The Efficient Path to Knowledge Transfer and Collaboration; Platforms for Lean Subsurface Evaluations*

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Abstract

Hess has an established stage gate process for major capital projects. Subsurface uncertainty and its impact on field development options is the primary driver in most major capitol decisions. We recognized a need to provide guidelines for the types of technical work required from subsurface teams and ensure that the right work was done at the right time, with the right level of technical rigor to improve the inputs into the value assurance process for major field development projects. A challenge is how to build efficiency and consistent process or practices into the scientific evaluation of the subsurface without taking away from the creative and innovative methods and approaches teams can utilize in their work. Toward this end, we developed a common, global system for subsurface evaluations. This system, the Subsurface Milestone & Deliverables (SMD), provides guidelines for project management and stewardship; defines milestones for the delivery of technical products; set standards for integrity of technical products and emphasizes timely collaboration, documentation and knowledge transfer. In 2012 we developed an online system to house the SMD system: PathFinder2020. Using lean and continuous improvement approaches for tool development, we married the need for collecting high quality information content, with ease of use, rapid deployment, measurable adoption and clear alignment with the E&P strategy. As of 2015 we have seen the following changes and improvements across the company: - The ability to track and measure the progress of technical evaluations over time - Significant increase in understanding of the multi-disciplinary dependencies at key decision points - Increased efficiency in technical assurance, and reporting findings and recommendations into the major capital project decision process. At Hess, PathFinder2020 is not simply a tool. It represents the “Hess way” of working leading to higher performance, consistency and comparability among assets and opportunities. It allows us to manage knowledge about our assets and provides a corporate memory of the technical basis for the business decisions we make. Because of the standardization of work, the intelligent data base it creates, and reporting functionality, PathFinder2020 provides a Lean method for subsurface evaluations.

The Efficient Path to Knowledge Transfer and Collaboration; Platforms for Lean Subsurface Evaluations

Rick Beaubouef (Hess Corp) and Kandy Lukats (3GiG)

AAPG Calgary 2016

Outline of Presentation

1. Introduction and Opportunity
2. Subsurface Milestone Deliverables (SMD) System
3. Hess PathFinder^{2020}
4. Design and Implementation
5. Vision and Value
6. Concluding Remarks

Opportunity

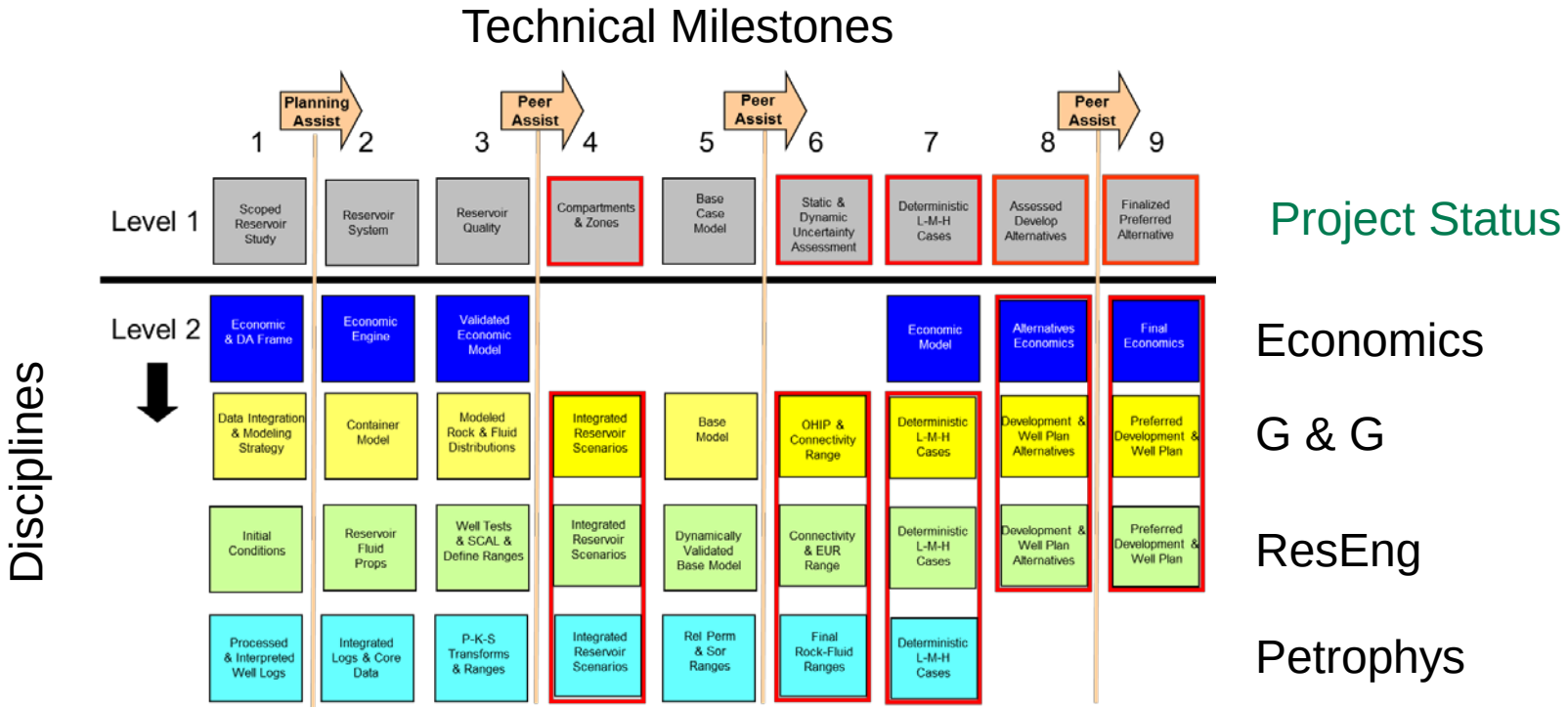
Challenge

- Develop a common system for subsurface evaluations performed by asset teams throughout the global E&P business
  - Complementary with Value Assurance process

Solution

- **Subsurface Milestone & Deliverables (SMD)** designed to :
  - Provide guidelines for project management and stewardship
  - Define common milestones for the delivery of technical products
  - Set standards for integrity of technical products
  - Emphasize timely collaboration, documentation and knowledge transfer

