NEI-NO--819
NO9705271

CONF-9608193--30

ONS CONFERENCE 1996
27-30 AUGUST
STAVANGER. NORWAY

NO9705271

Paper no. G3

Session:

ORGANISATION, THE HUMAN CHALLENGE

Paper title:

# «Integrating technology in a changing organisation»

Speaker :

Olivier Guillon
Elf Aquitaine Production, France

# Integrating Technology in a Changing Organisation

**Olivier GUILLON (Elf Aquitaine Production)**

## 1. INTRODUCTION

Elf Aquitaine is a major international oil and gas company, with strong activities in the chemical and the health and beauty businesses. However, the main income of the company is generated by its oil and gas operations. These are affected by two major emerging trends : a durable period of relatively low oil prices and an increasing concern for the environment. Therefore, there is a strong pressure to cut costs and be more effective in our operations.

Because of its long-standing commitment to technology, Elf's R&D spending in exploration and production stands at a fairly high level compared to the industry (see Fig. 1). It is understandably under scrutiny in the current mood for cost cutting : Therefore a process was initiated in 1994 to reanalyse our E&P research and development in order to enhance its alignment with the company assets needs, with a subsequent prioritisation of R&D projects.

In addition, we wanted to build a strategy for cooperation with other oil or service companies, putting the emphasis not on the financial leverage effect but rather on the union of two strengths, may be with different experiences and view points but with a common goal. This, in our view, is a requirement for us to stay among the technology leaders and be in a better position to get good acreage or be selected as operator.

Finally, it became obvious during the course of our R&D program reanalysis that the new challenges are not strictly directed along the technical disciplines but rather transverse to them. Therefore whether for R&D or for technical services provision, to perform optimally it is necessary to evolve from a linear process (where each contribution is made in series) to an integrated one (where all contributors share the interpreted data) and from a function oriented to an object oriented culture.

This paper will present the process set up to align our R&D program to the business needs of our operations, the various levels of cooperation that we use, and finally an illustration, in the domain of the geosciences, of the various facets of the ongoing cultural revolution which is required to reach a true integration.

## 2. HOW CAN R&D CONTRIBUTE TO OUR BUSINESS ?

R&D does not contribute equally to each element of our business ; It is sometimes difficult to distinguish the R&D contribution in most of the improvements that impact the bottom line. For instance, a reduction in drilling costs may owe more to a better contract, or to a better planning of the logging operations, than to an improvement in bit performance. If R&D is certainly a major contributor in :

- accessing new ventures,
- discovering new reserves,
- reducing costs,
- improving the recovery of producing fields,

it cannot be separated from other factors of company efficiency.

In addition, it should be clearly stated that, R&D serves three purposes (see Fig. 2) :

- directly enhance the global business of the company,
- investigate new ideas, evaluate their potential and prepare for a long-term investment,
- maintain and improve the technical level of company professionals and equipment.

Research aimed at satisfying the first purpose will be called "strategic R&D" as it is part of the company strategy and should be tightly linked to business objectives. The second is "blue sky". Without this type of research, very few breakthrough would ever occur in our industry, like 3D seismic, MWD or horizontal wells... The third one, is considered very important for the efficiency and the quality of our operations. I would like to point out that because of Elf's tradition of rotating professionals between operations, research and technical services, state-of-the-art technology developed in our main technical centre, is quickly available and used by each business asset. It is also a strong element of culture within our company. The allocation of resources is approximately 75 % for strategic R&D and 25 % for the rest.

The strategic part of the portfolio is the only one that directly impacts the bottom line. The direct contribution of R&D to improving the company profitability can be twofold :

- by reducing expenses, for a given amount of barrels discovered, or produced,
- by increasing the amount of oil and gas discovered (for a given exploration expense) or the recovery, or the daily rate of production (at constant costs).

For example, R&D on drilling performance contributes to the first type, while 3D seismic imaging generally aims for the second type of contribution.

