standing career in Operators. Extensive experience in drilling, well engineering and offshore operations.

Eric Wesselingh



Engineering Manager

Experienced senior manager with 30 years' experience in the oil and gas industry and strong background from Drilling Contractors.

Mark Gillard

Technical Manager

Experienced professional with over 40 years of well engineering experience working for Operators, Training Centre and Regulator.

Juliana Bond

Corporate Communications Manager

Very skilled journalist with over 15 years of experience in Media, Communications and Marketing.

Timeline

Safe Influx
Founded in October

2018

2020

Minimum Viable Product available

Lloyd's Register Technology Qualification achieved

IP Agreement signed off by RGU

OGTC funding awarded

Conferences

Successful FIELD TRIAL and Technology Qualification extended to traditional land rigs

2021

Finalist for the SPE Offshore Achievements Awards and Global Energy Awards

Conferences

Global Partnership with Weatherford MPD

2021

UK Patent granted

Successful Safe Influx and Weatherford MPD RIG TRIAL

SPE Technical Papers

Conferences

Finalist for the World Oil Awards

Why Automated Well Control?

Safe Influx.
AUTOMATED WELL CONTROL

Drillers' loss of Level 1 Situational Awareness (loss of attention) causes **up to 67% of blowouts**

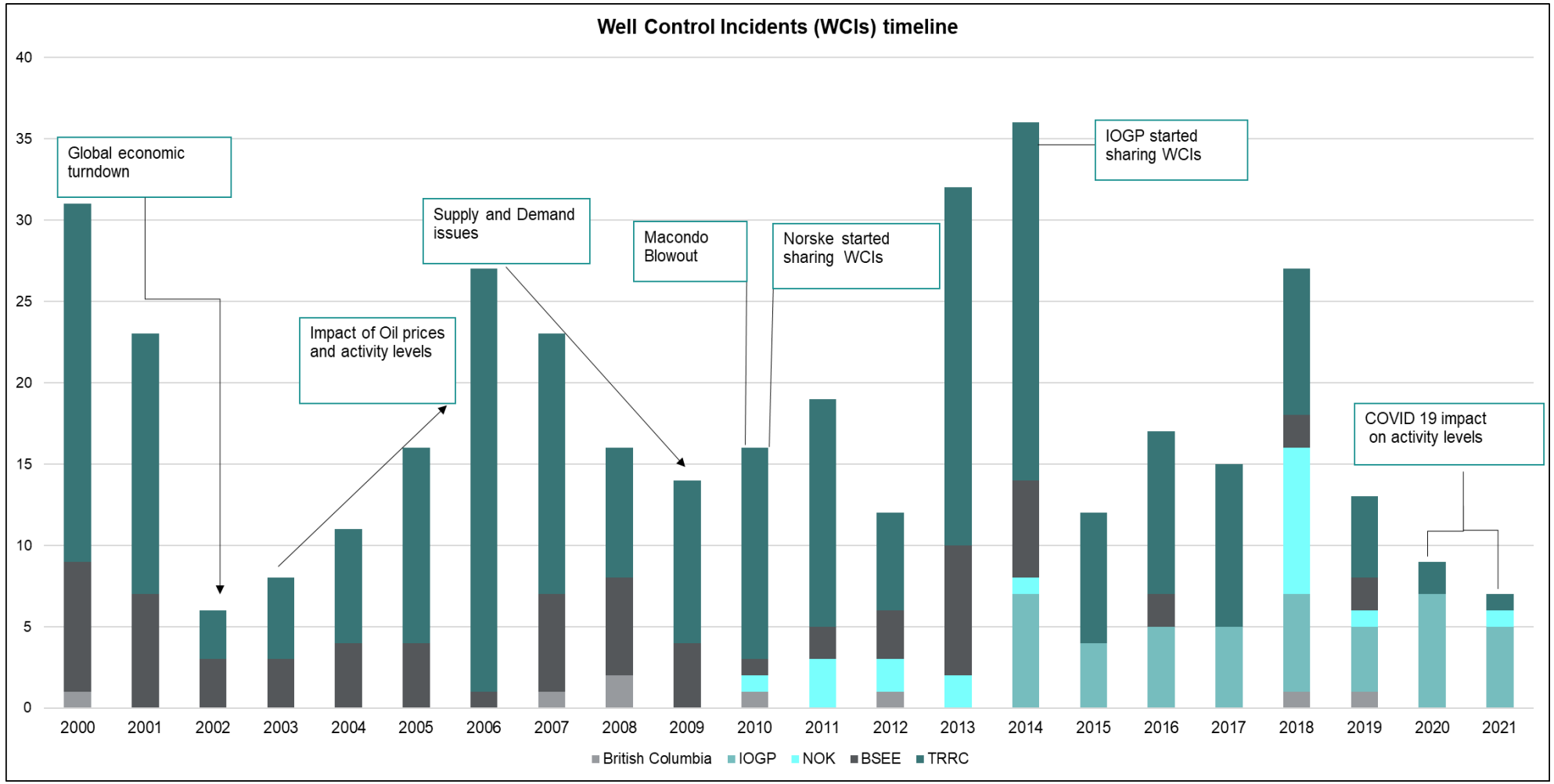
Loss of Well Control frequency is **6.04 wells/1000** for exploration wells in US GoM

71% of Well Control Incidents caused by Human Factors

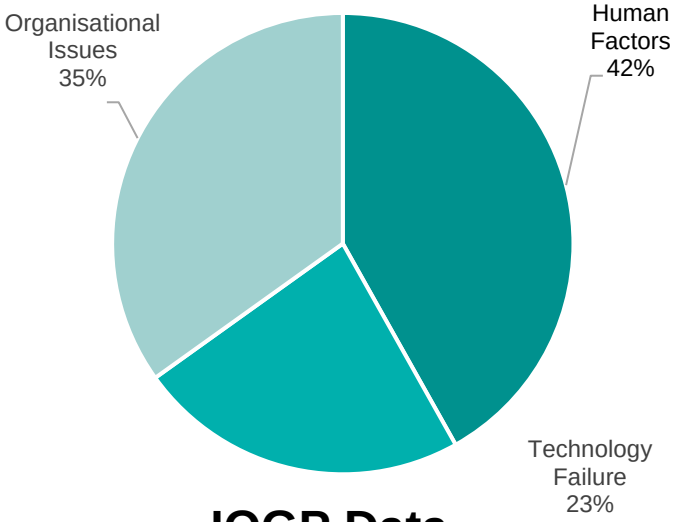
Loss of Well Control frequency is **1.50 wells/1000** for exploration wells in a North Sea Standard operation