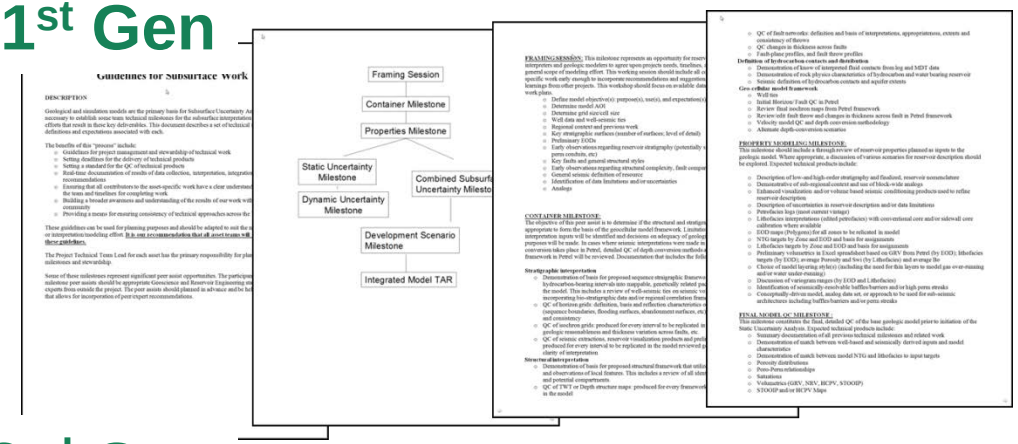
SMD System


Technical Milestones
Planning Assist
Peer Assist
Peer Assist
Peer Assist
1
2
3
4
5
6
7
8
9
Level 1
Scoped Reservoir Study
Reservoir System
Reservoir Quality
Compartments & Zones
Base Case Model
Static & Dynamic Uncertainty Assessment
Deterministic L-M-H Cases
Assessed Develop Alternatives
Finalized Preferred Alternative
Level 2
Economic & DA Frame
Economic Engine
Validated Economic Model
Economic Model
Alternatives Economics
Final Economics
Data Integration & Modeling Strategy
Container Model
Modeled Rock & Fluid Distributions
Integrated Reservoir Scenarios
Base Model
OHIP & Connectivity Range
Deterministic L-M-H Cases
Development & Well Plan Alternatives
Preferred Development & Well Plan
Initial Conditions
Reservoir Fluid Props
Well Tests & SCAL & Define Ranges
Integrated Reservoir Scenarios
Dynamically Validated Base Model
Connectivity & EUR Range
Deterministic L-M-H Cases
Development & Well Plan Alternatives
Preferred Development & Well Plan
Processed & Interpreted Well Logs
Integrated Logs & Core Data
P-K-S Transforms & Ranges
Integrated Reservoir Scenarios
Rel Perm & Sor Ranges
Final Rock-Fluid Ranges
Deterministic L-M-H Cases
Disciplines
Project Status
Economics
G & G
ResEng
Petrophys