In order to structure our portfolio, senior E&P managers, coordinated by R&D management began by translating the strategic guidelines of our E&P into eight challenges (see Fig. 3) ; a challenge is an area where any improvement is likely to have a major impact on our business objectives. Although these challenges have a strong technology content, they are not related only to R&D, and can strongly be affected by factors such as organisation, integration with contractors, new relationships with partners in joint ventures, etc. Also, the importance of the eight challenges identified by Elf could be quite different for another oil company, depending on its acreage for instance.

Each of the eight challenges was then "processed" along two axes (see Fig. 4) : the business axis consisted of devising adequate quantitative objectives and indicators (like finding costs, positive/negative exploration wells,...) which directly impact the E&P challenge. The second axis was the technology axis where we first established a set of progress areas, defined as a technical area where R&D can bring a definite improvement within five years, then prioritised these areas within each challenge. In the process, many specialists and operational staff were involved ; starting from one hundred progress areas, after elimination of redundancies, eighty had to be processed. The screening process used four criteria, as follows (see Fig. 5) :

- business value : impact on the company acreage versus the estimated contribution to the quantitative objectives (as mentioned above),
- need for R&D : business value versus the degree of improvement brought by R&D,
- availability of results : likely duration of R&D versus the estimated probability of success,
- company implication : need for internal expertise versus the need for exclusiveness.

The selected progress areas ranked high in business value, need for R&D and company implication (and the final number may be easily adjusted). The "availability of results" is used more cautiously as the frontier between strategic and "blue-sky" research is sometimes tenuous.

Thus, over a period of two years we have managed to focus our strategic research on a hard-core of thirty progress areas. Thereafter a project-by-project analysis was performed for all major projects (1M$/year or more),in order to connect each of these projects to the quantitative objectives (and the E&P indicators if available) assigned to the relevant challenge (in terms of either reduced expenses or additional production / reserves, or both). However difficult and generally imperfect the analysis, it forced us to ask ourselves why we were doing each of these projects, and we could compare projects from an economic standpoint, eliminate the non-economic ones and redefine the boundaries of other. We ended up with twenty five major projects, representing two third of our strategic R&D. We are now in a position to evaluate the impact of most of our R&D on the global profitability of Elf E&P.

## 3. COOPERATE OR COMPETE ?

However strong our reliance on technology, we cannot afford to develop every solution to our business needs on our own. We have recognised this early on and have established an old (thirty years plus) tradition of cooperative R&D with universities, research centres, service companies and oil companies, in France initially and more recently with a few European and US leaders of technology.

Our main motivations are :

- access to outside expertise or data,
- leveraged budget for heavy or risky project,
- reduced failure risk of difficult projects,
- better standardisation of E&P practice,
- faster, better and cheaper industrialisation of R&D results.

Cooperation has to be built gradually, as it is based on mutual knowledge of each other's strengths and on trust. We have defined three levels of cooperation (see Fig. 6). The first one is the lightest, consisting mainly in exchanging R&D results. It implies little involvement in each other's program. The second one usually requires short stays within the partner's technical centre to actually exchange expertise and discuss the program or the results. The third one is the most integrated one and requires the allocation of R&D staff within the partnering organisation for a significant duration. The researcher is then a full member of the partner's project. It obviously implies a good and common understanding of the objectives for each of the partners (and a good deal of trust...). We are currently going through all levels of cooperation.

Cooperation has to be selective ; There are projects we wish to keep to ourselves either because we feel there would be no benefit in sharing or because it is too early to judge the potential applications of the idea. In order to optimise the cooperative R&D process, we have analysed all the progress areas which are part of the hard core R&D to decide which "cooperation profile" should apply (see Fig. 7). The projects with profile II can sometimes be opened to cooperation with research institutes. Those with profile III are usually aimed at an effective industrialisation of a prototype (which we hand over to our partner). The last two profiles are not operated in-house, the last one consisting of projects where we only want to be involved during the validation phase of a new technology (usually developed by a service company or a research institute). It should be mentioned that contracting projects out requires an internal follow-up (and costs) in order to guarantee our full appropriation of the results.

At this point, it may seem difficult to reconcile competition and cooperation among oil companies. In today's context of opening of new grounds for exploration and production, the competition is fiercer than ever and an edge is necessary for a company to get new acreage. Four factors may influence the results :

- the quality of the company's current acreage,
- the ability to evaluate the potential of new areas to be opened soon,
- the ability to negotiate the access to new leases under acceptable contractual conditions,
- the perception that local authorities may have of the company.

