

# Enabling Rational Decisions Through Digital Oil Fields



*In today's tough business environment, achieving production levels and replacing existing reserves are becoming challenging goals for upstream oil and gas organizations. Many of them are increasingly falling back on their existing asset base and making significant investments to improve production and recovery from them. In fact for organizations with sizable asset base, just 1% improvement on their expected recovery has potential to add many millions of barrels to their reserve base. Many successful efforts in this area have reported considerable benefits in terms of profitability and recovery.*

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Every oilfield has limited amount of hydrocarbons that can be produced economically. However producing that limited amount also requires constant asset vigilance and superior decision making that can identify and address potential threats to production and recovery throughout asset lifecycle.

Adoption of Digital Oil Fields (DOF) in upstream industry has been a widely practiced business improvement initiative focused on optimizing production and recovery through improved collaboration, streamlined workflows, right tools and better information management. Successful DOF programs have resulted in improved organization capability leading to better decision making and business outcome.

Based on our involvement in several industry DOF projects, a key success factor is the ability to identify right capabilities to pursue in DOF implementation. Many DOF programs have been started with poorly

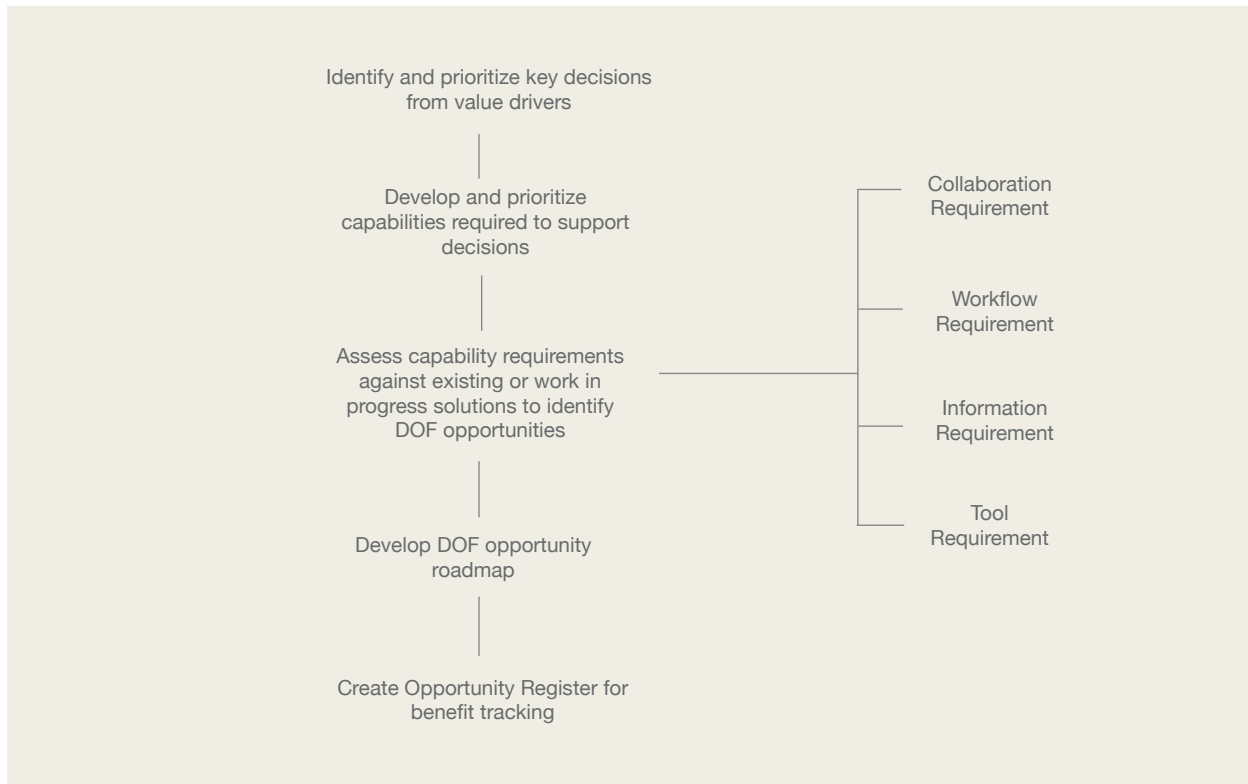
defined, misaligned or ambitious scope, resulting in lost opportunities or unclear benefits. A robust opportunity framing methodology is a must for organizations embarking on their DOF journey to generate maximum value out of it.