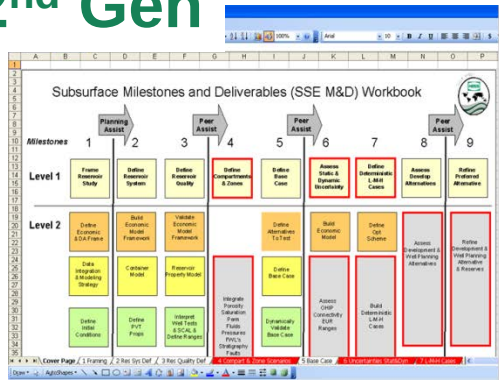
Early Attempts

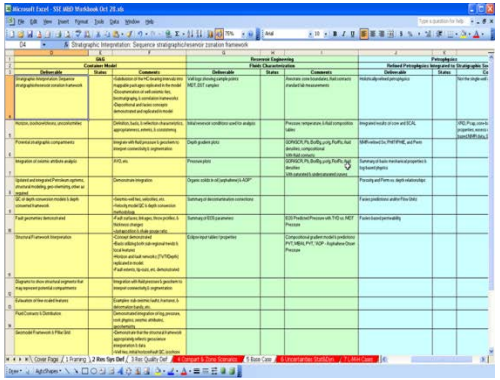
Lists, Workbooks & Presentations

1st Gen



2nd Gen

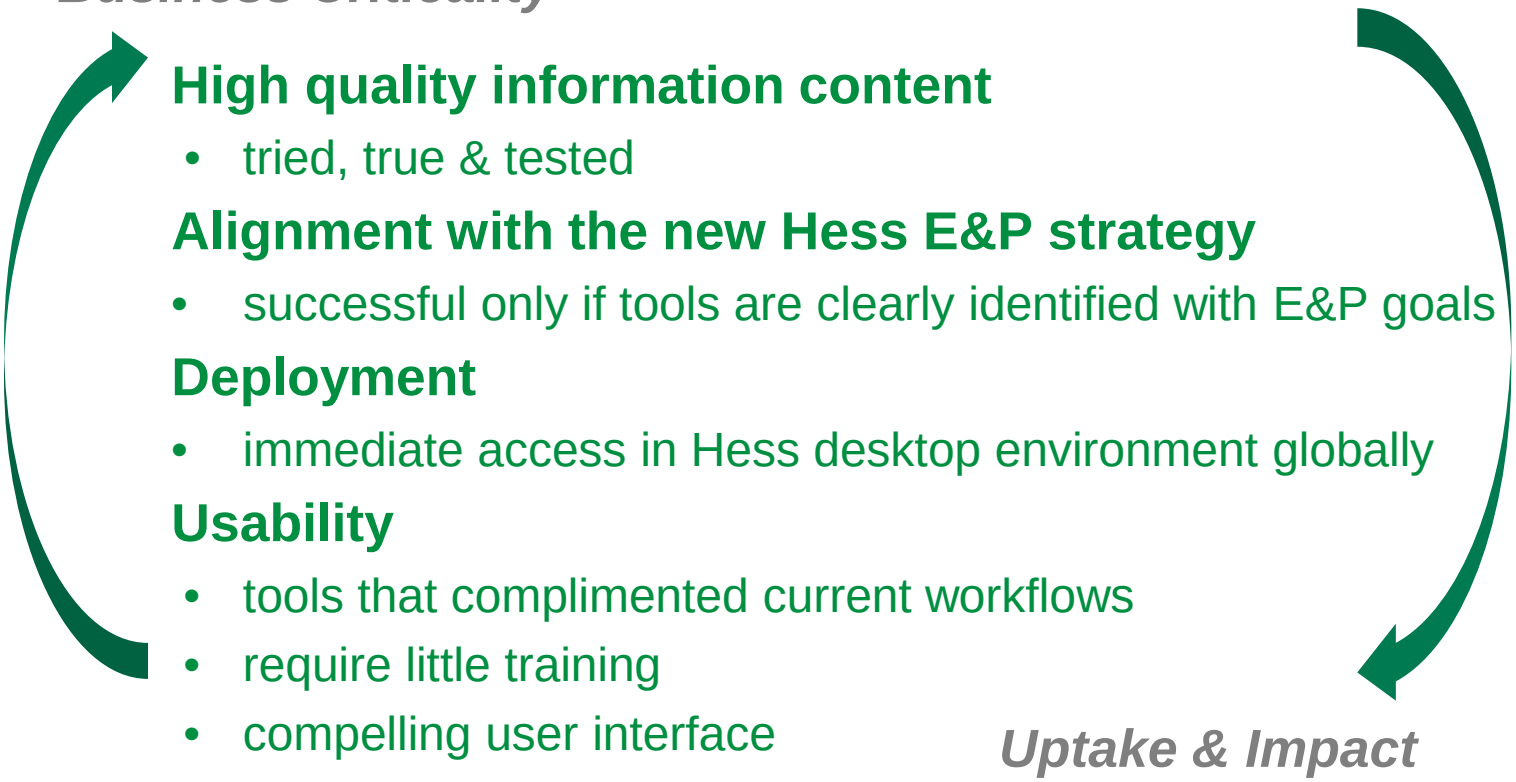




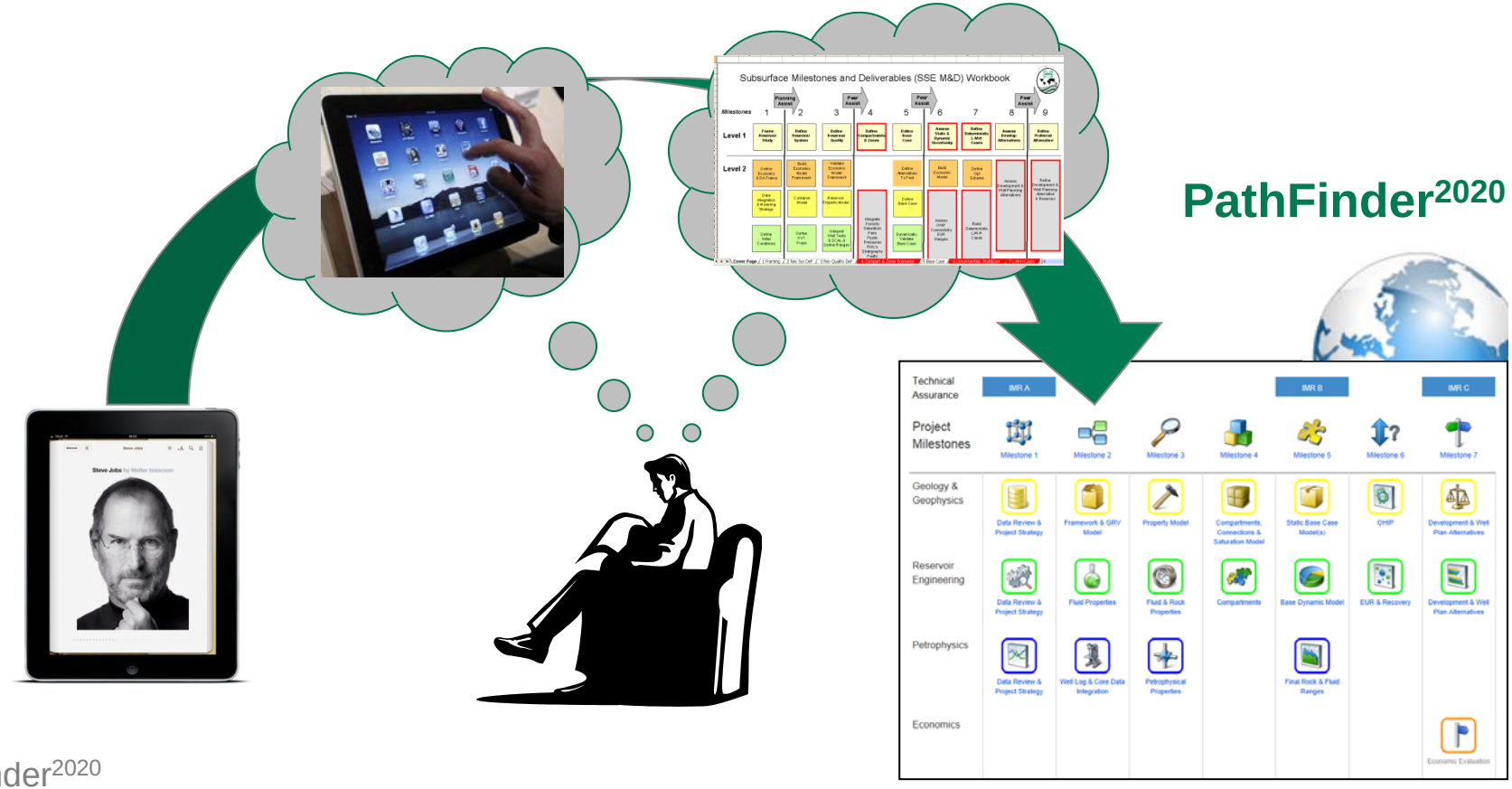
Content was OK, but implementation was difficult

- Information content overwhelming
- Products were dull
- User case was not compelling
- Delivery was awkward
- Maintenance was impossible

Implementation Challenge



Inspiration



What is PathFinder?

- A web-based application that was developed by the Hess subsurface technical communities to deliver the SMD system
  - a common system for subsurface evaluations performed by asset teams throughout the global E&P business

- Contains tools for Knowledge Management and Project Execution:

Compass Knowledge Center - illustrated subsurface guidelines and knowledge base of technical information accessed via a graphical “story board” interface

Expedition Project Center - a tool for subsurface teams to plan, document and share results of technical studies accomplished within the guidelines

PathFinder^{2020} Subsurface Milestones & Deliverables

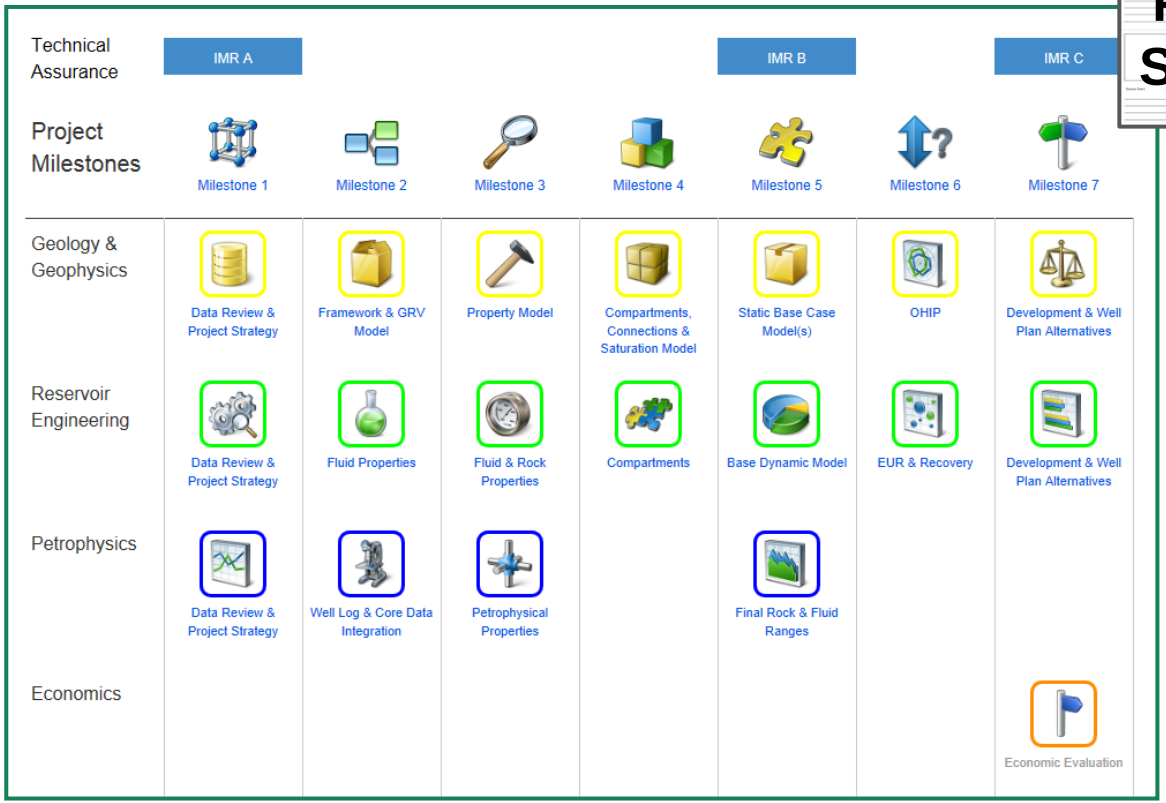
Subsurface Milestones

PathFinder Story Board

Assurance

Project Milestones

Discipline Swim Lanes



Compass Knowledge Center

Milestones

Project Milestones


Milestone 1


Milestone 2


Milestone 3


Milestone 4


Milestone 5


Milestone 6


Milestone 7

Conventionals Project Milestone Summary

Summary of the Project & Discipline Milestone Objectives

Milestone 5

The objective of this milestone is to incorporate products from milestones #1-4 to define the base or reference case model & properties. This applies to both the geological and simulation grids. The level of rigor will dictate the use of either a common scale model (geologic al and simulation model are one-in-the-same grid), or a coordinated set of fine and coarse scale models (geologic model is represented as a fine scale grid and subsequently "upscaled" onto a coarse simulation scale grid). This is a critical milestone; many projects will visit this milestone multiple times as iteration occurs. The goal is to "ground truth" or validate: that the geologic model reflects the input data, interpretation, and any analogs, and, in addition, that the dynamic model reflects the input data and assumptions, as well as, the geologic model. Primary products include a dynamic simulation model that behaves/responds as expected.

