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Using Analytics to Improve Production, Aberdeen - Sept 29th 2015

Data, Workflows, Models and Change Management: Towards improved operational performance

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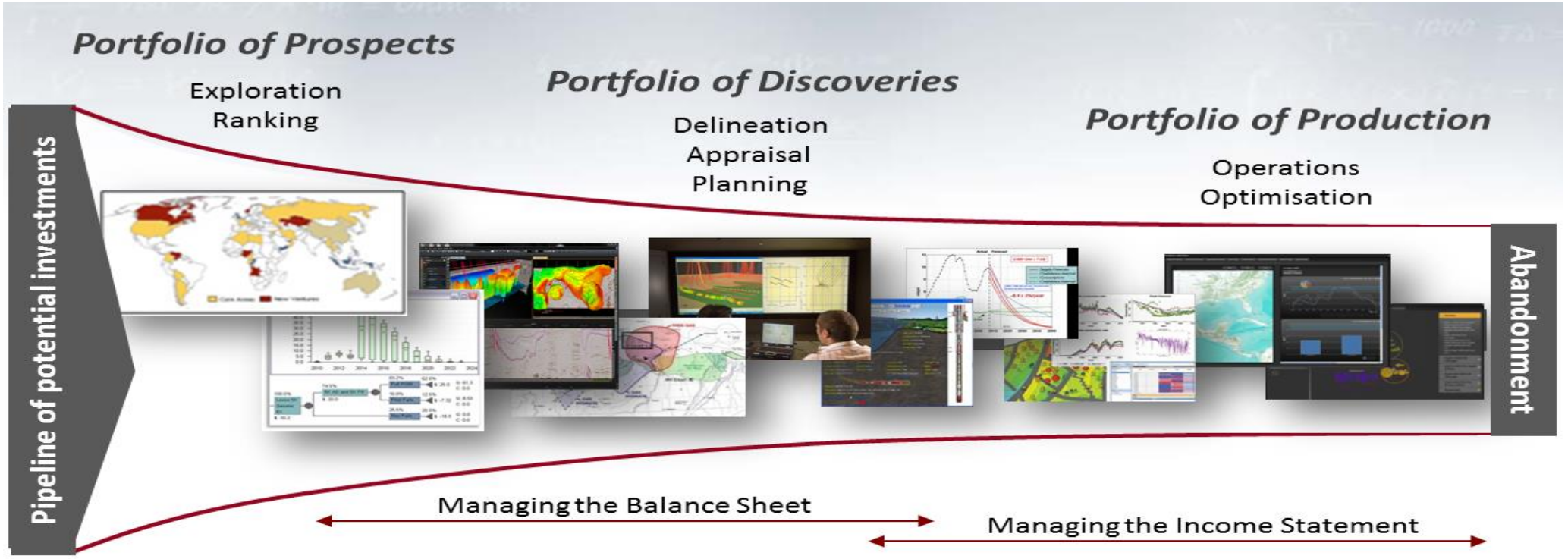
The E&P Space



Prospecting/Exploration	Development	Production
• Where to explore? • Which prospects to investigate? • Where to invest? • What are the fluid volumes?	• Which discoveries to develop? • What are the reserves?	• Real-time execution and control • Asset model driven performance

Investment

Return on Investment

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The Quest for Operational Efficiency

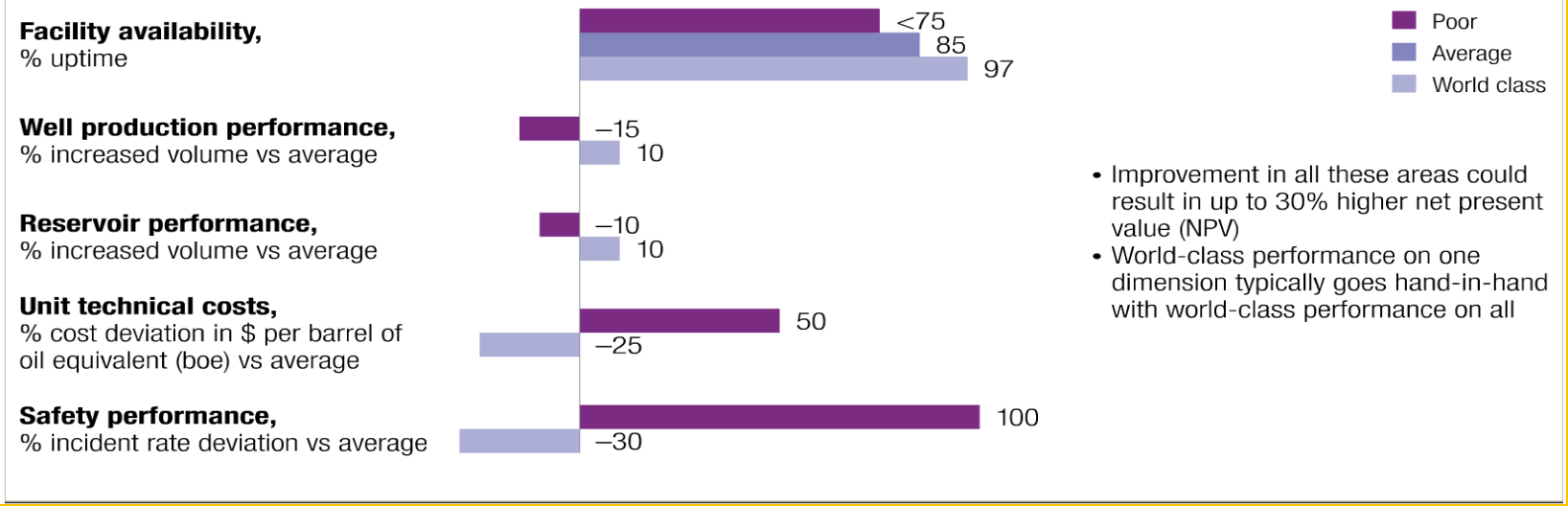
When the going gets tough, the tough gets going

Over the past few years, value in upstream operations has shifted from gaining access to new fields and delivering development projects to delivering best-in-class operational performance. Today's challenging economic environment for oil and gas operators means that better operational performance—both in costs and production volumes—will play a significant role in delivering positive returns over the coming years. https://www.mckinseyquarterly.com/PDFDownload.aspx?ar=2516 (**Febr. 2010**)

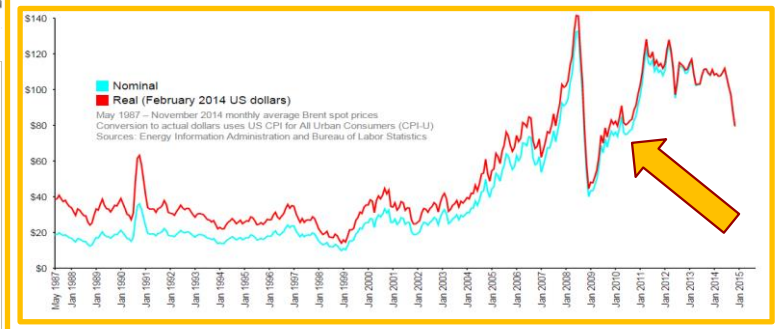
McKinsey Quarterly

This is the time to deliver on upstream operational excellence

Exhibit 1: **Better operations bring big rewards**



- Improvement in all these areas could result in up to 30% higher net present value (NPV)
- World-class performance on one dimension typically goes hand-in-hand with world-class performance on all