This article explores a decision-based framework to identify key decisions and capabilities (in new DOF programs) or ascertain if right capabilities have been included in the DOF roadmap (for existing programs). Framework can also be used to track benefits generated through DOF program in specific business areas. Fig 1 shows a high level summary of the framework.

### **Decision Making Challenges in Oilfields and Role of DOF**

Traditionally upstream organizations have been structured in departmental/discipline silos (operations, subsurface, petroleum engineering, etc.) with limited and ad-hoc interactions between them. Shift towards asset based organization model hasn't completely removed these silos as cultural, process and information barriers still exist. This has affected both quality and speed of decision making as each departmental silo has looked at different parts of the production system from their perspective and not from integrated production system perspective.

*Fig 1. High level decision-based framework for DOF opportunity identification*



To illustrate how this impacts decision making, let's consider an example of an oil field where a high producing well has shown high water-cut and as a result oil production from the well has reduced. Fig 2 shows different parts of the production system, various stakeholders responsible for them and their decision considerations.

In this example decision considerations are influenced by departmental goals that need to be honored by individual disciplines. This creates a lot of complication when various decision options exist for the problem and when certain decisions need to be made in a fairly short term to avoid business impact (in this case production loss).

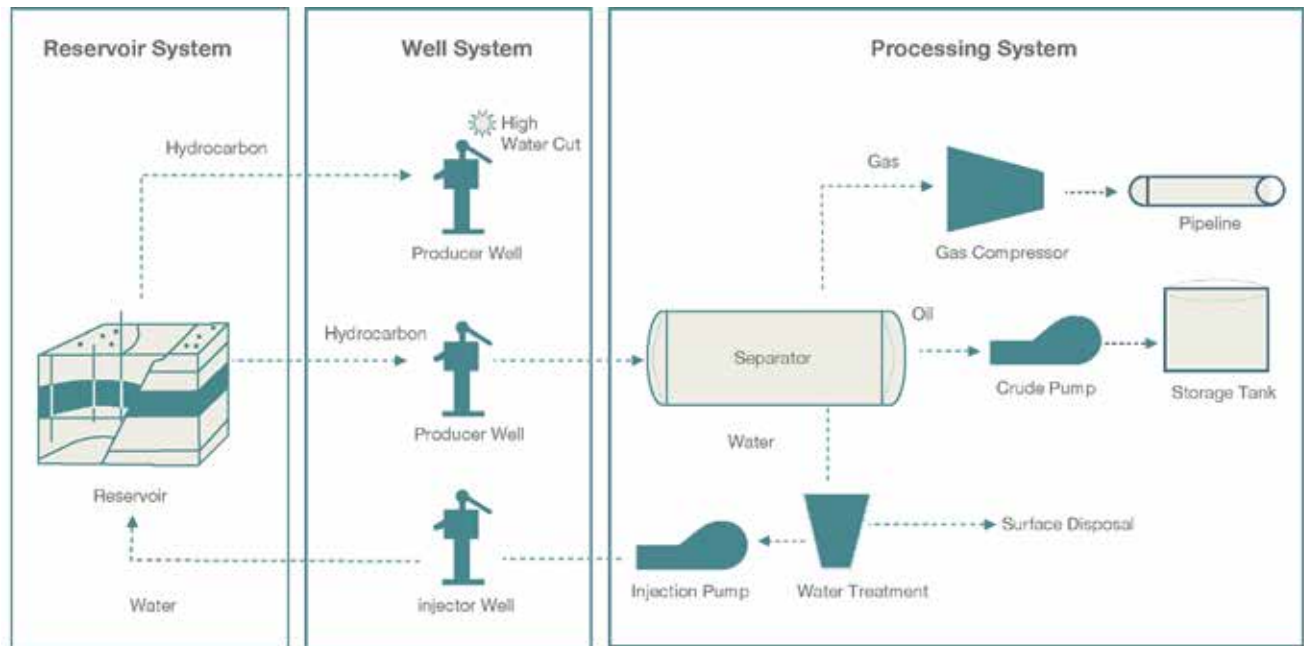
Table 1 presents an example of decision options common in such situations along with their associated timescales.

Traditional way of working in silos in this situation would delay the decision making as different disciplines may spend a lot of time to find all the relevant information, clarify their understanding of the problem with each other and identify various decision options. Also if the organization lacks sophisticated tools, they may not identify right decisions or effectively evaluate long term economic or recovery impact of these decisions.

The overall result is high production deferment, suboptimal recovery or high cost solution.