Petrophysics	Geology & Geophysics	Reservoir Engineering	Production Engineering
			
Final Rock & Fluid Ranges	**Static Base Case Model(s)**	**Base Dynamic Model**	**Well Optimization**
The objective of this milestone is to provide uncertainty ranges for the Petrophysics. This milestone is a joint effort between disciplines to not only provide Petrophysical property uncertainty ranges but to document agreement between modeled parameters and actual "at the well" Petrophysics.	The objective of this milestone is to demonstrate a consistent representation of the base or reference case grid and properties in both the geological and simulation grids. Primary products include: Justification and demonstration that Geological and Geophysical input to the simulation grid design and properties accurately characterize the most likely reservoir & fluid behavior. Validation of Input: Log and core data, analogs, and depositional/facies concept. Validation of Model: Model reflects geological concept and honors input data. Up-scaled grid (when applicable) properly reflects fine-scale grid behavior.	The objective of this milestone is to calibrate the static model to measured dynamic performance data such as MDT pressures, oil/gas rates, water breakthroughs, regional pressures, etc. The base model is not going to go forward until it is able to match observed reservoir performance.	The objective of this milestone is to utilize information from milestones #1-4 and from D&C regarding completion design in order to initiate the process of well optimization (casing and tubular requirements, artificial lift requirements, and material selection), well surveillance needs and well integrity plan.

Compass Knowledge Center

Deliverables

Deliverables Lists

Conventionals Discipline Milestone Summary

Summary of the Discipline Milestone Objectives & Deliverables

Milestone 4

Geology & Geophysics - Compartments, Connections & Saturation Model

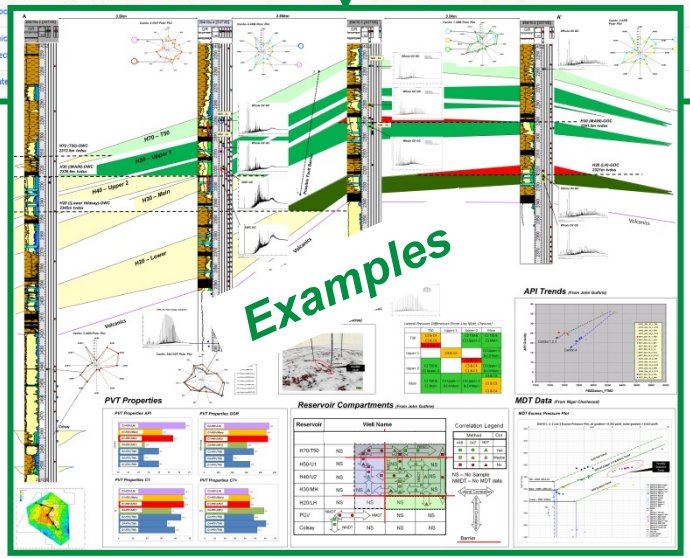
The objective of this milestone is to validate pressure, rock (both reservoir & seal), & fluid properties used to constrain seal capacities, compartments, and hydrocarbon distribution. The full range of uncertainty should be estimated and alternate scenarios considered. Primary products include demonstration of consistent representation of grid, properties, and compartments and baffles, estimates of seal capacity (incl. fault), and Hydrocarbon Pore Volume (HCPV) range.

	Deliverables	Recommended Products and Examples
1.	Validate Structural Input	• Structural Seal / Leak indicator of potential compartments: a) Fault plane maps with tip-out and throw; b) Allen diagrams with juxtaposition, SGR
2.	Validate Stratigraphic Input	• Stratigraphic indicator of potential compartments: 1) Mapping of intra-formation seals; 2) Mapping of high-resolution reservoir internal architecture
3.	Validate Hydrocarbon Systems Input	• Geochemical indicator of potential compartments: Display and plot of geochemical fingerprint (both HC and water) differences and similarities • Pressure indicator of potential compartments: Plots of pressure and overpressure for each well penetration showing differences and similarities in both water and HC pressure trends
4.	Validate Geophysical Input	attributes for fault identification • Integrated use of seismic velocity, analogs, basin modeling to derive pressure/seal capacity interpretation • For producing assets, 4D inversion products, if available
5.	Validate Reservoir Compartments	• Integrated reservoir compartment analysis: combining stratigraphic & structural interpretation with fluid pressure and geochemistry data to interpret connectivity and segmentation • Maps and cross sections showing loc
6.	Validate Reservoir Connections	• Identification of potential stratigraphic • Identification of potential fault connec
7.	Validate Geomodel Properties	• Displays and tables showing estimate

Compass

Conventionals Subsurface Knowledge Center

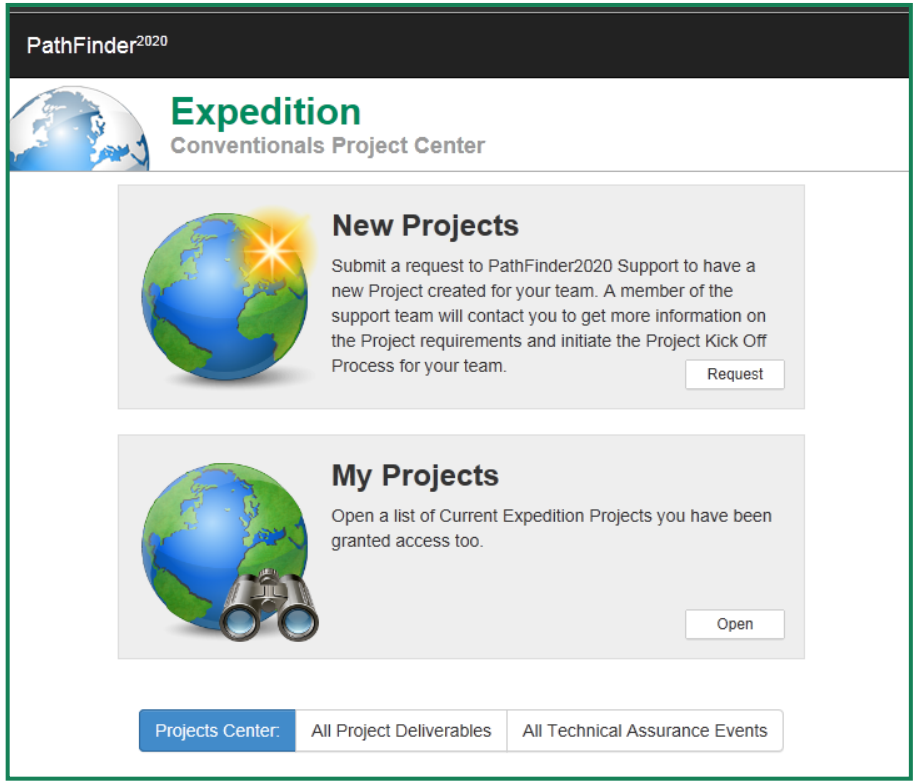
Technical Assurance	IMR A				IN		
Project Milestones	Milestone 1	Milestone 2	Milestone 3	Milestone 4	Milestone 5	Milestone 6	Milestone 7
Petrophysics	Data Review & Project Strategy	Well Log & Core Data Integration	Petrophysical Properties		Final Rock & Fluid Ranges		
Geology & Geophysics	Data Review & Project Strategy	Framework & GRV Model	Property Model	Compartments, Connections & Saturation Model	Static Base Case Model(s)	OHIP	Alternative Well Plans and/or Alternative Field Development Plan (FDP)

