

Gaffney
Cline

Mature Fields Optimisation



About GaffneyCline

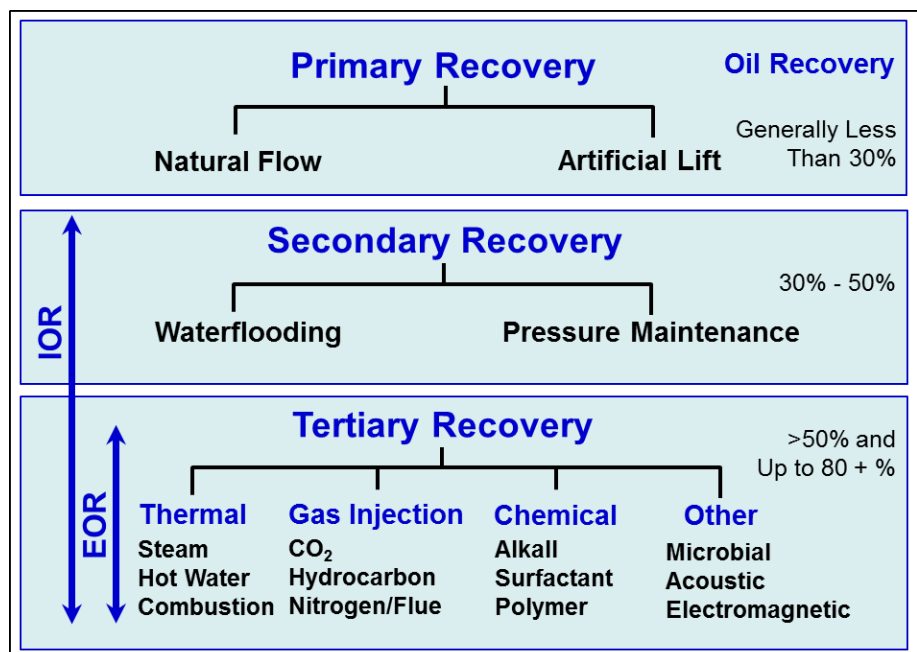
GaffneyCline is a global consultancy that has been offering technical, commercial, and strategic advice to the oil and gas sector since 1962. GaffneyCline's reputation demonstrates that its advice, along with its insight, is high-quality, impartial, technically based, and commercially astute. GaffneyCline is often referred to as one of the leading Reserves consultants within the industry, but in reality, GaffneyCline offers a full range of upstream, midstream and downstream technical and commercial consultancy services. These include seismic interpretation, static and dynamic reservoir modelling, field development planning, field engineering, gas monetisation, LNG/GTL, expert witness, mergers and acquisition, economics and project finance. GaffneyCline operates worldwide from three main offices in London, Houston and Singapore, and from regional offices located in Buenos Aires, Sydney and Dubai.

Mature Fields Optimisation

There are many angles to be considered when describing a field as mature. An oil field can be considered as mature when its production rate has significantly declined and/ or when it is close to reaching its economic limit. A field might also be considered mature when it has been in production for many years and has depleted its primary and secondary recovery. Consequently, facilities and technology at mature fields could be old. However, far from being diminishing assets, these mature fields offer one of our most important opportunities to extract further oil and gas resources to meet future energy demands. While the world hydrocarbon demand is estimated to increase by approximately 1.5% per year, the number and size distribution of new discoveries are declining, whereas mature fields are more predictable (less risk and less uncertainty). Mature fields are also seen as attractive in uncertain times, given the benefits of regular, reliable cashflows.

GaffneyCline recognises through direct and extensive experience the typical needs of mature fields and the significance of fit for purpose models and technically appropriate solutions for such fields. The achievement of optimally profitable operations is particularly challenging in a low oil price environment; many projects are currently stalled due to weak forward economics. However, even if commodity prices are weak or flat, mature fields can be managed to improve the fiscal position by either reducing costs or increasing production.

Mature fields, many in the secondary or tertiary production phases, account for over 70% of the World's oil and gas production. Considering, the average recovery factor being circa 70% for gas and circa 35% for oil, innovative methodologies, combining new techniques and technologies, are proving that revitalisation activities can be economical, and



Source: Modified from SPE 84908

thereby increasing ultimate recovery by 20% or more. The development of these mature assets is significant to the global economy. Simply boosting the recovery factor of the World's existing oil fields by 1% would provide for two to three years of worldwide consumption.

The challenges for production optimisation of mature fields span the whole spectrum from field dynamics, facilities and their constraints as well as permitting and economics. A fully integrated approach to oil and gas project work, across all disciplines involved in the evaluation, is crucial to mature fields optimisation. Almost all operations can be improved. Most operators focus on the subsurface heavily, but facilities also dictate achievable rates, possibly to a greater degree than the subsurface in many cases.

