

## The NOC Technology & Innovation Management Challenge

*Improving performance in technology management*



National Oil Companies (NOCs) are spending more and more on R&D. But this has not yet had much of an impact. With the oil price currently well below the break-even point of their nations' budgets, they are still behind Independent Oil Companies (IOCs) in terms of R&D effectiveness. IOCs have been shown to adjust faster to a new baseline price. Arthur D. Little (ADL)'s framework for E&P Technology management suggests that better focus on delivering the corporate strategy through active portfolio management, and an organizational form that links technology with projects or operations and embeds deployment in budgetary planning, can help.

### The continued rise of NOCs in technology development

Five years ago, ADL observed a shift, with some NOCs notably increasing their R&D expenditures.<sup>1</sup> With energy demand rising at home and resource nationalism increasing, NOCs began to realize the importance of mastering technology leadership in facing the challenges posed domestically and in their international operations. Since then, some NOCs have raised their technical capabilities and gained confidence in "going it alone" without IOC expertise, while often relying on support from Oil Field Service (OFS) companies. At the same time, IOCs pledged significant investments in new projects for the next five years, partly in an attempt to maintain their technical capabilities. However, the rate of growth for their R&D investment has averaged 5.0% since 2004, whilst leading NOCs have grown at 9.9% and that of leading service companies at 6.8%.

Over this time period, some NOCs (e.g. PetroChina, Petrobras, and Saudi Aramco<sup>2</sup>) invested more than IOCs and OFS companies in R&D. The technology lead of IOCs has been partially eroded. While some NOCs have established clear leadership in areas of particular significance to them (e.g. Petrobras in deep water and Statoil in arctic environment), others have partnered with peers for access to their resources (e.g. PetroChina with Petrobras).

### 2004-2015 R&D spending for selected IOCs, NOCs and OFS companies



Source: Arthur D. Little analysis, Companies' financial disclosures

R&D spending by NOCs has allowed them to become credible partners to other resource-holding NOCs. Leading NOCs have become more sophisticated buyers, understand better what IOCs and OFS companies can bring, and have developed strategies for technology development of their own.

### The case for technology management

More recently the entire industry has been under tremendous cost-cutting pressure, and we expect that R&D budgets will continue to be under pressure for the foreseeable future –

<sup>1</sup> Thuriaux-Aleman *et al.*, *Journal of Petroleum Technology*, Oct 2010

<sup>2</sup> Aramco does not publish R&D expenditures but these are thought to be higher than the IOCs

technology & innovation management (TIM) will become critical for NOCs wishing to improve their performance.

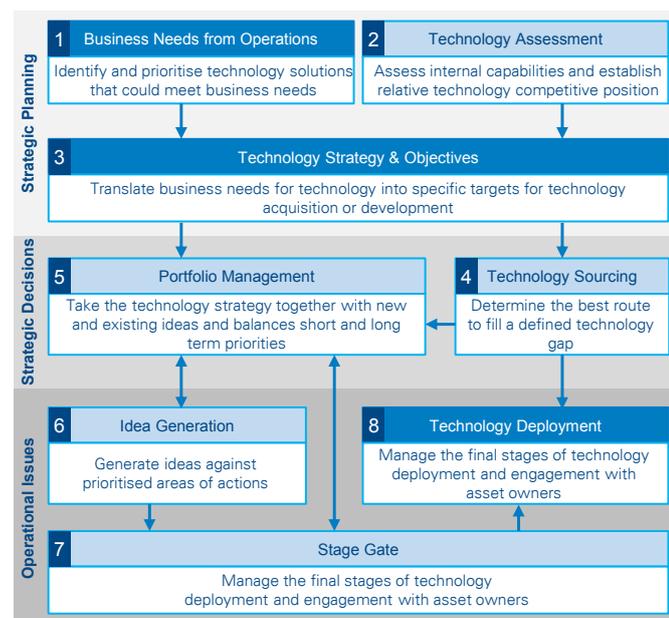
Despite the strong growth in R&D spending by leading NOCs, some have struggled to translate this into operational impact. And in the current context, increasing R&D spending is seen as the least likely area to improve innovation for O&G firms.<sup>3</sup>

IOCs have long experience of managing technology development to support both domestic and international operations. In contrast, some NOCs have found that operations in home markets and dependence on PSC partners or service companies may have hindered the development of strong technology management competencies. As a result, a number of NOCs need to develop better working practices and raise their technical capabilities.

## A framework for technology management

ADL has developed and deployed a framework for technology management (TIM) in E&P and in some cases we have developed specific TIM processes for companies. The framework consists of eight interlocking processes that operate at the level of strategic planning and formulation, which facilitate strategic decision-making and operationalize key aspects of technology and innovation management. These processes need to be tailored to the company's organizational structure (i.e. centralized E&P, BU-driven E&P or integrated Project & Technology functions).

