



Well Delivery Process

Drilling Design and Analysis Inc.

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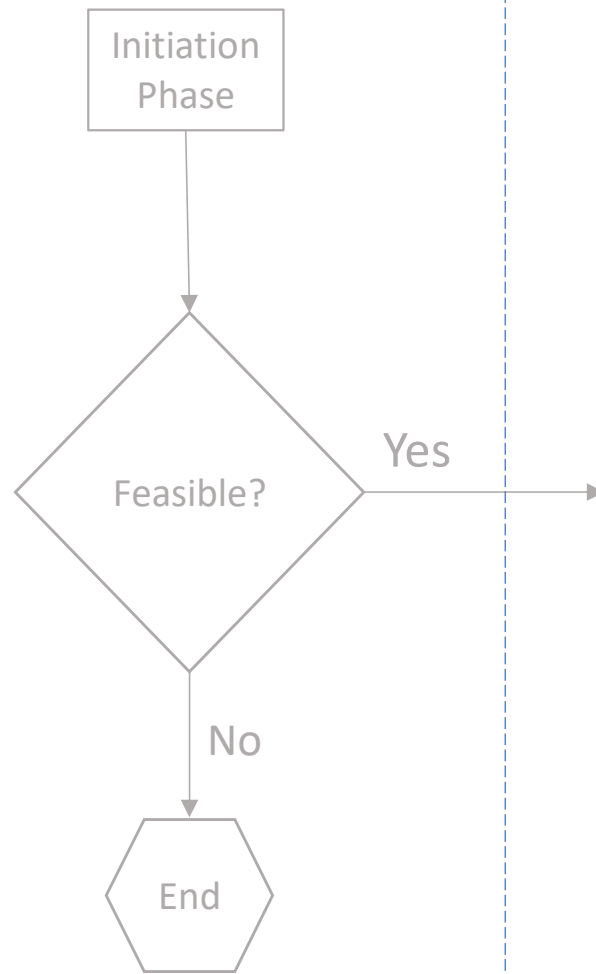




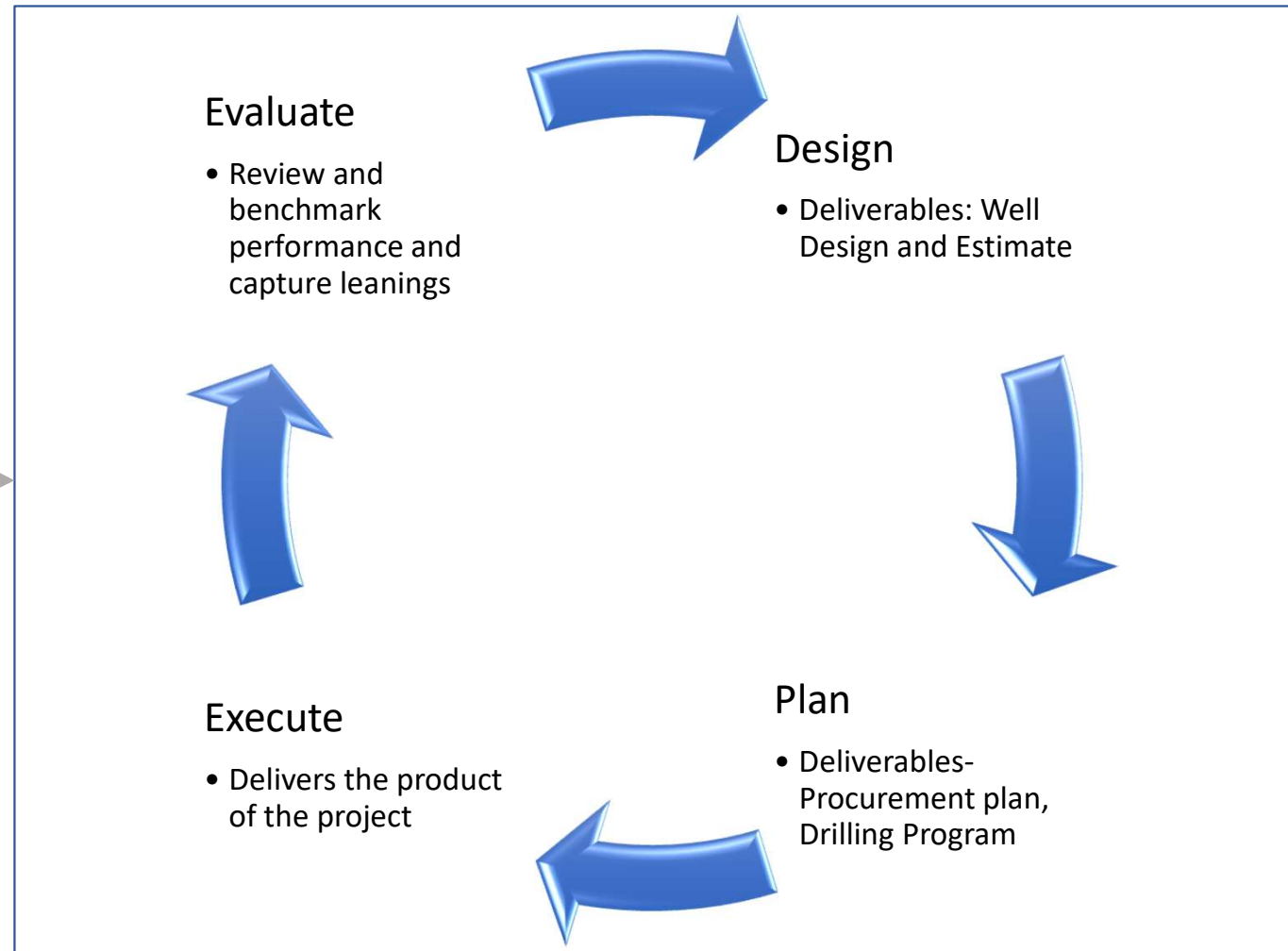
- Well Delivery Process is a structured approach to well construction activities
- It is a continuous improvement process- Learnings from one campaign feed into the next campaign
- Higher probability of accelerating the learning curve by adopting a structured approach
- Well suited for long drilling campaigns involving multi-well pads



