Digital Field Development Planning – A collaboration between technology & process to enable fast & efficient field development planning
Problem Statement: Developing fields today is getting more difficult in current O&G business environment

- Inefficiency in managing data quality and timeliness.
- Longer time for Resource Maturation.
- Slow decision making in important milestones events – e.g., FDP, UFC, UDC & UPC kept on increasing.
- RRR reducing
- Gap in resource / reserve matching.

Case for Change

Business Survival & Growth (FDP context)

- Inefficiency in managing data quality and timeliness.
- Longer time for Resource Maturation.
- Slow decision making in important milestones events – e.g., FDP.
- UFC, UDC & UPC kept on increasing.
- RRR reducing
- Gap in resource / reserve matching.
Digital FDP (Live FDP) will pave the way for Upstream Digital Transformation by transforming from passive to intuitive working model.
Live FDP will integrate full cycle of fields – Exploration to Abandonment

**STAKEHOLDERS**

- MPM
- Partners
- Asset
- G&G
- Petroleum Engineering
- Petroleum Economics
- Resource Maturation
- Wells
- PMT & PD&T integration
- Front end & ORSA

**Enterprise IO (Now)**

- Reservoir
- Well
- Surface Facilities
- Pipeline
- Terminal
- Customer
- Logistics

**Value optimization**

**Fast Track Resource Maturation**

- Exploration

**Fit For Purpose Field Development**

- Development

**Optimize, Maximize & Sustain via Best In Class Unit Production Cost**

- Production

**Facilities Rejuvenation & Optimization**

- Abandonment
## Major Business Value obtained from Live FDP supports Business Targets

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefit</th>
<th>Measurement</th>
<th>Unit</th>
<th>Estimated Value</th>
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</thead>
<tbody>
<tr>
<td>Reserve Replacement Ratio (RRR)</td>
<td>• Processes more FDPs.</td>
<td>RRR</td>
<td>No.</td>
<td>RRR &gt;= 1</td>
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<td>• Knowing FDP economics earlier for better issue and risk management.</td>
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<td></td>
<td>• Positive RRR.</td>
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<tr>
<td>Cost Saving</td>
<td>• Refined FDP accuracy, impacting development cost</td>
<td>Unit Development Cost (UDC)</td>
<td>$/bbl</td>
<td>40% reduction</td>
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<tr>
<td>Time Saving</td>
<td>• Shorten time taken per FDP.</td>
<td>Man-hours</td>
<td>Duration</td>
<td>50% reduction</td>
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<td>• Replicate-able project and design templates.</td>
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<td>• Increases data integrity and less re-work due to errors.</td>
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<td></td>
<td>• Full-text search capability</td>
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<td>• Distinct access of the same information by all members.</td>
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</table>
Data Architecture that governs data pathways all the way towards smart visualization allow Top Management to make informed decisions fast with less risk.

### 1. Data Sources

<table>
<thead>
<tr>
<th></th>
<th>Real Time</th>
<th>Recorded Time</th>
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<tbody>
<tr>
<td>Data Management</td>
<td>2016 Data Coverage PI = 24 / 48 Sites (51%) IO = 13 / 24 Sites (54%)</td>
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<td>Subsurface</td>
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<td>Drilling/Wells</td>
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<td>Subsurface</td>
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<td>Production</td>
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<td>Energy Technology</td>
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<tr>
<td>Production</td>
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</table>

### 2. Data Management

- Subsurface
- Drilling/Wells
- Subsurface
- Production
- Subsurface
- Energy Technology
- Production

### 3. Applications

<table>
<thead>
<tr>
<th></th>
<th>RTO</th>
<th>PI</th>
<th>OOMS</th>
<th>PGPS</th>
<th>Prospar</th>
<th>Gap</th>
<th>Winglue</th>
<th>ICON</th>
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<th>FPC</th>
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### 4. Workflows & Integration

- Business Process Automation Engine
- Business Process Automation Engine
- Analysis & Predictive Engines
- Optimization Engines

### 5. Smart Visualization

- Open Workflows & Integration
- Smart Visualization
- Applications
- Data Management

### 6. Informed Decisions

- Acquisition & Maturation
- Monitoring & Surveillance
- Analysis & Predictive
- Maximization & Rejuvenation
Data Flow Diagram shows how Live FDP system assimilate current softwares and integrate them within one ecosystem seamlessly.
Live FDP timeline and implementation plan until year 2020

1. Set-up initial requirement
2. Collaboration with industry key-player
3. Ongoing communication with service partners
4. Workshops with TM, TP
5. Syndication with SCM, GTD, Legal
6. Proof of Concept (PoC)
7. Full Phase Development
8. Full System Deployment (Subscription)
Ultimate Aspiration of Live FDP

**Definition**

A state of connectivity

Making an informed, un-coerced decision

Generating an unbounded sequence of outcomes towards the desired result

Predicting technical risk in order to plan ahead and make necessary measures

Prescriptive countering measures to prediction to make an informed business evaluation and decision

**Live FDP Roles**

Online

Online 24/7

Run simulation autonomously

Multiple iterations with significantly less amount of time

Able to predict the UDC, UPC, NPV, PIR based on historical data

Able to provide best concept based on range of value drivers
Project S Development Concepts