The triggering causes of 54% of kicks could be mitigated or prevented by EKDS and automated response

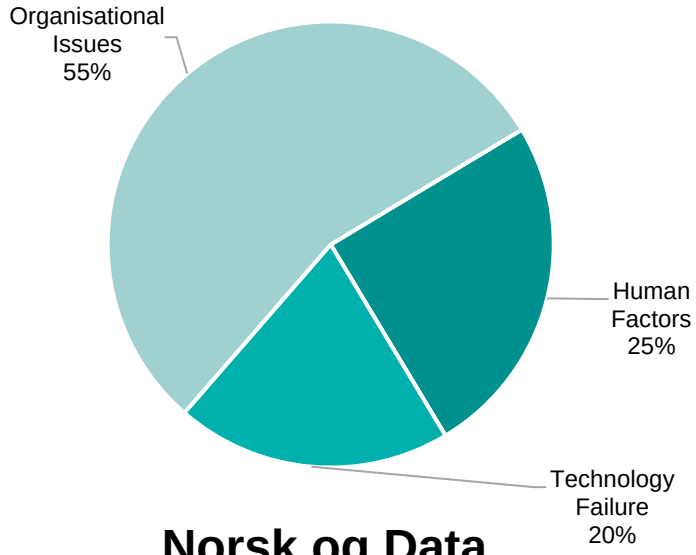
Well Control Incidents



Data Analysis – Key Contributing Factors



IOGP Data



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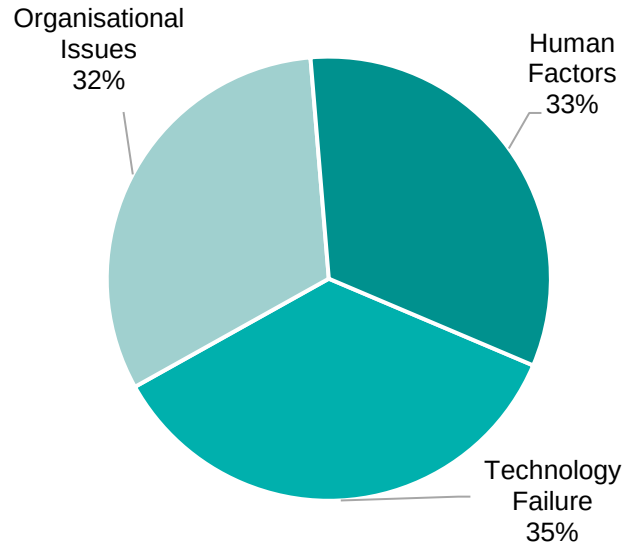


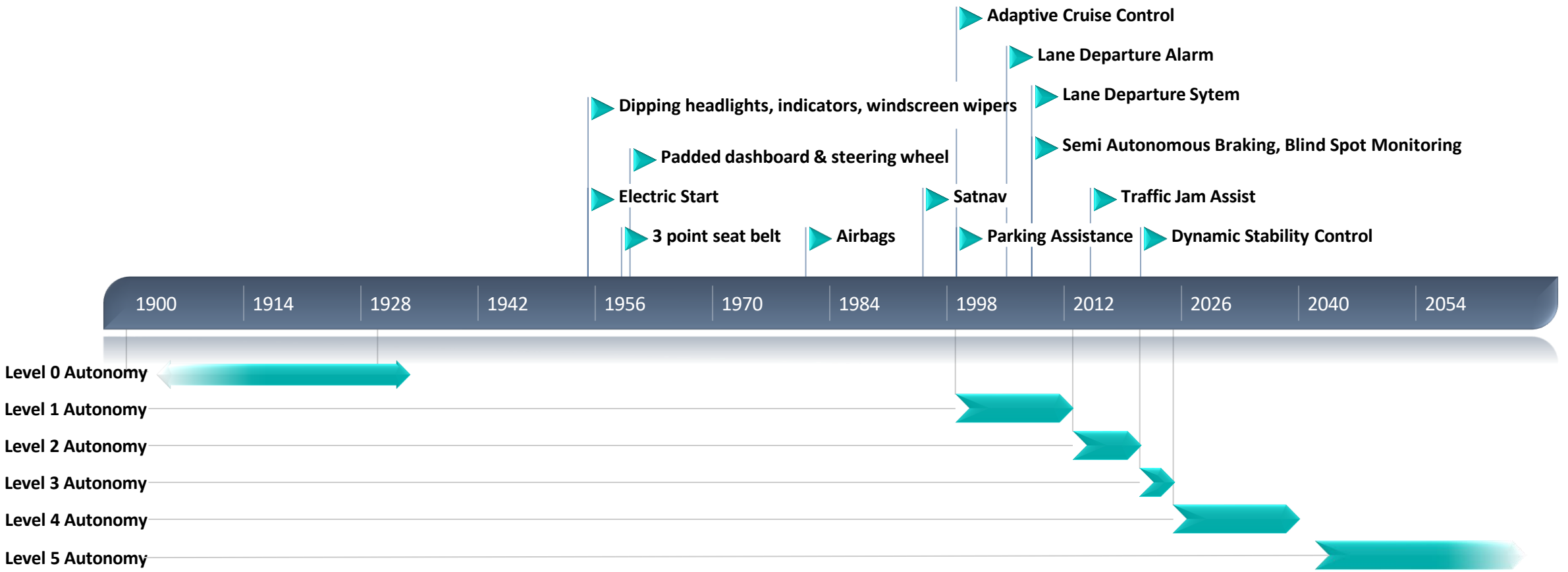
BSEE Data

Only **20-35%** of Well Control incidents can be definitively attributed to
Technology Failure
the remainder are attributed to either
Organisational Issues or Human Factors
which could be mitigated by automation