**Fig 2. Integrated Production System**

Illustration of a high water-cut scenario in a field and decision considerations of various departments



	<b>Reservoir Engineering</b>	<b>Production Engineering</b>	<b>Process Engineering</b>	<b>Maintenance and Integrity</b>	<b>Field Operations</b>
<b>Departmental Goal</b>	Manage reservoir and recovery	Manage well production and integrity	Manage facility processing efficiency	Manage equipment reliability and integrity	Manage production target, activity and HSE
<b>Decision Consideration</b>	<ul style="list-style-type: none"> <li>Shut-in well for work-over</li> <li>Manage draw down from other wells</li> </ul>	<ul style="list-style-type: none"> <li>Reduce production from current well and increase from other wells to maintain production</li> <li>Start Gas Lift in well to maintain production</li> </ul>	<ul style="list-style-type: none"> <li>Reduce production to manage separator water handling constraint</li> <li>Can't provide gas lift due to gas handling constraint on facility</li> </ul>	<ul style="list-style-type: none"> <li>Can't operate gas compressor at higher speed due to reliability issues</li> </ul>	<ul style="list-style-type: none"> <li>Maintain production level</li> <li>Reduce surface water disposal</li> <li>Can't plan immediate work over due to POB constraint</li> </ul>

**Role of Digital Oil Field (DOF) in Improving Decision Making**

The example above shows typical decision challenges that may exist across the organizations and impact business performance. This is where organizations are increasingly turning towards DOF to develop response to these challenges.

DOF is generally defined as a business improvement program that aims at developing upstream organizations' capability to make better decisions through a

combination of collaboration, workflow improvement, data and technology.

Over the last few years, we have seen many DOF programs getting started across organizations with key objectives of optimizing production and recovery. All of these initiatives demonstrate capability building in a few or all of the following areas:

- **Collaboration:** Efficient and structured collaboration between different disciplines

*Table 1: An example of decision options*

	Decision Time-Scale	Decision Type
Decision Option1	Short Term (Hours- Days- Weeks)	Reduce production from current well to manage separator water handling constraint + increase production from other wells to maintain production
Decision Option2		Start gas lift in current well to maintain production + optimize gas lift in other wells to honor gas supply constraint
Decision Option3		Reduce production from current well to manage separator water handling constraint + Accept reduction in production
Decision Option4	Medium/ Long Term (Months-Years )	Shut-in and work-over current well to shut off water production + increase production from wells + optimize simultaneous operation to allow POB for work-over
Decision Option5		Expand separator capacity to handle increased water production
Decision Option6		Debottlenecking of gas compression to increase gas lift supply

- **Workflows:** Streamlined and well specified workflows
- **Tools:** Standard tools and visualization systems, Decision support systems
- **Data Management:** Good quality, real or relevant time data easily accessible

Multiple opportunities for capability improvement usually exist in each one of these areas and right capabilities need to be pursued by organizations initiating a DOF program. Based on our involvement in several industry DOF projects this is identified as a key success factor. Many DOF programs have been started with poorly defined, misaligned or ambitious scope resulting in lost opportunities and unclear benefits.