- Focus at S Main; D5,5.5,6.0 & E6.0,7.0,8.0 reservoirs
- 3 open-sea appraisal wells (derisking)
- Infill + Water/Gas Injection for improving oil recovery
- Installation of WHP-B & WHP-C
- Oil processing & Injection modules on the FPSO (lease)

Oil Development

- Installation of WHP-B, WHP-C & WHP-SB
- Oil processing & lnj. modules on FPSO (lease)
- Gas processing & CO2 removal;
  a) @ TB - (gas rate: 150 MMscf/d)
  b) @ S FPSO - (gas rate: 250 MMscf/d)
- Gas export route;
  a) To TB Cluster - (rate: 150 MMscf/d)
  b) Directly to K Terminal via new or J pipeline - (rate: 250 MMscf/d)
Simulation Performance Improvement for Project S

Performance Improvement Due to:

- Model Tuning
- Input Data QA
- HM Performance in Ecosystem Environment
- Elasticity provided by Ecosystem Environment

• With less than an hour per case, engineer would be able to run 6 or more cases in a day
Fixed Platform Location with Economic Constraints

### Case 1: 18P 4Inj
- No. of new wells: 22
- RF: 22.1

### Case 2: 19P 5Inj
- No. of new wells: 24
- RF: 22.9

### Case 3: 19P 6Inj
- No. of new wells: 25
- RF: 22.9
Option 1
Project S to TB Hub

Option 2
Project S via J pipeline

Option 3
Project S to directly to K Terminal
Project S Development Scenarios – Results & Conclusion

Top Value Tier
Oil Development Only (WI/Gi)

High Value Integrated Development Tier
Oil & Gas (S Main + SB), Process on FPSO and Processed Gas Sent to K Terminal via J Pipeline, 250MMscf/day

Mid Value Integrated Development Tier
Oil & Gas (S Main + SB, Process on FPSO and Processed Gas Sent to K Terminal via New Pipeline, 250MMscf/day

Preferred Dev Option

Marginal Value Tier
Oil & Gas (S Main + SB), Oil process at FPSO and Wet Gas Sent to TB Hub for processing via CRA Pipeline, 150MMscf

Marginal Dev Option

Negative Value Tier
Oil & Gas (S Main only), Oil process at FPSO and Wet Gas Sent to TB for processing via CRA Pipeline, 150MMscf
Live FDP improves Efficiency, Analytics and Imposing New Way of FDP

**FDP Team**
- Data Gathering
- Modeling (Static & Dynamic)
- Well Design
- Evaluation Study
- Development Option
- Commercial Evaluation
- FDP Submission

**GG & RE**
- Ptech & Wells
- Facilities Engineer
- Economist
- Project Manager
- Operations Manager

**Business View** (Big Picture)
- HIIP & Reserves
- Completion & Strategy

**New Way of Doing Things**
- Ecosystem development analogues from multiple sources
  - Increased opportunity for joint Subsurface/Wells technical collaboration for generating recovery & cost optimization
  - Increased opportunity for joint Subsurface/Wells/Equipment technical collaboration for generating recovery & cost optimization
- Authoritative advisory and insights enabled by benchmarking to drive development concept identification
  - Automatic screening of geological realizations with dynamic data allowing users to select ‘right’ models for SPE and making robust designs of recovery concepts
- Auto-search on technical/solution keywords from past FDP documents or external sources
  - Automating data-driven search of the optimal development scenarios and multiple Subsurface realizations
- Cognititive search for opportunities to increase value through a selection of Development Analogues from multiple sources
- Enable PDP for area instead of field development (ADP vs FDP)
  - Enable multiple realizations with dynamic data allowing users to select ‘right’ models for SPE and making robust designs of recovery concepts
- Manage, design and enrich data lifecycle through DELFI Data Ecosystem
  - Auto-search on technical/solution keywords from past FDP documents or external sources
- Enable multi-domain data through data ecosystem
  - Enable multiple realizations with dynamic data allowing users to select ‘right’ models for SPE and making robust designs of recovery concepts
- DELFI Data Ecosystem
  - Enable multi-domain data through data ecosystem
  - Enable multi-domain data through data ecosystem

**TECHNOLOGY**
- DELFI Cloud Computing
- DELFI Analytics
- H2Rail
- Multi-Property Realization

**BUSINESS**
- HIIP & Reserves
- Completion & Strategy

**TECHNICAL**
- Well Design
- Evaluation Study
- Development Option
- Commercial Evaluation
- FDP Submission

**EFFICIENCY**
- Ptech & Wells
- Facilities Engineer
- Economist
- Project Manager
- Operations Manager

**ANALYTICS**
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- Completion & Strategy

**NEW WAY OF DOING THINGS**
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**GATHERING**
- (ADP vs FDP)

**MODELING**
- (Static & Dynamic)

**RESERVES**
- & Dynamic)

**SIMULATION**
- Model Realization

**INTEGRATION**
- Questor
- FDPlan
- DELFI Cloud Resources & Applications

**PERFORMANCE**
- Fasten static/dynamic model evaluations based on the new findings

**BEST PRACTICE**
- (Big Picture)
Thank You