Furthermore, appropriate evaluation of mature assets requires a judicious mixture of classical approaches and new technologies as the key for creating the opportunity for new life for mature reservoirs.

“Classical” Approach still very much applicable and includes:

- Review the data, ALL data
- Challenge assumptions – bring in a new set of eyes Know your physical set-up
- Understand laws, regulations and contracts Longevity, condition and lifespan

“New” Technologies can be game changers:

- 3D Visualization
- Geology to Reservoir to Market linked models/simulations
Horizontal drilling
- Fracture stimulation Real time pore pressure Facility revamp

The Process

The first step in any mature field optimisation should always be to ensure that available optimal well and facility capacity is being used, and to see how rates, utilisation, exports and uptime could be improved. Keys to mature field optimisation include:

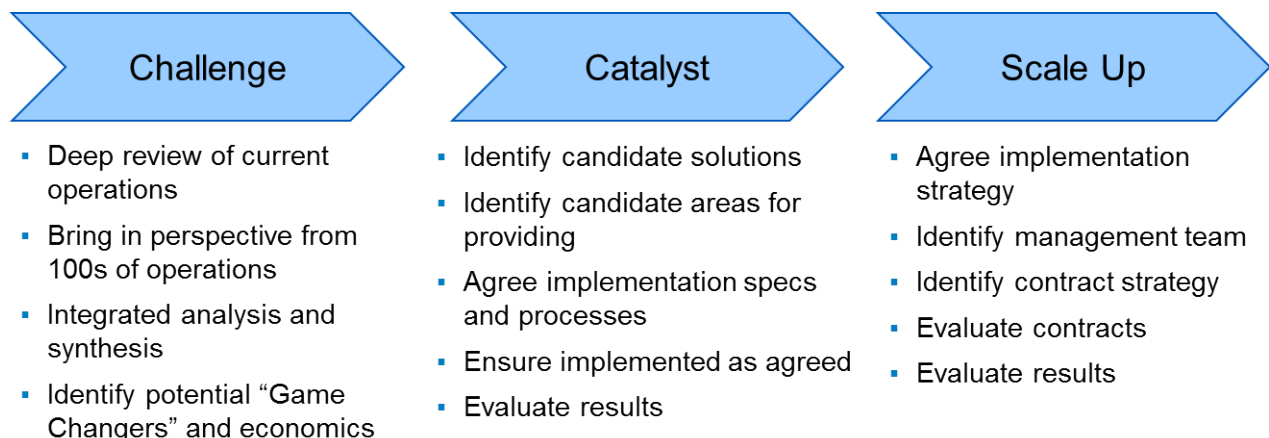
Reservoir Management: issues such as allocations; gas / water breakthrough; the appropriate well spacing; etc.

Wells and Completions: lift technologies; chemistry, well clean-up processes, cost vs zonal control trade-off; work-over processes; etc.

Facilities: such as manning levels; minimal well slot cost, realignment of processes, sharing of facilities, etc.

Commercial: contract operations; supplier’s discounts vs min volumes; lease vs ownership; EPC vs piecewise contracts, monetisation; etc.

