A comparative analysis of the major European oil and gas companies

1 Introduction

The major premises of the resource-based view of the firm (RBV) are that firms are bundles of idiosyncratic resources and capabilities and that firms with valuable, rare, inimitable and non-substitutable resources and capabilities outperform in their industries (Barney, 2001; Dierickx and Cool, 1989; Wernerfelt, 1984, 1995). Drawing on Barney (1991), Miller and Shamsie (1996) define property-based resources as appropriable resources controlled by the corporation through property rights, and in contrast, knowledge-based resources are those "protected from imitation not by property rights but by knowledge barriers", and often include technical, creative or collaborative skills (1996: 522).

This paper uses the resource-based view framework to conduct a comparative analysis of the major European oil and gas companies. This study will look at six companies namely BP, Eni, Repsol, Shell, Statoil, and Total, and identify which resources are drivers and determinants of their competitive advantage and financial performance. Drawing on the framework of property-based and knowledge-based resources, the paper will analyse six resource categories of oil and gas companies namely annual capital expenditure, annual changes in liquids and gas reserves, annual replacement ratios, refinery distillation capacity and number of service stations, number of employees and net income per employee, and annual levels of drilling activity in exploration and development with a disaggregation of successful and unsuccessful wells drilled.

Section two of the paper will present the resource-based view framework. Sections three and four will analyse the property-based and knowledge-based resource measures respectively. Section five will discuss and outline areas of further research. Section six will highlight the implications for Management Practice, and section seven will conclude.

2 Resource-based view framework

Miller and Shamsie (1996) studied the major US film studios between 1936 and 1965, and they found that particular kinds of resources were valuable in different types of environments. Specifically, property-based resources improved the financial performance of the studios in a stable, predictable environment, whereas knowledge-based resources improved performance in an uncertain environment. This view that the strategic value of resources depends on the kind of environment in which they are used is referred to as "the contingency view of the strategic value of resources" (Tseng et al., 2007; Wiklund and Shepherd, 2003).

The hypothesis stemming from this is that knowledge-based resources will be associated with success in more 'difficult' environments, whereas the opposite should be true for property-based resources. The argument being put forward is that knowledge-based resources will become more critical for success in the future compared to property-based resources. This paper will therefore compare how the major European oil and gas companies perform relative to each other within the framework of the two kinds of resources. In Miller and Shamsie (1996), property-based resources

included the number of film theatres and the number of film stars under long-term contracts, and knowledge-based resources included the number of Academy Awards and the history of per film production costs.

This paper will analyse the following resources namely annual capital expenditure, annual changes in liquids and gas reserves, annual replacement ratios, refinery distillation capacity and number of service stations, number of employees and net income per employee, and annual levels of drilling activity in exploration and development outlining total wells drilled with a disaggregation of successful and unsuccessful drilling.

With regards to building up property-based resources, a key factor for oil and gas companies is their level of investment in exploration, development, and production. A measure used to capture some aspects of this is their annual capital expenditure, with upstream and downstream disaggregation. This measure gives us an insight into the levels of investment undertaken by the companies at both the upstream (reserves increment) and downstream (refinery and retail infrastructure) levels.

Technology is an important factor in the petroleum industry and continues to play a crucial role at all stages in upstream oil and gas activities. This includes conducting initial seismic studies and their interpretations to establish whether a particular acreage has good prospects for oil and/or gas reserves; drilling exploratory wells to establish the type and scale of reserves; developing oil and gas fields to achieve efficient production; and maintaining fields for optimal production.

These upstream technology challenges can be particularly severe in offshore and deepwater acreages as well as in new onshore oil provinces that have limited geological data. Mature fields also pose real technology challenges for oil and gas companies as they seek to maintain output while production levels peak and start to decline. This includes efforts such as enhanced oil recovery and pumping gas to maintain pressure for a continuous flow. As the 'easy' reserves become exhausted, it will become more technically difficult to continue production from existing fields and to establish new ones.

Therefore, a measure used in this analysis is the companies' annual changes in liquids and gas reserves. Since this is an absolute measure, it does not give a clear indication of the size of the new reserves (or depleted reserves) relative to the companies' existing reserve base or production levels. As a result, a further comparative measure used is the annual replacement ratios, which gives a better measure and understanding of reserves changes in relation to the companies' existing production levels. On the downstream side, a measure used is the amount of refinery distillation capacity and the number of service stations.

To capture some aspects of the knowledge-based resources of the companies, a measure used to provide some insight into the level and relative performance of their employees is the number of employees and net income per employee. This measure gives us some understanding of the output and efficiency of the companies in the context of knowledge-based resources. The argument is that the technical and management capabilities of the employees of an oil and gas company determine to a large extent its level of success. This includes geologists, petroleum and reservoir engineers, project managers, senior managers, marketing executives, and finance specialists.

An issue for consideration within the oil and gas industry is that as current employees get older and eventually retire, there is the danger that a capability vacuum will start to emerge as an insufficient number of experts are being trained in the relevant areas to replace and expand current capacity. There are arguments that careers in the petroleum industry can be perceived by the younger generation to have limited future prospects and therefore young graduates become more attracted to jobs in IT, biotechnology, and financial services that can be perceived to be more modern and with greater future prospects.

Hence, a key human resource challenge for oil and gas companies is to be able to attract, train, and retain talented young professionals. To address this challenge, the argument is that they must identify the key technical and management roles that are critical and vulnerable to skills shortage and ensure that recruitment into these key areas is attractive enough in terms of training, financial rewards and future prospects. A further measure used to capture the level of technical knowledge and expertise of the employees of the companies is the companies' annual levels of drilling activity. This includes highlighting the total number of wells that they drilled with a disaggregation of successful and unsuccessful drilling for both the exploration and development stages. This measure reveals the success rate of the companies in both exploration and development drilling.

3 Property-based resources

3.1 Annual capital expenditure

The total capital expenditure for the nine years from 2000 to 2008 for the six companies is shown in Figure 1. This chart shows us that BP spent the most over the period at around US$ 200billion, followed by Shell at around US$ 176billion. However, if we look further into the split between upstream and downstream expenditure in Figure 2, we see that Shell spent marginally more in upstream, about US$ 6billion more, perhaps reflecting the higher prospects of its upstream assets or perhaps an indicator that it needed to invest more in upstream to replenish its increasingly depleted/revised reserve base. In contrast, BP spent over US$ 12billion more in downstream highlighting its focus on revamping and rebranding its service stations to reflect the company's new direction of 'Beyond Petroleum'.