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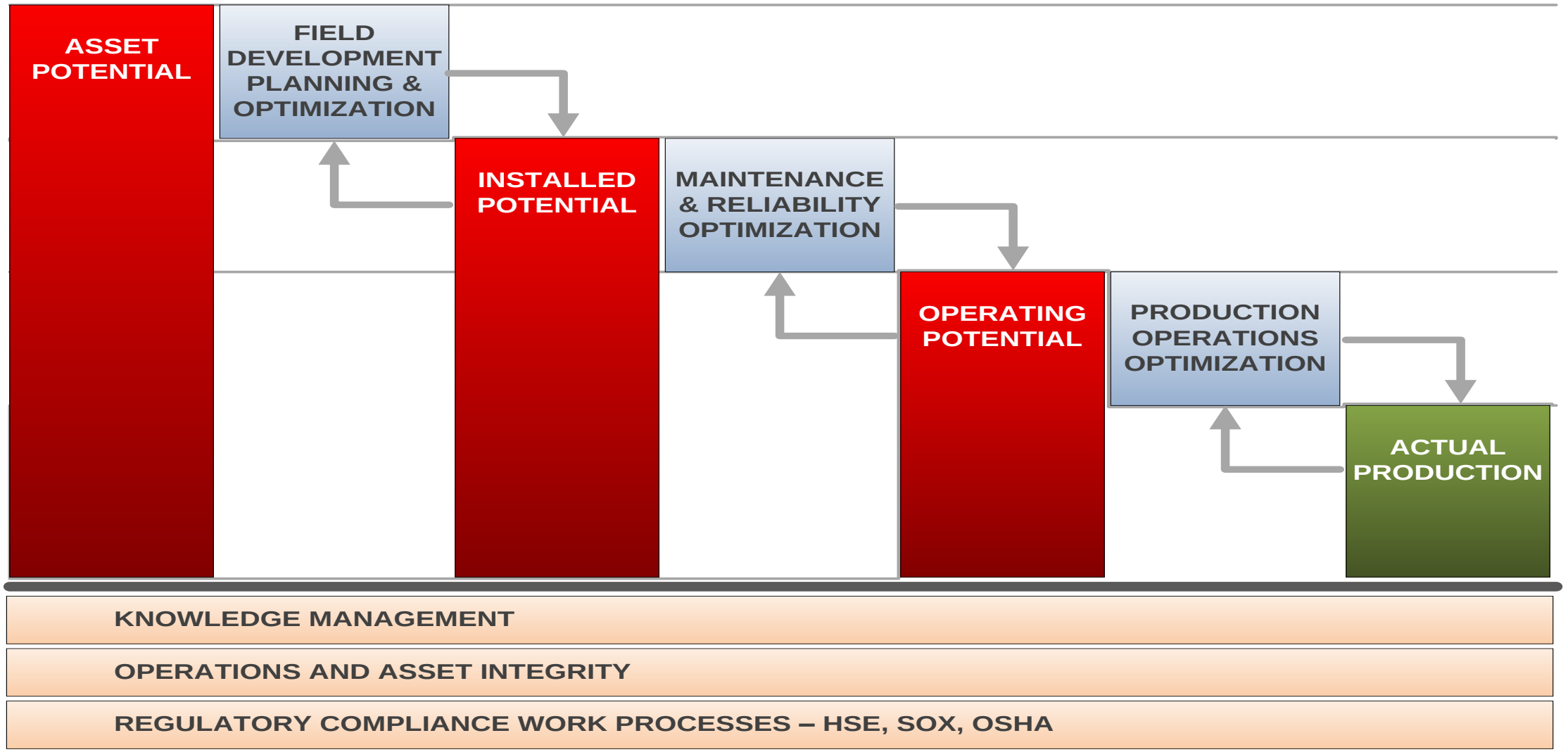
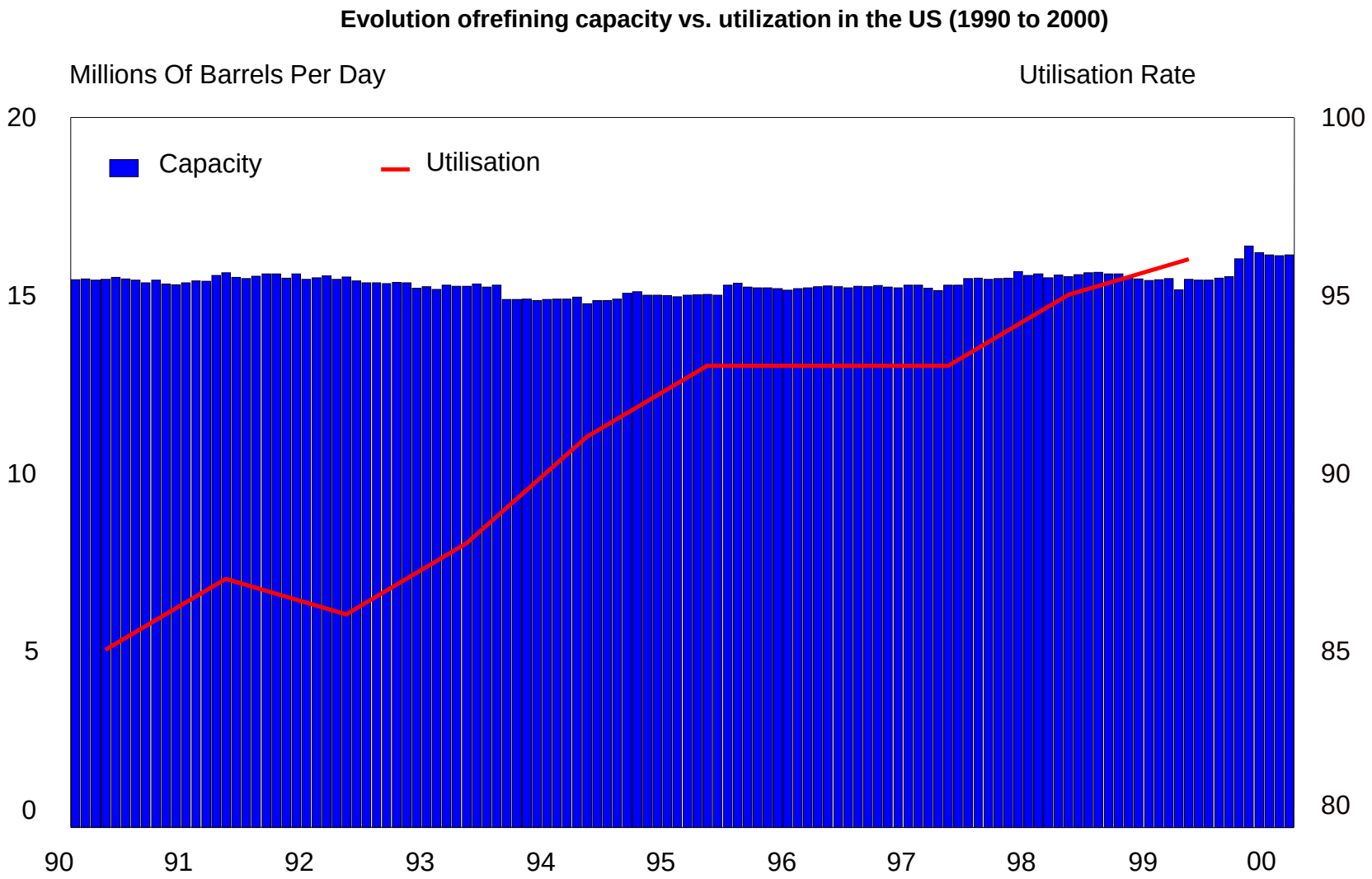
But… where can we look for more Operational Efficiency



Refinery Capacity Utilization in the US (1990 to 2000)



What is DOF anyway?

Digital oil field is the umbrella term for technology-centric solutions that allow companies to leverage limited resources. For instance, such technology can help employees more quickly and accurately analyze the growing volumes of data generated by increasingly sophisticated engineering technologies, such as down-hole multiphase sensors, measurement-while-drilling (MWD) applications, multilateral completions, and down-hole separation.

Generally, the digital oil field encompasses both the tools and the processes surrounding data and information management across the entire suite of upstream activities.

More specifically, digital oil field technologies allow companies to capture more data, with greater frequency, from all parts of the oil and gas value chain and analyze it in real or near-real time, thus optimizing reservoir, well, and facility performance.

http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/unleashing-productivity-digital-field-advantage

The concept strives to enhance quality and speed of decision making and execution. This is achieved by integrating people, process and technology supported by access to (real-time) data, information, use of simulation models and other analytical tools. This enables the asset team to monitor the performance of wells and field facilities against target in order to realize the differences and detect anomalies at an early stage.

http://www.adco.ae/En/Technology/Pages/AutomationSmartFields.aspx

Components of the DOF

Remote real-Time Facility monitoring and Control
The off-site control of facility process systems through the networking of SCADA (systems control and data analysis) and its transfer to onshore control rooms, enabling field data capture, set point control, and valve/pump manipulation.

Real-Time Drilling
The collection and integration of real-time drilling data such as RPM, circulation solids, downhole pressures captured through MWD, and remotely steerable down-hole tools.

Real-Time Production Surveillance
The utilization of advanced alarm systems to trigger analysis of important production integrity trends to help optimize and maintain installed capacity levels.