TRRC

British Columbia

Automation in the Automotive Industry



ABS and Dynamic Stability Control

The Benefits of Automation

Safety	• The end result is pre-determined
Assurance	• Protocols, procedures and sequencing can be agreed before operations commence
Consistency	• the sequence duration is pre-determined
Execution	• the sequence will continue unless halted

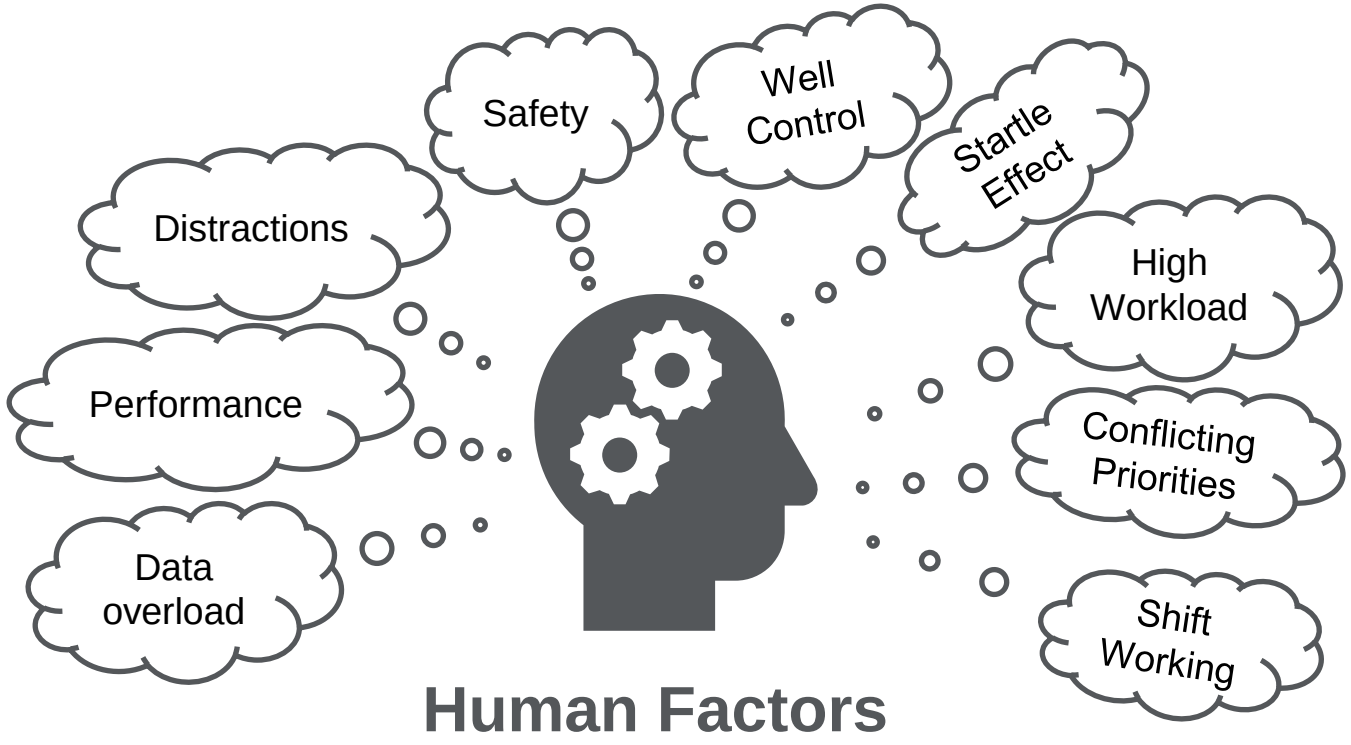
Why Automated Well Control?

Safe Influx.
AUTOMATED WELL CONTROL

- Reduced Well Control Risks?
- Cost Effective Wells?
- Environmental Performance?

[Safe Influx Automated Well Control Field Trial - Oct 2019 - YouTube]