Total and Eni showed a balanced mix of upstream and downstream spend with Total spending relatively more in downstream. However, the striking feature is that of Statoil which spent about 88 per cent of its US$ 64billion total expenditure in upstream, which reflects its strong focus on upstream offshore activities. In contrast, Repsol, which has the lowest total expenditure among the six companies at US$ 49billion, spent almost US$ 11billion in downstream, more than Eni and Statoil. What does this strategy of a more upstream or more downstream focus mean for the long-term profitability for these companies?

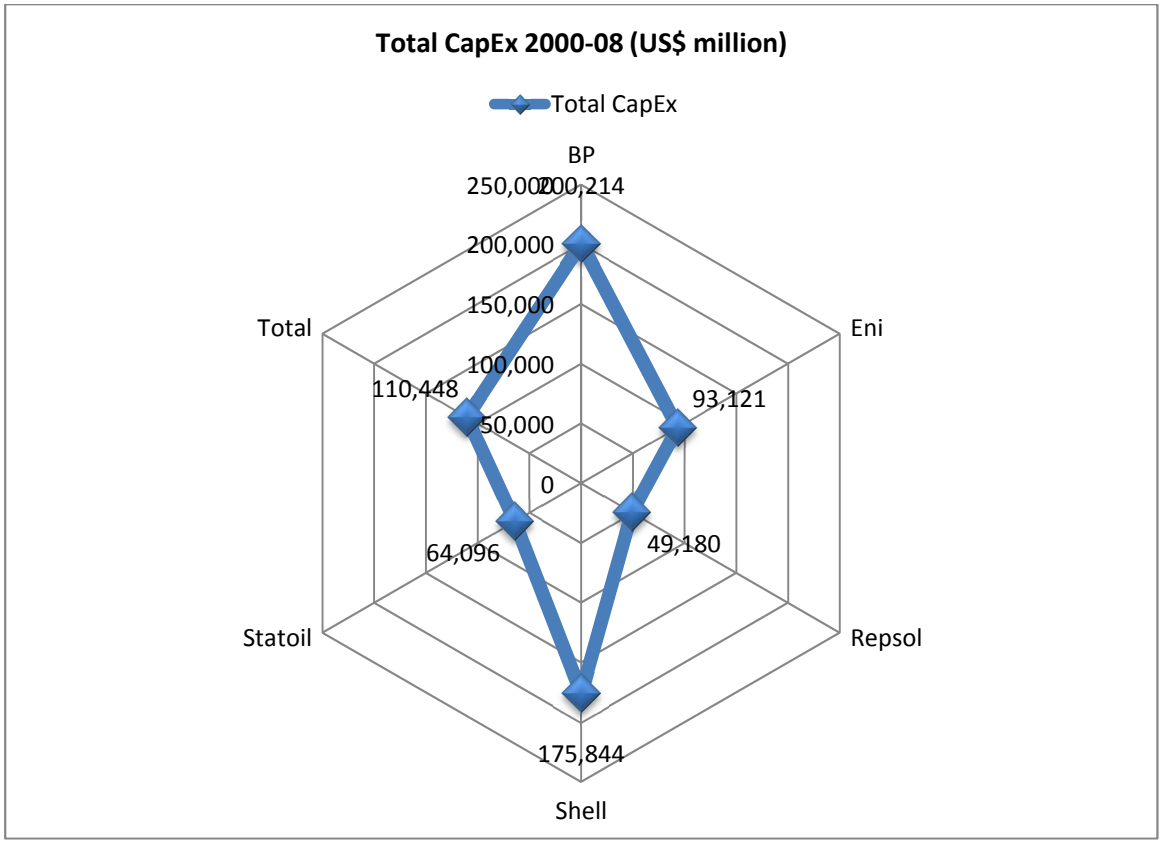


Figure 1: Total CapEx 2000-08

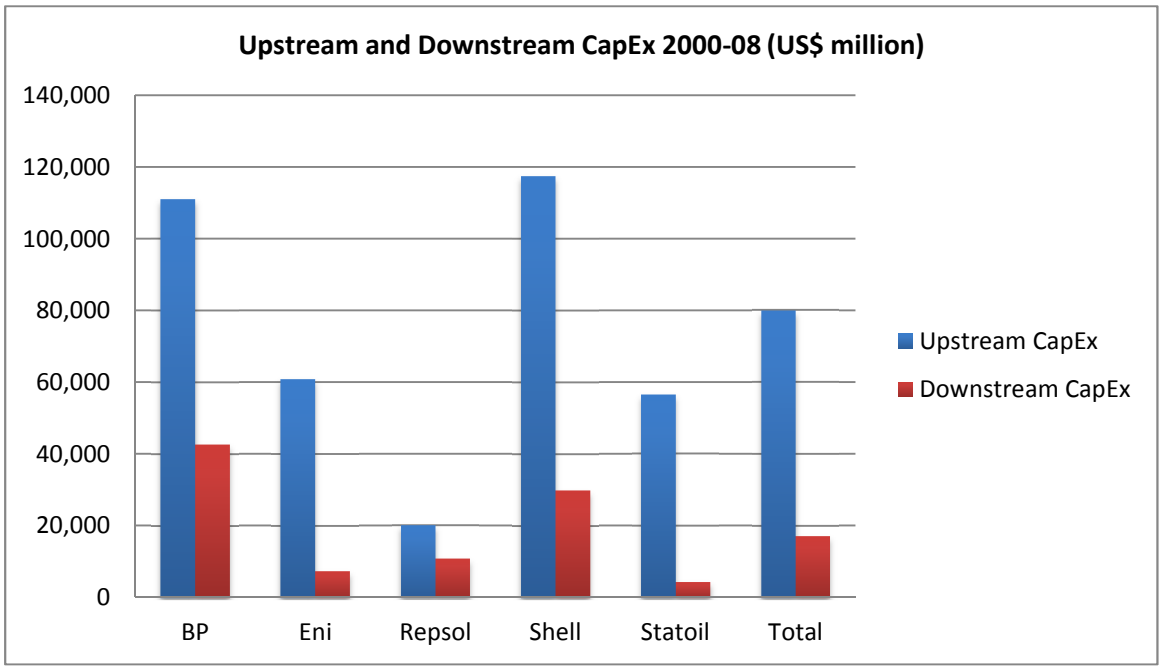


Figure 2: Upstream and Downstream CapEx 2000-08

3.2 Annual changes in liquids and gas reserves

In the upstream domain, a key measure is the change in liquids and gas reserves and Figure 3 shows us the cumulative change for both oil and gas for the six companies from 2000 to 2008. The best performer was BP with a total oil reserves increment over the period of about 2.8 