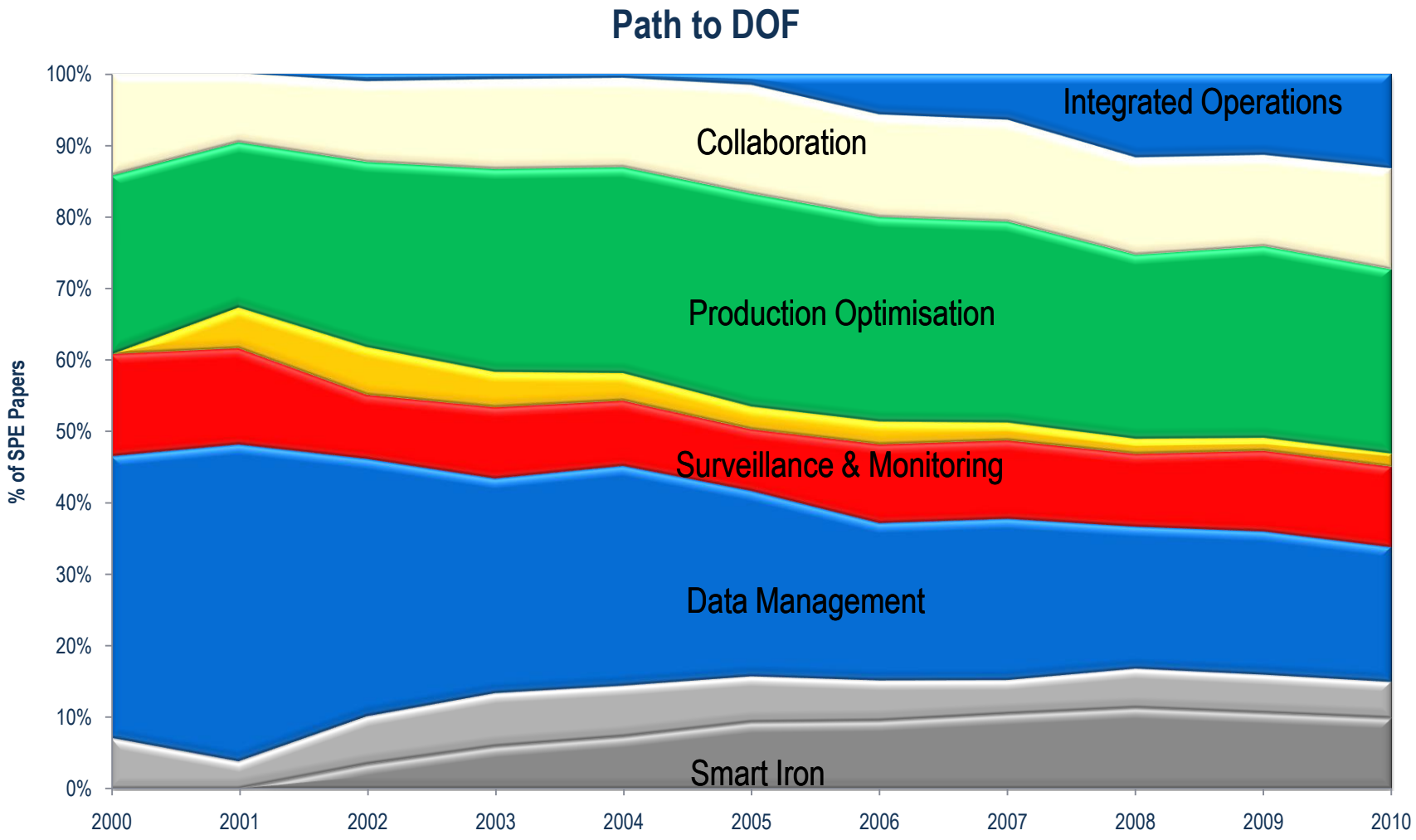
Digital Oilfield – A Template based Approach

Meyer Bengio
Vice President Petroleum Engineering
Schlumberger Information Solutions

DOF

- What is it
- Who will benefit from it
- Why Digitize
- How to Approach the Problem
- What is a possible Solution

What is it ?