Technology has an obvious impact on the above second and fourth factors, Yet, however strong the competition might appear, technology development can be shared and exchanged to a large extent. As a matter of fact, because of the associative nature of our operations, we have to disclose the technology we use as operator to our partners. Similarly, through the distribution of work between operators and services companies, technologies are disseminated very rapidly throughout the industry, so that any competitive advantage in the mastering of a technology disappears after a couple of years at most. In fact, the true value of technology comes from its application, its integration in the way we do our operations. Moreover, when we cooperate with a partner we have identified as a champion in a technical area which is important to our assets, hopefully we shall get better equipped to compete with the rest of the industry. Therefore cooperation and competition are not in conflict but complement each other (see Fig. 8).

## 4. TEAM INTEGRATION VERSUS INTEGRATED SOLUTION

Unsurprisingly our strategic approach, starting from the E&P challenges, on to screening of progress areas, ended up with a list of high priority R&D projects which generally did not coincide with the traditional technical disciplines but involved two or more of those disciplines in a transverse way. The practical management of such "transverse" projects is not easy in a traditional organisation by functions : Most technology centres are well equipped to provide high-tech solutions to an operational problem as long as it calls for the involvement of only one expertise. For large integrated studies, involving different disciplines at various stages, leading to an appraisal well location, or a development decision or an improved oil recovery process implementation, the organisation by functions is not optimal as it leads to a linear, sequential treatment of the technical tasks. The difficulty has been perceived for some time and the obvious response has been to set up "integrated project teams" dedicated to a specified "object", (often outside the existing organisation) as soon as it was necessary to manage a large (usually building) project. It is however more difficult to react similarly in the subsurface arena (mainly geosciences and reservoir engineering) because of the three dimensional, uncertain and complex nature of the objects of study because of the strong interactions between highly technical disciplines that are necessary to make a coherent model of the real object, and because of the cultural evolution that is required from the members of the team to go from appropriation to contribution, (not to mention their ability to reach a good level of understanding other members technical jargon and vision without deterioration of their own high level of competence).

I shall present now three examples of integration that may be of interest because of their potential impact on our future organisation.

The first example is offered by the Geoscience Research Centre of Elf Caledonia Ltd, created in London (in 1991) to take advantage of the very rich environment (universities, research centres and oil and service companies actively engaged in E&P research) that could complement our in-house effort and to promote cooperation with a few UK partners (see Fig. 9). On the technical side, the idea was to bring together experts in various aspects of subsurface modelling : geophysicists, reservoir engineers and geologists. The preliminary objective was to achieve significant advances in each technical area (reservoir characterisation by AVO from 3D seismic, fast estimation of a 3D seismic velocity model in moderate to complex structural environments, modelling of sedimentary objets and fracture networks, compositional reservoir simulation, history matching, etc.). But more important, we wanted to detect those problems which, being located in the no-man's land present between those disciplines, would have been intractable by any discipline on its own but which could be resolved with a complementary approach (for example, constraining well test interpretation by 3D seismic , using repetitive seismic information on reservoir fluid saturation to history match a reservoir model, estimating the consequences of uncertainties in the static description on the dynamic reservoir performance...). It was also hoped that transverse methods and techniques such as three dimensional visualisation, inversion, high performance computing applications, gridding and upscaling... might benefit from a multi-disciplinary definition and testing.

The result have exceeded our expectations in terms of creativity. In retrospect, the conditions for success were gathered : - a small team, of highly competent members, very curious of other disciplines, working with good equipment, in an environment open to outside experts and free from operational constraints was bound to be exceptionally productive. However, care had to exercised to make sure that the technologies developed met to the most urgent needs of our assets and that the results were taken up effectively by the main technology centre (and the end customer). This means that it is absolutely necessary to maintain close links at all stages of R&D and especially to exercise a strong control on the programme of this small unit by the central organisation.

The second example is taken from our experience on the development of a "Shared Earth Model" concept and of the "3D Geomodelling" activity which both are essential to the successful integration of subsurface teams.