Intelligent Wells
Surface-controlled, down-hole equipment, enabled by fiber-optic sensors, allows for continuous monitoring of conditions and response.

4-D Visualization and modeling
Successive 3-D seismic surveys track fluid movements, allowing for additional insight into production enhancement and redirecting enhanced recovery mechanisms.

Remote Communications Technology
Off-site facilities with real-time visual, voice, and data communication with the field allow more rapid, analytical responses by a mix of off-site and on-site staff.

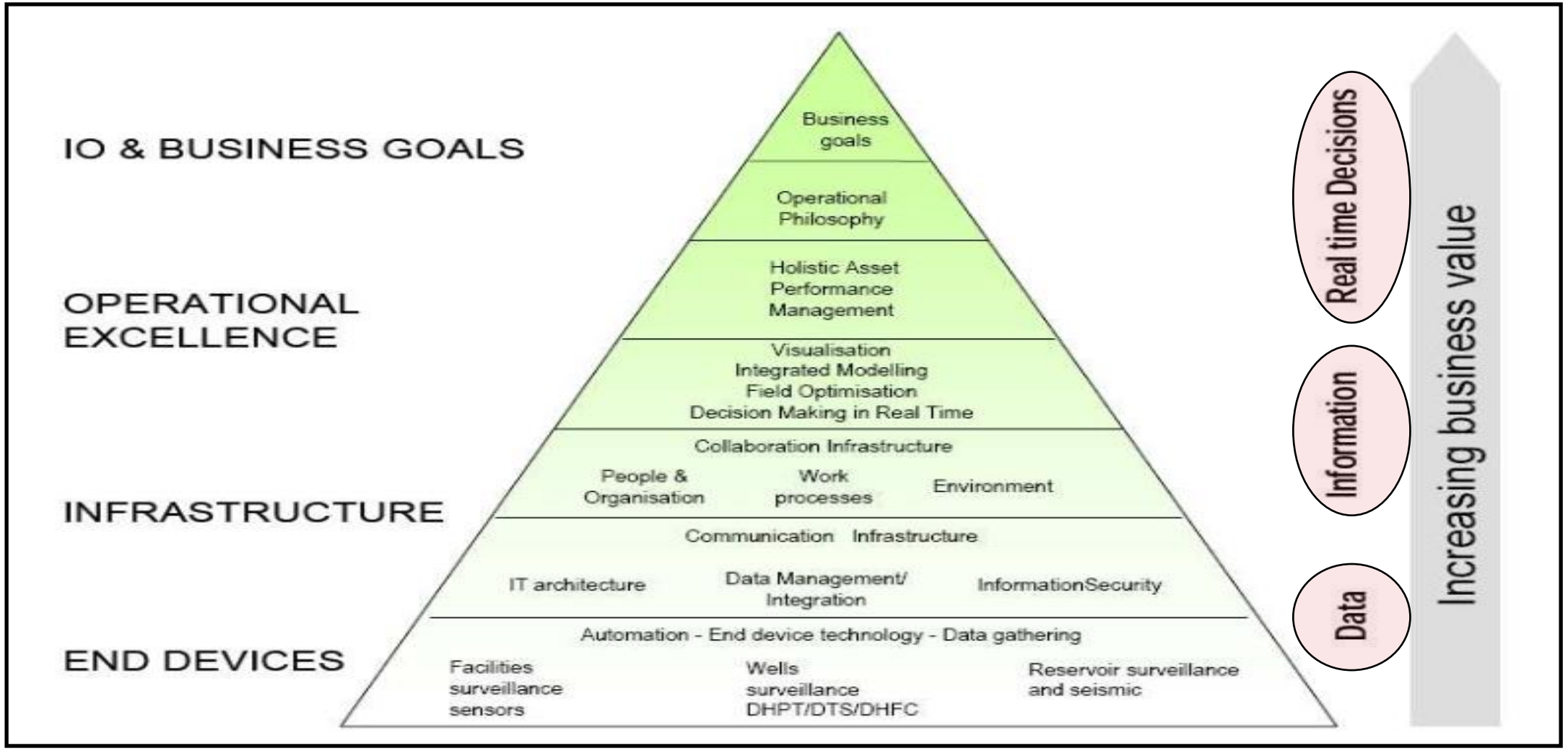
Integrated asset models
Applications that model complete production system performance from the producing horizon, through the well-bore, through the production facility, and onto the export/sales point across disparate data sources and multisite work teams.

Workflow and Knowledge management Systems
Robust historical data and document-management solutions that allow assets and functions to quickly execute workflows and
routines by calling up complete historical analyses quickly and accurately.

Production Volume management Systems
Standardized production data and production allocations, allowing more efficient real-time production decisions that result
in reduced deferment and improved operational integrity.

http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/unleashing-productivity-digital-field-advantage

The OLF Model for Integrated Operations



To look is one thing, to see what you look at is another, to understand what you see is a third, to learn what you understand is still something else, to act on what you learn is all that really matters.

W. Churchill

What Analysts Say

Integrated operations value proposition

Realistic hard benefit potential

Ultimate reservoir recovery increase	3 - 5 %
Well production rate increase	3 - 10%
Lift efficiency improvements	5 - 10 %
Decrease in lost production	2 - 5%
Field personnel staffing decreased	10 - 30%
Maintenance/workover cost reduction	15 - 20 %
Reduced energy usage	15 - 20%
Time to first oil reduction	Up to 50%
Major facilities cost reduction	Up to 50%

Fig. 2. Integrated operations' potential to remake the upstream oil and gas business.

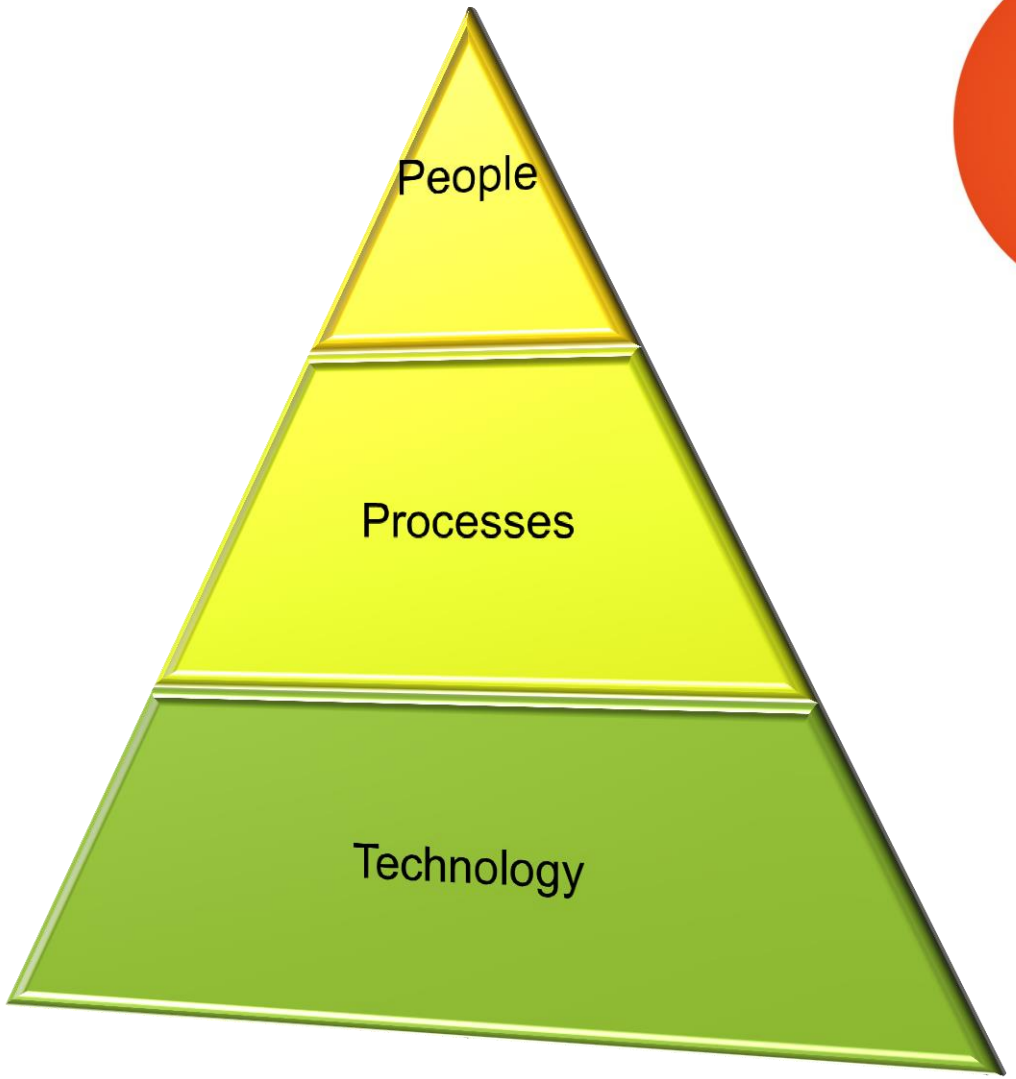
Shemwell, Murphy, Strategic Decision Sciences, Houston