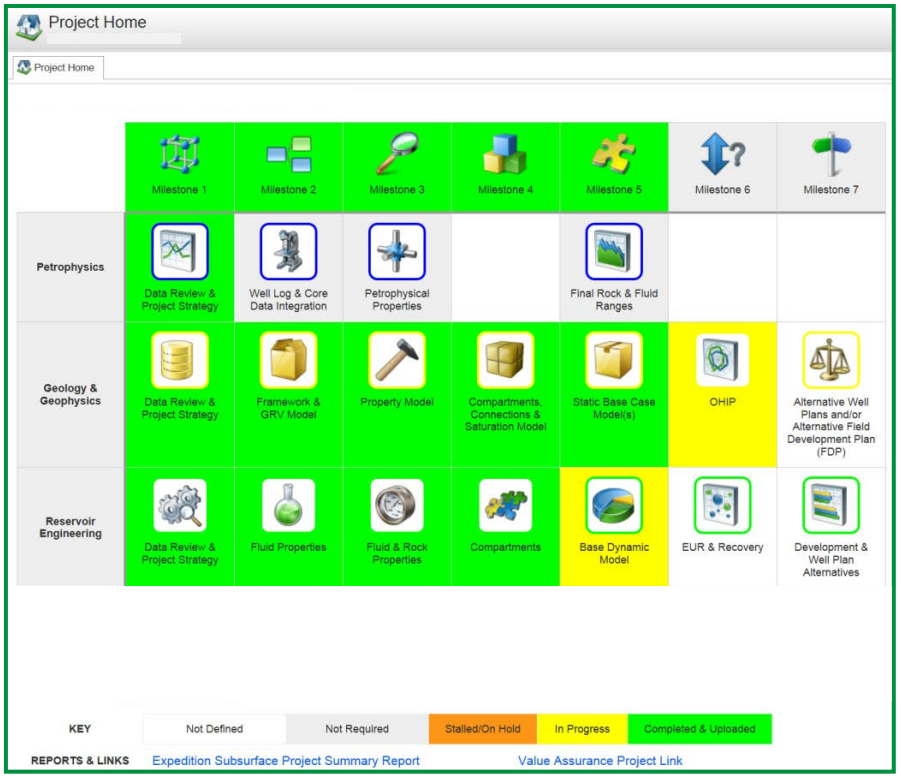


Expedition Project Center

Project Tracking

These Boards Tell A Story

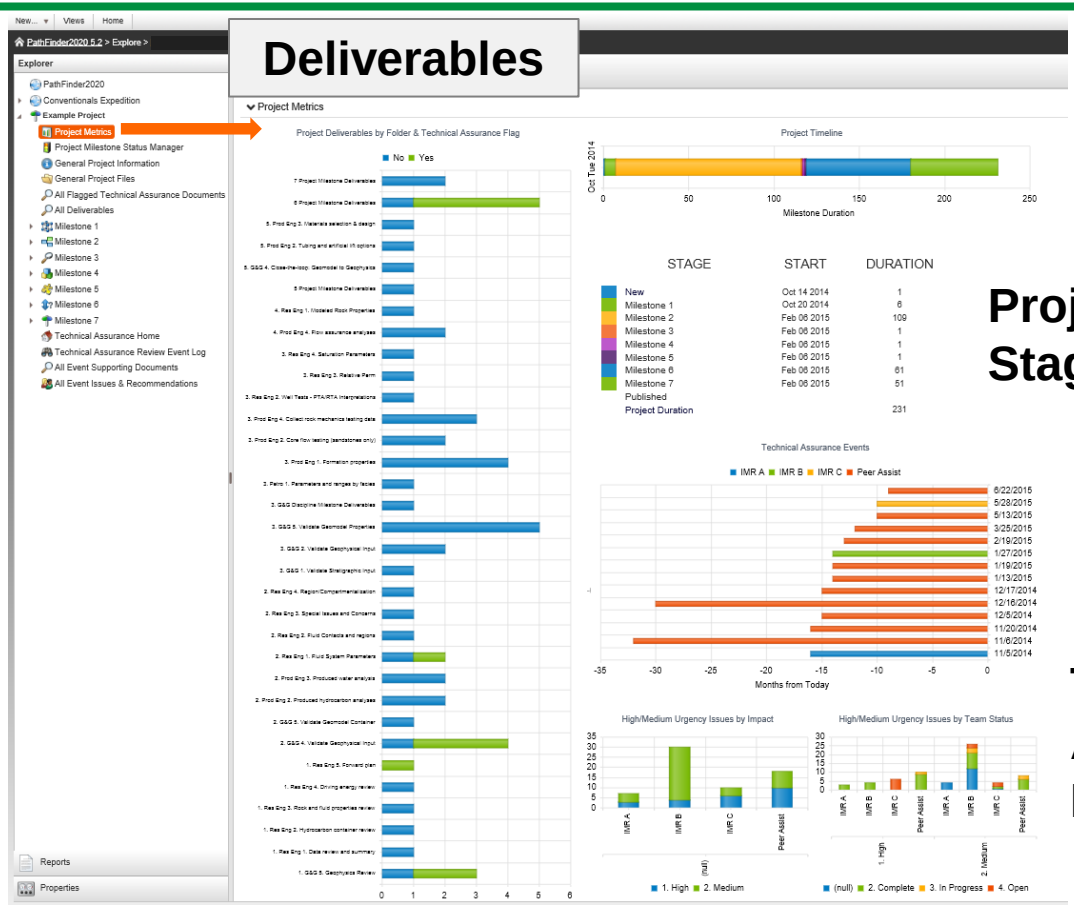




Expedition Project Center

Project Metrics

PathFinder Project Directory "Tree"



