RELATIONSHIP BETWEEN DIFFERENT BUSINESS VALUE COMPONENTS WITHIN THE OIL AND GAS INDUSTRY

Brlečić Valčić, Sonja

Sonja Brlečić Valčić
Saipem SpA Croatian Branch
Alda Colonnella 2,
51000 Rijeka, Croatia
sonja.brlecic@gmail.com
Phone: +385957205103

RELATIONSHIP BETWEEN DIFFERENT BUSINESS VALUE COMPONENTS WITHIN THE OIL AND GAS INDUSTRY

Abstract

The oil and gas industry is characterized by many complexities and specificities of business operations. The above is also reflected in the identification of value components, and the understanding of their inter-relationships. In order to have an effective value management, it is especially important to follow up on the movements in key financial indicators and qualitative factors which impact the creation of financial results. This paper presents the theoretical basis in order to identify the most important qualitative value components in oil and gas companies. Therefore, the specificities of all sectors within this industry are highlighted in order for them to be related to the key financial factors influencing the creation of stable cash flows. For this purpose, a cluster analysis of selected key financial factors has been performed using self-organizing neural networks. Connecting identified qualitative value components affecting cash flows with the financial parameters through which they are reflected, creates a framework for developing an effective value management model.

Keywords: Oil and gas industry, business value components, free cash flow, self-organizing neural networks

1. Introduction

The value of a company is not taken as the sum of individual values, but as the overall value of a set of effects (Tichy, 2009). The rationale behind this value is the survival and future of business operations i.e. the possibility of creating future business results and may be defined through expected business development.

In order for a company to be able to operate within the context of sustainability and continuous business activity, its strategies should be set to generate satisfactory cash flows through a value network. This of course depends on a variety of factors such as the number of years of its existence, the industry, industrial concentration, the type of consumer as well as other internal and external factors affecting a company's business operations (Brlečić Valčić, 2015). Therefore, value components can be defined

as the links in the value chain that affect business advantages, customer perception and the possibility of creating satisfactory business results i.e. satisfactory cash flows.

One of the key problems in identifying the value components of a company is that they are qualitative in nature and are as such not recorded in financial statements. Namely, the financial ratios are just their indirect indicator. Therefore, it is necessary to find an adequate way to examine their relationship with financial effects.

By tracking the movements in working capital and by linking the factors that, within the value chain, affect these movements, it is possible to identify the most important value components within an industry.

A few basic sectors define the oil and gas industry, and each of them is focused on specific processes within the value chain. As this extremely active industry is characterized by significant complexities, many companies focus on just one of these sectors. The planning of future costs and revenues depends on the specific features of each sector within the oil and gas industry. The great diversity in relation to other types of companies stems from the fact that this industry is highly cyclical and dependent on the prices of commodities. This particularly applies to the inability to control revenues. Furthermore, such companies are to a large extent dependent on assets and thus the revenues of exploitative manufacturing companies will depend on oil and gas reserves, whereas of those belonging to other oil and gas sectors on technologies supporting this industry. The above is reflected in the production processes, production equipment and operating business activities (Brlečić Valčić, 2014).

Therefore, in the context of the above said, the research problem imposing itself is the identification of qualitative factors that affect the value components of oil and gas companies, and their relationship with financial factors.

The goals of the paper are to investigate and analyse relevant factors of a qualitative and quantitative nature that affect the creation of cash flows within the value creation concepts in the oil and gas industry, as well as, based on objective scientific facts and the applicable theoretical and practical knowledge about the specificities of business in this industry, to formulate the results of research that can provide better business organization focused on creating long-term sustainable business.

By using self-organizing maps (SOM), the author has established the connections and relations between financial parameters and cash flows, and has proposed measures for monitoring and evaluating their interaction.

2. Theoretical background

As value creation must be considered in the context of business networks that include suppliers, partners, distribution channels, as well as associations that expand access to resources (Zott et al., 2011), it must also be observed with regard to the specific features of the industry. In the oil and gas industry they are reflected in the production processes, production equipment and business operations (Raymond, Laffer, 2006), and result in financial specificities (Johnston, 2006; Cormier, Magnan, 2002). Total amount of created value, will be lost if a group of value creators does not participate in its further creation (Chatain and Zemsky, 2009). Therefore, there is a need for the understanding of all stakeholders in chain of value creation in order to enable sustainable business in the future.

Furthermore, the movements in oil and gas prices and risks that accompany this industry greatly affect the financial results of these companies (Basher, 2012; Adelman, 2005), which, in addition to the mentioned specificities, make the value components of these companies typical (Osmundsen et al., 2006; Misund et al., 2008).