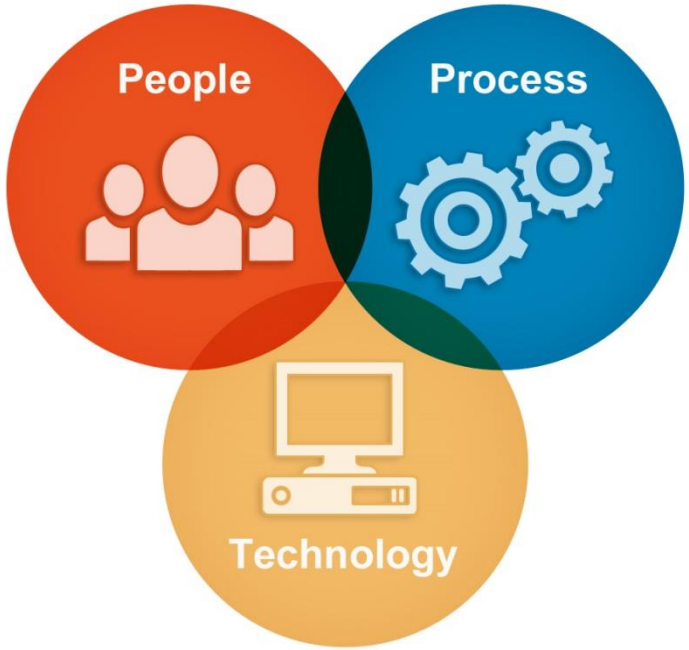
Article available online:
http://www.worldoil.com/November-2004-Knowing-the-economic-value-of-information.html

Some industry analysis suggests improved net present value of up to approximately 25 percent from digital oil field–related implementation; from a human capital perspective, digital oil field technologies can allow companies to operate with significantly fewer resources and scale the existing resources more effectively by capturing and displaying relevant conditions more quickly and to a wider collaborative environment. For instance, one oil and gas company has quantified its productivity-based gain from introducing select digital oil field technologies at US$20 million annually. It identified opportunities for direct deferment; by automating data updates and reports across a standardized master production data-store, the company removed the responsibility for routine data collection and analysis requirements from its scarce engineering talent.

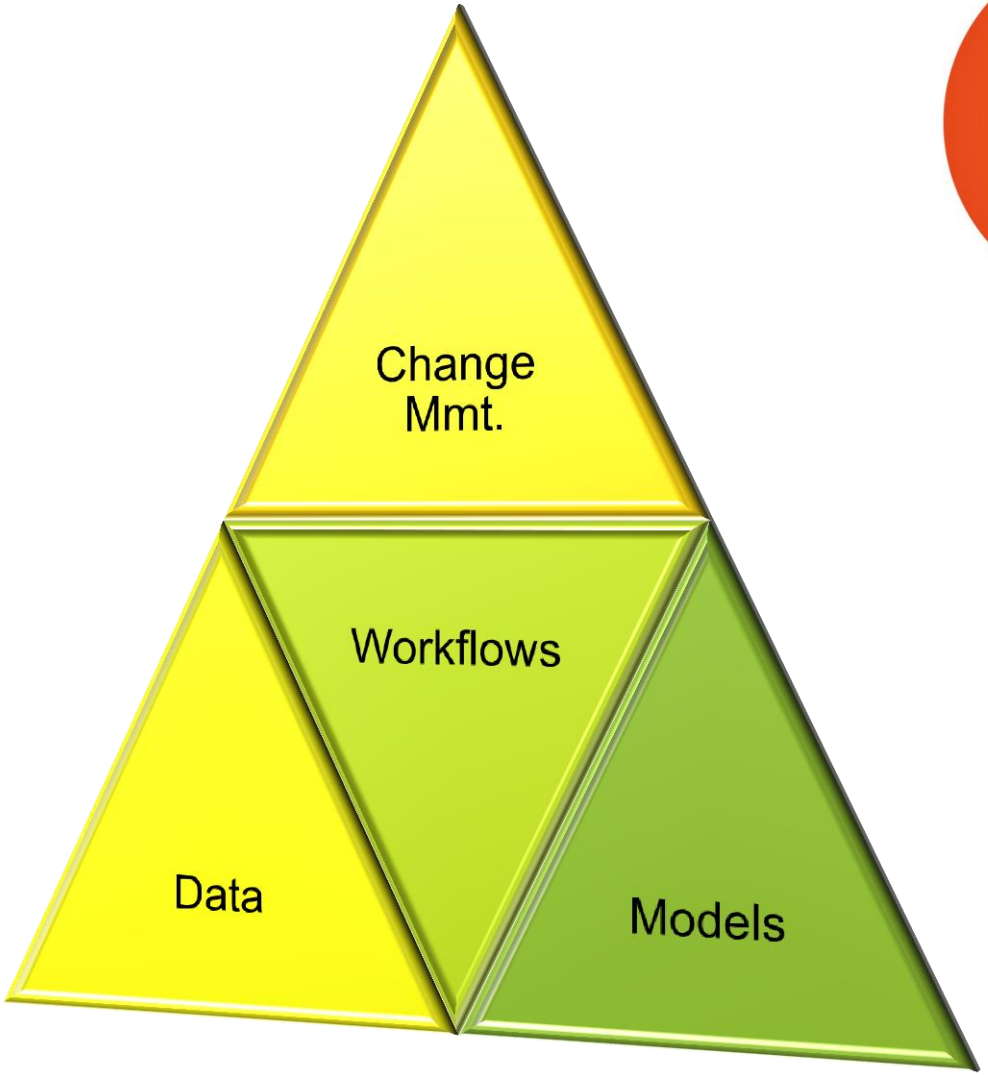
http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/unleashing-productivity-digital-field-advantage

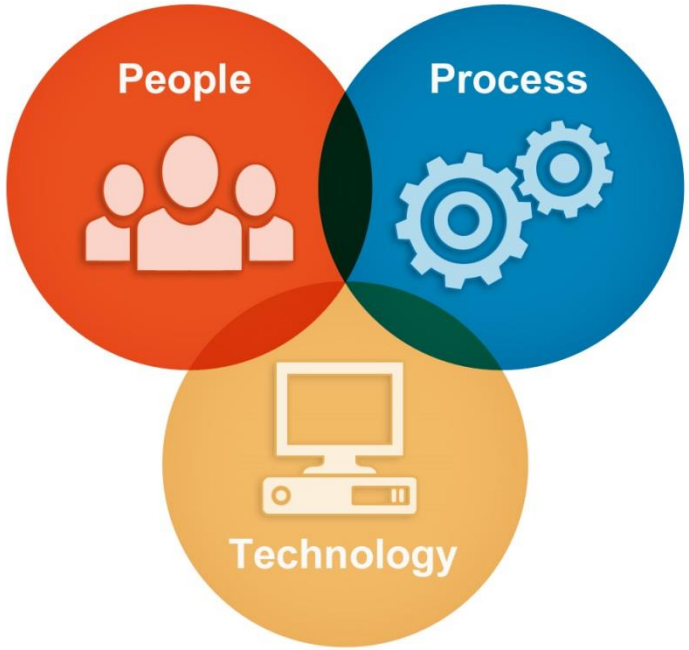
The People-Process-Technology Paradigm





The People-Process-Technology Paradigm





The Need for Data

Data Management – Architectural Models

Data Federation

- Uses information from its source
- No duplication
- Performance?
- Business rules may intefere
- Cost

Operational Data Store

- Collects information into an ODS
- Duplication
- Performance
- Different business rules for original than for copy
- Cost