Path to DOF
% of SPE Papers
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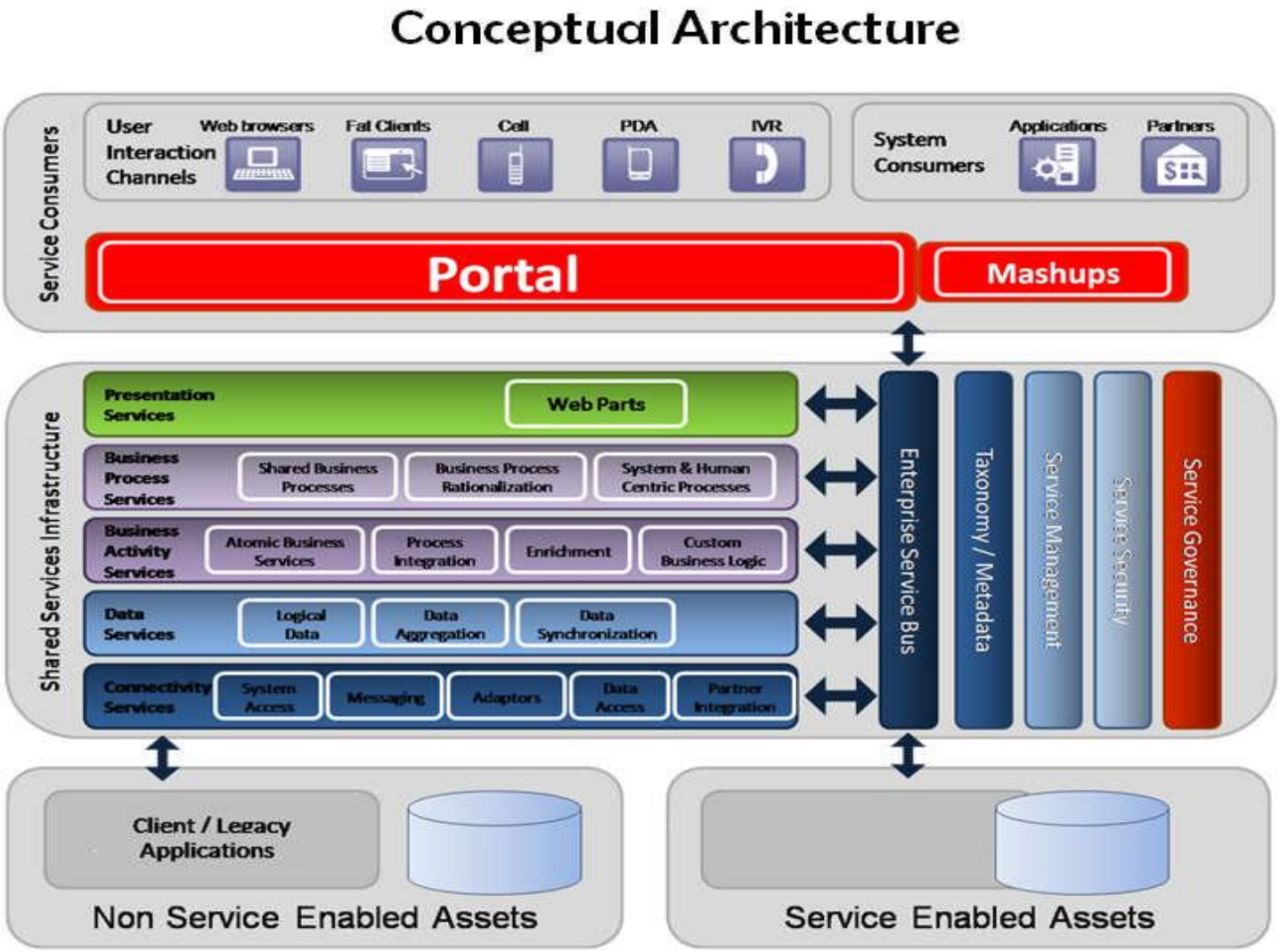
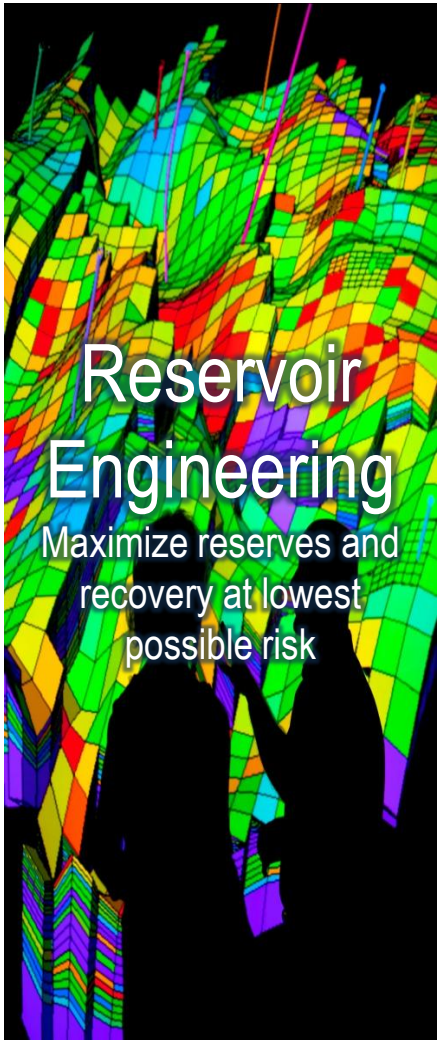
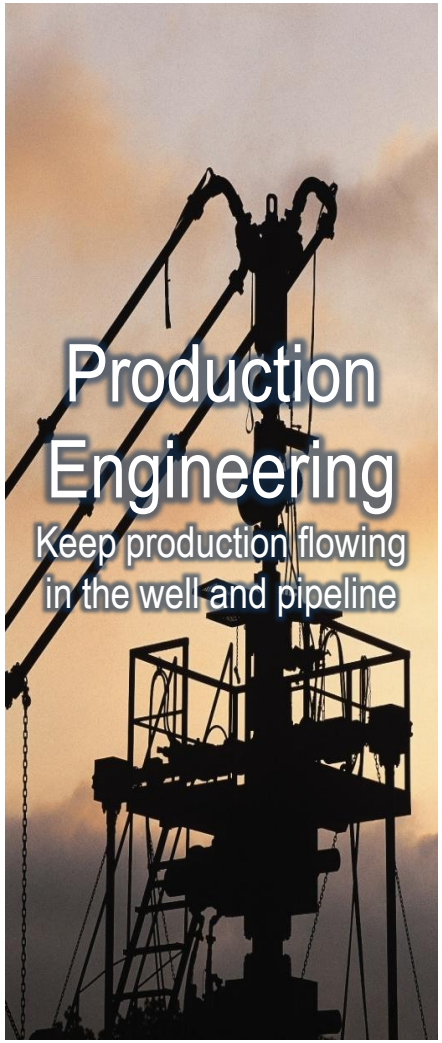
Integrated Operations
Collaboration
Production Optimisation
Surveillance & Monitoring
Data Management
Smart Iron