The development of the "Shared Earth Model" concept, bringing together geoscientists and reservoir engineers to build and use shared 3D numerical models of the subsurface was a joint project with BPX (ARAMIS, partly funded by the European Union under the thermie scheme), aiming at improving the quality of reservoir performance prediction. It was based on real case studies, using existing software tools. The work was concerned with learning how to implement the Shared Earth Model concept, and then with exploring the opportunities which this created for further cross-disciplinary integration. It served to ease the progress towards the availability of tools through the demonstration of what could be done. It influenced the development of 3D modelling and visualisation packages in the directions that we recommended.

The Shared Earth Model is now accepted as being a description of a geometric subsurface object, common to the geoscientists and to the reservoir engineer. The methods and tools to interactively build, edit and update the Shared Earth Model make up what we call the 3D geomodelling activity. The industry is still learning how to integrate all phase of the process from structural modelling to reservoir simulations (see Fig. 10). But there still lack solutions at three levels :

- the data level, where databases and files should be linked effectively : EPICENTRE fulfils this need but is not yet fully implemented in existing software,
- the application level, with the need for linking different representations of common subsurface elements,
- the business process level, which should define the links between applications and calls for a good understanding between disciplines.

We have been actively engaged in such a process internally and in association with others (POSC, SAVE,...). More recently we have initiated a joint industry club on 3D geomodelling to share experiences on geomodelling methods and tools, to speed up the maturation process of geomodelling, to give consolidated directions to software vendors and to facilitate the exchange of geomodels between companies in joint ventures. This hopefully will lead to the realisation of a fully shared Earth Model, a model which is easily updated and fully consistent with all available data, on which it will be possible to interact at any scale and with various techniques, to test or predict the reservoir behaviour.

The third and final illustration of our view upon integration is given by the "asset driven subsurface project team" (see Fig. 11) which we set up, as early as possible during the approval stage of a discovery and systematically for the preliminary study of a field development.

Depending on the situation (technical environment, cost factors, staff availability,...) the team might be based locally (in the subsidiary) or in our main technical centre (in Pau), where the close contact will all the specialists is an added factor of success. The team consists of at least one geophysicist and one geologist who are the main contributors to the structural modelling phase. A reservoir engineer and a production geologist are associated to this phase but in a minor way. They are however more involved in the geological modelling phase where the internal architecture of the reservoir is described (and constrained by dynamic information). Finally everybody contributes to the last phase - the dynamic modelling - where the reservoir is characterised in terms of petrophysical properties assigned to grid blocks at a scale generally much coarser than the one used in the previous phase.

Naturally, one should not forget the interactive way in which this process is actually producing a Shared Earth Model : For example, once the first well-tests are interpreted on the dynamic model, the structural as well as the stratigraphic models will be constrained by the dynamic information under the control of any member of the team. If needed, expert advice is available from outside the team and logistic support is accessed through the traditional function lines. The team is delegated a large responsibility to deliver its mission as fast and as effectively as possible under the control of the functional lines (which establish the state-of-the-art, recommends the methods and processes to be followed in each type of studies). This organisation has been put to work on various subsurface projects and has shown its value. However it is complex to manage in some respects : the individual members are supposed to have so many good and sometimes conflicting characteristics as to make them a rare commodity ; the recognition of the value of the work goes naturally to the team leader, which is somewhat unfair and inefficient as far staff management is concerned ; what happens when the project is completed ? Is the team disbanded or does it take another project ? If the team works in a permanent "object-oriented" mode, what happens to the maintenance of the technical competence which is best experienced in a functional mode ? Is it better to keep all the team members in their functional lines, working on different objects at the same time - even on R&D projects - constituting only a virtually integrated team but providing an integrated solution ? The optimum has not been found yet and each company offers a specific balance between function and objet, permanent and ad-hoc.

## 5. CONCLUDING REMARKS

In the climate of fierce competition for getting new acreage, we believe that technology can give use a competitive advantage. Therefore, we have integrated our R&D in the overall E&P strategy to make it more effective. Moreover, we have implemented system which should allow us to quantify the impact of successful R&D projects on the profitability of the company. Thus we can adapt, reorient, shift our R&D effort where it is most efficient for the business.