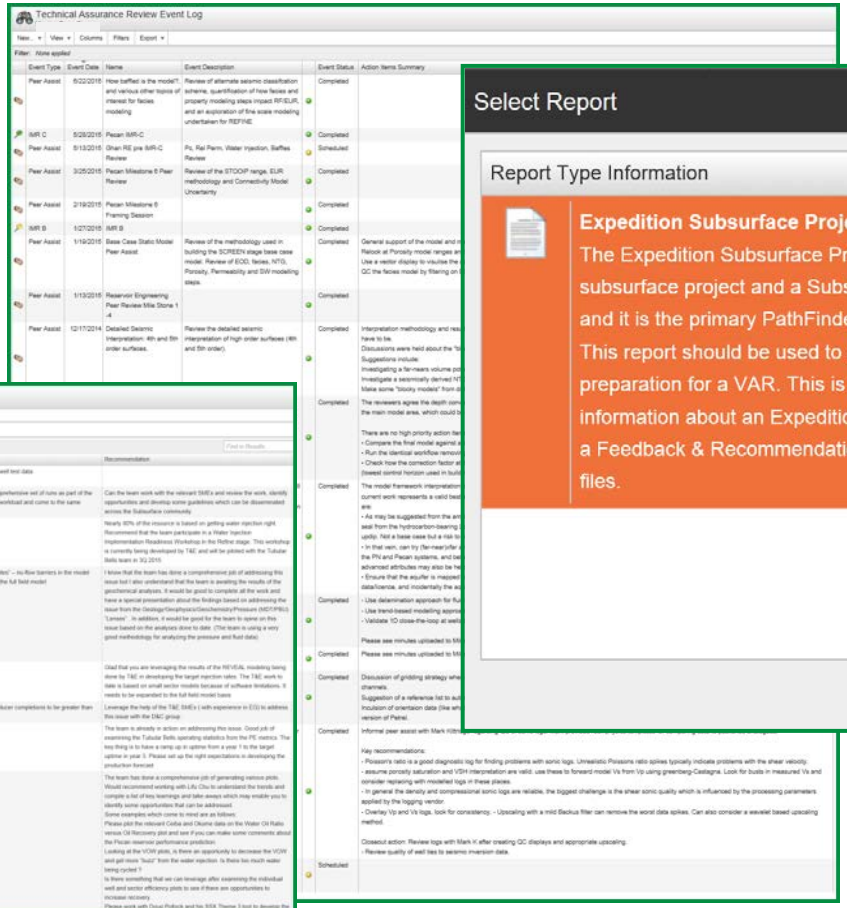
Project Timeline & Stage Duration

Technical Assurance History

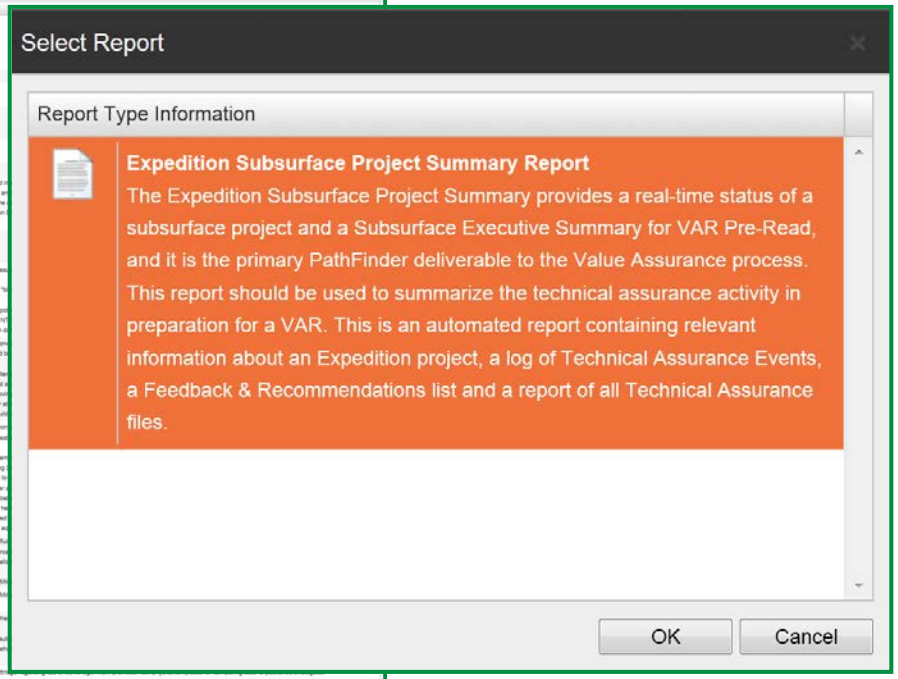
Expedition

Technical Assurance Home

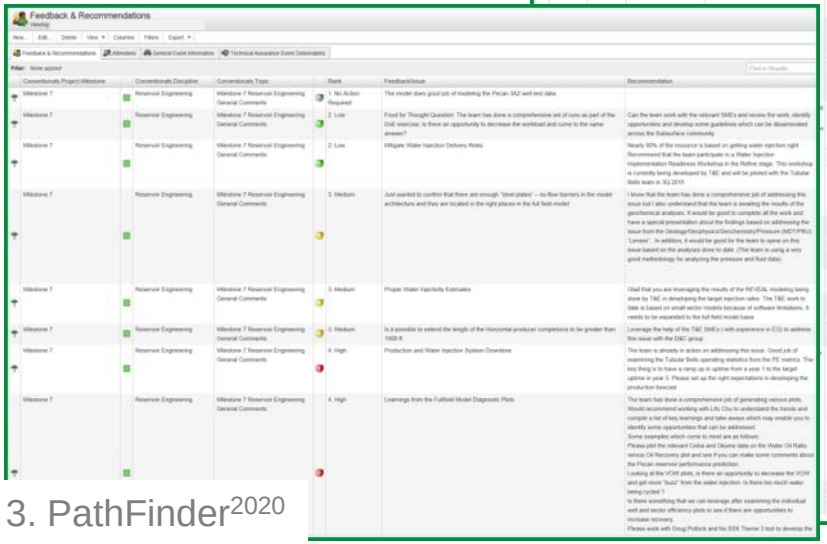
Technical Assurance Events



Reports

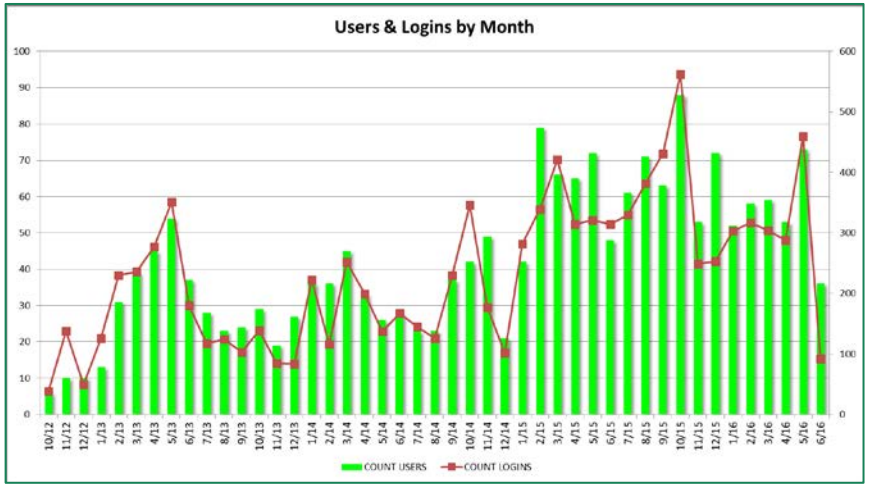


Reviewer Feedback

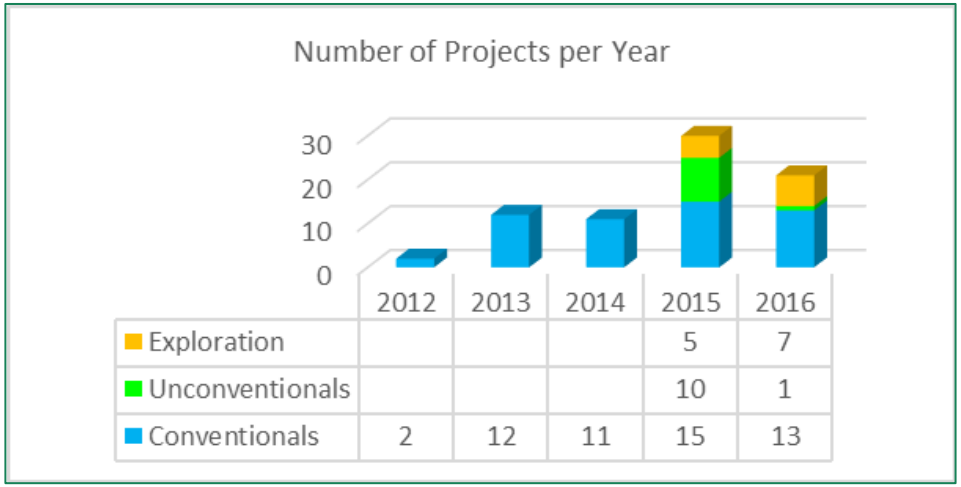


Technical Assurance Database

PathFinder^{2020} Implementation 2012-2016



Total PathFinder Usage



Expedition Project Count

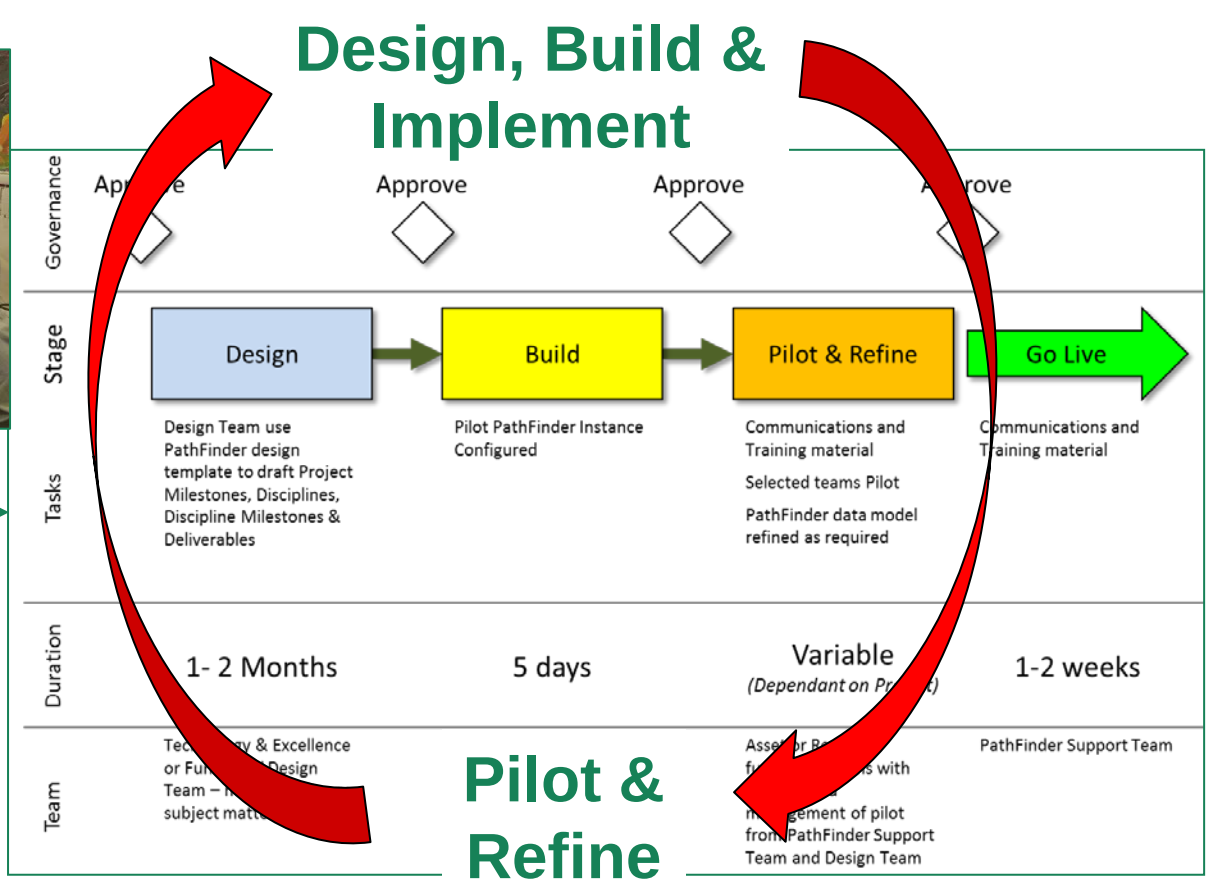
Main Points

- ✓ Growth is Organic
- ✓ No Executive Management “Edict”
- ✓ No Formal Roll Out or Training
- ✓ Distinct versions for different organizations