billion barrels and a total gas reserves increment of about 9.7 trillion cubic feet. Eni and Total fared well with the former performing marginally better, especially in oil as Total experienced a decline over the period of about 1.2 billion barrels in its oil reserves.

The worst performer, in terms of reserves increment, was Shell despite spending the most among the six companies with a cumulative upstream capital expenditure of US$ 117billion. Shell's oil reserves declined by about 5.1 billion barrels and more dramatically its gas reserves declined by more than 11.8 trillion cubic feet over the period. This was primarily due to significant revisions to its reserve base, especially in West Africa. In 2003 alone, Shell announced downwards revision of about 3.5 billion barrels of oil and about 8.5 trillion cubic feet of gas, particularly from its Nigerian assets. Figure 4 shows the annual average changes for the six companies for both oil and gas and further helps to depict the contrast in their performance.

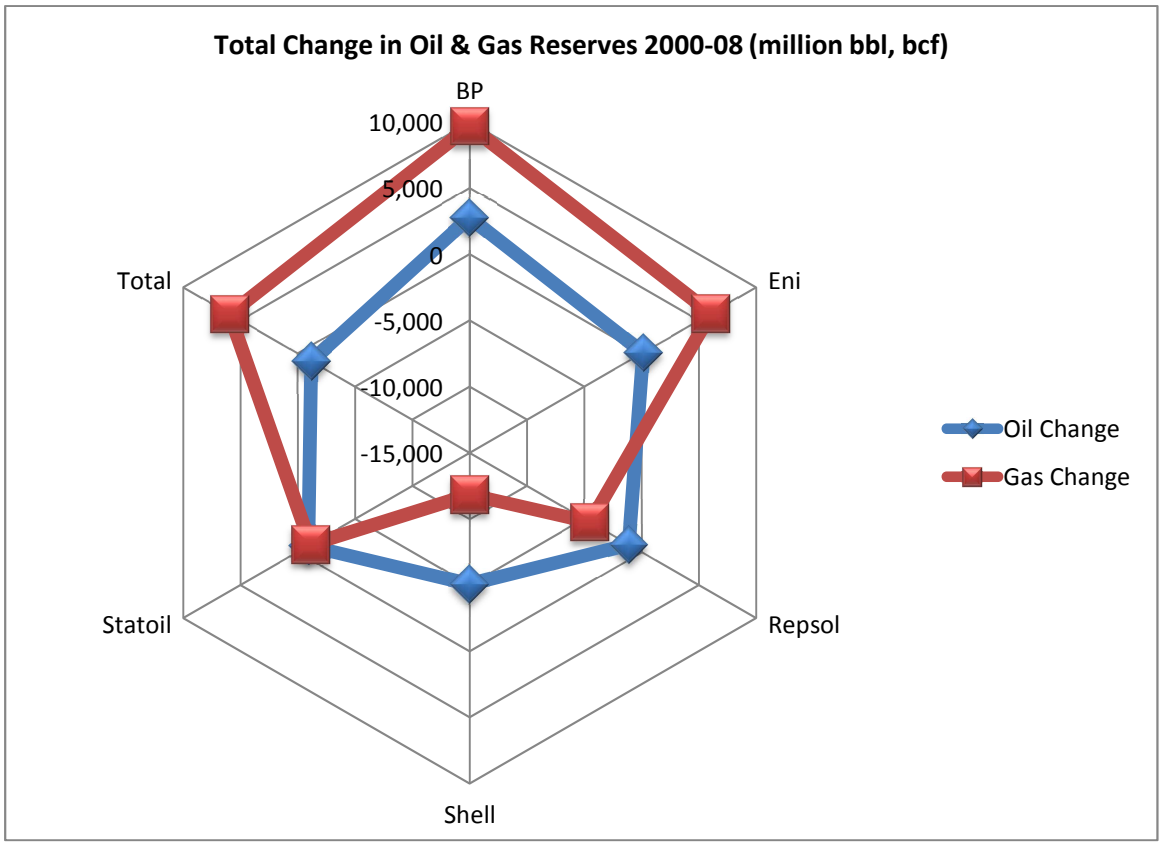
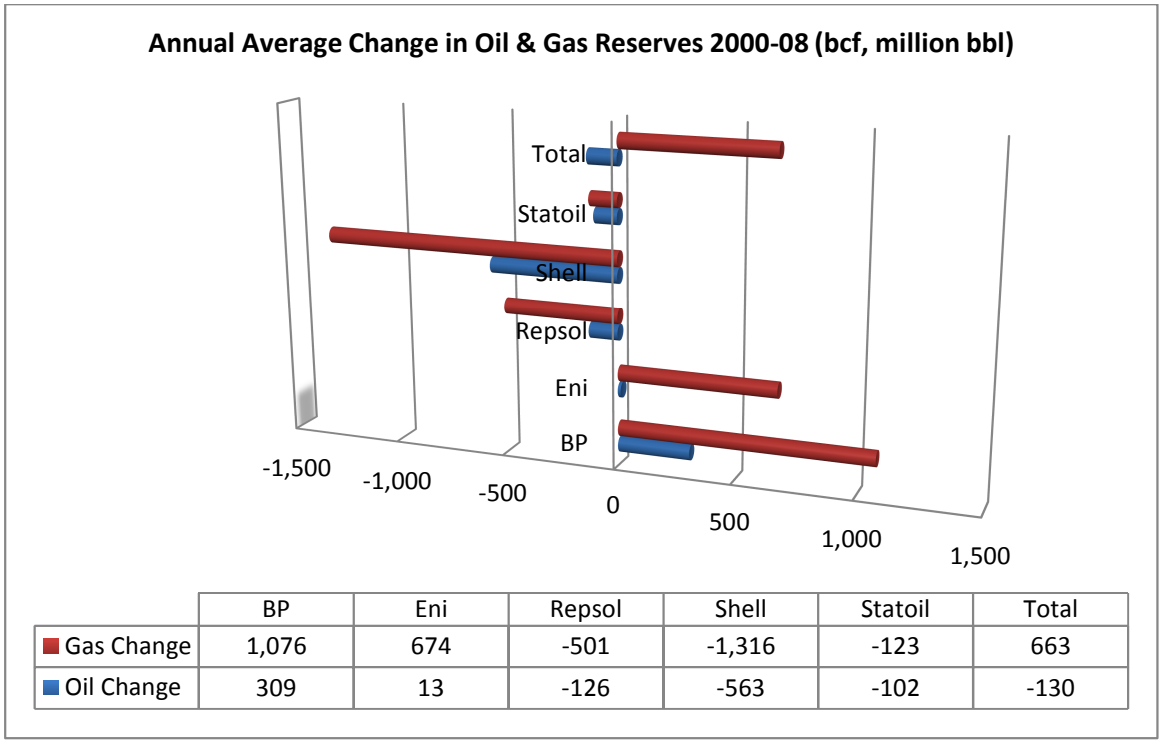


