powering **Data** for **Energy**
from seismic to production

Store everything

.....analyze anything

..........build what you need

..............act confidently

EMC Global
Oil and Gas Program

Big Data & Analytics 3rd platform approach and life-cycle use case example

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Agenda

- Introductions – EMC Oil and Gas Program

- Four Digital Disruptions Transforming Upstream Operations

- 3rd Platform Evolution and Discussion

- Remember, it's about business not technology

- Upstream and Production Data Lakes

- Use Case Discussion: Production Optimization Life-cycle

EMC Oil And Gas Strategy
– Focused on Partner and Customer Successes

ADVANCE
existing EMC oil and gas solutions

ENABLE & LEVERAGE
a robust partner ecosystem

RESEARCH
investments in innovation

EMC² Pivotal RSA vmware

EMC Oil and Gas Technology Enablement Model

Brazil Research & Development
- Dedicated E&P data scientists
- $100MM EMC Investment

Pivotal Labs Agile Development
- Faster time to value
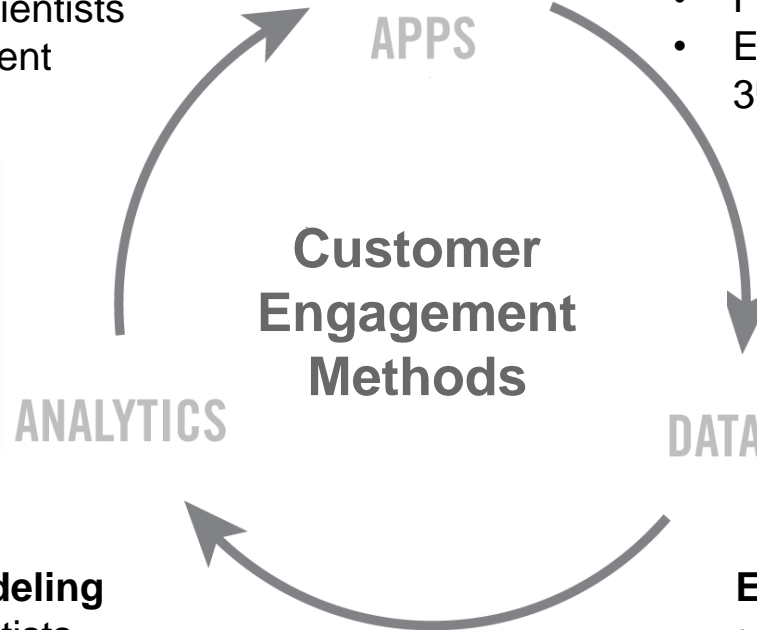- Enable customer self-efficiency for 3rd Platform

APPS

Customer Engagement Methods

ANALYTICS

DATA

DEFINE   DESIGN

DEVELOP   DEPLOY

Pivotal Data Science Modeling
- Consultative data scientists
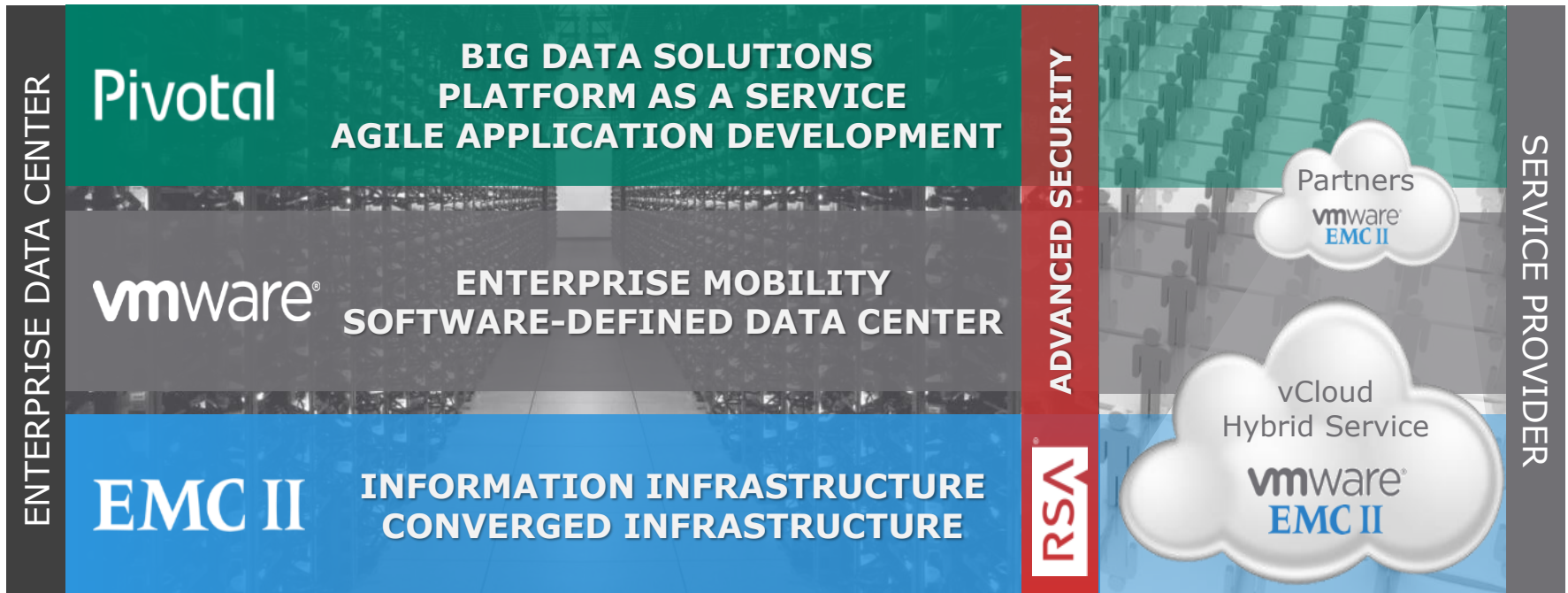- Deep analytical solutions