### Technology & Innovation Management core processes



A key insight from integrating the different parts of these eight processes is that, in order to manage technology development effectively, it is critical to keep a strong link between the company overall strategy and its technology strategy. IOCs tend to keep a much stronger link between corporate strategy and technology and have more effective technology management processes. This allows them to achieve better focus – for example, by deciding what technology development they should focus on internally versus what technology they should collaborate on. This ability to focus and refocus has helped them deal with fundamental changes to the industry.

While some NOCs have had long-ranging technology strategies seamlessly aligned with their field development objectives (e.g. deep water for Petrobras, subsea operations for Statoil, heavy oil for Ecopetrol, and most recently shale oil & gas for YPF), others may be struggling to strike a balance between long-term R&D objectives and short-term focus in support of their operations.

Despite progress in alignment with strategy, we continue to see issues with effective prioritization of technological opportunities in terms of potential value creation and associated risks. Often this is driven by aggressive targeting of assets by technology vendors.

IOCs such as BP often have an excellent grip on the field deployment process of technology – including for technology they did not develop – through robust project management practices. In contrast, we know from experience that some NOCs struggle with deployment and find it difficult to leverage their efforts at this crucial step of the technology development, in part because of weaker integration of TIM processes, lack of experience in dealing with stage development across geographies and understanding of scale effects.

Sometimes technology assessment and deployment efforts are carried out in isolation by one single E&P asset and/or dedicated functional team, missing much broader opportunities for implementation across the company's operations. This typically results in very low success ratios for deployment across operations.

## How can NOCs improve their technology management effectiveness?

In our experience NOCs improving efficiency in the management of technology is one of the most impactful ways to boost performance without increasing R&D budgets. The issues can be broken down into three main areas: **strategic issues, organizational issues and process issues**, and all need to be addressed to improve performance.

<sup>3</sup> Lloyds Register Energy, 2015, *Innovating in a new environment*

## Typical Technology Management issues along with opportunities for improvements

<p>Strategic alignment &amp; Portfolio rebalancing</p>	<ul style="list-style-type: none"> <li>■ The technology strategy must be regularly updated top down (by aligning with the corporate strategy and targeted resource play) and bottom up by identifying future needs from operating units. This requires strategic engagement with corporate planning and with operations.</li> <li>■ Launch a portfolio review of ongoing technology activities driven by the impact of recent changes (e.g., drop in oil price) and to drive fundamental strategic resource transfer in the portfolio. Our recent research shows that this requires a clear idea of how the technology portfolio should be balanced prior to carrying out the review.<sup>4)</sup></li> </ul>
<p>Organizational integration of R&amp;D with Projects or Operations</p>	<ul style="list-style-type: none"> <li>■ One option is to position technology so it is jointly integrated with a Projects &amp; Procurement division (as in Shell, Statoil and PETRONAS)<sup>5)</sup> to ensure that high Capex projects benefit from integration with technology deployment.</li> <li>■ Alternatively, re-organizing so that R&amp;D reports into business units (i.e. reporting directly into E&amp;P) and is funded by the relevant BU typically leads to increased relevance of technology to operations and this can increase the short-term impact of technology.</li> </ul>
<p>Process alignment with operations on deployment</p>	<ul style="list-style-type: none"> <li>■ Technology developments should be properly scoped from birth. Business owners must co-manage the technology road maps to deployment in articulation with their key business projects' critical paths. Knowledge and experience sharing platforms may help to further widespread the technology.</li> <li>■ Adopting stronger requirements for BU funding for technology deployment can help embed technology in asset plans. For example, the requirement to include BU budgetary provision for piloting technology (subject to success in scale-up and prototyping) forces early discussion of the value and relevance of technology.</li> </ul>

a) This is based on our R&D management best practice study: [Finding you balance: Insights into world class portfolio management](#)

b) See for example The Projects, Technology & Procurement Organization: The Emergence of a New Organization Form in E&P. [www.adl.com/emergence](http://www.adl.com/emergence)

### A. Strategic issues

Being a passive adopter of technology can lead to significant underperformance<sup>4</sup>, but that does not mean NOCs have to follow selective technology leadership strategies – we have shown that variants of the fast-follower strategy, such as the intelligent adopter (those with sufficient capability to integrate, adopt and improve supplier technology through dedicated investments), can be very successful.

However, this requires considerable focus and clarity of action, and some NOCs suffer from a lack of focus on defining how technology will support the corporate strategy and core focus of the organization. As an example, a few years ago one NOC with mature fields had one of its strongest research groups in engine development rather than in EOR.