Figure 3: Total Change in Oil & Gas Reserves 2000-08



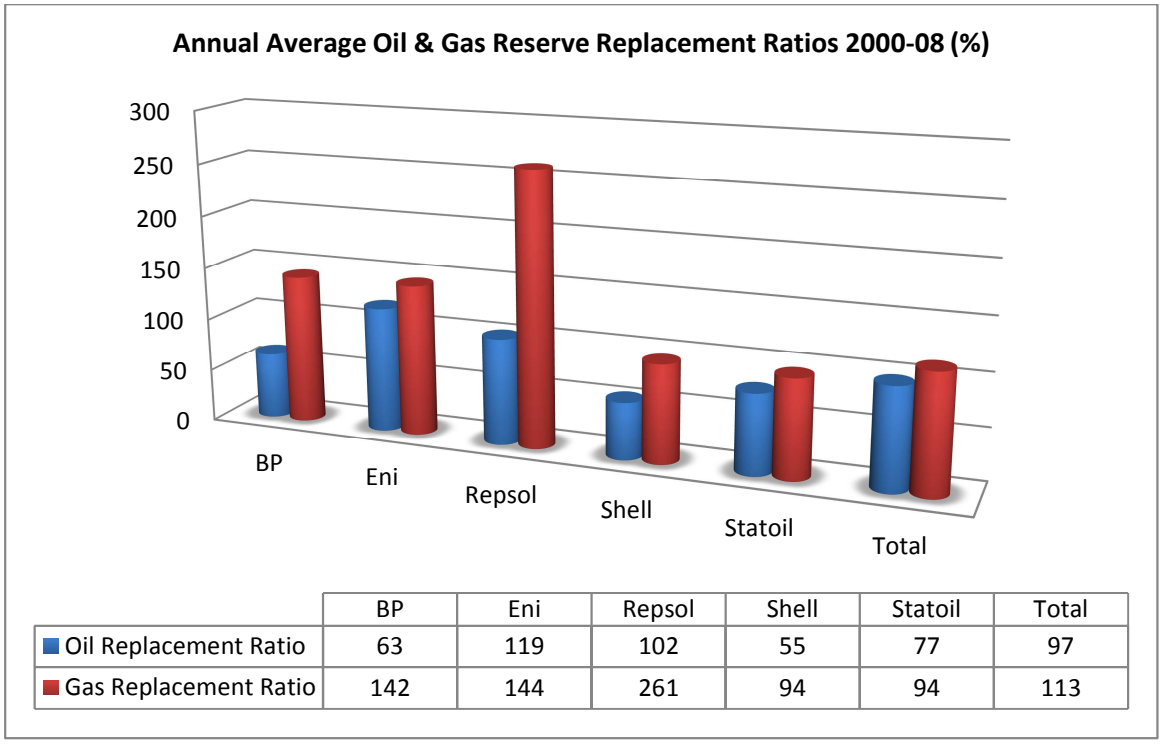
	BP	Eni	Repsol	Shell	Statoil	Total
Gas Change	1,076	674	-501	-1,316	-123	663
Oil Change	309	13	-126	-563	-102	-130

Figure 4: Annual Average Change in Oil & Gas Reserves 2000-08

3.3 Annual replacement ratios

To gain a deeper understanding of the companies' changes in oil and gas reserves, one must also look at reserve replacement ratios which gives further insight into how much new reserves are added relative to the production levels of the respective companies. This is shown in Figure 5, which compares the annual average replacement ratios for both oil and gas for the six companies between 2000 and 2008. For example, we see that despite BP's oil reserves increment of about 2.8 billion barrels over the period, its increase in oil production outpaced its increase in oil reserves, as its annual average oil replacement ratio over the period was 63 per cent. In contrast, its annual average gas replacement ratio was 142 per cent highlighting a sustainable increase in its gas reserves.

When looking at Repsol's replacement ratios, we see that it was about breaking even in oil with a replacement ratio of 102 per cent but its gas replacement ratio was a striking 261 per cent. This was due to the significant gas reserve increases in 2000 and 2001, which yielded replacement ratios of 987 and 912 per cent respectively. Eni showed a sustainable reserve increment in both oil and gas with annual average replacement ratios of 119 and 144 per cent respectively. Total fared less well but its performance was relatively better in gas with a replacement ratio of 113 per cent compared to oil, for which it was barely breaking even in terms of new reserves relative to production levels with an annual average replacement ratio of 97 per cent.