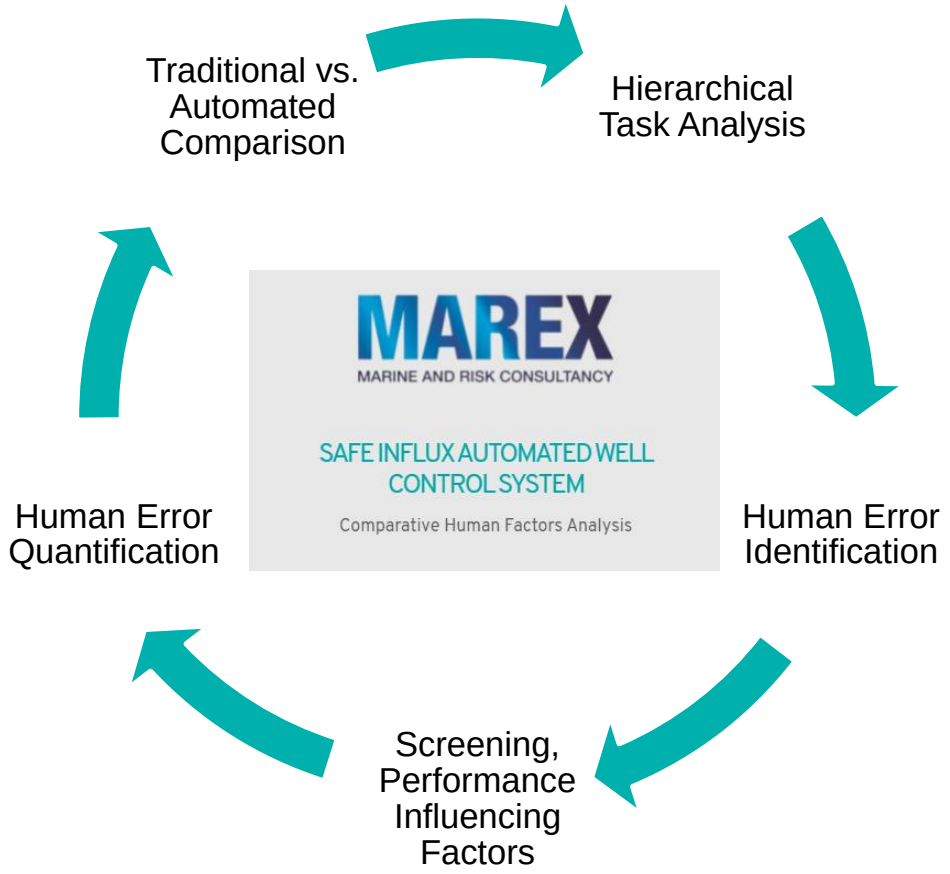
Human Factors



Drillers' loss of Level 1 Situational Awareness (loss of attention) causes

up to 67% of blowouts

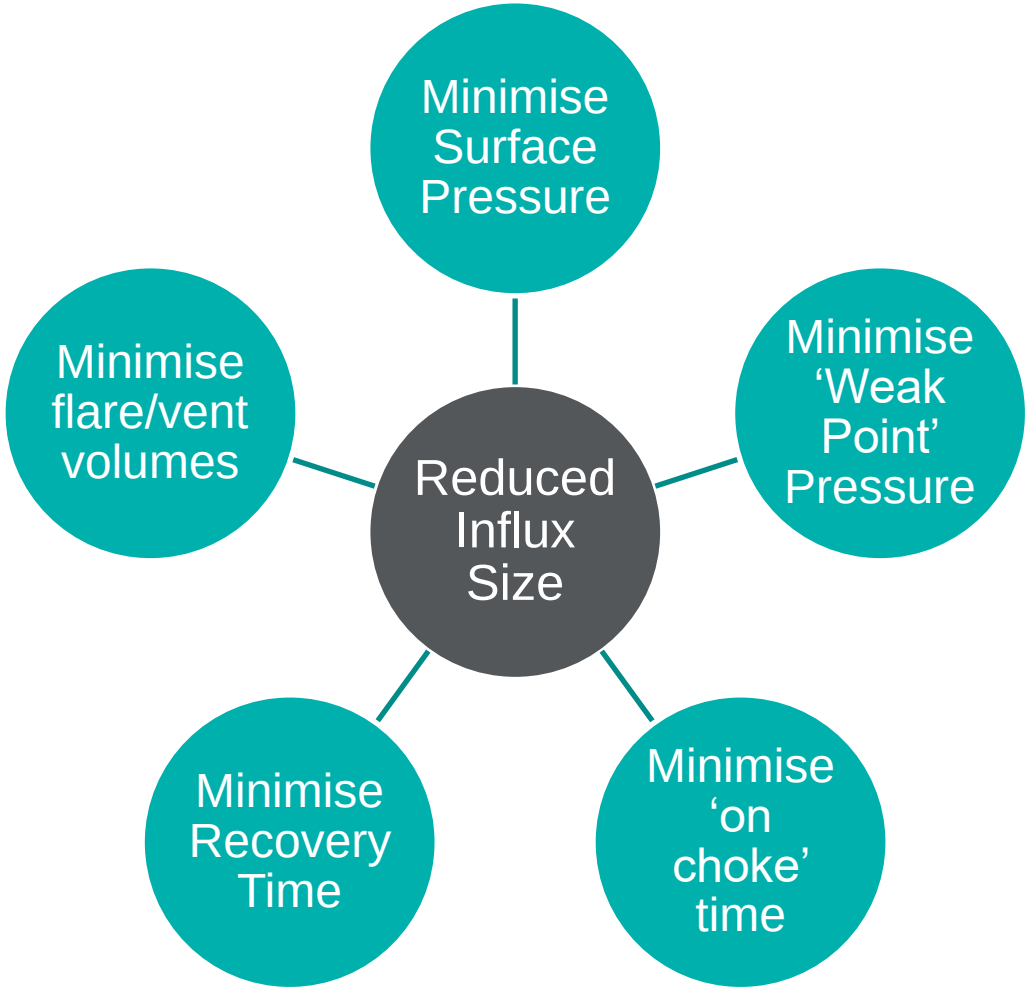
Comparative Human Factors Analysis



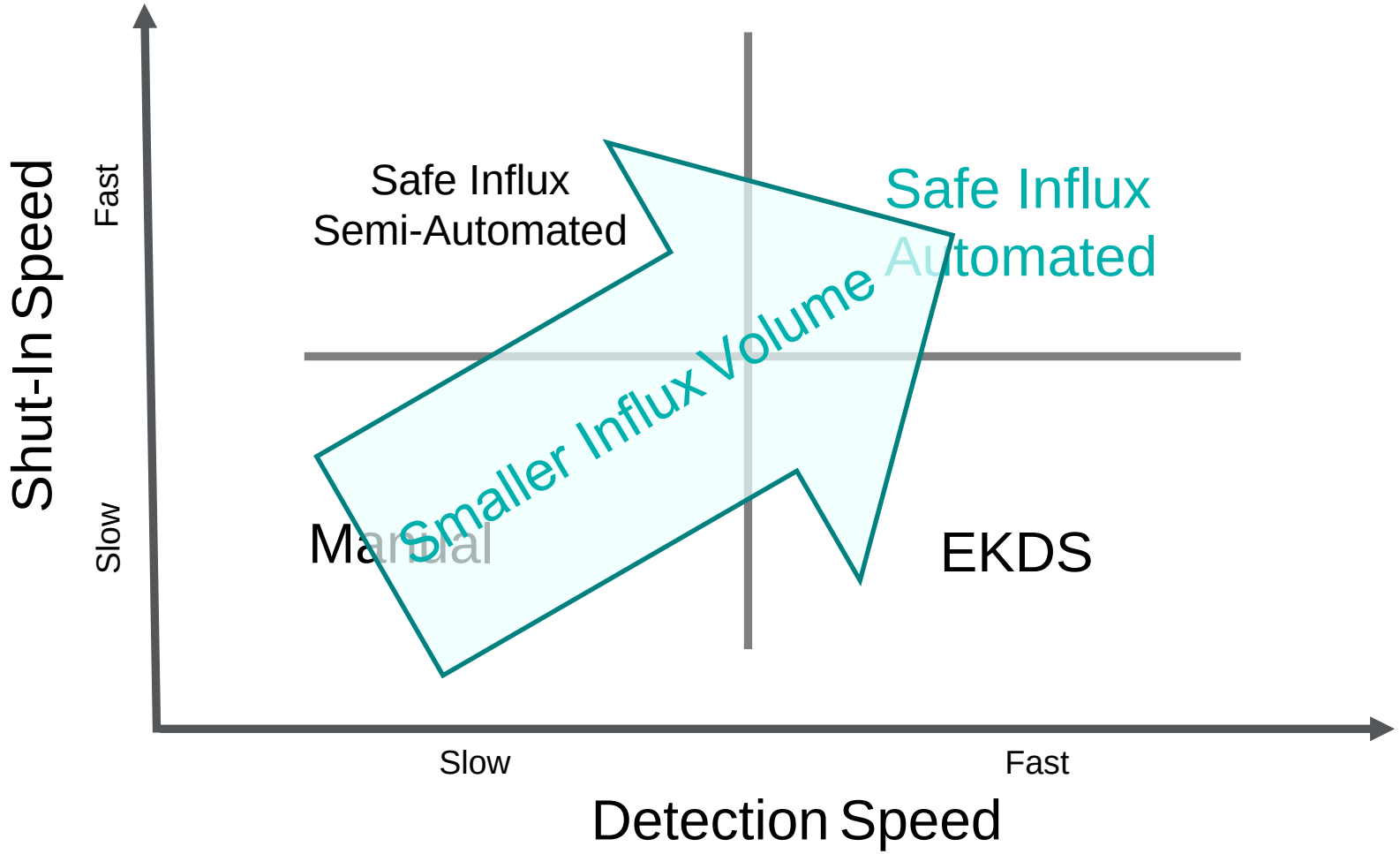
94%

Reduction in Probability of Human Error

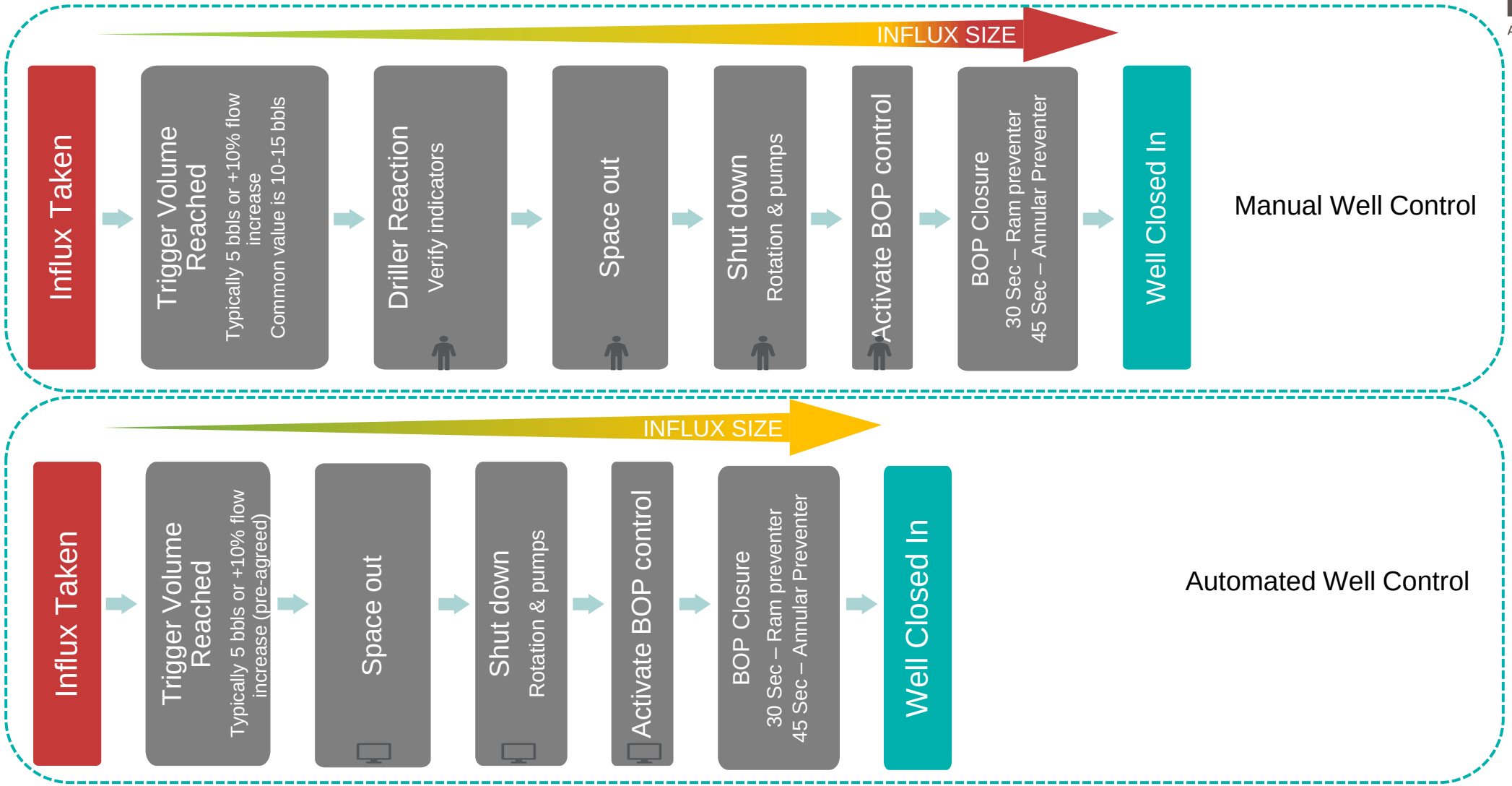
Reducing Influx Size