Application of the MFO Process

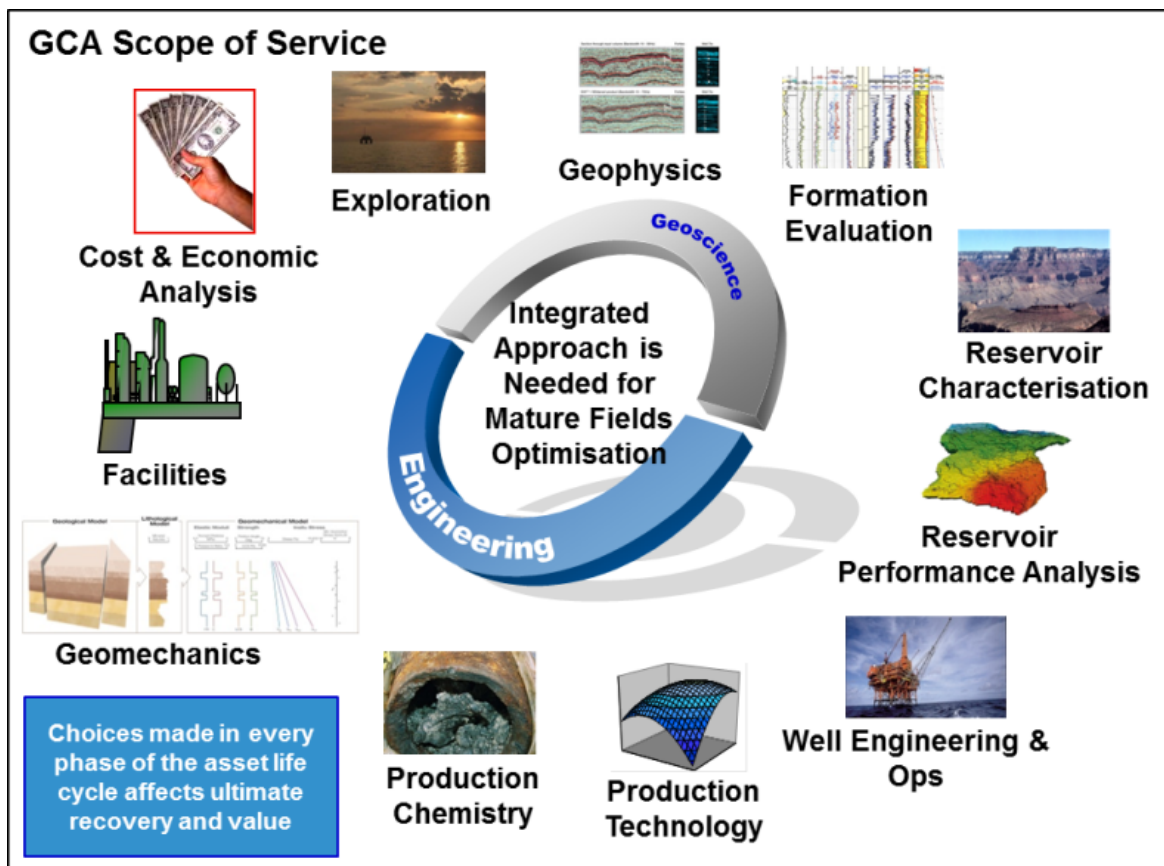


Scope of Services

GaffneyCline employs many experienced professionals who cover all technical, operational and regulatory disciplines across the entire hydrocarbon spectrum. Our professionals use their considerable experience and training to look for weaknesses, gaps and inconsistencies in asset evaluations, development plans and project execution strategies. GaffneyCline covers in depth, through in-house expertise: exploration; geology; geophysics; petrophysics; geo-modelling; reservoir modelling, field development and management; wells and completions engineering; deep-water, onshore and offshore production; as well as transportation and downstream gas monetisation technologies of all types. We are skilful in conducting discussion across the specifics of each discipline and can claim a unique level of integrated evaluation skills.

GaffneyCline works with the asset owner, organisation or stakeholder to provide the required due diligence using senior and experienced professionals. Working within the industry for more than 50 years has provided GaffneyCline with unequalled experience in such type of work.

GaffneyCline has a core of senior personnel across all disciplines, typically with over 30 years' experience in the industry.



Our Experience

The following examples provide a brief overview of GaffneyCline experience in the area of mature fields optimisation. In all cases, GaffneyCline's role has focused on reservoir management, value retention and operational improvement where applicable.

Field Management - Mature Kazakh Field/World Bank Funded

GaffneyCline management of the field resulted in:

- Average Work-Over time reduced from 35 days to 10 days.
- Pump life increased from average 100 days to 300 days.
- Production increased by 70% in two years.

Achieved through:

- Optimised w/o procedures.
- Well monitoring.
- Appropriate pump selection.
- Improved production chemistry.
- Appropriate rig selection.

Field Development Review - Confidential Offshore Carbonate/ Mid East

GaffneyCline reviewed field operations and recommended an alternate development plan which saved \$20bn in CAPEX, \$12bn in OPEX over 25 years through:

- Optimised well configuration.
- Simplified completions procedures (lower cost, higher production per well).
Simplified wellhead platforms and offshore logistics.
- Enhanced metering, virtual metering and production allocation. Consolidated processing facilities.
- Simplified contract structures.

Due Diligence and Field Operations Review - Confidential Offshore Carbonate/Asia

GaffneyCline reviewed field performance where gas evolution below bubble point impacted well's production. GaffneyCline improved average well rate from 200 to 2,000 bpd - 9 wells saved for every 1 drilled.

GaffneyCline Proved Integrated Solutions

No prescriptive solutions, each project customised to meet goals. Examples include:

- Anadarko - Sonatrach (Algeria)
- Apache - Khalda (Egypt)
- BP - START Initiative
- Pico (Egypt) - 2 projects
- Shell EPT-AGI (The Netherlands)
- Shell - SPDC (Nigeria) - 2 projects
- Shell - Bapetco (Egypt) - 2 projects
- Petronas - D18 redevelopment
- UAE - Confidential field optimisation
- Occidental (Oman)
- Shell - PDO (Oman)
- Dominion (US) - tight gas
- Medco - Madura, Sulawesi
- ONGC - Mumbai High
- Uzenskoye - field redevelopment
- Confidential Client - Carbonate redevelopment
- Waha Oil Company/Libya - Sand complex redevelopment



For more information about GaffneyCline's integrated services, please contact your regional GaffneyCline office.

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