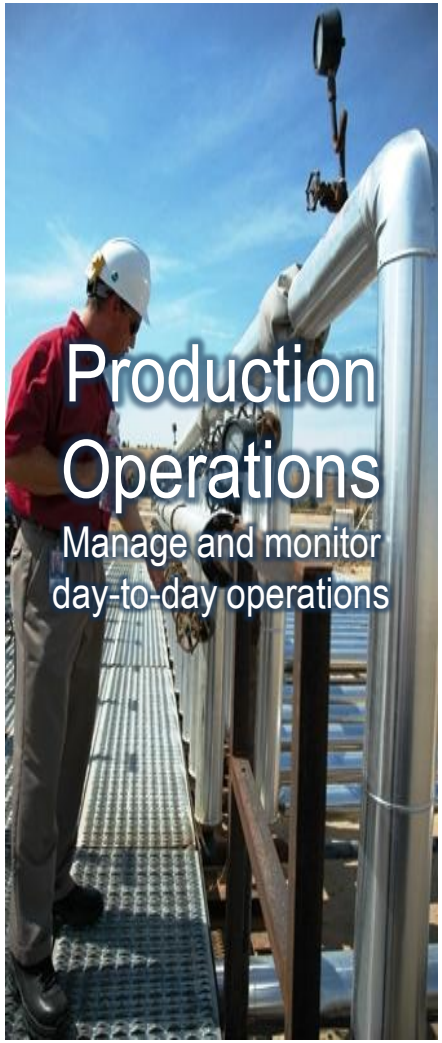
The IT view


Conceptual Architecture
Service Consumers
User Interaction Channels
Web browsers
Fat Clients
Cell
PDA
IVR
System Consumers
Applications
Partners
Portal
Mashups
Shared Services Infrastructure
Presentation Services
Web Parts
Business Process Services
Shared Business Processes
Business Process Rationalization
System & Human Centric Processes
Business Activity Services
Atomic Business Services
Process Integration
Enrichment
Custom Business Logic
Data Services
Logical Data
Data Aggregation
Data Synchronization
Connectivity Services
System Access
Messaging
Adaptors
Data Access
Partner Integration
Enterprise Service Bus
Taxonomy / Metadata
Service Management
Service Security
Service Governance
Client / Legacy Applications
Non Service Enabled Assets
Service Enabled Assets

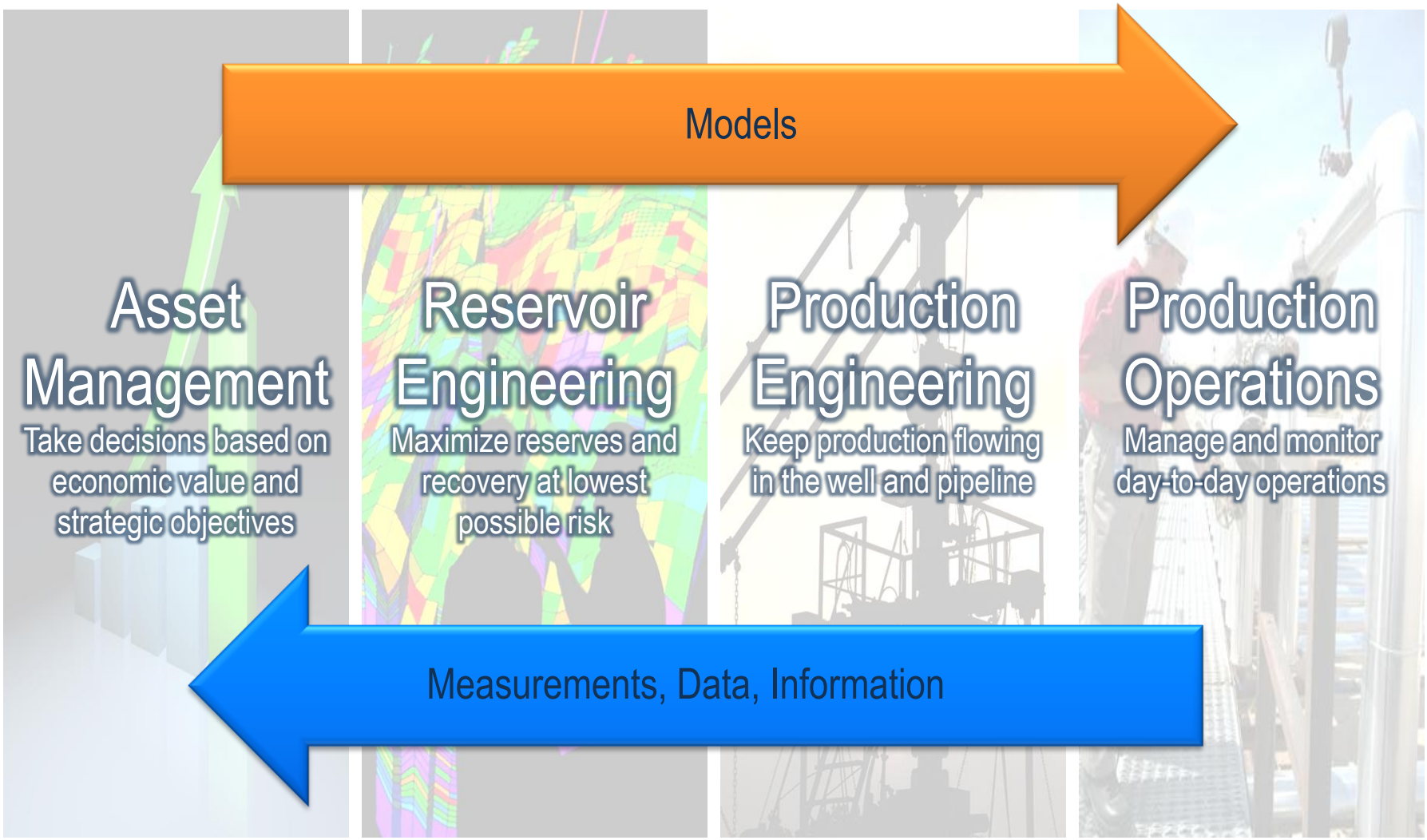
Who are the Users we are trying to serve ?







