

HOW DO WE GET BEYOND R&D?

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Thank you so much for the invitation to talk about my favorite subject in front of such a competent and distinguished audience.

I will briefly touch upon the importance of R&D for building competence and knowledge. Then I'll discuss what we can learn from the past and what we can possibly learn from the way we do exploration. Hopefully, I will end up with a couple of useful recommendations.

First, let me congratulate the National IOR Center with a glowing mid term evaluation. You are part of a long chain of joint R&D programs between industry and the authorities that go back to the late 80ies and early 90ies, which could be called the golden period of Norwegian IOR.

I think it has been wise of the IOR Center to narrow the scope of their R&D program, and I have no problem with the prioritized areas of polymer injection in sandstone reservoirs and smart water injection in carbonates. Hopefully this research effort will result in promising methods that can be tested in field pilots by the industry.

On research results and communication I feel it is appropriate to quote the evaluation team: "It could be said that the centre is now a focal point for IOR internationally".

Congratulations. Let us keep it that way!

I sincerely hope the IOR Center will be able to secure funding to continue their effort with even stronger involvement and direction from industry participants.

Just one last comment on research. One of the many (maybe too many?) proposals of my committee in 2010 was to strengthen the R&D effort within enhanced oil recovery. This was viewed as important, but maybe not the most urgent one. Not surprising though, it turned out to be the easiest for the authorities to fulfil. And, I am happy to say, it resulted in the establishment of the National IOR Center in 2013.

The main thrust of our report was the urgency for action in the largest producing fields before it would be too late. This was based on earlier studies, laboratory tests and field pilots demonstrating a large potential for EOR in existing fields.

On this subject, I am sorry to say, I'm disappointed. There seems to be a lack of urgency both in the industry as well as with the authorities.

Let us look at the success stories from the golden period of IOR (late 80ies, early 90ies) to see if we can learn something. In this period Norway was in the forefront of technology

development with strong individual and joint effort by the three Norwegian companies. Several smaller pilots were done that resulted in improved knowledge and experience. But, for various reasons, this effort did not lead to full field implementations.

The two (or maybe three) successes, Ekofisk Water Injection and Troll Oil (the third one being Troll Oseberg Gas Injection), all had a different background.

I had the good fortune to be part of the Ekofisk Waterflood on both sides of the table through my work at the NPD and Phillips Petroleum. The project had some internal backing and a strong champion at the technical level but needed a gentle and persistent push from the NPD to get management approval to go ahead with the field pilot. Next, there was willingness by the government, including the Parliament, to adjust the financial framework to allow immediate expensing of the investment and make the economics of the initial waterflood project acceptable for management approval.

There were certainly risks and uncertainties, and it was easy to show that the project could be an economical failure (if that was what you wanted to show). Fortunately, the project moved forward in a stepwise manner and turned out to be a success beyond anyone's expectations. Without the push from the NPD and the government's willingness to adjust the terms, the history of Ekofisk could have been very different.

Troll Oil was not a traditional IOR project but is a good illustration of what it takes to get a controversial project accepted and implemented. The project was completely dependent on the initiative and persistent pressure from the NPD. One key ingredient was the formation at the NPD of a dedicated Troll team to work on an in-house study of the field. And I think the NPD's initiative to arrange a seminar on horizontal drilling and urging the licensees to consider testing the oil zone by horizontally drilled wells was instrumental in convincing the licensees that producing the oil zone could be commercial.

I will not get into detail of the push-back NPD got from the licensees, only remark that the NPD showed impressive strength and self-confidence which led to the realization of this incredibly successful project.

None of these projects would have been possible without field pilots and persistent push from the NPD based on competent evaluation of the fields in question. It should be stated here that simulations can never give you the correct potential. It may look good on paper and may be useful in convincing management, but field tests are an absolute must to be able to move forward.

Goals and statements about total potential are important but will not be enough. Let us look at some of the statements made in the past: In their report on IOR in 1993 the NPD pointed to the potential of lifting the then 36% recovery factor for oil to 45% and four years later

raised it to “at least 50%”. In the Åm-committee report of 2010 this was further raised to 70%.

This would imply that the EOR-potential on the Norwegian Continental Shelf is of the same order of magnitude as the total (risked) exploration potential. To turn this potential into profitable production we need to attack the immobile oil, be it by smart water, polymers or surfactants.

It is a mystery to me that these potential reserves are not vigorously pursued by the licensees. In today’s risk-averse climate I see possible EOR opportunities risked to death, and I only see mild pressure, nowhere near the maximum extent of the law being exercised by the authorities. I realize there are hurdles to climb. We are, for instance, looking for biodegradable chemicals that will last long enough to be effective.

I wonder if this hesitation is not just to avoid vociferous protests from the green lobby? There is a saying stating that it is amazing what you can do if you really want to. I like to turn this around and say that it is amazing what you can NOT do if you don’t want to.

I am curious to know if we can learn from Exploration where the understanding and acceptance of risk is very different. The most glaring difference is that Exploration has its own budget and a dedicated organization with a clear purpose. The inherent exploration risk is well understood and accepted by the company.

Exploration wells seem to have about 10% probability of commercial success. In EOR-projects the oil has already been found. I will claim that an IOR/EOR-project will have economic viability on par with the development of new fields of similar magnitude. In addition, they can be developed quicker and have less risk than exploration projects.

This is the place to quote from NPD’s 1993 brochure on IOR: “The return from projects for improved recovery may during the next 10 to 15 years be of the same order of magnitude as the return from exploring for new resources, and many projects for improved oil recovery may be equally profitable as development of new fields”.

Wise words that I think are still valid!

So, what can we learn from all this?

- EOR/IOR projects depend on cooperation between authorities and the industry
- Pressure from the authorities is necessary and helpful.
- Willingness by the government to consider incentives for individual projects is important.
- Dedicated and competent teams at the NPD conducting internal work on individual high priority fields to give the NPD confidence enough to challenge the licensees.

- To generate and drive EOR projects forward, you need a competent organization fully dedicated to EOR at least in the operating companies.
- Field pilots are essential, and the responsibility for implementing these falls squarely on the industry. As far as I know there is a pilot agreement in FORCE that has never been used
- There is an urgent need for active redevelopment of several fields that are coming close to the end of their economic life. I happen to believe that it is still possible to save some of these reserves, but it requires a much more urgent action based on existing knowledge and experience. The best effort I have seen on this subject is IFRA/EIOR's Joint Industry Project a couple of years ago on reactivation of sandstone reservoirs based on gel injection to limit water production followed by polymer assisted surfactant flooding. Both the industry and the NPD has shown limited interest in the results of this JIP. My only comment here is that NPD seems to have picked up on the alternative definition of EOR as "Early or Regret" and dedicated most of their effort to get EOR included in the new development projects. This is great, but I hope they will also keep in mind the old saying "Better late than never".

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