We are advocating more cooperation among oil companies and between oil companies, service companies and universities because of the considerable amount of development and testing that is required to meet tomorrow's technical challenges in a faster, cheaper and safer way.

Finally, the time for delivering integrated solution in the field of geosciences has come ; it has been made possible by the high level of standardisation in data management, the high level of computing performance which brings interactivity, and the emergence of an object oriented culture which has been in existence for quite some time in our R&D. In fact, R&D is often a testing ground for multidisciplinary ideas, projects and even organisations. The geosciences and reservoir engineering are at the core of our business, their integration, which after all is what differentiates us from the best service providers, will be a key factor of success for oil companies.

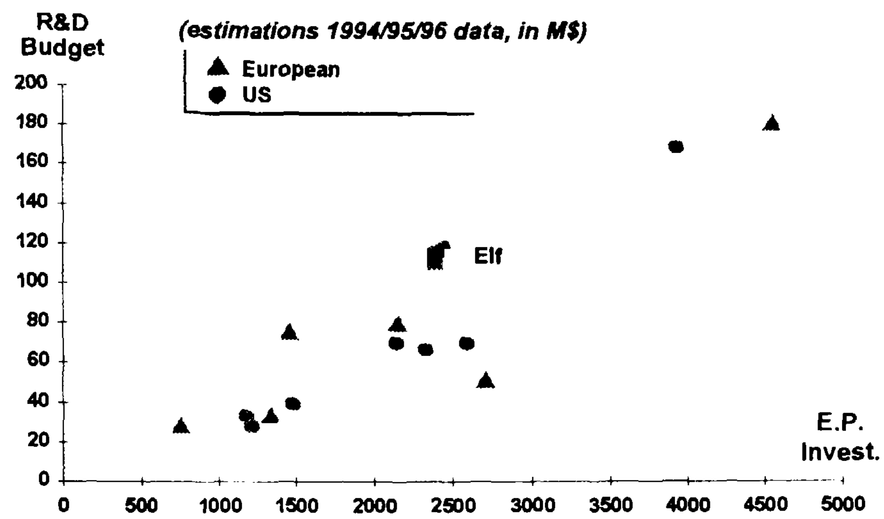



Fig. 1 : Annual R&D expenses versus CAPEX for the major international oil companies.