Digitize = Velocity + Quality ….. of decisions



Example : The Operations and Production Cycle

Optimize the dehydration process performed

Reach a gas utilization of 99%, installing gas low pressure equipments.

Increase gas utilization efficiency.

Increase the reliability of compression equipment.

Optimize the lifting systems, while maintaining low lifting costs.

Optimize gas lift allocation on a field-wide scale

Maintain production costs near current levels

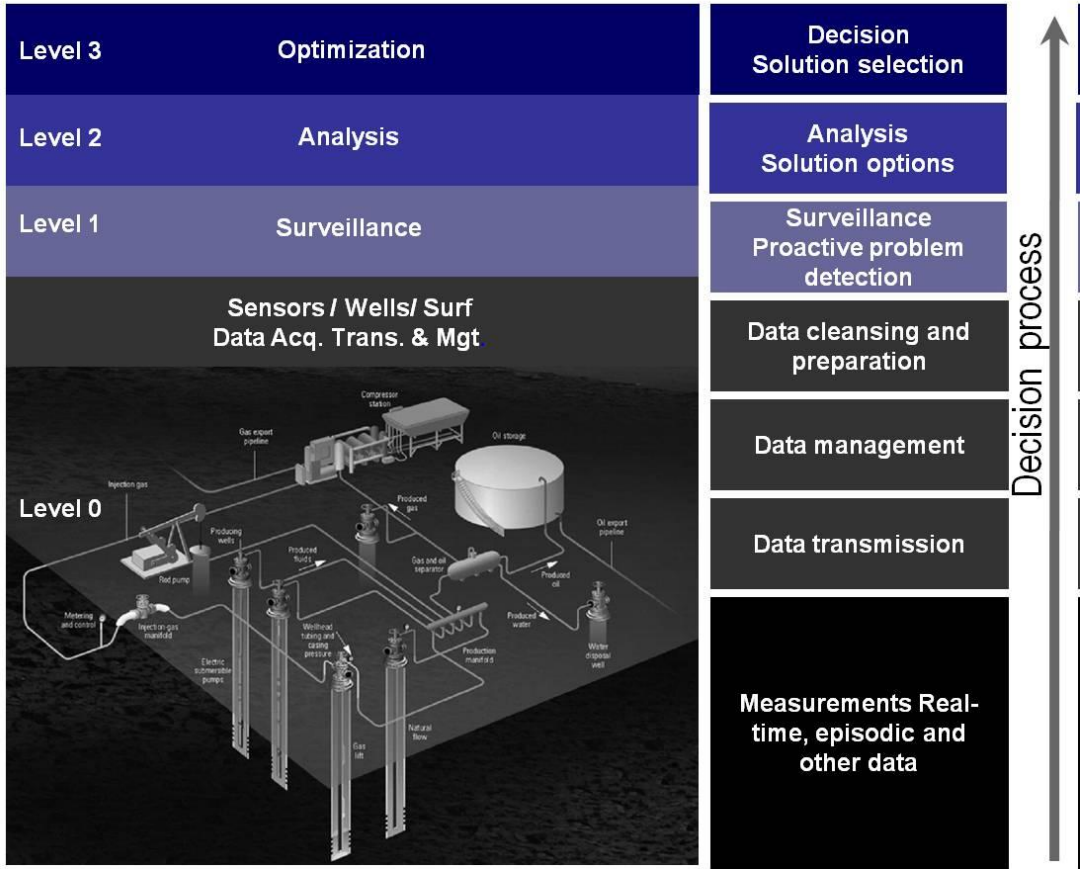
The “reservoir management” cycle

Accelerate production incorporation from new fields

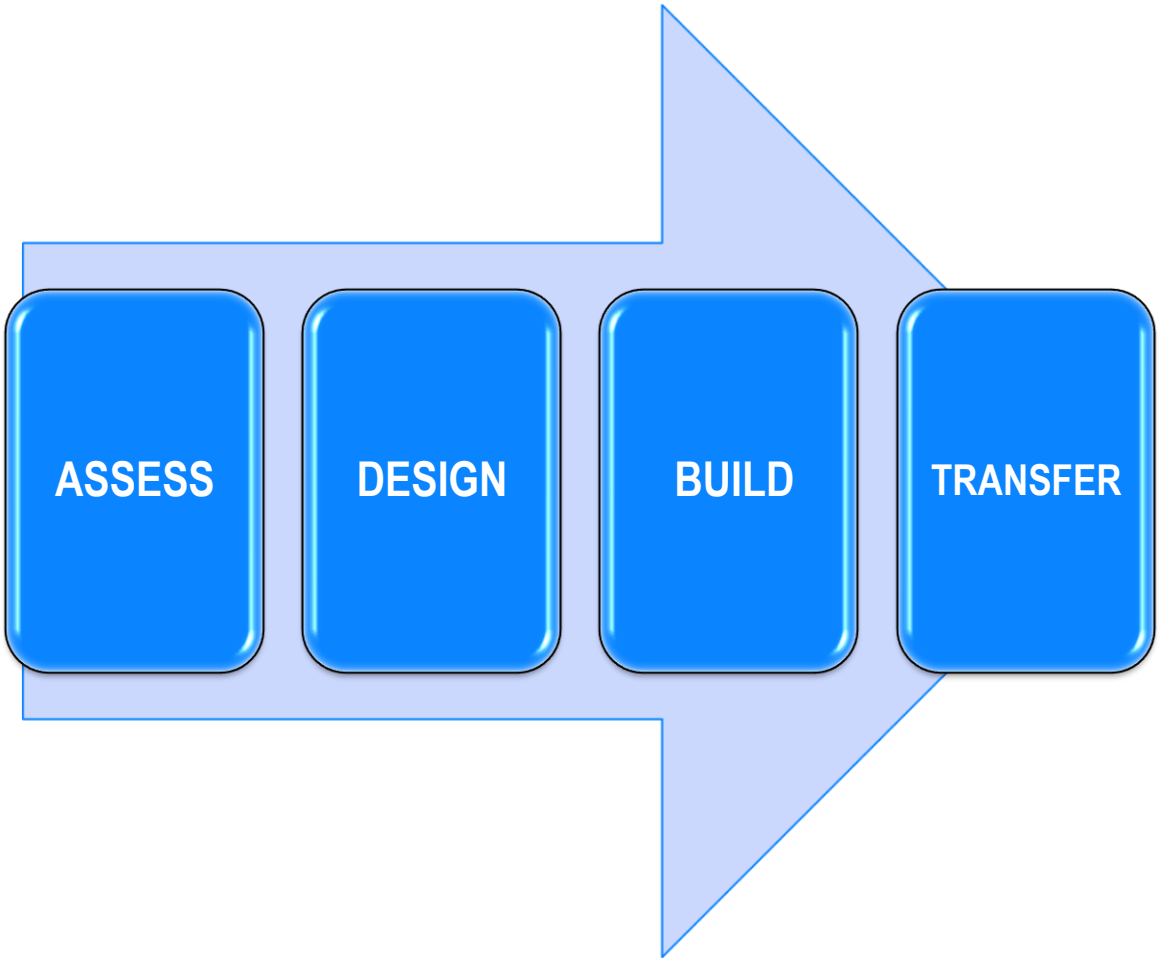
Implement enhanced recovery systems to increase recovery factors.

Design optimum in-fill drilling strategies and reservoir depletion strategy.

An Approach


Level 3
Optimization
Level 2
Analysis
Level 1
Surveillance
Sensors / Wells/ Surf
Data Acq. Trans. & Mgt.
Level 0
Decision
Solution selection
Analysis
Solution options
Surveillance
Proactive problem
detection
Data cleansing and
preparation
Data management
Data transmission
Measurements Real-
time, episodic and
other data
Decision process

A Bottom Up Approach



Field Assessment

- What Production Challenges
- What Environment
- What Recovery Mechanism
- What Lifting Mechanism
- What Sensors, Meters, Controls
- What Infrastructure
- What Models
- What Integration

System Level Requirements

- Acquisition and Data Exchange Standards : OPC-HDA, PRODML, WITSML
- Presentation Standards
- Workflow Automation
- Event and Time based Scheduling
- Openness & Extensibility
- Optimisation Libraries

Standard Workflows Examples

- Data conditioning: Automated cleansing and aggregation
- Rate estimation: Using neural networks, historical and real-time production data
- Well test validation: Compare well test rates to rate predictions from nodal analysis, neural networks and back allocation
- Liquid loading detection in gas wells
- Wax deposition prediction
- Sanding Prediction

