Field Management & Information System using integrated modeling to optimize Hassi Messaoud Algerian Field

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I am just thinking…

- have a nice Car
- But, Can not Drive
- ..., Don’t have Insurance
- ..., Lost the Trajectory
- ..., Get stacked in a traffic jam
So, Drive your field
The approach vary from field to another, depends on:
- Green, Brown or mature field
- Field Size, wells number and reservoir types
- Exploitation constraints, Man power and technology
- Economic Constraints

However, The term of field management is almost the same worldwide.
Hassi Messaoud Algerian Oil Field

**Discovery** : 1956
**Start of production** : 1958

**Superficial** : 3300 Km²
**Depth** : 3100 until 3380 m

**Thickness** : Up to 200 m
**Formation** : Cambro - Ordovician

**Rock type:** Quartzite Sandstone; Porosity range 5 to 10 %.
Permeability range from less than 1 md to 1000 md in opened fissured layers

**Oil °API** from 43.7 to 45 ; Viscosity at surface is 2 cp.
Bo is 1.6-1.7 rb/stb; Pb ranges from 145 to 200 kg/cm² from west to east
Reservoir Temp is @ 118 °C; Original WOC @ 3380 m subsea.

**Wells** : Total of 1400 wells (700 NF, 350 GL and 300 gas and water injector)
**Well deviation:** Vertical, horizontal, short radius and sidetrack…..

**Surface Facilities**: about 4500 Km of piping, 20 processing Satellites and 04 Huge Centre of Treatments
Objective of this work

**Improve Management of Production on Daily Basis**
due to better understand what the wells are doing. Where to focus engineering efforts and how to effectively use engineering resources to optimize field production

**Generalize Integrated Production Optimization System**
due to an accurate use of an integrated model (Reservoir, wells and Surface facilities), enabling optimization and assessment of field production and identifying bottlenecks in the system

**Emphasize the Importance of Information System**
automate field surveillance, improve data management system via web base interfaces to easy access, analyze and help for decision making
Field Management & Information System Process

Through

Decision Making
Approval & decide
Field Actions
Operation & Monitoring
Actions Evaluation
Benefits & Constraints

Field Management Process

Data Handling
Validation, Interpretation
Integrated Modeling
Reservoir, Wells & Surface
Field Performance
Production Optimization

Data Integration
Real time
Information Transfer
Availability Access
Visualization
Interfaces Building

Reservoir Management
Well/facilities Management
Operations Management
Telemetry
Data Storage
SCADA System
DATA BASE

Integrated Production Optimization Asset

The right Decision at the right time
The right information at the right time

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“You can’t manage what you don’t measure.”
By utilizing a real time, integrated information system we can achieve a sea change in response time and effective data delivery. Some of the benefits are:

- Vastly reduced timescales for data acquisition
- Faster updates of interpretations and analysis
- Improved response times to stakeholder enquiries with associated increases in stakeholder confidence
- Increased productivity through faster data delivery to interpreters, managers, engineers, economists, and other professionals
- Immediate reporting of key performance indicators (KPIs)
Current Approach

Creation of Platform for Data Management

Web base Interface for online data analysis

Reduce time of decision making

Delay in Decision Making

Next Target

Telemetry and SCADA System

Real time data integration and Analysis

Right time Decision Making

DATA FLOW

Conventional Data Base

Conventional Data analysis approach

Conventional approach

Information System - Target Vision

Transform HMD to Digital Field

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Information System - Web base Interface Developed In House

Efficient Data Management Improve Understanding and Analysis Quality

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Integrated Production Modelling
Hassi Messaoud field
Case study
Case Study: Production chain of Hassi Messaoud field

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Declining production and increasing unit costs characterize many production areas (satellites) in the field.

The production profile of the most areas of HMD field is not sustained.

Huge benefits can be achieved if we can meet this challenge (Target becomes sustainable).
**Case Study: Main problems experienced in HMD Field**

<table>
<thead>
<tr>
<th>Issue</th>
<th>SAT1</th>
<th>SAT2</th>
<th>SAT3</th>
<th>SAT4</th>
<th>SAT5</th>
<th>SAT6</th>
<th>SAT7</th>
<th>SAT8</th>
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<tr>
<td>Poor Pressure support</td>
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<td>Gas Break through</td>
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<td>Water Break through</td>
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<td>Gas Lift Issue (hydrate,…)</td>
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<tr>
<td>Salt deposit</td>
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<td>BaSO4 deposit</td>
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<td>✅</td>
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<tr>
<td>Gas capacity Limit</td>
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<tr>
<td>Surface Network problem</td>
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Maintenance of about 100 wells done on daily base, and usually many wells postponed.

To cover the optimized corrective plan more resource required (manpower and equipment)
Case Study: Main phases of the project

- **Build offline model of Integrated Production System**
  Enabling assessment of field production, ability to optimize network, identifying bottlenecks in the system and opportunities to increase oil production.

- **Integrate Real Time Daily Data Monitoring System**
  Enabling the offline model to be updated online for production optimization and real time production solutions based on informed decision making.
Case Study: IPO Process

Integrated Production Optimization

- Well & Production Data Gathering
- Data Quality Control
- Well Basic Models (Integrated with Surface Base Model)
- IPO Base Model
- Measurement Campaign
- Wells Models Update (Integrated with Integrated Model Tuning & Calibration)

Continuous Update

Integration:
- Well Basic Models
- IPO Base Model
- Surface Base Model
- Integrated Model

Optimization Scenarios

Final IPO Model
Case Study: Data Gathering

Similar to any project, data collection, preparation and validation have taken a big part of time. It is very important to determine required data, its availability as well as its quality.