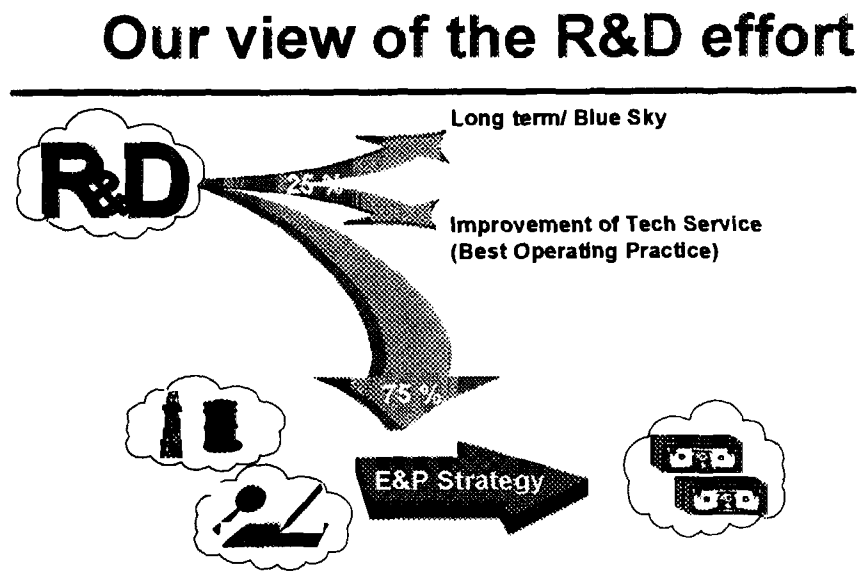



Fig. 2 : Structure of Elf Aquitaine R&D in Exploration and production

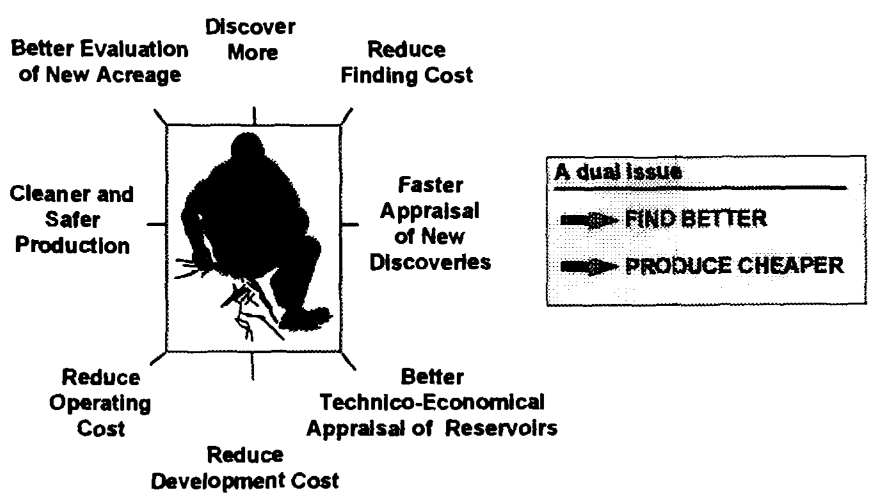



Fig. 3 : The strategic E&P challenges for Elf Aquitaine

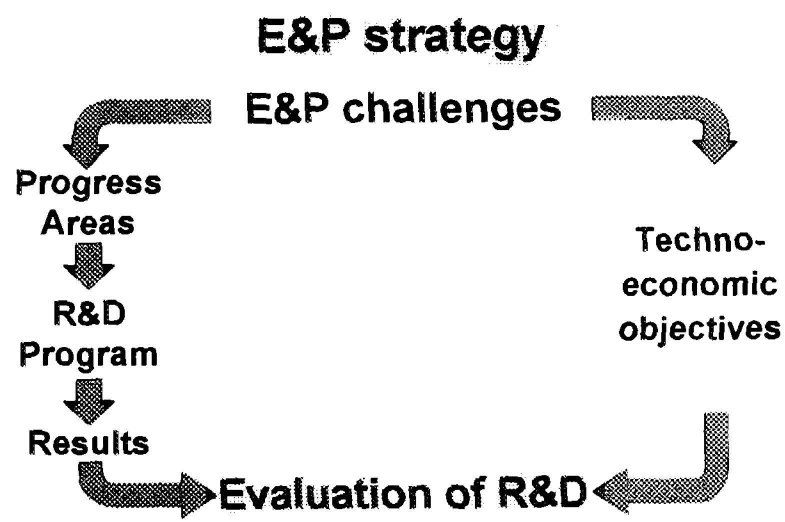



Fig. 4 : The method used to analyse the strategic R&D portfolio

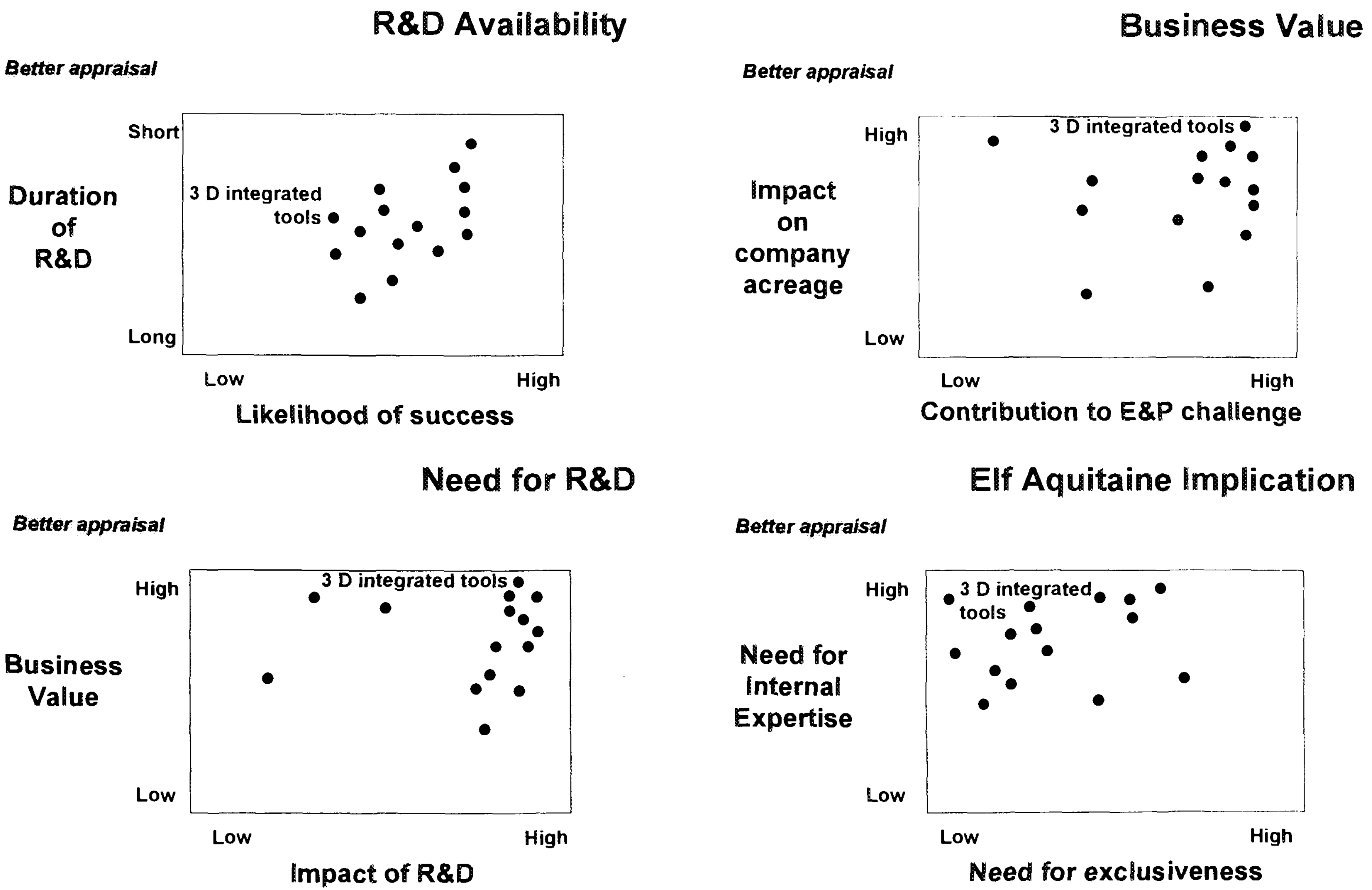



Fig. 5 : The four selection criteria applied to the "Better appraisal of reservoir" challenge

**Level 1**

- Unformal exchange of information
- Common position in joint industry projects

---

**Level 2**

- Exchange of R&D results
- Visits to each other's laboratories
- Common investigations for new ideas

---

**Level 3**

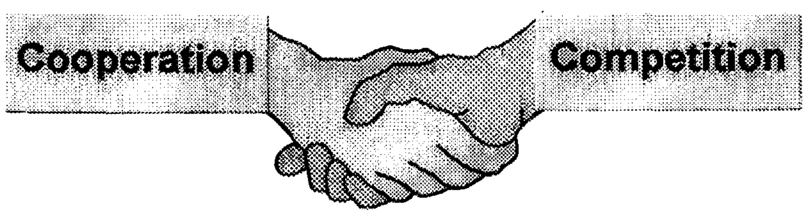
- Long term assignment in each other's projects
- Sharing of results and products of R&D
- Integrated management of R&D programs

Fig. 6 : The three levels of technical cooperation between oil companies

## How can we cooperate ?

- **I** Do, with emergency and priority
- **II** Do, in cooperation with oil company(ies)
- **III** Do, in cooperation with service company(ies)
- **IV** Participate in joint projects, elsewhere operated (JIP, PhD thesis,... )
- **V** Leave the work to others, with technical support at the validation phase