Business Development



Well Delivery





Inputs

Economic Objectives

Technical Objectives

Offsetting Analogs

Constraints

Regulations

Risks and uncertainties

Interfaces & Environment
geology, production, reservoir,
surface facilities

Scope

Design Phase

Tools and Techniques
Policies/ procedures
Engineering models
Third party studies

Deliverables

Basis of Design

Pad Design

Well Design

Risk Register

Time and Cost Estimates

Procurement Strategy

Key Services Specifications

Quality Specifications



- Design is **description of the product** that the project will deliver
 - In well construction projects, **wells and their arrangement are the final product**
 - Design phase focuses on **describing the wells** and how they will be arranged in space - **pad layout**
 - Also desired from this phase are **preliminary cost and time estimates** for executing the project
- Typical Well Design entails design of the following aspects of the well
 - ✓ Completions
 - ✓ Well Sizing
 - ✓ Casing Design
 - ✓ Trajectory
 - ✓ Wellhead
 - ✓ Cement



Inputs

Design Deliverables
Service Specifications
Procurement Strategy
Risk Register
Regulations
Risks and uncertainties
Quality Specifications
Scope

Plan Phase

Tools and Techniques
Operational Studies
Tendering/RFX/Awards
Economic Modeling
Schedule Development
HR activities

Deliverables

Technology Selection
Secure Long Leads
Procurement Plan
Updated Risk Register
Project Schedule
AFE Class Cost Estimates
Manpower Plan
Logistics Plan
MOC Protocol
HS&E Plan



- Decision on key technologies:
 - ✓ Drilling Rig
 - ✓ Directional and Surveying
 - ✓ Drilling Fluids
 - ✓ MPD/UBD
 - ✓ Drill Bits
 - ✓ Drill string
 - ✓ Formation Evaluation
 - ✓ Testing
 - ✓ Waste Management
- Technology selection drives the rest of the planning phase



Inputs

Design Deliverables

Plan Deliverables

Risk Register

Regulations

Interfaces

geology, production, reservoir,
surface facilities

Materials and Services

Execution Phase

Tools and Techniques

- Operations
- Communications
- Supervision
- Monitoring
- Reporting
- Change management
- Cost control
- Capturing lessons learnt
- Events recording

Deliverables

Drilling Program

Project Execution

Performance Reports

Technical Reports

Quality Reports

Cost Tracking

MOC, LL and Events
register



Inputs

Design Deliverables

Plan Deliverables

Evaluation Deliverables

Regulations

Interfaces

geology, production, reservoir,
surface facilities, field supervision

Evaluation Phase

Tools and Techniques

- Plan vs Actuals for as-built, cost, performance, and quality
- Review of logistics, MOC, safety and environmental performance
- Brainstorming sessions
- Celebration