The Need for Predictive Models

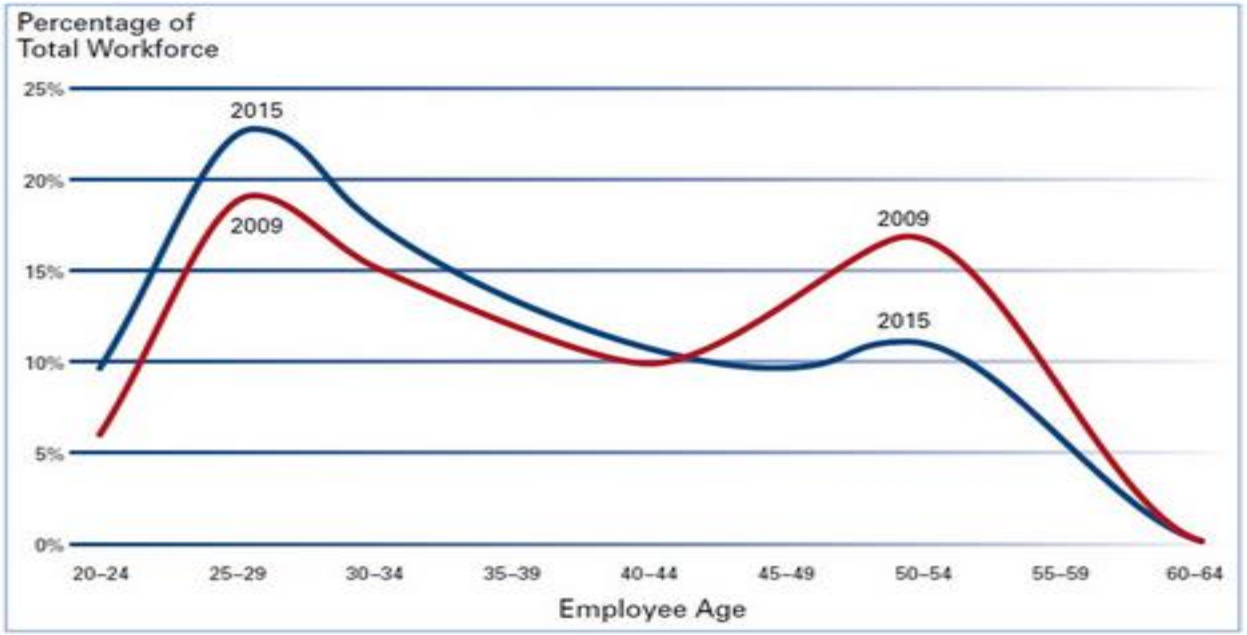
We are drowning in information but starved for knowledge.

John Naisbitt

If you can't model your process, you don't understand it. If you don't understand it, you can't improve it. And, if you can't improve it, you won't be competitive in the 21st century.

James Trainham, Former CTO Invista

The Need for Workflows



The "big crew change" or large turnover of retiring industry personnel to a younger workforce is currently happening.

Graph displays the percentage of PTPs per age category on a global basis. The retirement rate is at 20% for 55–59 year-olds, 90% for 60–64 year-olds, and 100% for 65+ year-olds.

The attrition rate is at 1.4% and is defined as the people leaving the E&P industry.

SOURCE: 2010 SBC O&G HR BENCHMARK

The Need for Workflows

Industry studies show that it takes between 7 and 11 years for new explorationists to make independent innovative decisions

Considerations for Workflow Design: Proper Division of Labor

Humans

- Strategy
- Designs and choices
- Constraints & objectives
- Decisions

Machines

- Repetitive tasks
- Running models
- Optimizing
- Monitoring, trending & alarming