Fig. 7 : Cooperation profiles




**Access outside expertise**
**Reduce costs**

**Get good acreage**
**Be selected as an operator**

Fig. 8 : Cooperate ... to compete

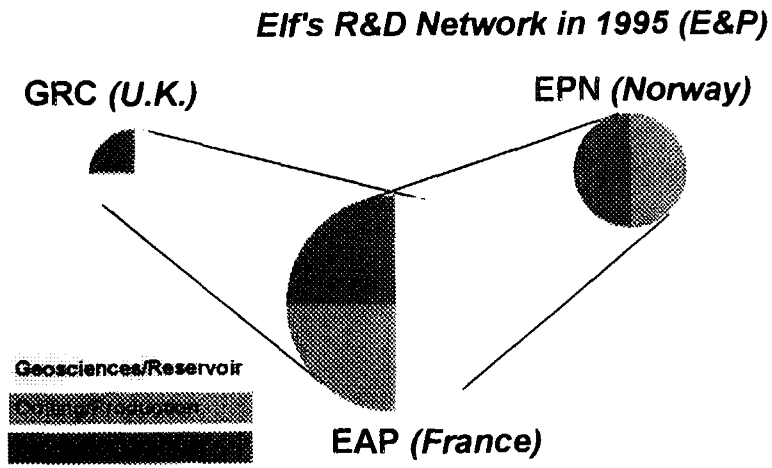



Fig. 9 : Elf R&D network in exploration and production.

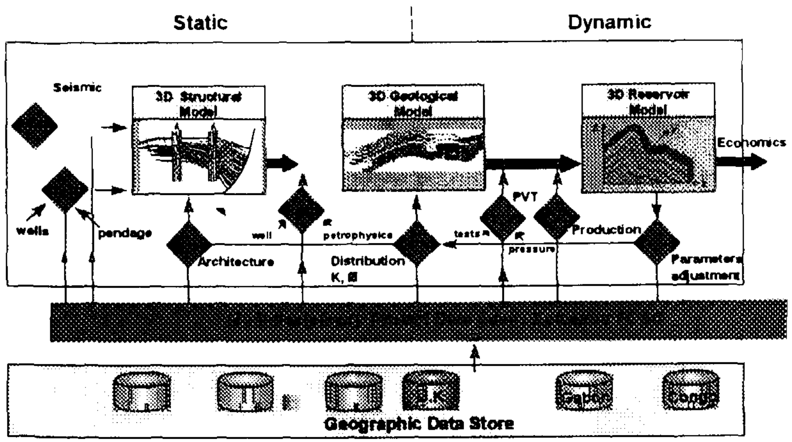



Fig. 10 : Subsurface process integration

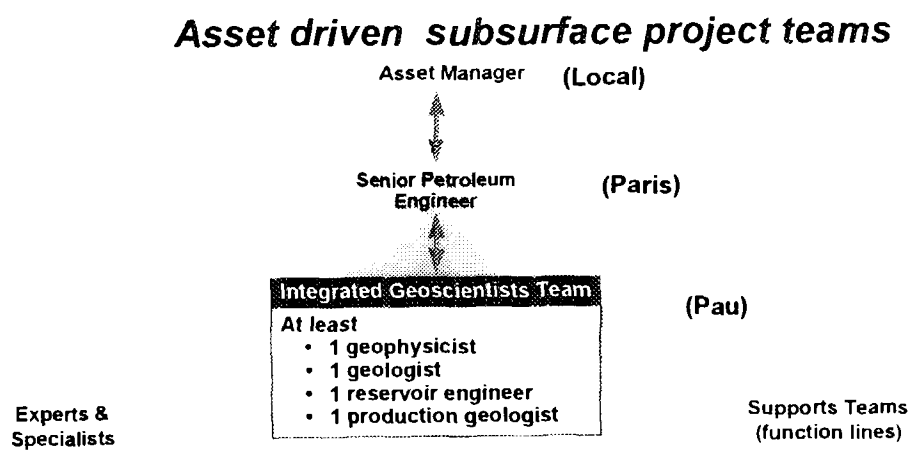



Fig. 11 : An integrated geoscience team