EMC Consulting
- Infrastructure, PaaS
- Optimized cloud models
- Mobility and Security

EMC: A Unique Federation Of Companies

Delivering The Software-Defined Enterprise. Solutions & Choice.

SOFTWARE DEFINED DATA CENTER	PLATFORM AS A SERVICE	VIRTUAL WORKSPACE	BUSINESS DATA LAKE	SECURITY ANALYTICS

ENTERPRISE DATA CENTER

Pivotal
BIG DATA SOLUTIONS
PLATFORM AS A SERVICE
AGILE APPLICATION DEVELOPMENT

vmware
ENTERPRISE MOBILITY
SOFTWARE-DEFINED DATA CENTER

EMC II
INFORMATION INFRASTRUCTURE
CONVERGED INFRASTRUCTURE

ADVANCED SECURITY

RSA

SERVICE PROVIDER

Partners
vmware
EMC II

vCloud
Hybrid Service
vmware
EMC II

EMC² · Pivotal · RSA · vmware

Four themes of digital disruptions transforming all aspects of upstream operations

- **Business asset planning and optimization**. This highlights more-extensive use of data to plan and optimize the performance of business assets across the entire life cycle.

- **Digital oil fields.** This focuses on expanded use of digital sensors in oil fields (and other plants and equipment), generating massive volumes of operational data that, in combination with other data, are enabling business optimization in near real time.

- **Intuitive workflow.** This leverages mobile and collaboration technologies to consolidate workflows around specific roles, making work more intuitive and enabling more agile change implementation.

- **Integration of core upstream processes, data and systems.** This is essential to create higher business performance levels, as systems become smarter and the business processes they support become more sophisticated and productive.

Source: Gartner Hype Cycle for Upstream Oil & Gas Technology 2014

3rd Platform Evolution

- **Most disruptive** platform shifts and advances in technology in over 30 years

- **Need for Speed:** Must compete, innovate & execute globally and faster than ever before