	BP	Eni	Repsol	Shell	Statoil	Total
Oil Replacement Ratio	63	119	102	55	77	97
Gas Replacement Ratio	142	144	261	94	94	113

Figure 5: Annual Average Oil & Gas Reserve Replacement Ratios 2000-08

3.4 Refinery distillation capacity and number of service stations

In the downstream domain, the key measures shown in Figure 6 of refinery distillation capacity and number of service stations capture the level of property-based resources for the six companies between 2000 and 2008. We see that despite BP's cumulative downstream capital expenditure of US$ 43billion, over US$ 12billion more than Shell's, it has on an annual average basis significantly less number of service stations at 26,144 compared to Shell's 35,778. In fact, if we look at the final year's figures in 2008, BP had 22,600 service stations compared to Shell's 45,000. What does this tell us about both companies, is BP focusing more on higher value locations and spending more on refurbishment and branding? How profitable is upstream versus downstream and is it worthwhile to be as vertically integrated?

Statoil is the least vertically integrated of the six companies and has spent only 7 per cent of its cumulative capital expenditure between 2000 and 2008 in downstream. It has the least number of service stations at just over 2,000 and its refinery distillation capacity is the smallest at an annual average of only 319 thousand barrels per day. In contrast, Shell and BP had an annual average refinery distillation capacity of 3.9 and 3.0 million barrels per day respectively. Given that historically downstream has been less profitable than upstream, should companies with successful upstream activities adopt Statoil's model by focusing predominantly on upstream and leaving the less profitable downstream activities for others? Or is there some hidden value in maintaining significant downstream operations for the future?

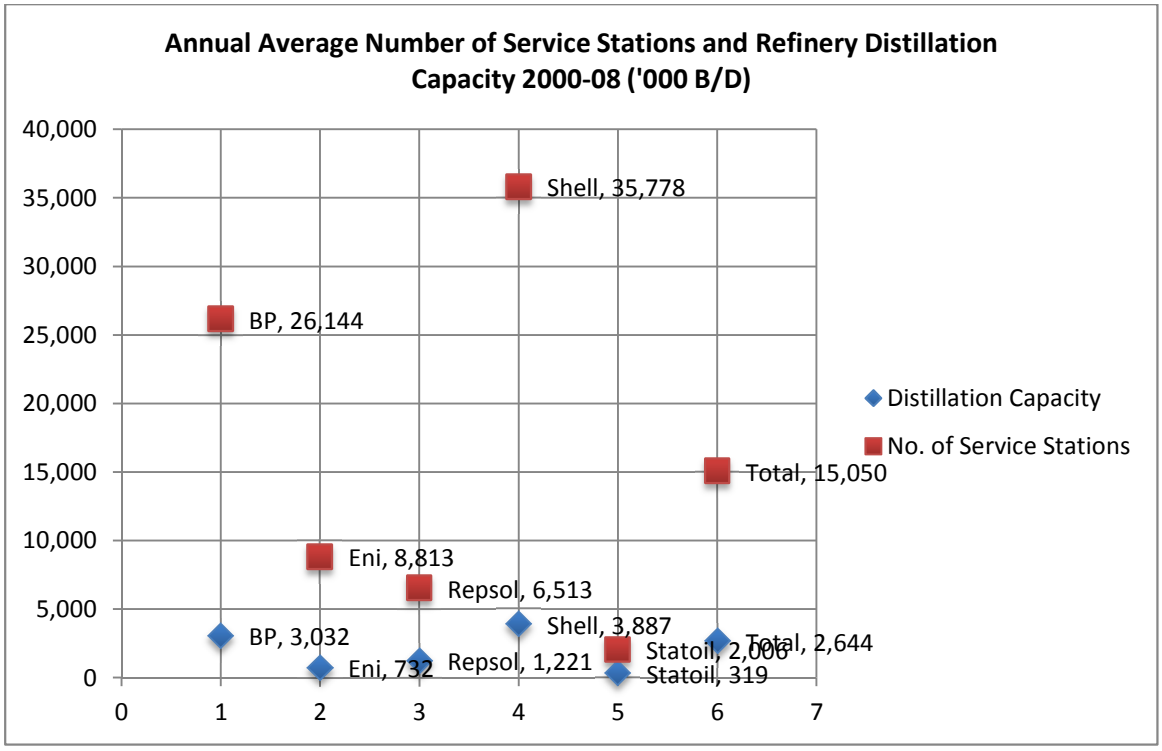


Figure 6: Annual Average Number of Service Stations and Refinery Distillation Capacity 2000-08

4 Knowledge-based resources

4.1 Number of employees and net income per employee

The annual average number of employees and the net income per employee of the six companies between 2000 and 2008 is shown in Figure 7. We see that Total appears to have the highest average number of employees at just over 110,000 but this is due to the relatively high employee numbers of over 120,000 from 2000 to 2002. This swelling of its ranks can be attributed to the two acquisitions of Petrofina and Elf Aquitaine in 1999 and 2000 respectively. Total has since trimmed its employee numbers as evident from the final year's figures in 2008, when it had less than 97,000 employees, which was less than Shell at 120,000 but more than BP at 92,000.

In terms of efficiency per employee, Total did not fare as well with the second lowest annual average net income per employee of US$ 108,611, only better than Repsol. In fact, Total's efficiency only really picked up from 2004, probably as a result of trimming employee numbers after the acquisitions as well as developing its higher margin upstream business. The best performer in terms of employee efficiency was Shell with an annual average net income per employee of US$ 182,667, followed by Statoil at US$ 170,875 which we know focused predominantly on upstream. Was this performance based on the inimitable knowledge and expertise of their employees or was it based on the high-yielding oil and gas assets that they held? In other words, was this due primarily to knowledge-based or property-based resources or was it a combination of the two?