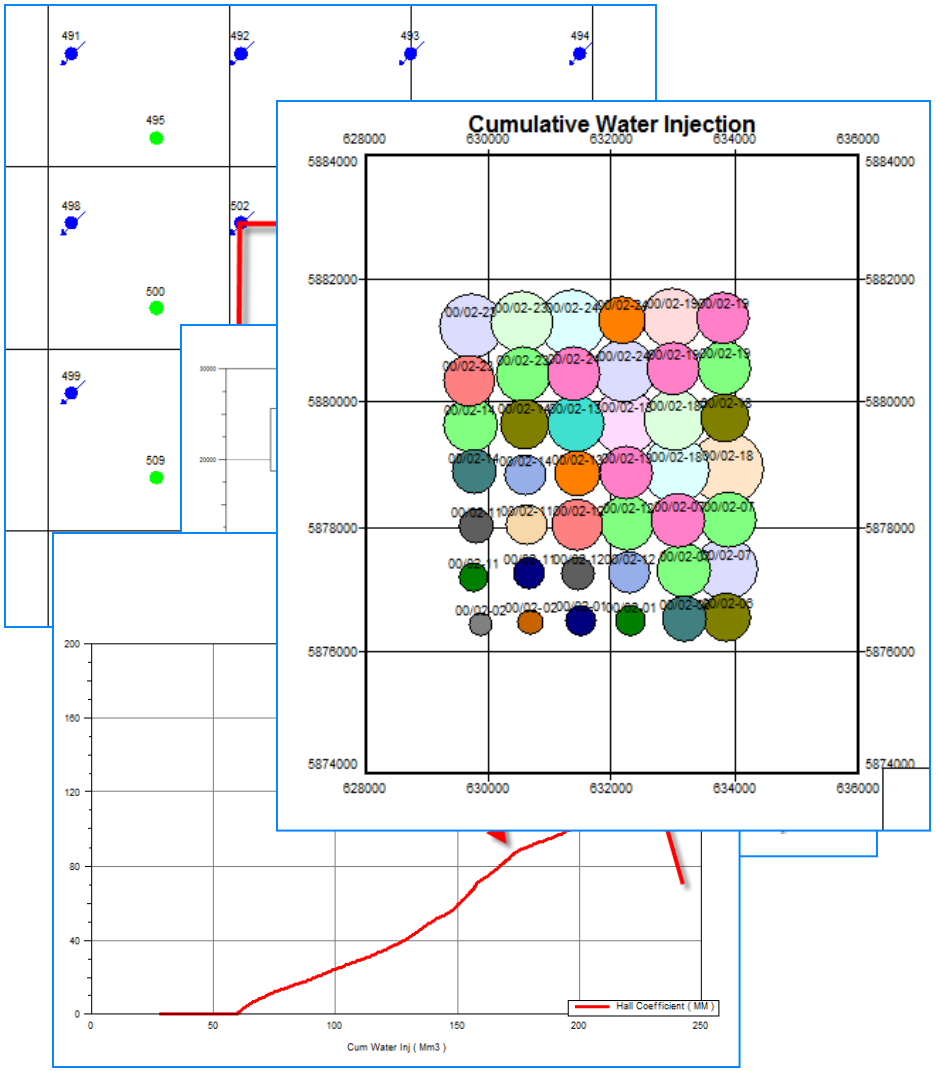
Standard Template example: Waterflooding

Key concepts:

- Most common form of secondary recovery
- Wells are usually drilled in geometric grids or “patterns”

Pain points and Solutions:

- *Large volumes of data. QC can be overwhelming* > Workspace: collection of maps, comparative plots, outlier identification reports
- *Determining allocation factors* > Compare measured pressures with calculated (e.g. via MB), Streamline
- Calculations require PVT, but pressure data is sparse > Multiple estimation methods for creating continuous pressure streams



Innovate. For the Long Run.

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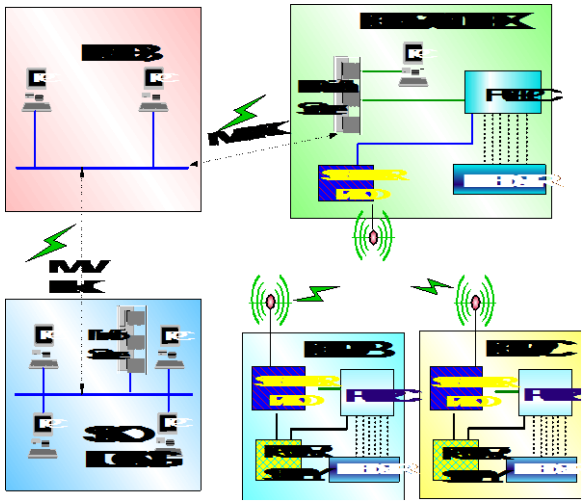
Optimisation

