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PARTICULARS AND IMPACT OF TECHNOLOGY ON THE OIL & GAS BUSINESS

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As fuel prices increase, the global population more urbanized, and resource deposits more remote, a new global paradigm is development, focused on using fewer resources and generating less pollution, seeking the cleanest and most efficient way to power the economy. This has made the topics of energy efficiency, green energy and process optimization one of the main points of discussion at international summits, as well as at the Boards of Directors meetings of major corporations.

Oil & gas companies are, by far, the largest in the world, in terms of market capitalization and fixed asset values. Compared to the average size of the companies that work in other sectors, energy companies are usually among the ones that generate the highest revenues and provide the largest dividends to their shareholders.

For these reasons the energy business has been chosen for this analysis.

Problems. The energy business has many peculiarities that differentiate it from other types of business. It has a distinct history, it follows its own rules and it is intensely influenced by the technology and process flow. It also more strongly feels the effects of changes in the global political balance and global economic changes than do other industries. For these reasons, it's impossible to create a competitive business in the energy industry without a strong understanding of all its characteristics.

The influence of technology, in particular, is a very important consideration for the energy industry. Unlike the heavily labor-driven operations of years past, energy companies today are affected by technology in every part of their business and throughout their network of operations, from extraction to sale thought to power and heat production, transmission, distribution, maintenance and emissions control.

The efficiency of energy companies' production and distribution cycles, influenced by the role of technology in their networks of operation, also play an important role. These cycles are specific to each company, as they can be influence by many different options available for producing energy from traditional fuel sources. These include simple gas cycles, simple steam cycles, CHP, combined cycles, etc. Each option has its own characteristics and specific efficiency levels. They are also not entirely or absolutely interchangeable, as each of them has its own fields of application. Additionally, companies must consider the cost and efficiency of each option. Although higher cycle efficiency results in lower the fuel consumption, the additional cost necessary to achieve higher efficiency creates a trade-off issue for management.

Finally, ecological restrictions represent another significant issue for energy producers, especially in EU nations. If emissions exceed legally-established limits, heavy fines are imposed. Yet, respecting the emissions limits set by governments also requires large investments by energy companies in more efficient production options. Emission control systems have been shown to have a negative impact on the complexity of a company's structure, as well as on the cycle efficiency. This creates another trade-off for companies to manage.

The last 2 problems described above are strictly related to technology. As such, this thesis will mainly concentrate in the impact of the technology in the energy business.

Study of the problem. The approach adopted to solve these problems is to analyze every component which is involved in the profit of energy companies.

It is possible to understand the components which have this impact with the following expression:

$$COE = \frac{\frac{C_{inv} * CCC + C_{O\&M} + C_{ins} + C_{hr}}{P}}{h_{eq}} + \frac{C_{fuel}}{\eta},$$

where:

COE= Cost of electricity [$\frac{€}{MWh}$];

C_{inv}= Cost of investment [$\frac{€}{year}$] ;

CCC= Capital carrying charge [%];

$C_{O\&M}$=Operation and maintenance costs[$\frac{€}{year}$];

C_{ins}= Insurance costs [$\frac{€}{year}$];

C_{hr}= Personnel costs [$\frac{€}{year}$];

C_{fuel}= Fuel cost [$\frac{€}{MWh}$]; ;

h_{eq}= Hours equivalent [$\frac{h}{year}$];

η= Efficiency [%];

P=Plant power [MW].

From this formula it is also possible to deduce the relations which relate the different components and the effect which ever component has to the cost of electricity (and obviously to the profit).

It's important to say that the investment costs depend on the plant size, the more the plant is big the more the investment cost for power unit is low, this fact is related to the scale economies. The situation is very similar for personnel costs.

The hours equivalent are related to the operation and maintenance policy. The more hours spent on maintenance, the lower the hours equivalent will be. Yet, at the same time, if the failure time will be very high, it will influence the hours equivalent. For these reasons it's very important to choose the best maintenance policy.

The cost of fuel is very specific for every country and for each fuel type, it can be as well influenced by the plant size as it's possible to get big discounts in case of big amount of fuel purchased.

The efficiency of the plant is related to the investment cost and to the operation and maintenance cost (if the plants is very complex, with a high number of components which allow a higher efficiency, for sure it has big investment and maintenance cost).

The COE is finally influenced by the useful life of the plant, the longer the life is the more the investments will be spread during the years and so the COE will be lower (the CCC will be lower in the formula is the life is long).

This model doesn't contain all the variables which influence the COE, it is possible to improve it introducing other 2 very important voices, the cost of auxiliaries and the carbon tax (which will be probably be introduced soon). The model so becomes:

$$COE = \frac{\frac{C_{inv} * CCC + C_{O\&M} + C_{ins} + C_{hr} + C_{aux}}{P}}{h_{eq}} + \frac{C_{fuel}}{\eta} + \frac{CO_2}{\eta} * CT$$

Where:

C_{aux}= Cost of auxiliaries [$\frac{€}{year}$];

CO_2= Production of carbon dioxide [$\frac{KG_{co2}}{MWh}$];

CT = Carbon tax [$\frac{€}{KGco2}$];

For both these new elements it is possible to exploit the scale effect, which means that the bigger the plant is, the lower the cost per MW will be.

Conclusion and expected results. After a deep study of every part of the system and having understood exactly how every part work it starts the last phase of the thesis, at this point the target is to find the right instruments which allow a correct management of the energy companies. The tools which are most expected are basically of 3 types:

- **Strategic management models:** it is expected to understand which are the most appropriate models which are useful for the management in order to take the right strategic decisions;
- **PLM (Product Lifecycle Management) tools:** these instruments are expected to play an important role, in fact they allow to take into consideration all the costs related to the whole lifecycle of a product, especially PLM application for gas turbines and for other machines, because the TCO (Total Cost of Ownership) of the energy company's assets definitely influences its revenues;
- **Maintenance policy:** the maintenance is expected to be extremely important. It is expected to understand the best policies for every plant configuration, or at least for the main ones.