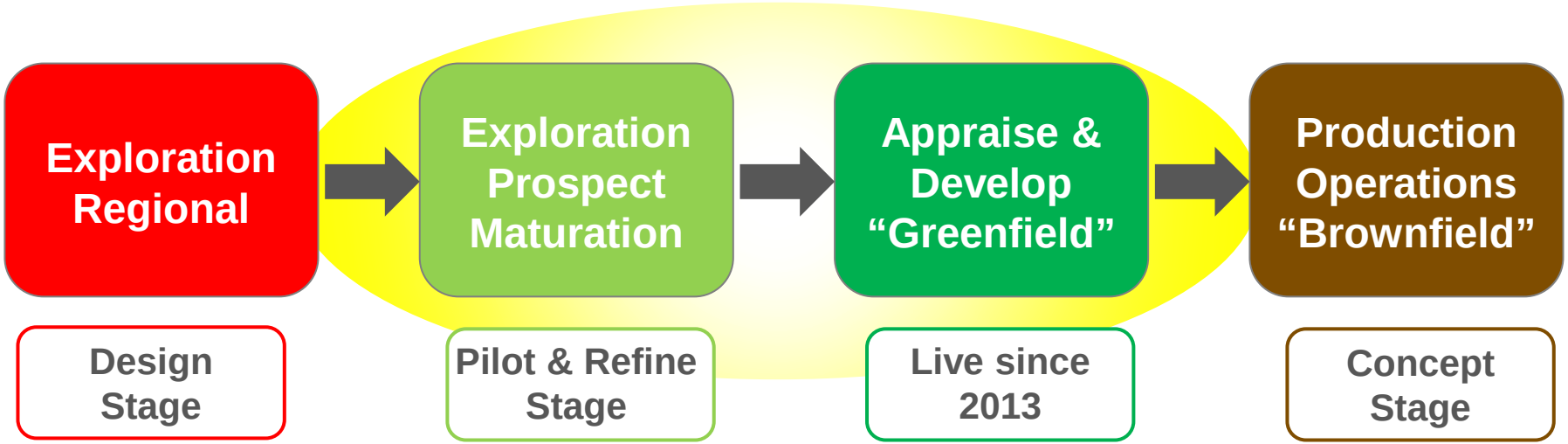
PathFinder2020

Design to Go Live Process

Team discussing New Exploration – Regional PathFinder Design



Getting Closer to the Goal



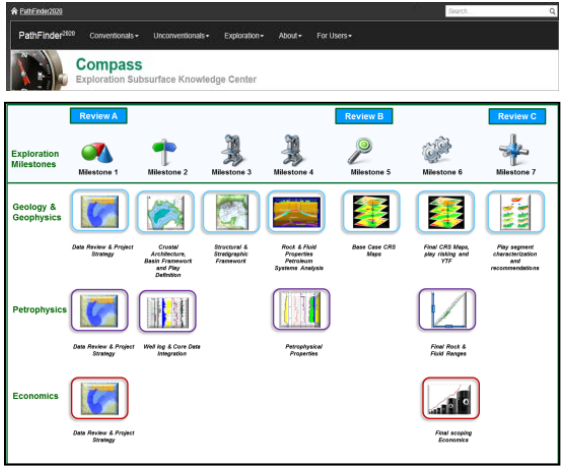
Common system for subsurface evaluations throughout the global E&P business

PathFinder2020

Getting to 1st Oil

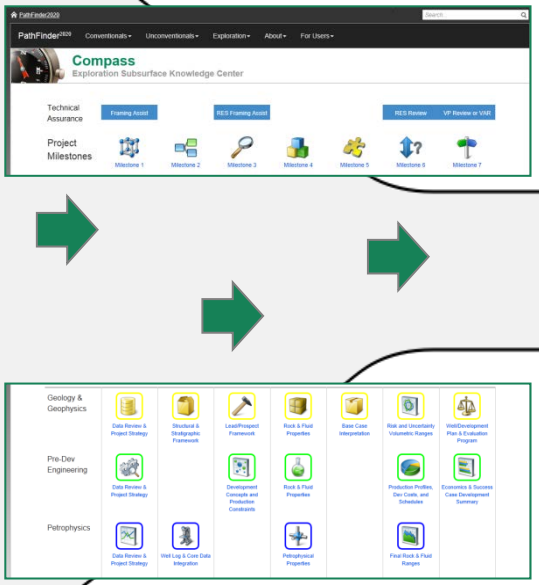
Exploration Regional

Access | Basin | Play



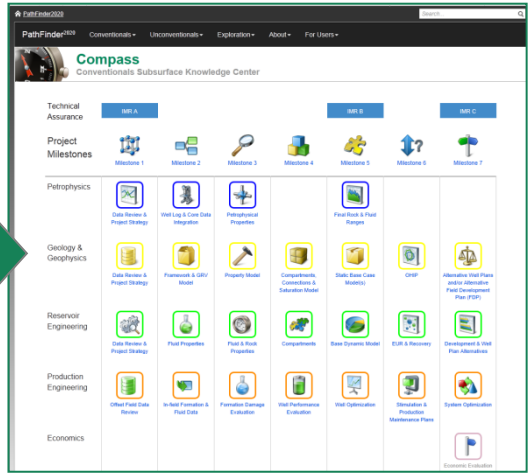
Exploration Prospecting

Lead | Prospect | Drillable | Drill Ready



Appraisal & Development

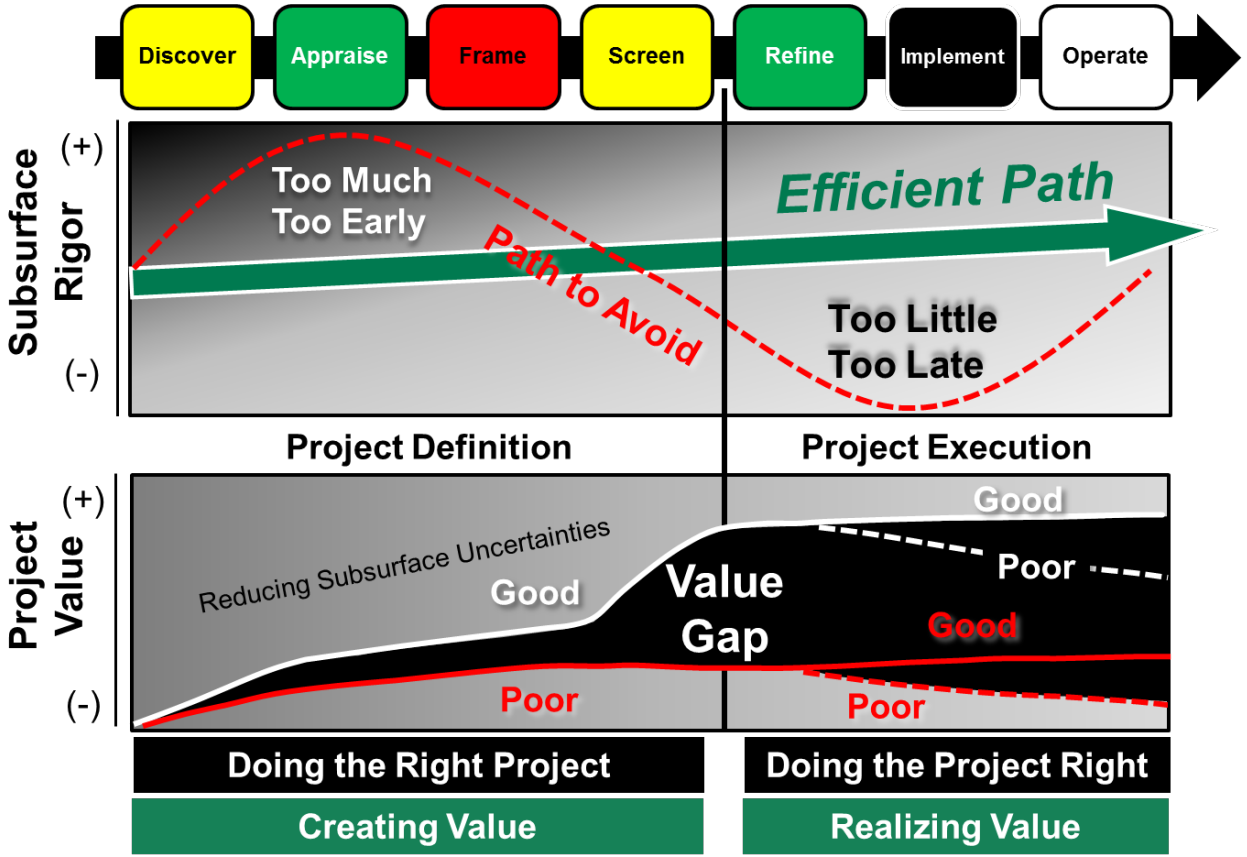
Frame | Screen | Refine | Impli ment



Quality Opportunities

Through the Funnel Faster

What is the Efficient Path?



- ✓ Doing the Right Work
- ✓ In the Right Way
- ✓ To Answer the Right Questions
- ✓ At the Right Time
- ➢ **PathFinder is the Way we Do It**

Not Simply a Tool

It is a *way of working* that leads to:

- Higher quality, consistency and comparability

- An efficient (Lean) method for subsurface evaluations because of the:
  - standardization of work
  - intelligent data base it creates
  - reporting functionality

- Knowledge management regarding our assets and a corporate memory of the technical basis for the business decisions we make