- **Cloud-Enabled Resources**
- **New Data Fabric**
- **Mobility Mantra**
- **Open Source Driven Innovation**
- **Massive sensor data explosion**
- **Internet of Things**
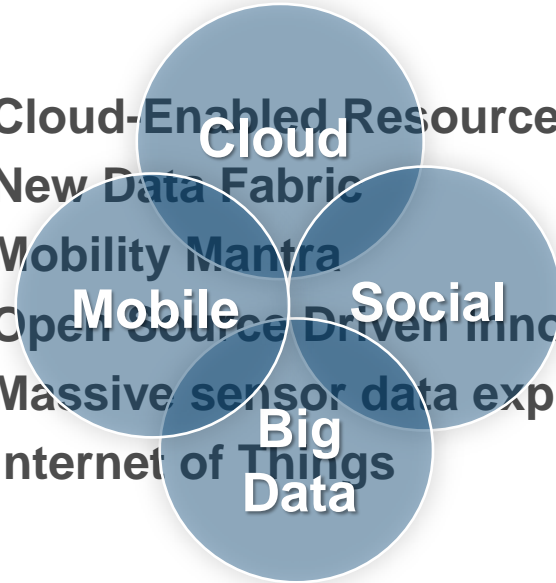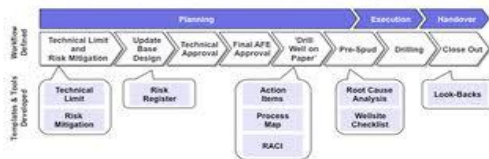
Oil & Gas Companies Three Fundamental Questions
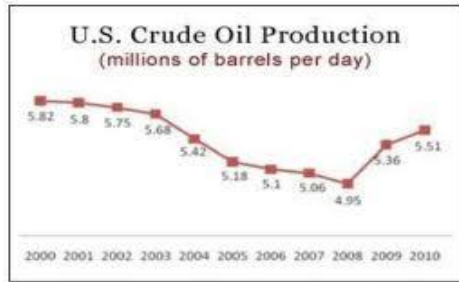
How can I increase <u>PRODUCTION</u> & <u>RECOVERY</u>...

- per Asset?
- per Well?

...while I decrease <u>COST</u>...

- per Asset?
- per Well?
- per Business Function Engaged in Well Lifecycle?

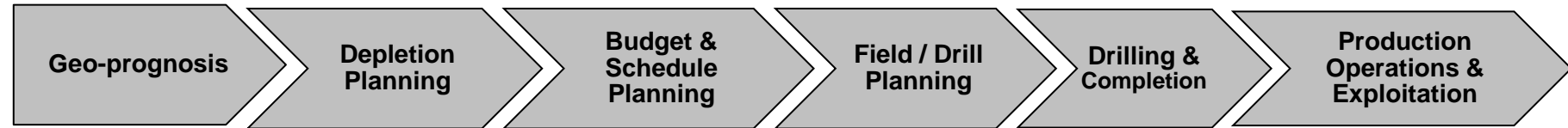**...and deploy <u>CAPITAL</u> more efficiently?**

- per Asset?
- per Well?
- per Business Function?

Modest Improvements in Efficiency - Staggering Impact

| Geo-prognosis | Depletion Planning | Budget & Schedule Planning | Field / Drill Planning | Drilling & Completion | Production Operations & Exploitation |

Planning ~ 200 Days

Build Predictive / Prescriptive Models That:
- Improve production & reserves forecasting
- Improve ultimate reservoir recovery (IUR)
- Optimize completions engineering designs
- Enable targeting of high value acreage / acquisitions / Joint Venture partnerships

Drilling ~ 60 Days

Utilize Analytics To:
- Optimize drilling for production "sweet spots" (placement, spacing, steering)
- Optimize drilling and completions models & costs
- Improve "non-productive time"

Production ~ Years

Utilize Analytics To:
- Optimize production operations & exploitation
- Optimize health & safety
- Improve production and cost forecasts vs actuals
- Close well life-cycle loop

Example Returns for Unconventional Asset BD&A Project

Common Model Facts:
- 2014 Capital: **$1.0B**
- 2014 Forecast: **75,000 BOE/D**
- 2014 Drill plan: **150 Wells**

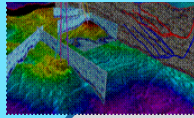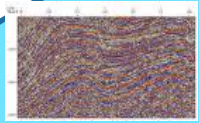**Early Impact Analysis Returns:**
- Increase oil production from **3-7%**
- Decreases operations costs up to **5%**

At this operational scale, the net impact potential of a data driven approach is $70MM to $160MM ($80/BOE) in top line revenue and ~$50MM in cost reductions per year.

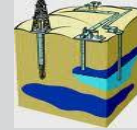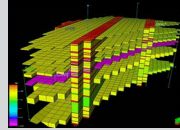# Big Data & Analytics Applied Across Upstream

Exploration **Development** **Drilling** **Production**

- Seismic acquisition
- Seismic processing
- Seismic interpretation
- Geological interpretation
- Reservoir Modeling

- Reservoir Modeling & Simulation
- Fracture modeling
- Facilities & Reservoir Engineering
- Drilling program
- Integrated Field Plan

- Drilling & Completion
- Near borehole modeling
- Stimulation Optimization
- Production Operations
- Production Surveillance
- Integrated Optimization

- Seismic
  - SEGD, Pre-Stack, Post-Stack
- Navigation
- **MASSIVE** Sensor data

- Recently Acquired and Historical
  - Log curves
  - App data / models
  - Production data
  - Drilling and test
  - Micro seismic
  - **Small Data**
  - Tops
  - Lithology
  - Cultural
  - Cores
  - Eng Calc's

- Real Time Data
  - Digital Logs
  - LWD, MWD
  - Mud logging
  - Rate of Penetration
- Production Data
  - Real time SCADA
  - Operational data
  - Application models
  - Actuals vs forecast

Volume   Variety   Velocity

EMC²   Pivotal   RSA   vmware

Upstream Data Lake

Store everything, analyze anything, build what you need

A data lake lets you store all data and provides for analytics over all of this data. It underpins new and old applications.