Workflows in E&P Operations

Well Integrity Management

Steam Flood Optimization

Smart Production Surveillance

Artificial Lift Optimization

Well Performance Assurance

Production Losses/Recovery Reports

KPI Monitoring

Well Test Validation

Facility Monitoring

Reservoir Visualization & Analysis

Reporting & Distribution

Oil Hauling & Tank Management

Water Flood Optimization

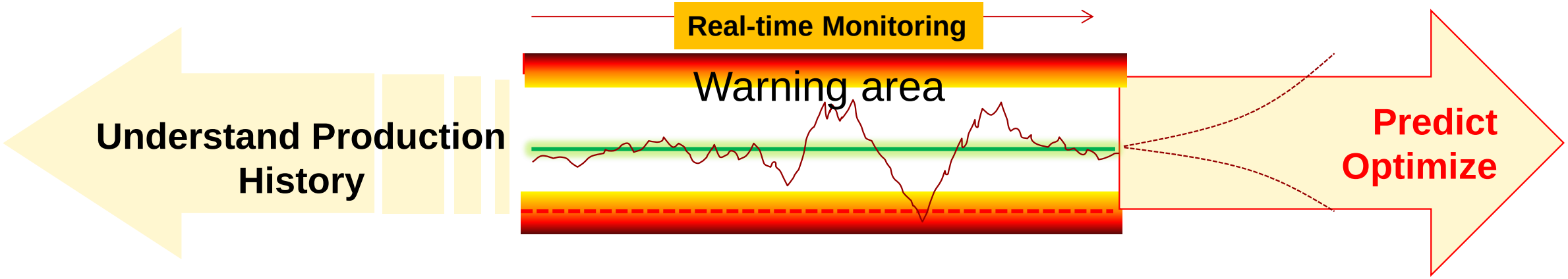
History Matching

Operational Target Setting

Field Development Planning

Workflows in E&P Operations

Well Integrity Management



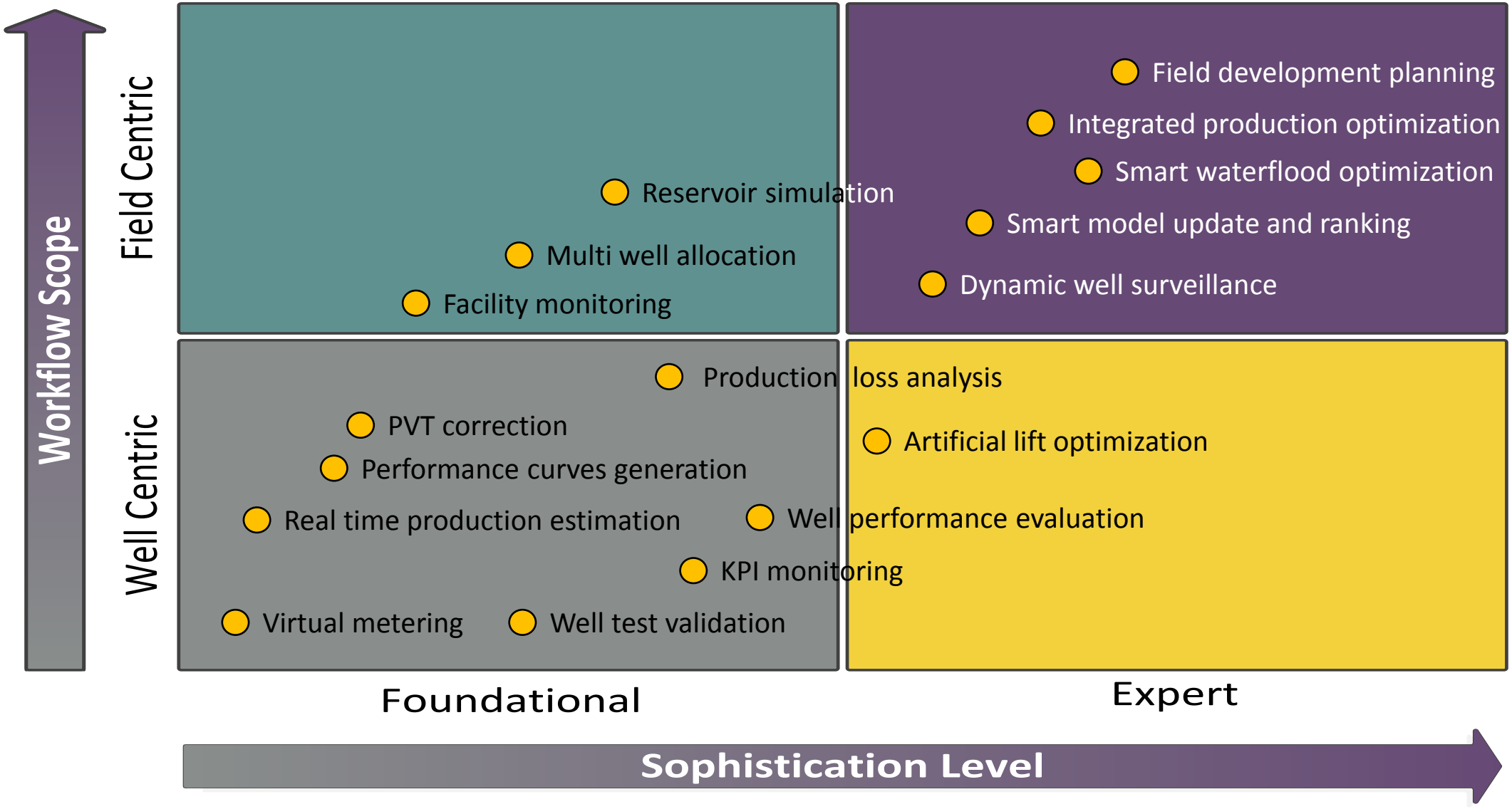
Understand
Analytical Tools

Monitoring
Alarming & Visualization Tools

Recommend
Predictive Analytics
Optimization

Past **Present** **Future**

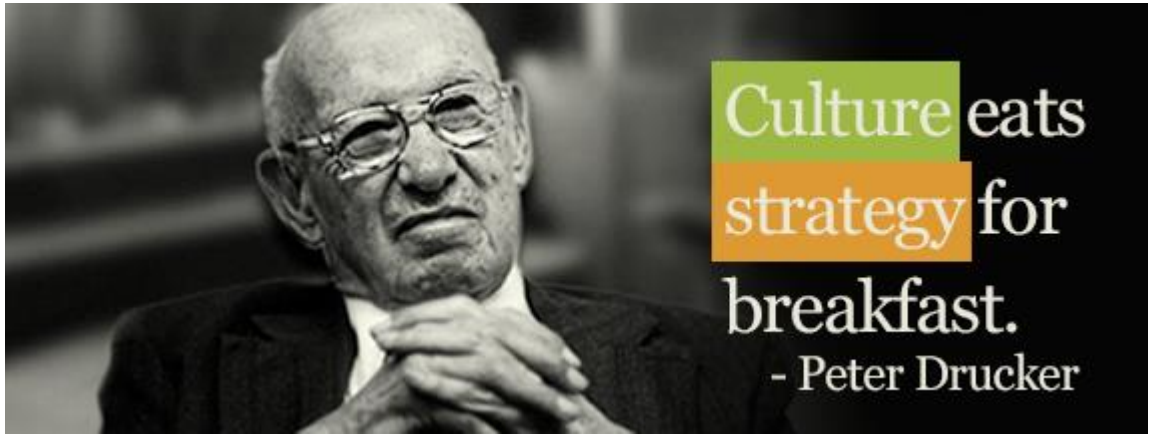
More high impact workflows are **possible** and **affordable** than ever before



Old habits die hard

Humans are allergic to change. They love to say, "We've always done it this way." I try to fight that. That's why I have a clock on my wall that runs counter-clockwise.

The most dangerous phrase in the language is, "We've always done it this way."



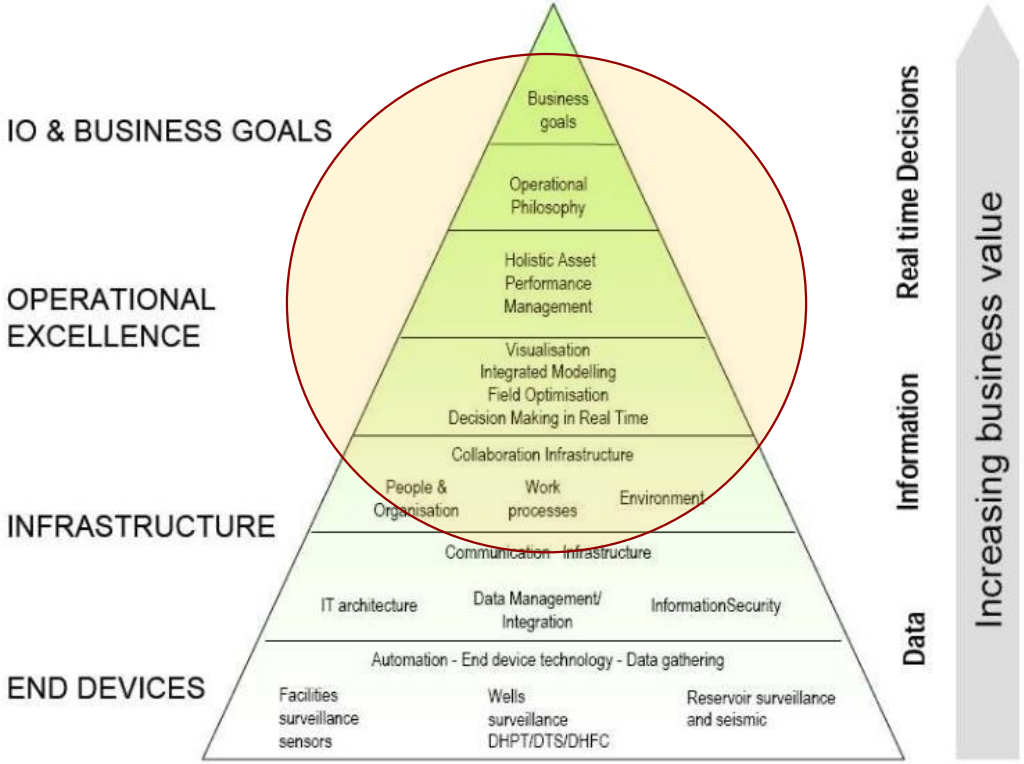
The Need for Change Management

Aligning the Organization
The ability of a company, a business unit, or a team to execute a strategy is not something that can be mandated by fiat. It is inherent in the organization's DNA and expressed in the hundreds of decisions and actions that collectively constitute and define performance. Would-be digital oil field operators can, however, attempt to align the building blocks of a company's DNA—decision rights, information flows, organizational structure, and motivators—to better capture the digital oil field's benefits. In order to realize the full potential of digital oil field technologies, organizations must be aligned and interrelationships established—for instance, between engineering functions, assets, and functional reporting relationships through an integrated set of key performance indicators (KPIs) (see Exhibit 8).

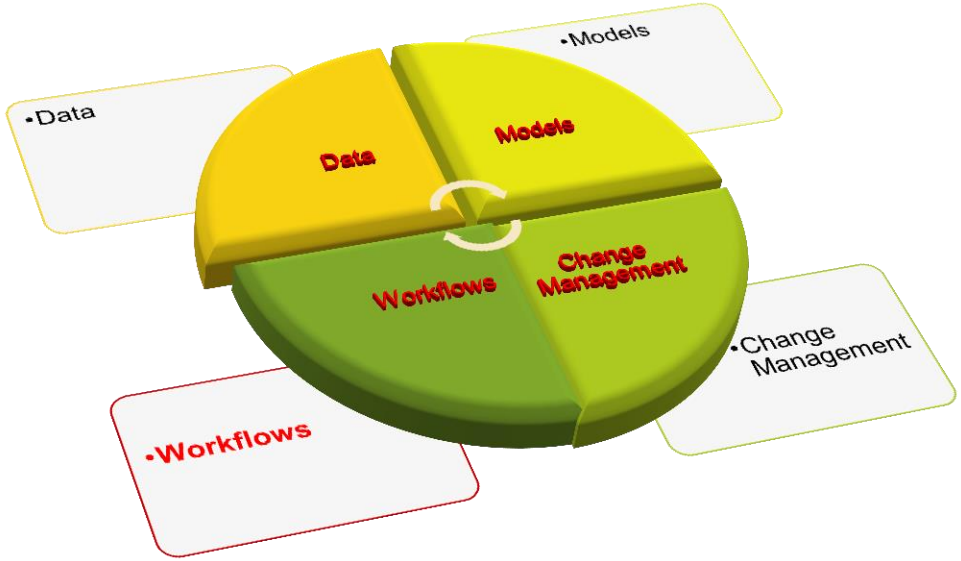
A significant part of organizational alignment will involve creating new roles, redesigning existing processes, and aligning performance measures to support and execute collaborative working conditions.

