

Are you looking for more than a set of simulator profiles, churned out and put in a report?

Do you want engineering insight, design and optimisation of your field development?

Do you need solutions to non-standard problems?

Experienced managers and engineers in the oil industry all too often see more junior staff, lost in the details of their latest big computational models, failing to analyse properly the key decisions that need to be made – “What recovery mechanism shall we use? How many wells do we drill? What facilities capacity do we need? How do we operate the artificial lift system? What do we do if reservoir permeability is better than we expect?”

To solve these problems and to derive early on the insights that would otherwise come from long and expensive experience, Serafim Consultancy uses mathematics and simplified system models in conjunction with the industry-standard computational models.

If you want high-quality reservoir and petroleum engineers with the tools to see the big picture, contact Serafim Consultancy.

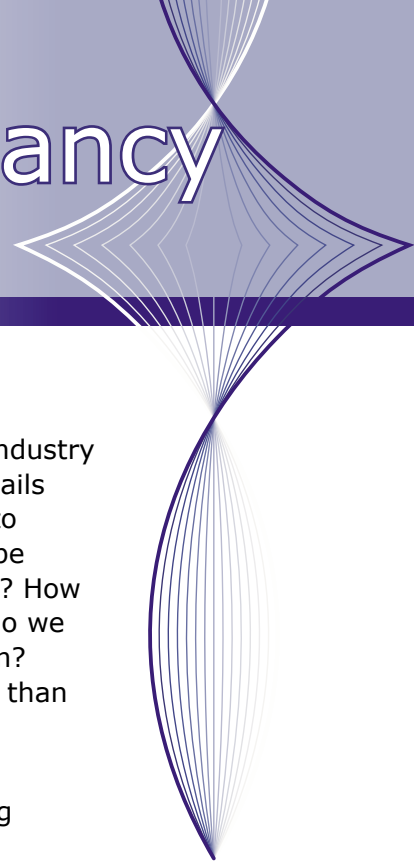
Challenging non-standard problems

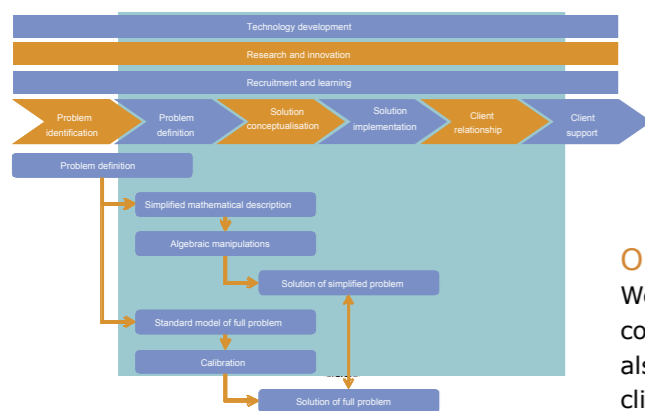
Serafim Consultancy has a proven record of accomplishment when it comes to successfully tackling non-standard problems in Reservoir and Petroleum Engineering. In many cases, as a result of working on a non-standard problem, we have created algorithms, based on a set of equations that we derived. Our clients continue to use our innovative methods and we have implemented several of our developments in our software packages.

C-Curves, Free Gas:Liquid Ratio, Dual Discount Rate for Project NPV are only a few examples of our achievements. We believe that our unique set of skills allow us to reach innovative solutions faster adding excellent value to our clients' business.

How can mathematics help your business decisions?

When we tackle a problem, we attempt to maximise the use of the, generally, scarce information available. Be it production history, petrophysical or geological data, we transform it into meaningful information by approaching it from different angles using different tools. For instance, we implement simple data mining techniques to understand the quality of the data or the interrelationships that may exist between apparently different unconnected parameters. We also derive theoretical limits for the probable variance of the data in order to avoid studying impossible cases when working on uncertainty issues. We thus uncover otherwise unobvious interpretations/limitations of the data improving your decision-making.





Our approach

We believe that our strength resides not only in the combination of skills and experiences that we have but also in the way we do things internally and with our clients. We work with our clients closely to define the problems they attempt to solve (be it an entire project (field development, acquisition, reservoir management etc...) or a non-standard problem (modelling unique reservoir behaviour, solving a complex production allocation problem, estimating the economic value of heavy oil fields etc). We then agree with our clients on a specific formulation of the problem that we model analytically before moving to work that is more detailed. We also work on maximising the use of the data available by mining for interrelationships and quality issues. The major contribution that Serafim Consultancy provides to its clients is the problem specific analytical model that will be used both to understand the situation better and to assess the detailed work (like simulations).



Our work with clients (directly or through virtual teams), is supported by our capacity to learn and innovate. We have a strong record of accomplishment of deriving specific formulations for non-standard problems and the development of cutting edge algorithms to solve them. Moreover, we enjoy sharing our knowledge with our clients and learning from them.

Why is our service relevant for you?

We can add true value to your business when working with you on technical issues central to your business. We may be helpful if you are:

- Looking for high quality reservoir and petroleum engineers capable of using both the industry-standard software and basic mathematics and engineering reasoning.
- Needing additional resources to carry out in-depth analyses of the opportunities you come across
- Challenged by non-standard reservoir engineering problems
- Needing a simple yet robust analytical model of the behaviour of your reservoir to make an immediate decision
- Studying the potential of a field using a limited amount of information
- Setting up a calculation methodologies for a commercially sensitive parameter (production allocation, production optimisation, lift optimisation, specific project assessment measure etc)
- Engaging in R&D projects and wanting an outsider's input

Our offer

Our consultancy service can offer support on:

Standard problems

- Project appraisals and economics
- Field development planning
- Reservoir characterisation
- Reservoir modelling and simulation
- Acquisition appraisals
- Reservoir management
- Production optimisation
- Risk analysis

Non-standard problems

- Modelling unique production fluid characteristics
- Modelling unique reservoir behaviours
- Solving complex calculations such as production allocation
- Optimisation of
 - Field development
 - Pressure networks
 - Production

Success stories

Heavy oil field development study

Context: The client was launching, together with a National Oil Company (NOC), a joint study of a difficult, heavy oil field. The client needed the study to show-case its expertise and demonstrate to the NOC the benefits that might arise if the client were given acreage to operate. Unfortunately, the work-load on the client's existing acreage had just gone up. Where would they find at short notice highly-expert staff to assist on the project?