.

INGEST   STORE EVERYTHING   ANALYZE   SURFACE   ACT
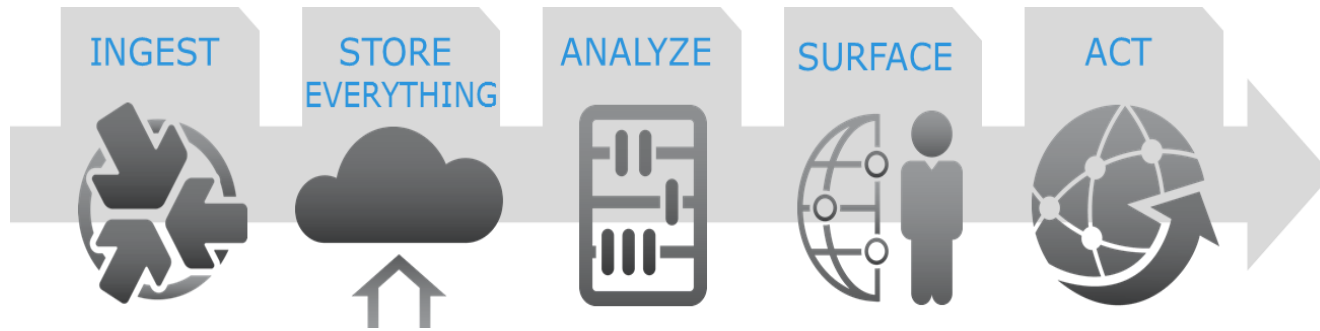
- **Ingest** data in real-time, near real-time and batch, across many protocols
- **Store** in source format in HDFS while leveraging other types of traditional storage.
- **Analyze** using the latest machine learning and data science techniques,
- **Surface** all of this data, over many different protocols, to Apps/Users, for
- **Act**ion on Business solutions in context of Relevant time workflows.