Namely, the oil and gas industry is an industry that has no direct effect on the price it will achieve through oil and gas sale. Therefore, it should base its production and capital investments on reserves and current prices of oil and gas as well as predictions on the movements of oil and gas prices in the future.

Considering the aforementioned, the theoretical background for relevant factors that affect the creation of cash flows within the value creation concepts in the oil and gas industry should be observed within dependence of oil and gas price trends on political and economic factors, specificities of companies in the oil and gas industry, as well as specificities of the working capital, cash flow and other financial factors within the oil and gas industry.

2.1 The dependence of oil and gas price trends on political and economic factors

Oil derivatives such as gasoline, jet fuel, diesel fuel, distillate oil, asphalt and raw materials used in chemical and plastics industries, classify oil as a leading commodity in the world market. More than 50 % of oil production is traded internationally, and this share represents approximately 10 % of total world trade (Johnston, 2006). In the supply of energy consumption, the trade in oil and oil products accounts for approximately 40 % (Wall Street Prep, 2009).

Natural gas is used in the industrial and commercial sectors as well as households as an energy source, but also as a raw material in chemical and refining processes. The demand for natural gas is becoming increasingly high due to the neutral impact it has on environmental pollution through the emission of harmful gases, and more than 26 % of world production is traded internationally. In the past, this industry was focused on supplying mostly Western markets with energy, and the competition between private companies was conditioned and oriented towards accessing existing reserves. As the demand for energy increased, and as the positive movements in the rise of oil and gas prices followed the trends in demand, this industry started to develop increasingly and grow accordingly. Such a trend in demand was followed by continuous development of new technologies that allow for the extraction of the until recently considered unconventional oil reservoirs. The reservoirs have spread to challenging areas such as the deep sea, the Arctic zone or politically unsafe areas of the world (Brlečić Valčić, 2014).

As with any commodity, the structure of the oil and gas market is characterized by the supply and demand ratio. However, unlike other commodities markets, political factors have, through history, noticeably impacted the supply and demand i.e. the economic structure of the oil and gas markets. Moreover, it can be said that there is no other commodity that has a more direct influence on economic and political development as do oil and gas, not only on single economies but also globally. This is evidenced by numerous oil shocks and events related to them.

The most important factors influencing the price of oil and gas include:

- Supply
- Reserves
- Demand and
- Other.

Throughout the twentieth century, the demand for oil had risen causing an increasing pressure on prices. Alongside the demand, the supply had also grown rapidly because new sources and new and cheaper production methods were found and developed.

Finally, the fast growing Asian economies and the political instability in the Middle East have raised the demand and decreased the supply of oil in the last decade. It is expected that the economic development of the economies of China and India will put pressure on the price of oil and gas in the near future. Moreover, it is expected that the current conflict between the Russian Federation and Western European countries and the United States will leave a serious trace and influence on the available quantities of oil and natural gas as well as their price in the near future.

The history of gas pricing policies has generally followed that of oil prices and was directly dependent on the supply and demand. Significant fluctuations in the prices of natural gas can also be linked to the above mentioned reasons impacting the significant changes in oil prices. It is important to emphasize that, only since recently, the trend in natural gas prices has been separated from that of oil prices and has become more similar to that in coal prices.

The need for energy changes over time with social and technological developments. Developing countries, that have not been highly dependent on energy, will, with time, have higher needs for energy. Therefore, it is uncertain whether the increase in living standards in developing countries will result in the scarcity of resources in the future and increased prices and whether new technologies and non-conventional energy sources will bridge the gaps in energy supply. However, the oil industry's monopoly in the transport market based on the use of oil and oil derivatives as the main fuel for vehicles is slowly decreasing despite expected production growth. The automotive industry is producing increasingly more efficient vehicles, and biofuels are gaining their place in the market as a replacement for oil products. The key factors causing oil to lose its monopoly as a key motor fuel are its high cost

and the increasingly influential government policies in limiting carbon dioxide emissions and other greenhouse gases. It is expected, therefore, that the number and impact of such policies will increase in the coming years, which will result in a decline in the use of fuels with high carbon dioxide emissions, especially in developed countries. This decline will be slower and longer in developing countries.

Among other factors affecting the demand for oil and gas, the most important ones to mention are technological improvements related to energy efficiency, seasonal weather patterns, and increased competitiveness of alternative energy sources accompanied by subsidies and incentives of individual governments, as well as the changes in technology and consumer preferences that alter the consumers' final choice. On the other hand, among the factors having the greatest impact on supply are, in first place, the discovery and development of new oil and gas sources as well as the technology for the improvement and recovery of existing sources. These factors have an impact tendency to reduce the prices within the limits in line with the increase in supply caused by the increase in demand. Likewise, the increase in the efficiency of the refining industry and production capacity are factors that have a tendency to reduce the margins on finished products.