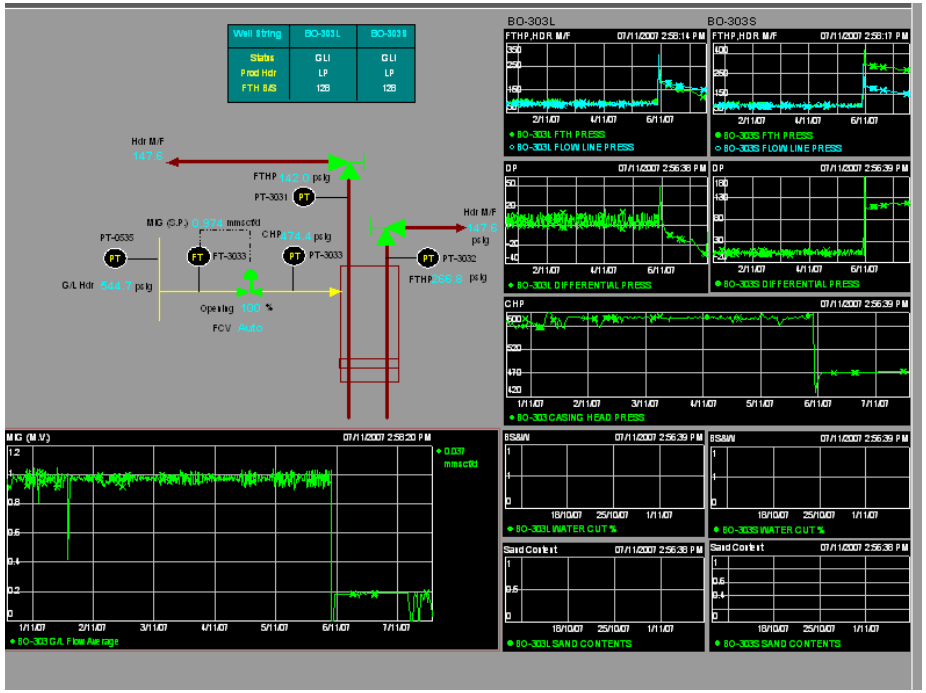
- Workover Candidate selection: Using historical and real-time data
- Gas Lift Optimization: Single Well / Field wide optimization
- Mixed Lift Optimisation
- Economic optimisation
- Waterflood pattern optimization: Analytical / Streamline
- Steam Assisted Gravity Drainage (SAGD) real-time optimization

Example : An Artificial Lift System

- Unreliable sources of lift gas
- Ageing facilities
- Unreliable instrumentation
- Dual gas lift completion
- Surface facilities constraints
- Increasing water cut and sand production
- Unmanned operations
- New wells online that will require additional gas lift in the near future