This lack of a robust “top-down” technology strategy leads to a shortage of focus and prevents some NOCs from achieving critical mass in core areas. A related problem that can also contribute to lack of relevance is a poor definition of “bottom-up” technology needs from the operating units, and insufficient efforts to quantify the value of solving operational challenges in a way that allows prioritization of technology needs across different operating areas.

The technology portfolio management process is responsible for operationalizing the strategy, but in NOCs the portfolio of technology activity is not managed as aggressively as in IOCs

– some NOCs have never carried out full reviews of their R&D portfolios and lack the necessary data on the range of projects they fund to undertake such an exercise. This increases the likelihood that legacy projects will progress into large-scale investments despite the fact that the underlying economic rationale for their projects no longer makes sense. This leads to strategic drift, with technically good but irrelevant projects soaking up scarce technical resources. For example, the recent dramatic reduction in oil price should result in portfolio rebalancing, but this has not yet occurred for many NOCs.

### B. Organizational issues

An organization set-up that separates R&D from operations and isolates it from operational concerns typically results in few technologies being deployed to field operations. Operations tend to treat R&D as a tax and do not actively manage the R&D budget. As a result, R&D is allowed to focus on long-term projects which struggle to compete with readily available external technology solutions, or which become irrelevant when operational strategy changes, the technology under development is superseded, or it is not made available on time to match key projects' critical paths.

A number of NOCs attempt to broaden their R&D resources through different forms of cooperation with governmental science and technology promotional agencies – ranging from loans and contracts to co-sponsored entities with different degrees of autonomy. This provides access to funds, top-level scientists, technology development services and labs. However, it exposes technology development to fiscal policy fluctuations, as well as losing focus and control of projects and portfolio if intellectual interests rather than business interests become the key driver. The mission of such joint ventures sometimes includes the option to market technologies to third parties, but they often fail to accomplish said commercial purpose, since technology marketing is not at the core of the NOC's business and scientists are not usually sales oriented.

Conversely, if R&D is strongly linked to operations, we often see R&D staff drift into providing increasing levels of technical service functions. This is typically driven by the scarce technical resources available, which means that short-term fire-fighting of operational problems with required technical expertise takes priority over long-term development activities. This prevents R&D staff from delivering other projects on time.

Furthermore, there are opportunities to strengthen the managerial competences of teams involved in technology management, especially in the areas of business vision (e.g. understanding the entire value chain, identifying local and worldwide industry trends) and economic and financial analysis.

<sup>4</sup>Thuriaux and Rogers, 2012, *Technology Application in Mid-Sized Oil and Gas Companies*

## C. Process issues

Engagement with operating units on technology deployment is often problematic, with operating units sourcing their own solutions because technology roadmaps for acquired or developed technology are not fully shared with and maintained in coordination with the assets either, due to lack of communication among business units/assets. As a result, assets often lack budget provisions to pilot and deploy technology, and no one has had the difficult conversation about how deployment will be financed.

From our case experience and study of R&D management best practices, the starting point lies with a prioritized technology strategy. Having such a strategy strongly linked to their corporate development strategy and core strategic business projects, and mastering a process to maintain this link, allows companies to do more with less, with better use of available resources. Likewise, NOCs should be more aggressive in actively managing their technology portfolios and kill projects.

## Conclusion

Some NOCs have now caught up to IOCs in R&D spending, and in some cases overtaken them. But while some IOCs, and some leading NOCs have started to adjust to the new baseline for oil price, others have been slower to learn to manage technology & innovation more effectively.

IOCs are more effective at managing their R&D spending and adjusting to current conditions. One of the reasons is that they are able to maintain a tighter link between their corporate strategy and technology strategy than some of the NOCs. IOCs are also generally much better at deploying technology and controlling the costliest phase of technology development.

From our experience, NOCs face three types of challenges with technology & innovation management:

- Strategic – Technology strategy and associated roadmaps must be reviewed on a regular basis to ensure strong alignment with the corporate development strategy, and portfolio reviews must be conducted frequently.
- Organizational – NOCs can also benefit from tighter integration of the technology function with other operational ones to help it deliver more efficiently on expectations from the business.
- Process-driven – Deployment of technology is too often the stage at which the development of technology fails, and NOCs should heed the need for an ongoing dialog with operations on budgeting and planning for this crucial phase.

NOCs have to raise their levels of expertise in technology & innovation management if they want to convert their R&D spending into long-term technology leadership.

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## Arthur D. Little

Arthur D. Little has been at the forefront of innovation since 1886. We are an acknowledged thought leader in linking strategy, innovation and transformation in technology-intensive and converging industries. We navigate our clients through changing business ecosystems to uncover new growth opportunities. We enable our clients to build innovation capabilities and transform their organizations.

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