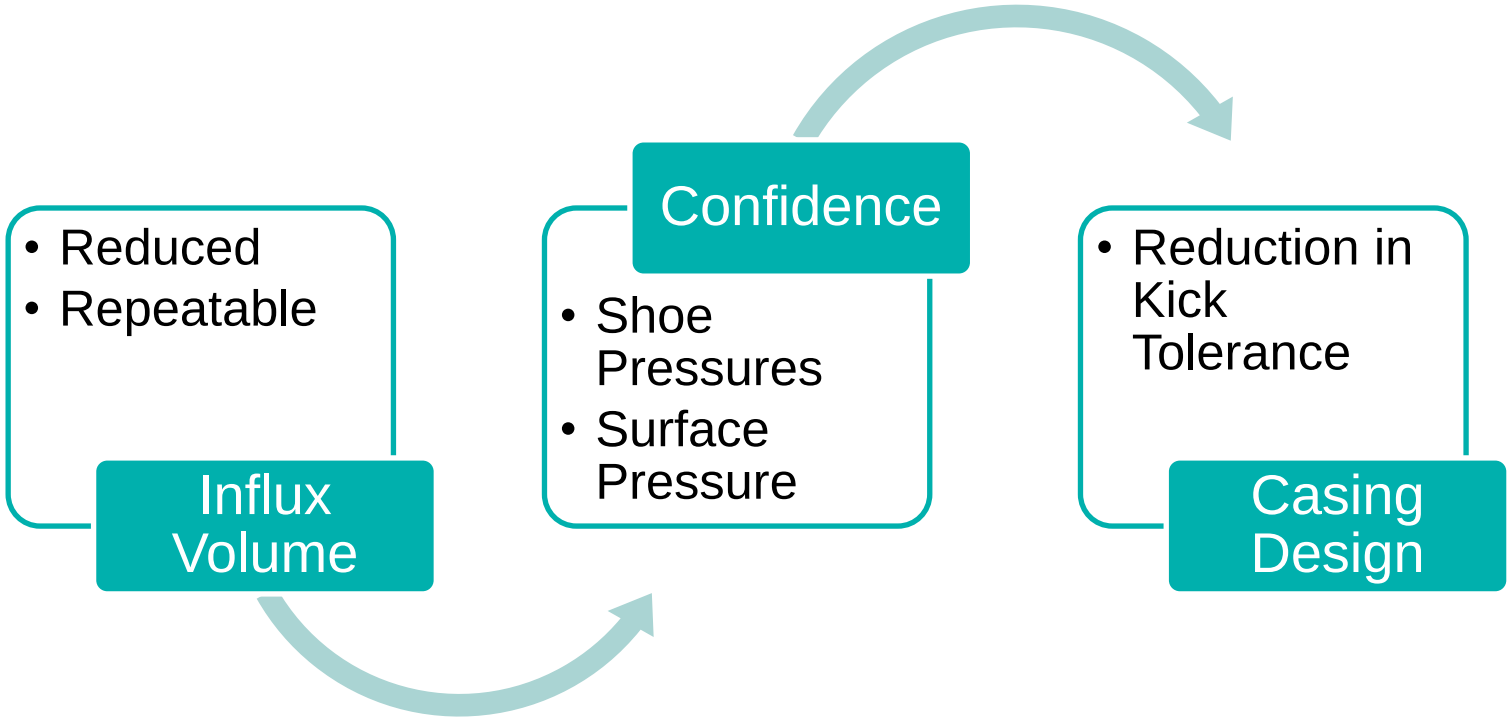
Influx Volume



Influx Volume



Casing Design



A reduction in kick tolerance parameters could result in the modification of casing design standards and in some cases lead to a reduced casing scheme for a given well type.

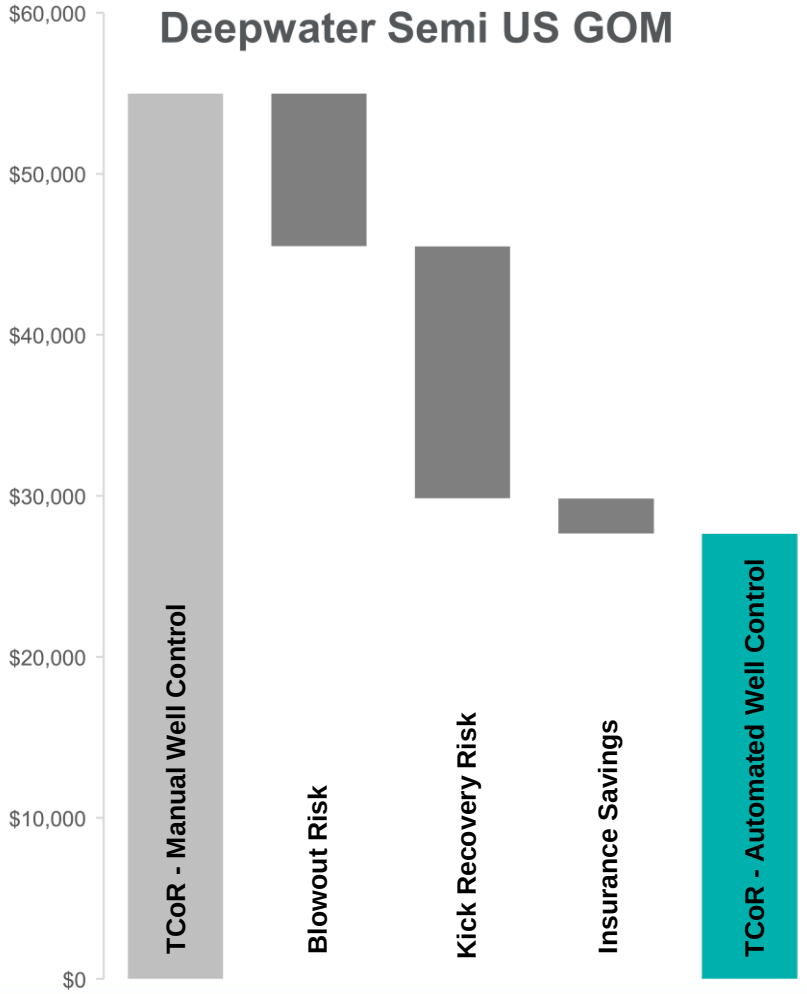
Study on UKCS Jurassic and Palaeocene targets has indicated that a 20% reduction in well costs could be achieved.

Total Cost of Risk – Well Control

Safe Influx
AUTOMATED WELL CONTROL

TCoR Model

TCoR Results



Key Points

Cost of Risk often not articulated in well AFE

Potential for up to 50% Risk Cost Savings per well with Automated Well Control

TCoR Model could include NPV of deferred / lost production

Why Automated Well Control?