The Journey to Big Data & Analytics

Big Data Architecture

Applied Data Science

Applied Labs Agile

Cloud Foundry Services

COLLECT

Store everything

Business Data Lake

ANALYZE

Generate Insights

Big Data Analytics

DEVELOP

Operationalize

Data-Driven Applications

INNOVATE

Iterate Rapidly

Agile Enterprise

Enterprise PaaS

Agile Development

Predictive Analytics

Big Data

Pivotal™
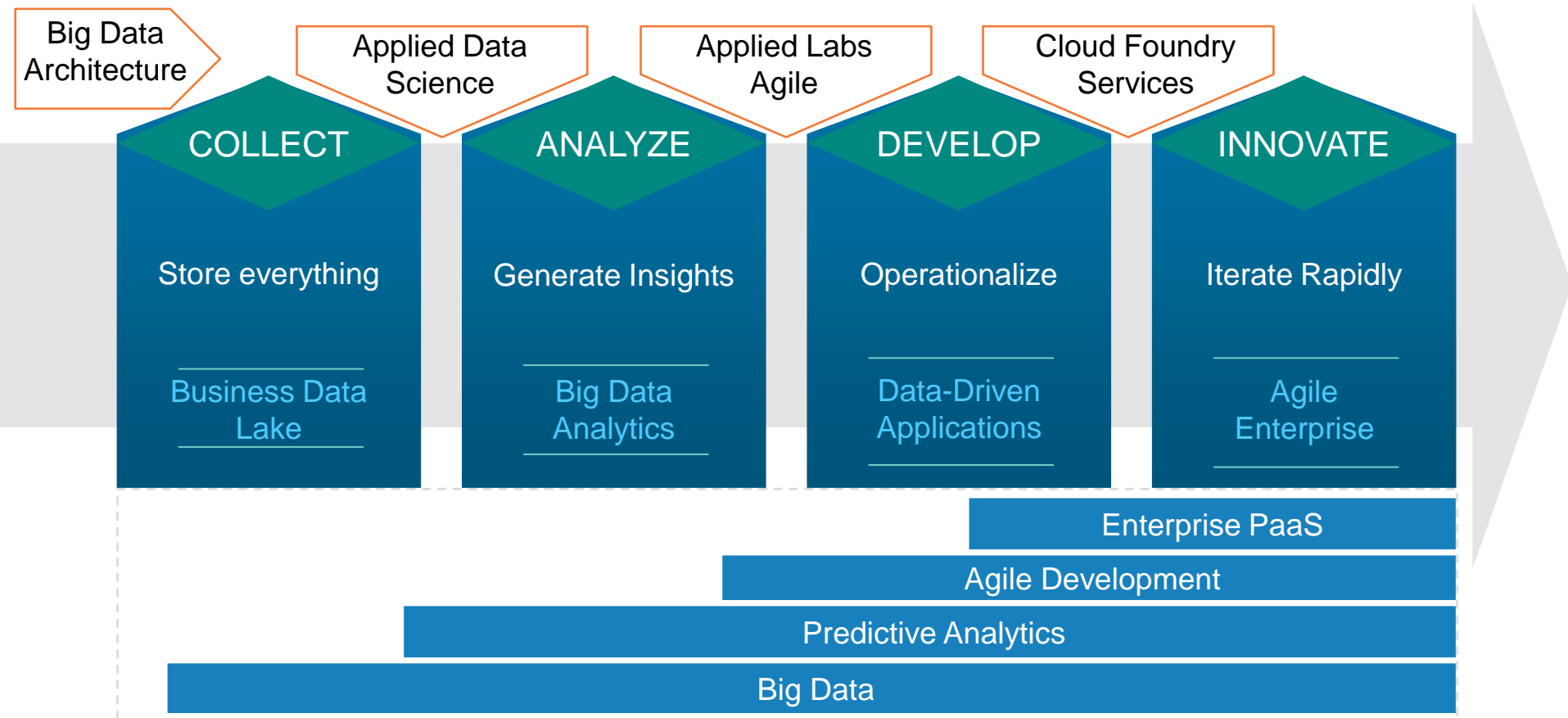
Production Data Lake and Core Workflows

Core Data Build Layers:
- Well Header
- Geospatial Data
- Public D&C, Prod Data
- Internal D&C, Prod Data
- Real Time Sensor Data
- Eng App Model Data
- Inline Mining & Calculations
- Data & Reporting Marts

Core Workflows:
- Visualization & Monitoring
- Exception Based Surveillance
- Well Planning & Forecasting
- Production Downtime
- Integrated Reporting
- Cross-functional Integration
- Integrated Analytics Models
- Relevant Time Workflow Feed

Use Case: Optimization Analytics Well Program
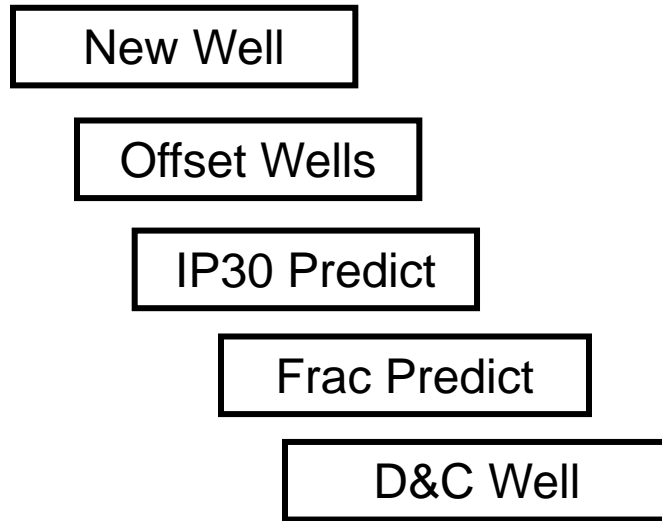
New Well

Offset Wells

IP30 Predict

Frac Predict

D&C Well

- Review all captured offset data, create models
- Drill and measure (log/microseismic)
- Design Completion
  - Existing Well Completion & Production data
  - Predict IP30 production
    - Analytic modeling
    - Empirical/mapping
  - Frac Design Sheets
    - Enhanced Frac
    - Enginer SW Frac
  - Predict Stress Profile

- **Capture** all needed data into a data environment for increased utilization

- Implement a **Learning Life Cycle** for continuous analysis and improvement

- **Improve** $/BOE metric and Enhanced Ultimate Recovery (well and asset)