Current System





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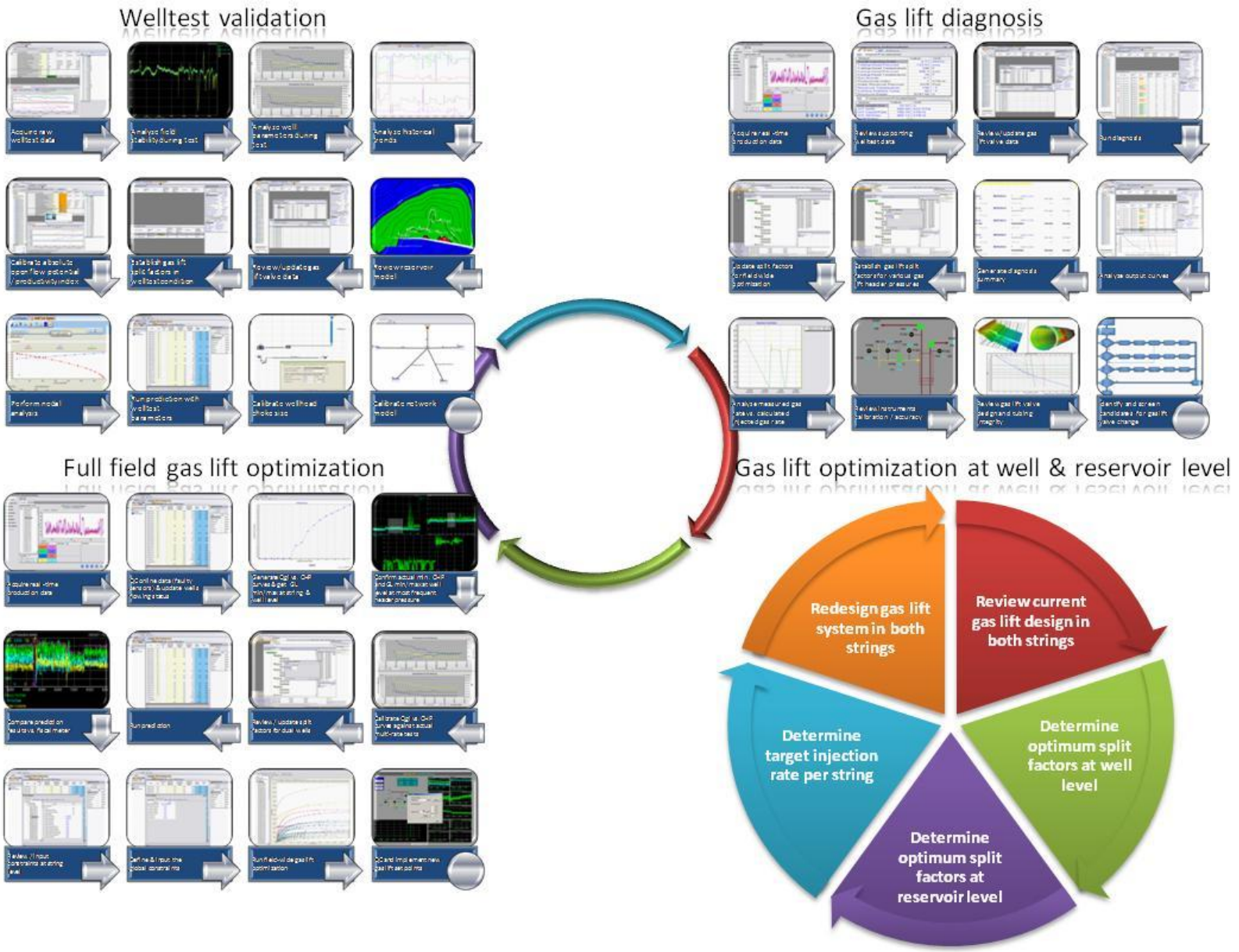
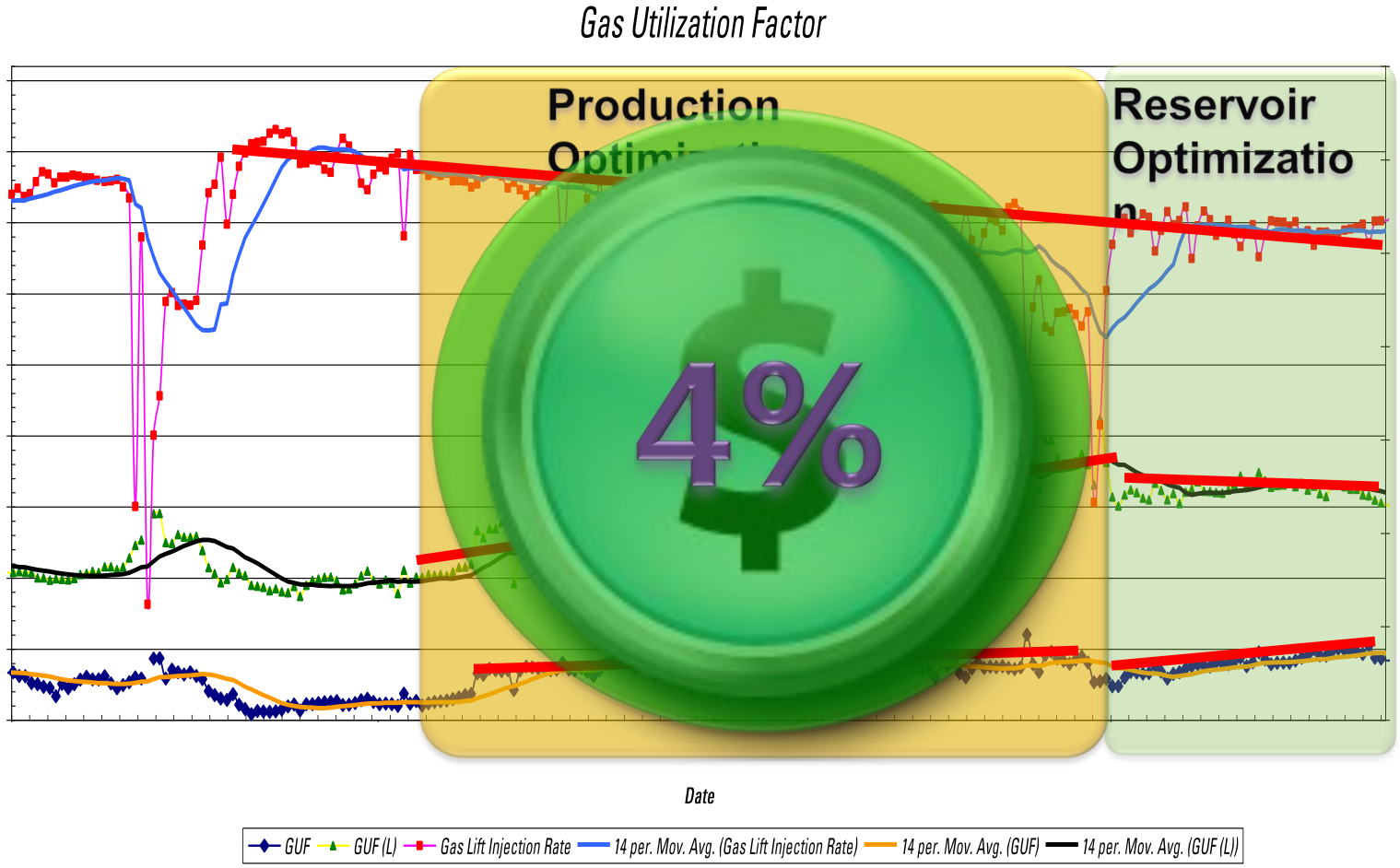
Limitations

- Scada and Historian is just a monitoring system but not an optimizer
- Additional powerful tools are needed to maximize the value of real time data and optimize the field
- Not equipped with alarms to warn users when abnormal parameters or trends are recorded
- Intensive utilization of resources (full time dedicated surveillance engineer)
- Not capable to condition the high frequency raw data
- Not capable to support automated surveillance workflows

Digitisation



Real Time Gas Lift Optimization



DOF over the Life Cycle of the Field

- Phase I
  - Mature Field ; Shallow , Unmanned platform; Gas Lifted
  - Increase Production Through Gas Lift Optimisation – Daily
  - Constraints: Well, Field level (pipeline, corrosion)
- Phase II Gas coming from Nearby Field
  - Optimise based on Gas availability and Gas contracts – Daily
  - Mixed Integer Optimisation
- Phase III Add ESP for certain Wells
  - Mixed optimisation Gas, ESP, Choke
- Phase IV WAG cycle design and optimise
- Phase V Minimise Water and Energy while maintaining Production levels