Reduced Well Control Risks

Reduction in probability of human error by 94%
Enhanced decision-making, efficiency and safety

Cost Effective Wells

Smaller influx volumes
Reduced well control costs
Reduction in casing and well costs by 20%

Environmental Performance

No spills
Reduced carbon footprint

Why Automated Well Control?

Safe Influx.
AUTOMATED WELL CONTROL

Reduced Well Control Risks

Reduction in probability of human error by 94%	☑
Enhanced decision-making, efficiency and safety	☑

Cost Effective Wells

Smaller influx volumes	☑
Reduced well control costs	☑
Reduction in casing and well costs by 20%	☑

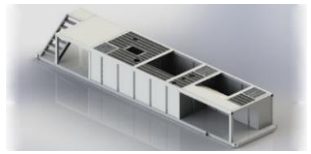
Environmental Performance

No spills	☑
Reduced carbon footprint	☑

Automated Well Control - System Topology

Safe Influx
AUTOMATED WELL CONTROL

Rig Equipment



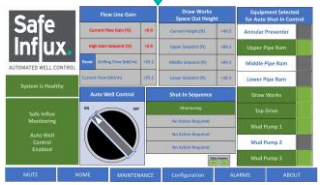
Flow meter

Victus™ MPD
Weatherford

Future Inputs

- EKDS
- Real-time Downhole Data
- Real-time Mud Properties

Safe Influx Automated Well Control System



HMI Screen

Existing Rig Equipment

STOP

Top Drive

SPACE OUT

Drawworks

STOP

Mud Pumps

CLOSE

BOP

Safe Influx

AUTOMATED WELL CONTROL

System is Healthy

Safe Influx Monitoring

Automated Well Control Enabled

Flow Line Gain

Current Flow Gain (%)	+0.0
High Gain Setpoint (%)	+2.0
Reset / Drilling Flow (bbl/m)	+25.2
Current Flow (bbl/m)	+25.2

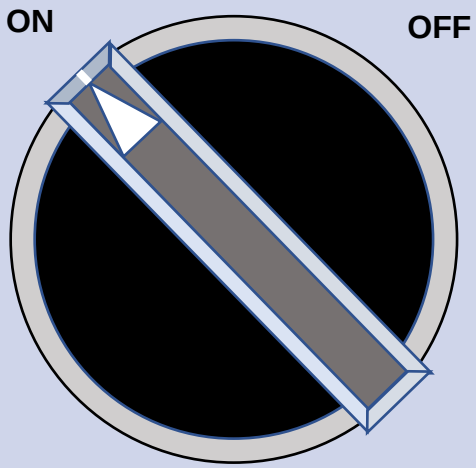
Draw Works Space Out Height

Current Height (ft)	+40.5
Upper Setpoint (ft)	+84.2
Middle Setpoint (ft)	+84.2
Lower Setpoint (ft)	+38.5

Equipment Selected for Auto Shut-In Control

- Annular Preventer
- Upper Pipe Ram
- Middle Pipe Ram
- Lower Pipe Ram
- Draw Works
- Top Drive
- Mud Pump 1
- Mud Pump 2
- Mud Pump 3

Auto Well Control



Shut-In Sequence

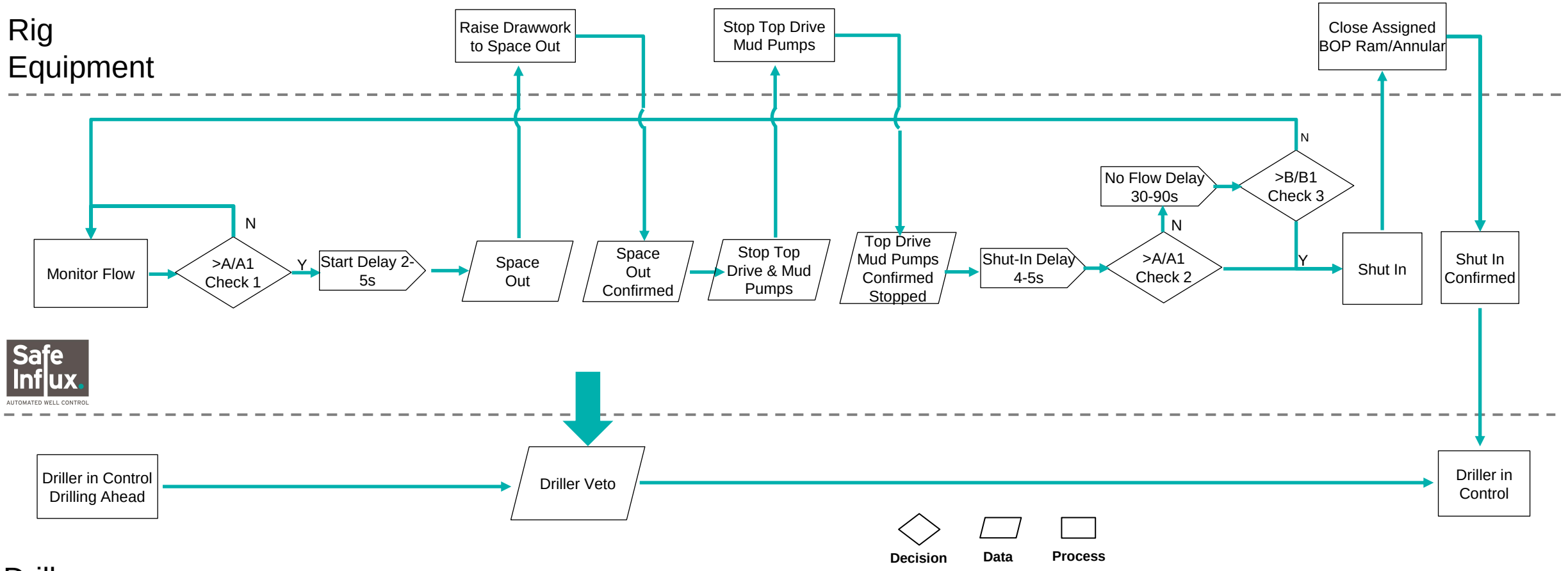
Monitoring
No Action Required
No Action Required
No Action Required