http://www.strategyand.pwc.com/media/file/UnleashingProductivity.pdf

The Risk of Organizational Fatigue



The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency.
Bill Gates

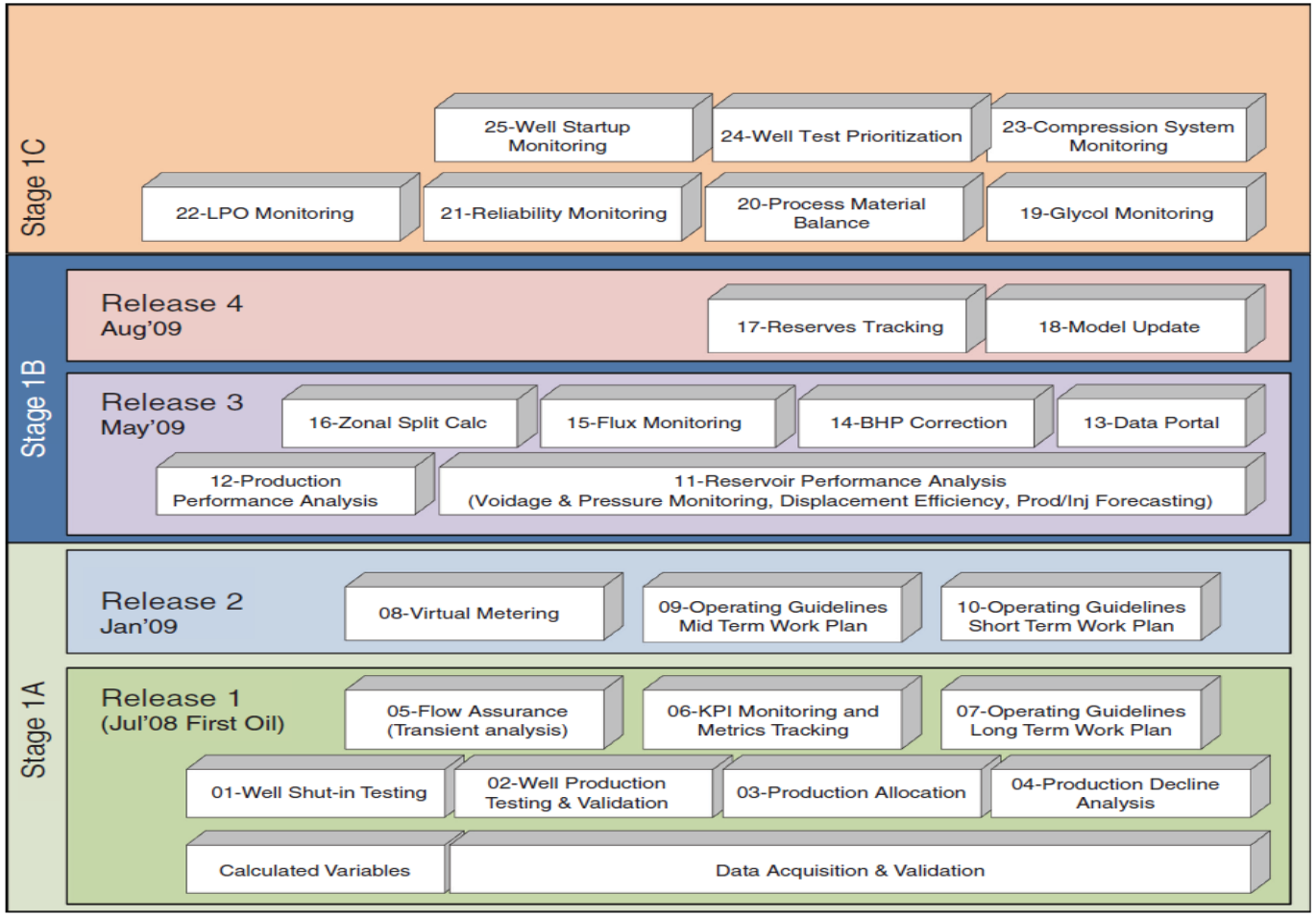


These engineering-based and information-based technologies can have a profound positive or negative impact on human capital efficiency depending on how they are introduced and embedded into the organization.

http://www.strategyand.pwc.com/global/home/what-we-think/reports-white-papers/article-display/unleashing-productivity-digital-field-advantage

Lessons Learned (SPE 115367)

1. Start planning early, synchronize with overall project plan and ensure alignment and upper management support.
2. Focus on business process delivery, quantify and demonstrate value to the asset team members. IT is a means, not an end. Improved efficiency is the end.
3. Ensure constant engagement with ALL the stakeholders
4. Carry out Proof-of Concept (PoC) for feasibility/scoping prior to committing to an overall project scope.
5. Ensure an Integrated System to be developed and deployed is based on modular solution (to allow for plug and play).
6. Use relevant subject matter experts (SMEs).
7. Implement project in stages to ensure maximum value is captured, prioritize workflows and focus on the “quick hits” first



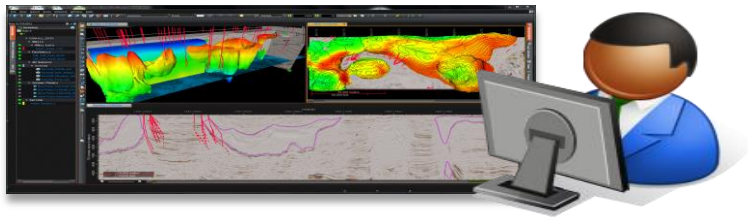
SPE 127691

The Need for a Platform

SMEs & Workflow Authors

Data Managers

Operators & Engineers



Reviewers

Production Applications and Plug-ins

- Production Monitoring
- Production Allocation
- Production Surveillance
- Well Integrity Management
- Economics
- Production Analytics
- Production Plug-ins

Integration Server

- PDM
- Business Process Management
- Web framework
- Data Integration
- Search

Data Quality

- Data Validation & Reconciliation

Analytics

- KPI & Dashboards
- Reporting
- Business Intelligence
- hadoop

RealTime Analytics

- Alarms
- Data Driven Models
- RT Computation

Engineering Tools

- Process Modelling and Simulation
- Real Time Production Management
- Model Management & Catalog
- Petro-technical Application Orchestration

Information Sources

- Corporate Databases
- 3rd Party Databases
- Semi Structured data
- Unstructured Data
- Real-time