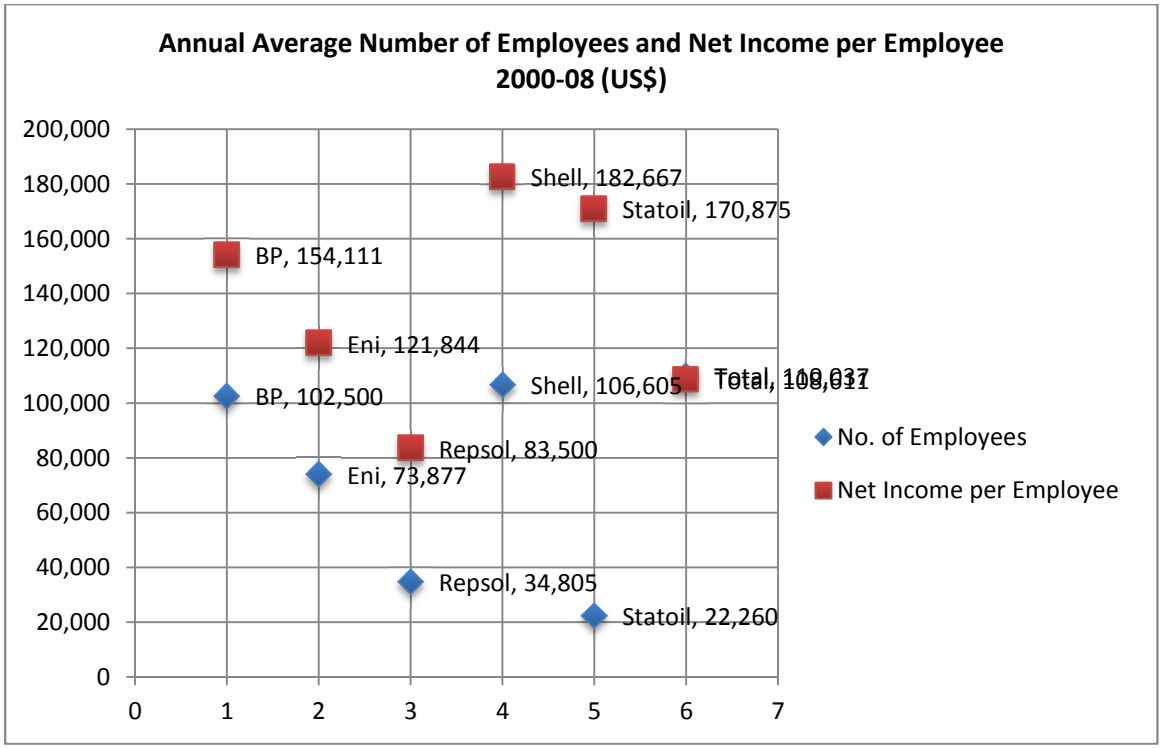


Figure 7: Annual Average Number of Employees and Net Income per Employee 2000-08

4.2 Annual levels of drilling activity

Figure 8 shows the cumulative exploration drilling activity for four of the companies (as data was not available for Eni and Repsol) from 2000 to 2008. We see that Shell was by far the most active company drilling 751 wells, almost double the number for BP, which is at second place with 382. Shell's drilling activity accelerated from about 2006 when it started to drill 3 to 4 times as many exploration wells as BP. This shows that despite Shell's significant downstream operations by having almost double the number of service stations of BP, it does invest significantly in upstream as well and therefore pursues a well-balanced mix of upstream and downstream. Statoil and Total are roughly at par with cumulative exploration wells of 141 and 175 respectively, despite Statoil's size as a company being much smaller than Total. This further reflects Statoil's focus on upstream.

The number of successful wells drilled in relation to the total number of wells drilled gives us an idea of how good these companies are and the level of technical, collaborative and project management expertise of their employees. This annual average success rate over the period is shown in Figure 10 and we see that BP, Shell and Statoil are at par at 64 per cent. Considering that the business of finding new reserves is the lifeblood of any oil and gas company, and that this is becoming increasingly difficult as most of the new reserves are in technically challenging regions, how well placed are the European oil and gas companies in terms of their knowledge-based resources in exploration?

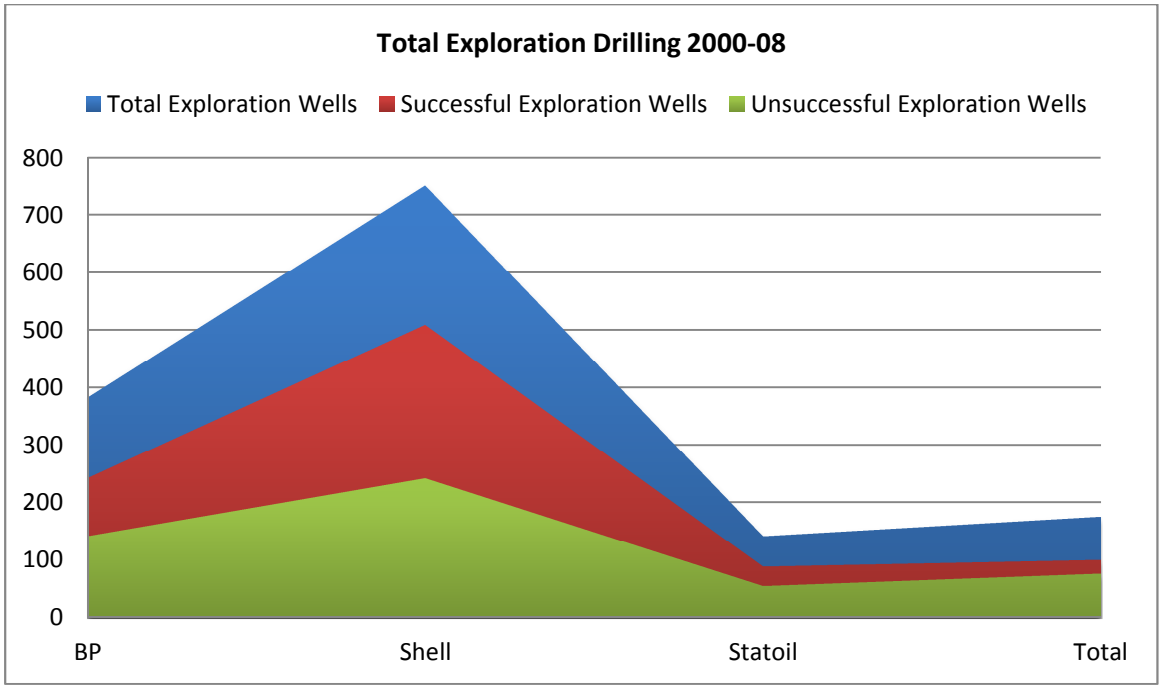


Figure 8: Total Exploration Drilling 2000-08

Since finding new reserves is only one part of what an oil and gas company has to be successful at, one has to look deeper at how successful they are at developing their assets. Figure 9 shows the cumulative development drilling activity of BP, Shell, Statoil and Total from 2000 to 2008, and we see interestingly that BP drilled over 700 more development wells than Shell. This could be attributed to a possible strategy of BP to acquire assets already discovered by smaller Exploration companies and hence minimise its exposure to exploration stage risk or it could possibly mean that it needed to drill more wells in order to successfully develop its reserves. A possible confirmation of the latter can be seen in Figure 10, which shows that BP's development success rate was 96 per cent, less than Shell's top performance of 99 per cent.