Optimization Analytics Life-cycle Well Program

New Well

Offset Wells

IP30 Predict
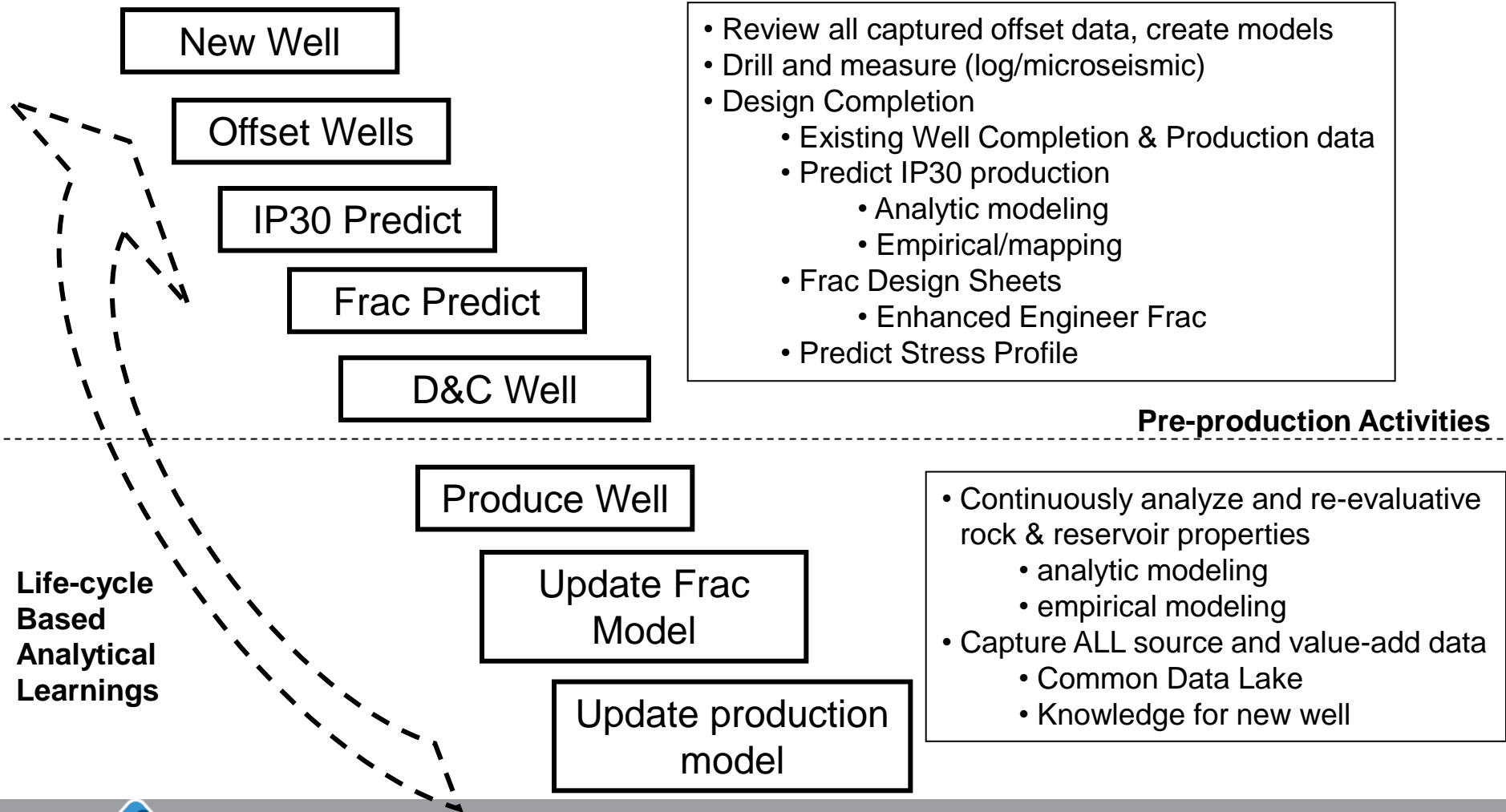
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    - Enhanced Engineer Frac
- Predict Stress Profile

Pre-production Activities

Produce Well

Life-cycle Based Analytical Learnings

Update Frac Model

Update production model

- Continuously analyze and re-evaluative rock & reservoir properties
  - analytic modeling
  - empirical modeling
- Capture ALL source and value-add data
  - Common Data Lake
  - Knowledge for new well

Thank You … Q&A

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