In addition of ordinary data collected for each branch of production chain (reservoir, wells and surface facilities), An integrated measurement campaign was conducted in order to:

- Simultaneously measure parameters of the whole system
- Improve the understanding of production system behaviour and
- Provides reliable measurement for modelling, tuning and calibration of the model.
Case Study: Measurement Campaign Examples

Surface Network Pressures recording (FLP, Manifolds and Separator)
Case Study: Measurement Campaign Examples

Well with Salt deposit problem

Back Pressure Impact _High GOR Well on GL Well

Impact of Hydrate for GL wells on total production
More than 1000 wells (GL and NF) were modelled and integrated with surface network model.

A Single well potential was assessed due to:

- Set guidelines and constraints for the production forecasts.
- Conduct performance prediction using various variables such as GOR, Wc and Reservoir pressure.
- Evaluate the inflow and outflow well performance.
- Run the scenarios cases as requested.
The model is successfully tuned and calibrated to match observed data.
Case Study: Integrated Modeling

Separator Pressure Sensitivities

- Oil Production Rate (Sm³/d)
- Change in Oil Rate (Sm³/d)

Separator Pressure (kg/cm²)
Pressure Difference from Normal Separator Operating Pressure (kg/cm²)
Case Study: Integrated Modeling - *Model Use Opportunities*

- Reflects field setup and reality (Field Mirror Image)
- Production Re-allocation.
- Optimize production directions for new and existing wells.
- Run any scenarios for field management to “Avoid Missing Opportunities”.
- Support decision making on major investments (check planned modifications before field implementation)
- Improve understanding of system behaviour (interaction between wells and network. i.e. backpressure)
- First step towards Real time (pending telemetry)
- Keep model updated to get reliable answers.
Case Study: Integrated Modeling - Value added so far

- Ability to answer production performance questions using Integrated Model.
- Important well potential observed with the lowest risk criteria.
- Initiated and promoted continuous well and system monitoring approach.
- Identified main problematic points in production accounting and reporting.
- Quantify the effect of back pressure on well production.
Case Study: Value Added-Back pressure Identification

Separator pressure increased because of pump shut down

Back pressure assessed by the model in some wells
Case Study: Value Added-Well Monitoring

Production Evolution of Satellite A

First Monitoring Increase of 7500 STB/d
Second Monitoring Increase of 12500 STB/d
Continuous Monitoring Plan

7500 STB/d Gain

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Case Study: Well Monitoring-performance Analysis Result

- **Priority 1:** Confirm the type of problem / improve operational strategy

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
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</thead>
<tbody>
<tr>
<td>High production wells</td>
<td>Priority 2: Maintain current operational strategy</td>
</tr>
<tr>
<td>Medium production wells</td>
<td></td>
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<tr>
<td>Low production wells</td>
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</table>

<table>
<thead>
<tr>
<th>Group 4</th>
<th>Group 3</th>
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</thead>
<tbody>
<tr>
<td>Priority 4:</td>
<td>Priority 3: Reservoir study</td>
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<tr>
<td>confirm the type of problem / improve operational strategy / reservoir study</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Average Production (m3/d)</th>
<th>Exploitation Coefficient or Well Availability factor</th>
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</thead>
<tbody>
<tr>
<td>250</td>
<td>100</td>
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<tr>
<td>200</td>
<td>150</td>
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<tr>
<td>150</td>
<td>100</td>
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<tr>
<td>100</td>
<td>50</td>
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<td>50</td>
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</tbody>
</table>

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Case Study: Well monitoring - Operations frequency determination

Total of 2500 STB/d as differed production due to downtime of these four wells

Salt deposit_Water Wash

Negative kick-off

Salt deposit_Water Wash

Asphaltene Treatment

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Case Study: Value Added - Virtual Team Organisation

Possible Production Centres for Field Management
(with personnel from: Reservoir, Production, and Operations)
Asset Team Work flow

- Data Acquisitions
- Surface facilities monitoring and surveillance
- Pressure drop analysis
- Back pressure detection
- Corrosion monitoring and prevention

- Field and office data integration
- Data Management and Reporting
- Online data access and visualization

- Well Test & Data Acquisitions
- Well monitoring and surveillance
- Well Modelling and optimisation
- Well intervention programs
- Well Operations evaluation
- Well Review (Shut in & under

- Reservoir monitoring and surveillance
- Reservoir Management
- Reservoir Modeling
- Reservoir Simulation
- Undesired fluid control

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Challenges

- Surface Network Modelling
- Surface monitoring and Surveillance
- Well Modelling and Analysis
- Well monitoring and Surveillance
- Reservoir Modelling and Simulation
- Reservoir monitoring and Surveillance

Flow Assurance
Smart Well - Sensors/Real time
Reservoir Recovery IOR/EOR

Via Information system and Management Support

Teamwork share tasks….
multiplies Success
Thank you for your attention

tak for din opmærksomhed

Your Questions are welcome