A similar argument can be said for Total, which had proportionately high development drilling relative to exploration drilling. We see from Figure 10 that Total's annual average success rate over the period was 89 per cent, the lowest of the four companies. This meant that it had a relatively higher number of unsuccessful development wells drilled which meant that it needed to drill more wells in order to successfully develop its reserves. Statoil, on the other hand, appeared to have been very lean with a total of only 435 development wells drilled but enjoyed an annual average success rate of 98 per cent, a close second to Shell's performance.

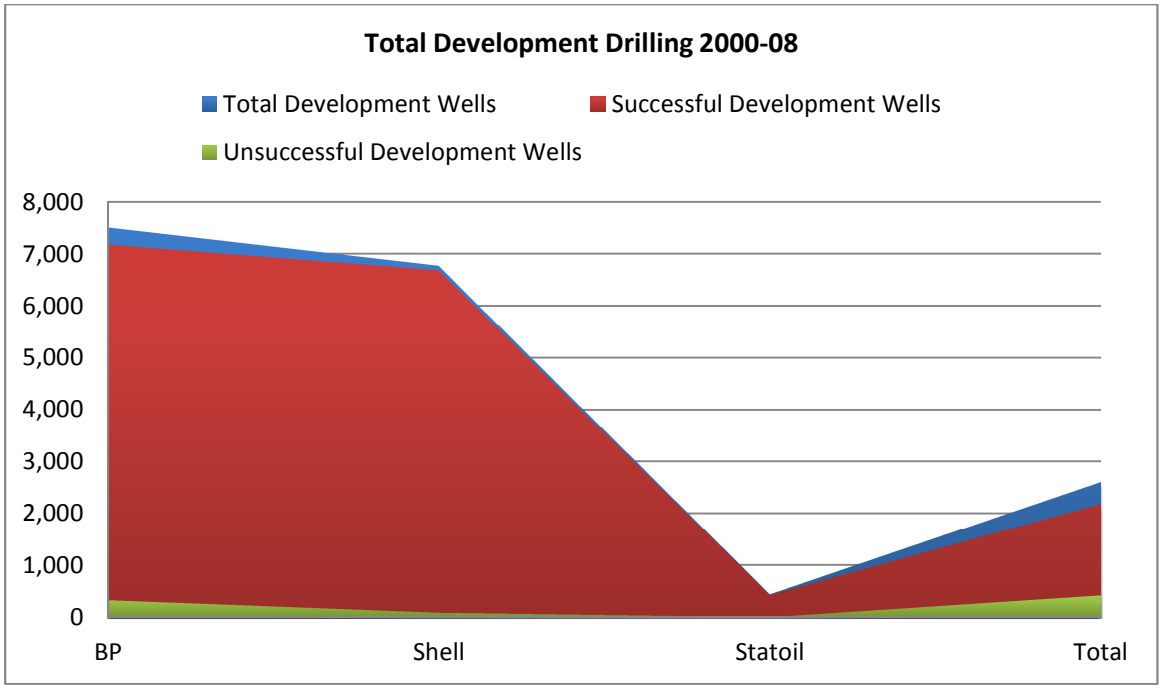


Figure 9: Total Development Drilling 2000-08

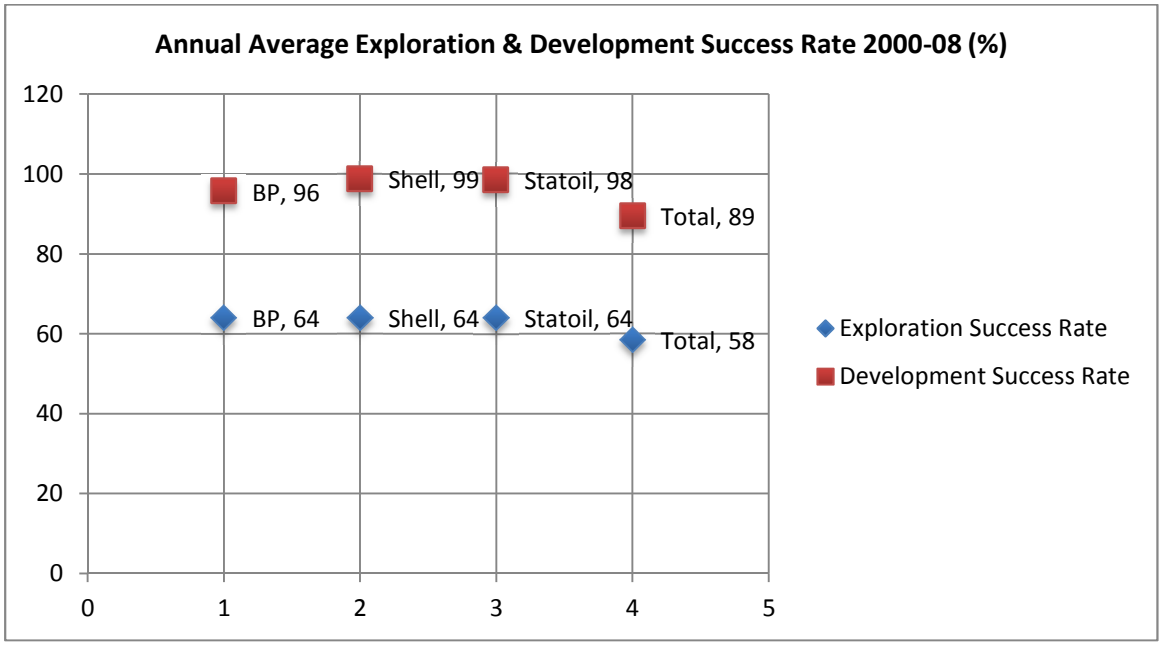


Figure 10: Annual Average Exploration & Development Success Rate 2000-08

5 Discussion

Oil and gas companies have played a dominant role in our lives for over a century in terms of being the single biggest provider of our energy needs for households; manufacturing as well as service companies; land, sea and air transport; and petrochemicals. From another dimension, they are some of the biggest companies in the world providing employment for hundreds of thousands of people and being high income-yielding investments for our pension funds. For example, BP and Shell during periods of high oil prices are the biggest companies, by market capitalisation, on the FTSE and are sometimes the biggest income-generating stocks to a number of pension funds in the UK.