Serafim Consultancy Contribution: Serafim supplied a reservoir engineer and petrophysicist to be part of the client's multi-discipline team and work in conjunction with the client and NOC reservoir engineers. The Serafim engineer helped with log analysis, well-test analysis, reservoir simulation and training and support of the NOC engineers.

Benefits: The Serafim reservoir engineer helped resolve the uncertainties about asphaltene behaviour and the discrepancies between well-test behaviour and laboratory PVT measurements. The NOC staff expressed themselves as very pleased with the training and support.

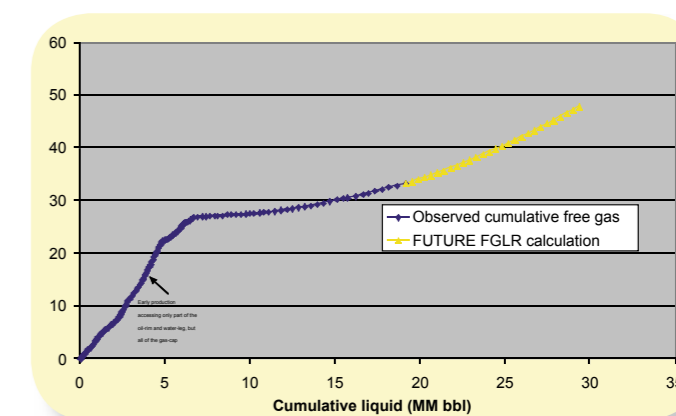
Free gas:liquid Ratio*

Context: our client, then a small producer with operations in Western Africa needed to model thin oil rim fields, with extensive gas coning. The bigger fields had reservoir simulation models, but the smaller and older fields did not. For investment and planning reasons, our client needed to forecast overall gas and oil profiles using the basic information on:

- Past production
- Gas coning
- The Geology of the reservoirs

Serafim Consultancy contribution: We derived a new algorithm to forecast associated gas production. The algorithm was based on the observation that, once the gas cones reach the production wells, the gas-liquid contact tends to reach an equilibrium position, with an associated equilibrium free-gas: liquid ratio that can be calculated from the gas and liquid volumes in place. The new algorithm was implemented in a software routine as part of the client's decline analysis work-flow.

Benefits: The resultant gas production forecasts have proved robust and suitable for both medium and long-term production forecasting. The insight into the fundamental mechanisms of oil-rim gas coning has helped determine the optimal choice of well cut-back criteria.



*More detailed presentation is to be published soon in open literature and on our website

C-Curves[†]

Context: In a combined reservoir/facilities/economics model of a heavy oil field, decline curves were being used to interpolate between the results of a small number of simulator runs. However, neither exponential nor hyperbolic curves gave a good match to the simulator profiles, whose decline rates diminished with time and then stabilized.

Serafim Consultancy Contribution: The Serafim reservoir engineer derived a mathematical formulation more general than the hyperbolic curve and successfully used it to match the simulator profiles.

Benefits: The combined reservoir/facilities/economics model was successfully calibrated to the simulator runs and then used for multiple optimisations, sensitivities and Monte Carlo calculations that would have taken an impossibly long time to calculate if the simulator had been directly linked into the combined runs. The client was able to analyse the full range of field development options, taking into account the key uncertainties in STOIP, reservoir quality, well deliverability and reliability.

[†]Details in SPE paper 96092

Production Allocation

Context: A major North Sea operator approached us to solve a production allocation problem. They had four wells producing to a subsea manifold, which in turn channels the multiphase flow through a 30km pipeline to a FPSO. The data they had consisted in downhole gauges readings of THP, THT, BHP and BHT for each well and the aggregate production measured at the FPSO. In theory, the data was sufficient to determine the individual well production rates, but the existing allocation calculation was giving incorrect results

Serafim Consultancy Contribution: Serafim examined all the aspects of the problem, from the reservoir to the details of the original tool measurements to the mathematics of the allocation calculation. The analysis showed that the allocation calculation was using an algorithm that was mathematically inappropriate for data with the level of noise seen in the gauge measurements, and that earlier attempts to solve the problem had been hindered by errors in data transfer. A software routine was written, implementing an alternative, more robust allocation calculation and this was applied to both current and historical production data.

Benefits: The new production allocation resolved a number of anomalies in apparent reservoir behaviour and has simplified the reservoir simulation history match, leading to a reservoir simulator model that can be used with more confidence to commit to planned new wells.



About Serafim Ltd

SERAFIM Ltd specialises in applying mathematics and mathematical reasoning to understand and solve practical problems in engineering and software development.

From the development of innovative solutions to their final implementation in the form of high value-adding software, our work is based on the techniques used in scientific and mathematical research. We currently work predominantly in oil-field reservoir engineering and project economics. Our clients are oil and gas companies, oil-field service firms, governments and other consultancies.

SERAFIM

for further information contact:

consultancy@serafimltd.com

P. +44 (0)2890 421106