Deliverables

KPIs Benchmarking

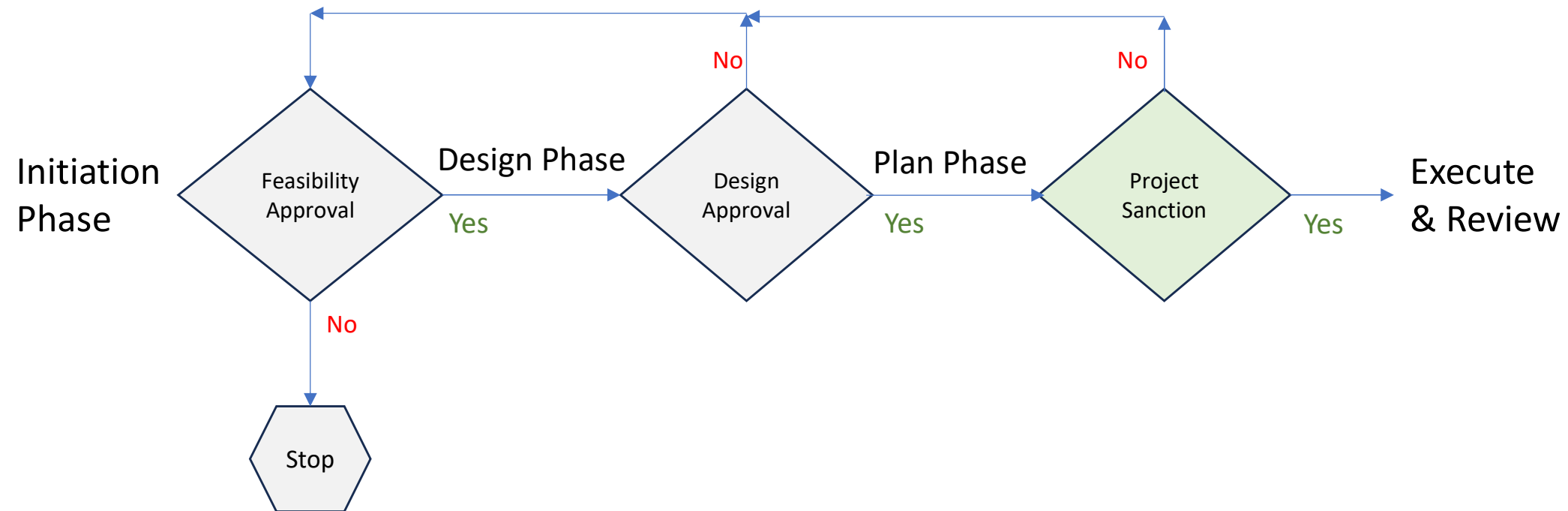
Lessons Learnt register

Filing of key documents

Improvement opportunities



- In practice the transitions between different phases of the WDP are not crisp.
- Fast tracking results in merging of phases. Merging of Design/ Plan and Plan / Execute phases are very typical. Fast tracking is inherently risky- An error in casing order can be very costly. Similarly, a wrong rig contracted prior to understanding the design can be a very costly mistake.
- Cut and Dry transitions with approvals at each transition creates process visibility and keeps the stake holders informed. Each approval stage whereby the progress is reviewed with all stake holders provides the opportunity to document major changes prior to moving ahead.



- Typically, multiple design approaches are evaluated in the Design Phase
- The WDP approval step becomes part of the larger project approval process involving all disciplines- subsurface, well construction, facilities construction, production and commercial
- The project approval process looks at both technical adequacy and commercial feasibility



26 years in various drilling engineering and management roles with Schlumberger, CNOOC (Nexen) and Drilling Design and Analysis

Experience

- SAGD wells with temp > 250 deg C
- Shale gas pad drilling with temp > 150 deg C
- HPHT wells exceeding 5500m TVD, 200 deg C and 69 Mpa
- Horizontal and ERD wells with ERD ratio exceeding 7

Publications

- SPE 14UNCV-167725: Numerous technological improvements slash drilling times in HRB
- SPE 128194: Successful application of RSS in nitrified drilling fluids
- AADE-07-NTCE-50: Screening tool for rotary steerable
- AADE 2009NTCE 05-04: RSS technology creates value in Western Canadian drilling environment
- AADE 2009NTCE-07-04: KPIs Benchmarking- Systematic Approach
- Patent number 8199166: Visualization technique for Oilfield operations