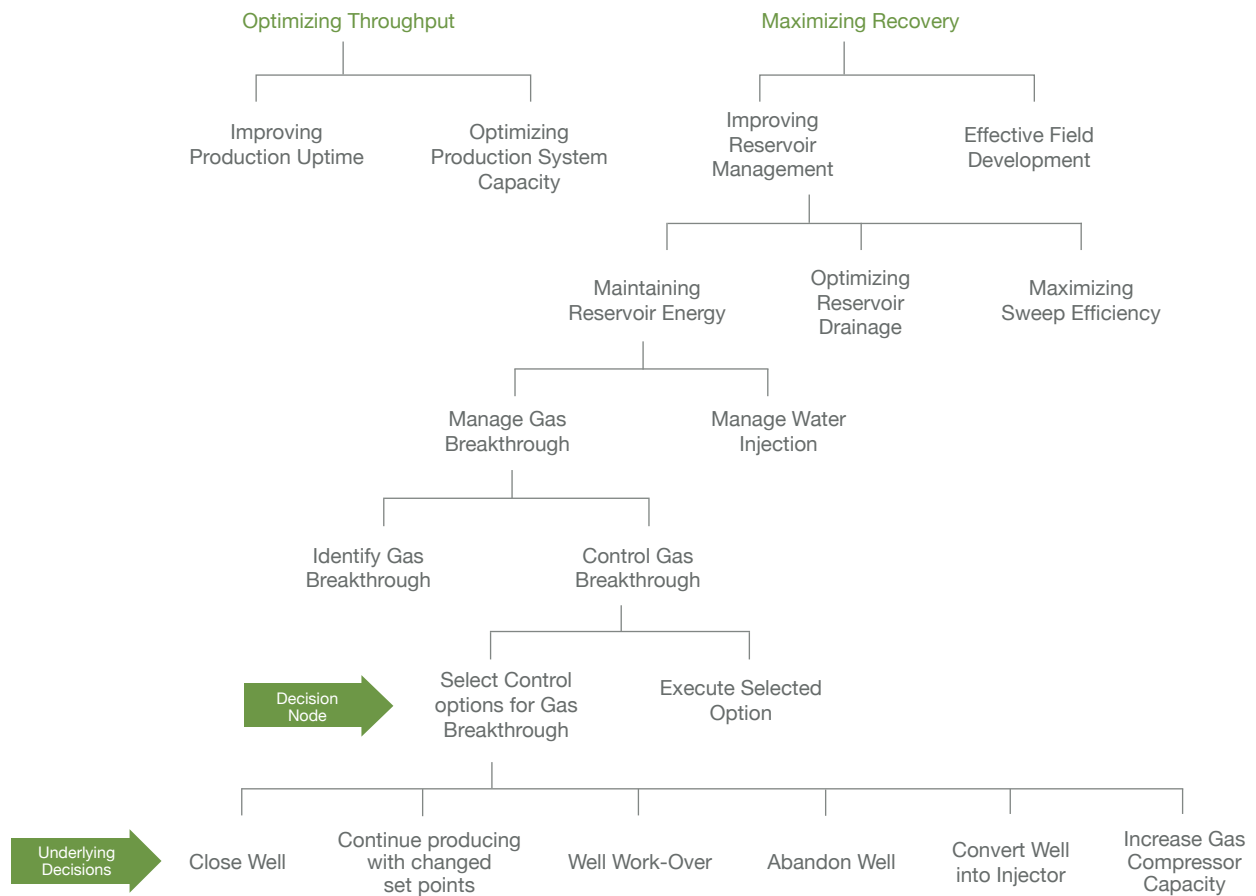
It’s not uncommon to see organizations, starting on their DOF journey, grapple with questions such as “What capabilities should we pursue in our DOF roadmap to realize maximum value?” or “What specific decisions can and should be improved through DOF implementation?”

Hence choosing the right DOF strategy is vital for upstream organizations to maximize their return from it.

**Decision-Based Opportunity Framing Methodology for DOF Implementation**

Decision based framework looks at identifying organization capabilities from the point of view of key decisions that they support. These capabilities are then

*Fig 3: A value tree breaking down business value drivers into low level operational drivers and identification of key decisions for one value driver*



translated into opportunities to be pursued in DOF implementation plan. This provides organizations a clear view of how their DOF investments would drive improvements in their decision making.

Following is a high level description of five key steps involved in the framework.

**1. Identify and prioritize key decisions from value drivers:** Value drivers need to be identified through

engagements with key stakeholders. A value tree should be constructed to segment the value drivers to the level where decision nodes become apparent. Once a decision node is reached, the underlying decisions should be listed for a particular value driver.

Fig 3 shows an example of value tree and its segmentation to decisions for one of the value drivers. Similarly other decisions can be identified for other value drivers at their decision nodes.

*Fig 4: An Illustration of capability identification to support various decisions occurring across various time-scales*