Data Comms: PLC 1 | PLC 2

MUTE | HOME | MAINTENANCE | Configuration | ALARMS | ABOUT

Automated Well Control – Logic Diagram

Drilling Ahead



Automated Well Control – System Overview

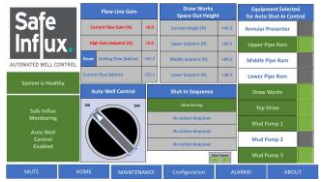
Overall Philosophy

- Uses existing rig monitoring equipment as Input for Influx Detection
- Interfaces with, and controls, existing rig drilling equipment
- Existing Rig Safety Systems remain fully functional
- Can be installed on both Conventional and Cyber based Drilling Systems
- Efficient install process minimizing impact on Operations

System Design (Cyber)

- Small Footprint (PLC Cabinet and HMI Screen)
- Easy Interface with Existing Drilling Controls Systems
- Interface arrangements to stay in place for future re-instatement

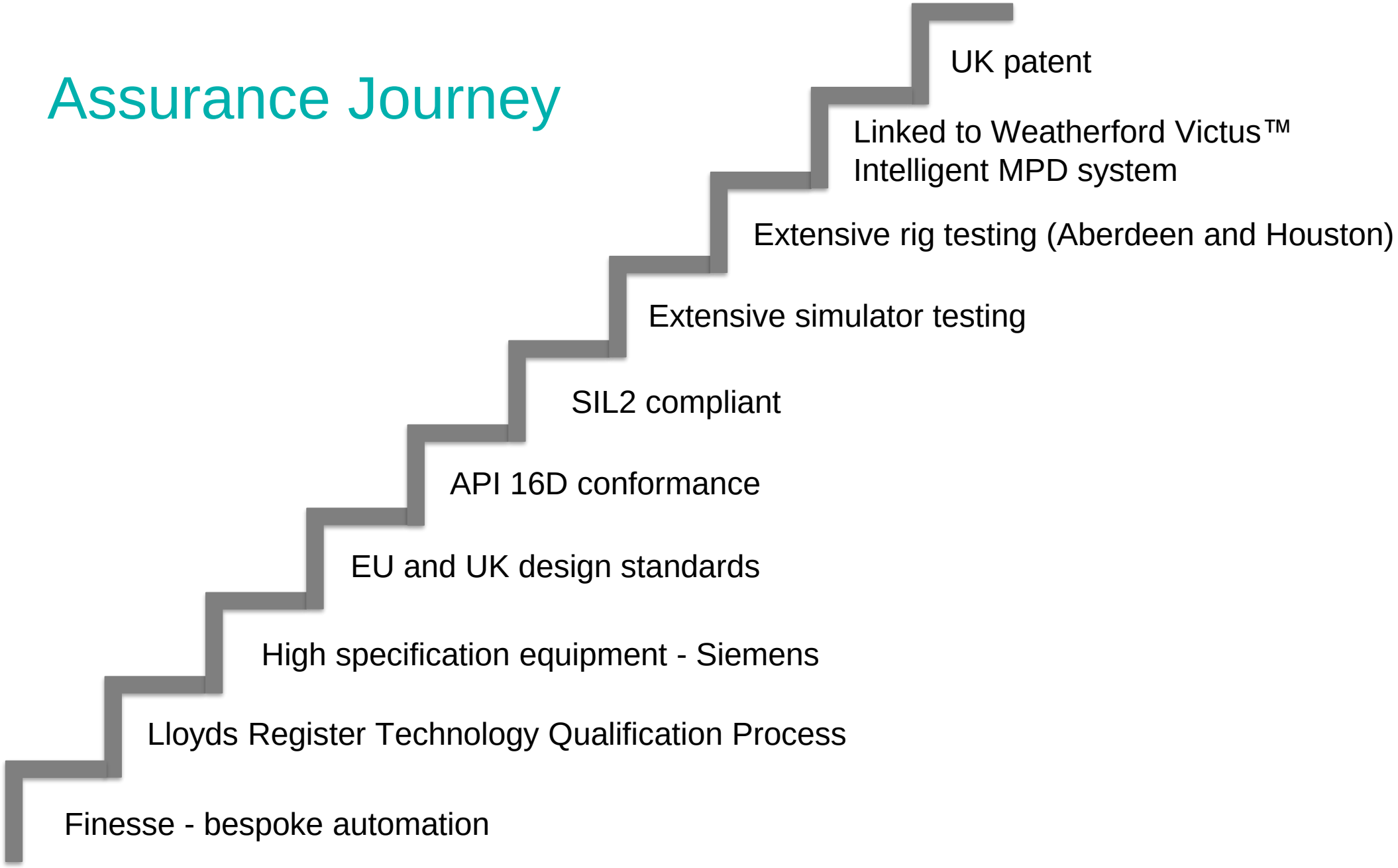
PLC Cabinet


HMI Screen

System Installation

- Rig Survey 2 Persons for 2-3 days (no impact on Operations)
- Design / Fabrication 3-4 months (driven by PLC supply)
- Installation / Commissioning 2 Persons for 2-4 days (limited impact on operations, most can be done off-line)
- Training ½ - day (Driller, Tool Pusher, AD as a minimum)

Assurance Journey



[Tested for Success | Weatherford Victus™ Intelligent MPD and Safe Influx Automated Well Control - YouTube]

Useful Links

www.safeinflux.com

Comparative Human Factors Analysis	https://www.safeinflux.com/reports/
Insights into the IOGP Well Control Database	https://www.safeinflux.com/reports/
Field Trial	https://www.youtube.com/watch?v=fMqtmoIHkIA
Automated Well Control/MPD	https://www.weatherford.com/en/landing/tested-for-success/

SPE-202091-MS **Automated Well Control: From Automated Detection to Automated Shut-In**
Presented at SPE/IADC Middle East Drilling Technology Conference and Exhibition - May 2021

SPE-206385-MS **The Integration of MPD and Automated Well Control Technology**
Presented at IADC/SPE Managed Pressure Drilling & Underbalanced Operations Conference & Exhibition - Sep 2021

Q&A

Safe Influx Automated Well Control

Protection against blowouts

Risk and cost reduction

Peace of mind

www.safeinflux.com

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