It is therefore worthwhile to deepen our understanding of oil and gas companies in terms of their operations and the key drivers and determinants for their successful performance. This study has looked at the major European oil and gas companies and provided a comparative analysis identifying the key measures, using the resource-based view (RBV) framework, that have contributed to their success in the past and discussed how significant they will be for the future. A further extension of this study could be comparing these major European oil and gas companies to major oil and gas companies around the world, in particular US companies like ExxonMobil and Chevron, as well as National Oil Companies like Saudi Aramco, PDVSA, and Petronas.

The resource-based view defines two kinds of resources to be property-based and knowledge-based. Property-based resources generally refer to physical resources controlled by the firm and in the context of oil and gas companies they refer to physical oil and gas reserves, number of platforms for drilling and production, pipelines, number of tankers, number of refineries, number of service stations, etc. In this study, we have used the measures of annual capital expenditure, annual changes in liquids and gas reserves, annual replacement ratios, and amount of refinery distillation capacity and number of service stations as proxies to capture the level of property-based resources at both upstream and downstream for the six companies.

Knowledge-based resources, on the other hand, is more subtle and refers to the intangible expertise and intellectual content within the firm including technical, creative and collaborative skills. In this study, we have used measures related to employee efficiency such as net income per employee and measures related to employee expertise such as the success rate of drilling exploration and development wells. The knowledge-based resource domain presents the most scope in widening and deepening this area for future research. Possible measures that could be looked at, data availability permitting include the amount of R&D expenditure for each company relative to their total revenue, net income, or on a per employee basis. A further measure could be the number of patents filed for and granted for each company, as this will give some insight into how successful their R&D operations are. Another measure that could be useful is the cost per barrel of finding new reserves as well as production.

The resource-based view further argues that the value of property-based and knowledge-based resources differ depending on the environment in which they are used. The argument is that property-based resources are more valuable in stable environments and knowledge-based resources are more valuable in uncertain environments. Therefore, in the context of the oil and gas industry, in which new reserves are becoming increasingly difficult and expensive to find and produce from, private oil and gas companies are finding it increasingly difficult to get access to key reserves in countries with National Oil Companies, oil prices are becoming increasingly volatile due to market

swings and new government regulation on carbon pricing and taxation, it is safe for one to argue that it will increasingly be an uncertain environment for oil and gas companies in this century. Therefore, according to the contingency argument of the strategic value of resources put forward by the resource-based view, oil and gas companies in this new era of increasing uncertainty and turbulence should focus more on developing their knowledge-based resources as that is what they will rely on more, as opposed to property-based resources, as the key drivers and determinants for their success in the future.

6 Implications for Management Practice

Drawing from the contingency view of the strategic value of resources (Tseng et al., 2007; Wiklund and Shepherd, 2003) and the argument that knowledge-based resources will play an increasingly significant role in the future success of oil and gas companies, one can argue that a key area of focus as a driver of their performance is their employees, and in particular the effective management of their employees. It can be argued that it is only when technical and analytical skills are combined with a high level of personal and interpersonal awareness (for successful collaboration) is there a sound foundation for effective management. Further, one can argue that rational and calculative techniques are of greater value in a management context when the employees also understand how to 'manage' themselves.

This additional dimension to employee performance as a driver of firm performance refers to the employees' conduct, and the impact, both intended and unintended, that this has on others as well as their own effectiveness. When firms achieve increased effectiveness among their employees, this will translate to the employees accomplishing tasks with and through others more effectively as well as better addressing the continuous challenges of 'doing' management. Such challenges include developing the capacity of employees for rational decision-making, enhancing their ability to work effectively with and through others, and strengthening their discipline and awareness of their day-to-day conduct and its impact on their relationship with colleagues. This therefore involves a focus on areas such as culture, communication, and leadership.

As a result, some key themes relevant to Management Practice can be identified and should be addressed by oil and gas companies in order for them to develop the effectiveness of their employees, which we have argued, are a key knowledge-based resource that will play an increasingly significant and vital role in their future performance. These themes include effectively managing inter-cultural differences in teams in terms of analysing and coping with different cultural views and approaches, managing the dynamic interdependence of tasks and what this means for team and individual needs as they develop over time, managing the personal and interpersonal dimensions of leadership, managing different communication preferences and skills including active listening and how well teams give and receive feedback, and also managing how group cultures develop and its role in anxiety avoidance and problem-solving.

7 Conclusion

This paper has analysed, using the resource-based view framework, the two kinds of resources of the six major European oil and gas companies, and has compared their relative performance between 2000 and 2008. The resource measures analysed under property-based resources include annual capital expenditure, annual changes in liquids and gas reserves, annual replacement ratios, and the amount of refinery distillation capacity and number of service stations. Under knowledge-based resources, the paper analysed the number of employees and net income per employee, and the annual levels of drilling activity with the success rate in exploration and development drilling.

In this new epoch of increasing uncertainty and change in how we produce and consume energy, with considerations ranging from the irreversible decline in global oil reserves, high oil prices, high technology requirements, and perhaps above all the global initiative to limit carbon emissions and adopt cleaner energy supplies, the increasingly pertinent question is how will oil and gas companies survive over the next century? Drawing from the contingency argument of the resource-based view, they will have to rely more on their knowledge-based resources in such times of unprecedented uncertainty and change. They will inevitably in the long run have to move beyond petroleum towards cleaner renewable energy.

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