	Short Time Scale Decisions	Medium Time Scale Decisions	Long Time Scale Decisions
	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Close Well</div> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Continue producing with changed set points</div>	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Well Work-Over</div> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Abandon Well</div>	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Convert Well into Injector</div> <div style="border: 1px solid black; padding: 5px; display: inline-block;">Increase Gas Compressor Capacity</div>
	<ul style="list-style-type: none"> <li>• Reservoir Engineer</li> <li>• Production Engineer</li> <li>• Process Engineer</li> <li>• Production Coordinator</li> <li>• Production Supervisor</li> </ul>	<ul style="list-style-type: none"> <li>• Asset Manager</li> <li>• Operations Manager</li> <li>• Reservoir Engineer</li> <li>• Production Engineer</li> <li>• Integrated Activity Planner</li> <li>• Well Service Group</li> </ul>	<ul style="list-style-type: none"> <li>• Asset Manager</li> <li>• Operations Manager</li> <li>• Reservoir Engineer</li> <li>• Production Engineer</li> <li>• Process Engineer</li> <li>• Production Planner</li> <li>• Integrated Activity Planner</li> <li>• Project Engineering Group</li> </ul>
	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Efficient On-demand collaboration between disciplines</div>		
	<ul style="list-style-type: none"> <li>• Short Term Production Optimization workflow</li> </ul>	<ul style="list-style-type: none"> <li>• Well Review Workflow</li> </ul>	<ul style="list-style-type: none"> <li>• Facility Review Workflow</li> </ul>
	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Streamlined and well specified workflows</div>		
Capabilities Required	<ul style="list-style-type: none"> <li>• Real Time Data</li> <li>• Production History</li> <li>• Integrated Asset Model</li> <li>• Models</li> <li>• Short Term Production Forecast</li> <li>• Limit Diagram</li> </ul>	<ul style="list-style-type: none"> <li>• Production History</li> <li>• Models</li> <li>• Pressure Surveys</li> <li>• Well Logs</li> <li>• Reservoir Maps</li> <li>• Well Event Register</li> <li>• Medium Term Production Forecast</li> <li>• Medium Term Activity Plan</li> </ul>	<ul style="list-style-type: none"> <li>• Production History</li> <li>• Models</li> <li>• Well Model</li> <li>• Long Term Production Forecast</li> <li>• Long Term Activity Plan</li> <li>• Asset Opportunity Register</li> </ul>
	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Quality data easily accessible</div>		
	<ul style="list-style-type: none"> <li>• Real Time Data Visualization</li> <li>• Modelling Tools</li> </ul>	<ul style="list-style-type: none"> <li>• Wellbook</li> <li>• Reservoir Book</li> <li>• Modelling Tools</li> <li>• Excel</li> </ul>	<ul style="list-style-type: none"> <li>• Wellbook</li> <li>• Reservoir Book</li> <li>• Facility Book</li> <li>• Modelling Tools</li> <li>• Excel</li> </ul>
	<div style="border: 1px solid black; padding: 5px; display: inline-block; margin-right: 10px;">Standardized tools</div>		

Identified decisions should be ranked and prioritized based on various criteria such as criticality of value drivers, occurrence and complexity of decisions. For example in Fig 3, a decision like increasing gas capacity has very limited occurrence and can be pushed down the ranking list.

Decisions can be grouped into short, medium and long time-scale to identify their time-criticality and help in further prioritization.

**2. Develop and prioritize capabilities required to support decisions:** Organization capability requirements should be identified through extensive engagement with stakeholders. They can be categorized under various themes such as Collaboration, Workflow, Information and Tools. This should be done for all decision nodes. Fig 4 illustrates various capabilities required to support underlying decisions identified in Fig 3 for “Maximizing Recovery” value driver.

Once all capabilities are identified they should be further prioritized based on decision time-scale or capability areas. For example in Fig 4 only short time-scale decisions can be considered.

This step provides a final list of capabilities to be considered in DOF implementation roadmap.

**3. Assess capability requirements against existing or work-in-progress solutions to identify DOF opportunities:** Gap analysis should be done against existing or work-in progress solutions in the organization and areas where solutions are not found can be identified as opportunities. Moreover where solutions exist, it is recommended to do a high level maturity assessment to gauge their effectiveness and suitability for inclusion in opportunity list.

**4. Develop DOF opportunity roadmap:** This provides an integrated view of opportunities and

their implementation plan. Relevant criteria should be developed in collaboration with key stakeholders and applied to prioritize opportunities.

**5. Create opportunity register for benefit tracking:** Before starting with roadmap implementation, all the opportunities should be comprehensively documented along with their relationship with key decisions, key assumptions and business justification for opportunity selection. This serves as a baseline to track improvements against the expected benefits post implementation.



**Summary**

Throughout the asset lifecycle, many key decisions are taken that have significant consequences for production and recovery. Upstream organizations looking to maximize their performance in these two areas need to develop strong capabilities that can improve their decision making.

DOF has been emerging as a key platform to enable organizations to build those capabilities.

Given that multiple opportunities may exist for DOF implementation and each of which may require significant investment and change management, organizations need to pursue the right DOF strategy to identify and pursue relevant capabilities that address key decisions in the organizations.

A decision-based opportunity framing methodology can help in identifying key decisions and the right set of capabilities which can then be translated into an opportunity roadmap. This also allows tracing opportunities back to business value drivers and KPIs which in turn can help in tracking benefits from DOF investments. ■