Conclusions

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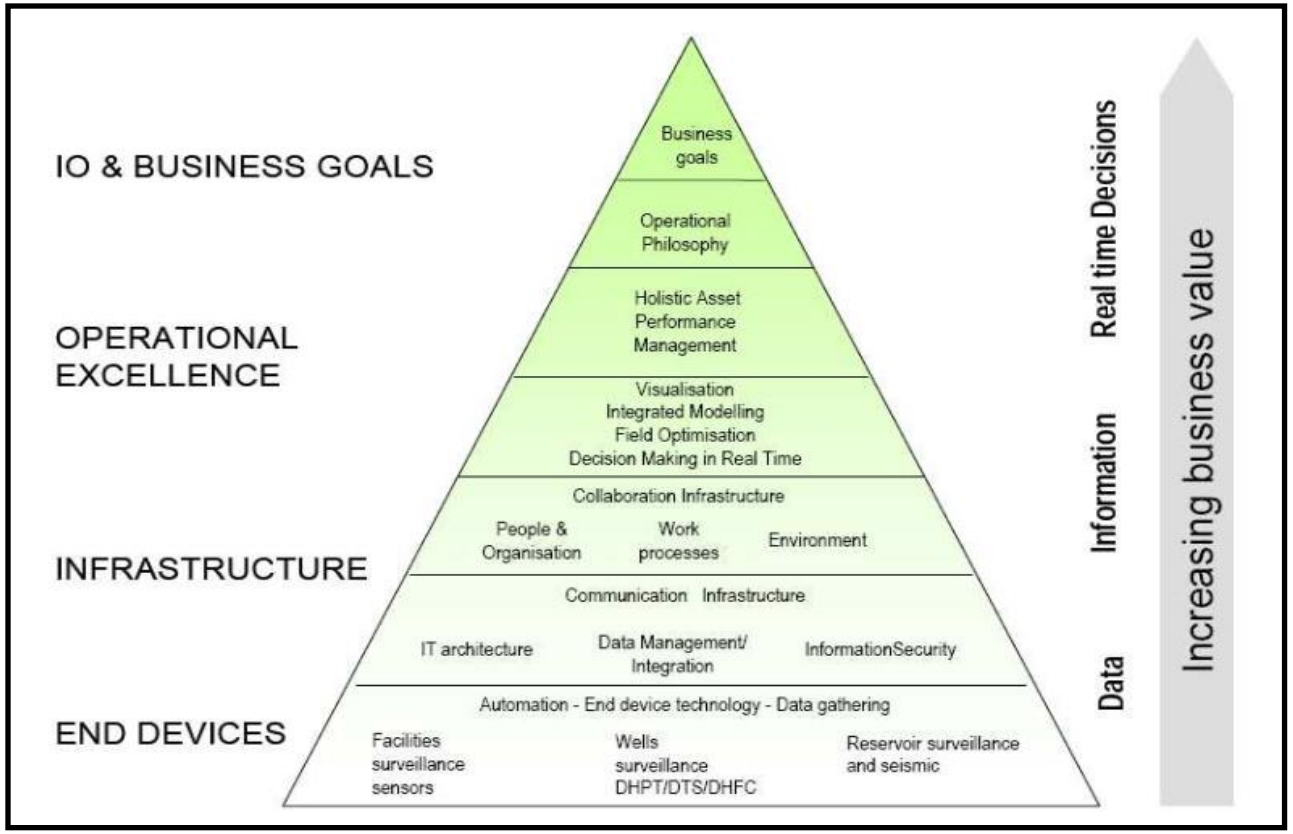
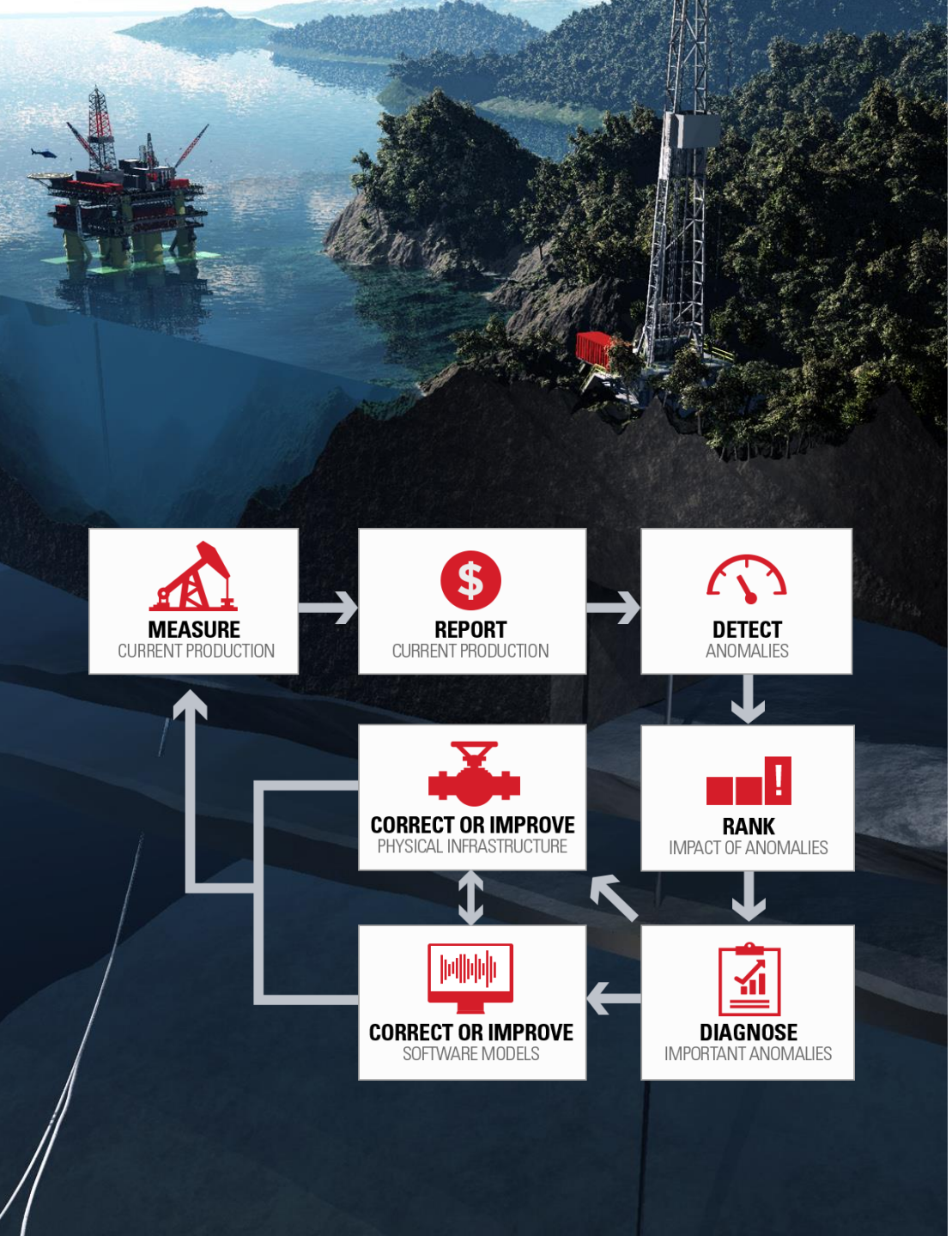
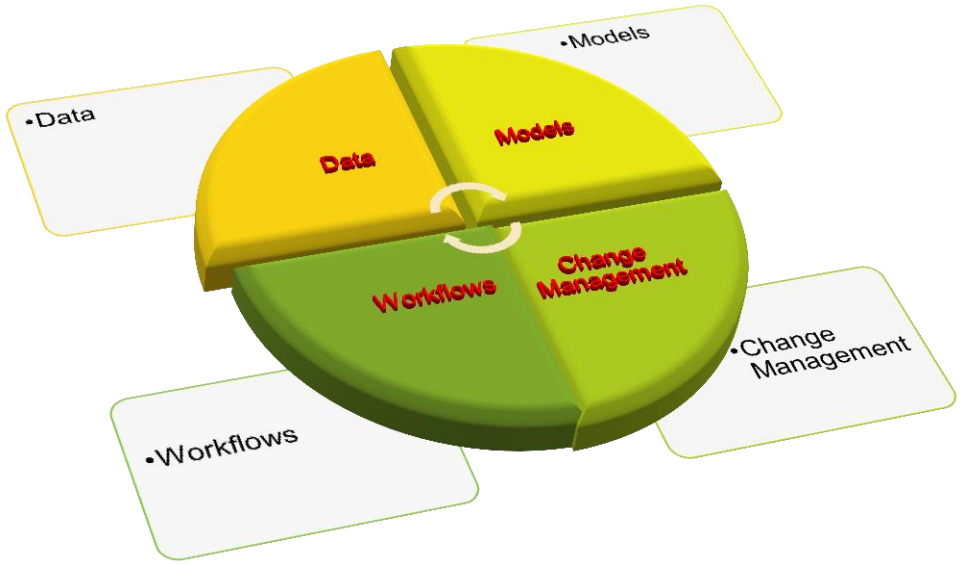
W. Churchill



- Begin with the end in mind (Covey)
  - You'll need data, IT infrastructure
  - But always think first what you are trying to accomplish
  - Data requirements comes after you decide what data you need for your workflows
  - Performance!
  - Who owns what (data, models, workflows,…)
- Build a business case (e.g. Uptime)
- Consider starting with Regulatory Compliance
  - Production Accounting
  - Well Integrity
- Iterative approach (complete system, a few workflows)
  - Assess performance early on
- Build on "stay on business" regulatory compliance and pursue operational efficiency
- Align with corporate priorities and standards
- Don´t let silos get in the way (sub-surface, surface, facilities)
- If you don't manage change, it won't happen (or won't happen as you thought it would!)
- Think of a platform to tie all this together (multiple data sources, multiple applications)


MEASURE
CURRENT PRODUCTION
REPORT
CURRENT PRODUCTION
DETECT
ANOMALIES
RANK
IMPACT OF ANOMALIES
DIAGNOSE
IMPORTANT ANOMALIES
CORRECT OR IMPROVE
SOFTWARE MODELS
CORRECT OR IMPROVE
PHYSICAL INFRASTRUCTURE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•Models
Data
Models
Workflows
Change Management
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