Potential factors that may, from an economic standpoint, also affect oil and gas prices in a negative way are inflation, interest rates, exchange rate fluctuations, as well as local and regional market conditions. From a political point of view, the factors having the greatest influence are those related to limitations in the access to oil reservoirs (Brlečić Valčić, 2014).

2.2 Specificities of companies in the oil and gas industry

Due to the complexity of business processes, from exploration, extraction to distribution of oil and gas to end users, the oil and gas industry is divided into the following five sectors:

- Exploration & Production, E&P, often termed internationally as the Upstream Sector;
- Transportation & Storage, T&S, widely known as the Midstream Sector;

- Refining & Marketing, R&M, known as the Downstream Sector;
- Oil Field Services, OFS;
- Integrated Majors, IM.

The oil and gas industry is characterized by the three basic organizational forms of companies with regard to ownership, namely, privately owned, joint stock and nationalized companies. In traditionally oil and gas export-oriented countries, the features of business operations of companies in this industry still depend on the state monopoly over these companies, even though in recent years, an increasing number of small privately owned companies have entered this industry either alone or in cooperation with the state-controlled companies. In most cases, the companies' development and business strategies in this industry are closely linked and dependent on the governments of countries in which they operate. However, recent research and studies show changes in government intervention in the operations of these companies, mostly caused by climate changes and the economic and physical security. The operative areas of business activities relate to the processes defined from the discovery of oil and gas to their supply to end-users, and thus the industry, as previously defined, is divided according to the operations carried out within these processes.

Exploration and production is the largest sector within the industry, not only by the size of the companies that operate within it, but also according to their number. It involves business operations associated with the discovery and extraction of oil and gas. The process of exploration relies on the application of geological sciences and drilling technologies which require a high level of expertise and qualifications of employees, especially in the detection of under-surface traps related to hydrocarbons. Production, in turn, implies activities related to the removal of oil and gas from sources and delivering it to the transport sector.

In economic terms, this sector is characterized by significant instability in achieving the ultimate achievable commodity prices (oil and gas) as well as the high costs involved in finding oil and gas and developing reservoirs and reserves for production and in addition to all this, often uncertain estimates of renewable resources for production. As reserves are, by their nature, depleted due to exploitation, this industrial sector is forced to continuously reinvest its proceeds into business operations to find

new resources for production, replace depleted reserves and increase production and sustainability. Conventional oil and gas reserves are becoming scarce and are, more recently, found in smaller reservoirs. However, as already mentioned, this industry is at a high level of yielding the benefits of modern technology which is constantly evolving, and made use of in finding unconventional reserves. Thus more and more attention is given to oil shales, especially in North America and Canada, and offshore resources and reserves in deep seas (Brazil, Arctic belt, etc.). The exploitation of offshore areas requires more capital investment per reservoir, and is therefore liable to greater risk. On the other hand, the exploitation of oil shales, involves minimal exploitation risk, as it is a well-defined and long-term resource. However, it is important to note that the extraction of oil from oil shales is somewhat controversial due to its potential negative impact on the environment, particularly in terms of groundwater. The latter is the subject of many discussions.

The sector of transportation and storage of oil and gas is a vital link between producers and consumers. The basic characteristics of this sector are related to the storage and transport of oil and gas from the reservoirs to refineries. Oil and gas are transported by pipelines, tanker trucks, and special ships for the transportation of crude oil, i.e. liquefied natural gas. Laying pipelines for collecting and transporting oil and gas are the backbone of this sector. In recent years, these companies have increased their focus on the infrastructure and transport means related to the delivery of gas.

The sector of refining and marketing involves activities related to refining crude oil in petrochemical plants (refineries), as well as the distribution of finished products (gasoline, diesel, jet fuel, distillate oil, asphalt, lubricants, synthetic rubber, plastics, fertilizers, pesticides, antifreeze, butane, propane, natural gas, etc.) to end users. Refined oil products and natural gas are transported in different ways to distribution centres for further consumption. This sector can be viewed separately, as a sub-sector of refining and as a sub-sector of marketing. Oil processing involves the separation of individual fractions, the so-called refines, from which the words refining and refineries are derived. In general, these procedures relate to removing sulphur, nitrogen compounds and salts from petroleum to achieve better quality.

The margins and profits of refineries depend on the difference in the price of crude oil and finished products, which is closely linked to the quality of the oil and the procedures performed in refining. The more complex refineries are able to perform such processes cheaper and can therefore yield higher returns.

The sub-sector of marketing is responsible for presenting the oil and gas industry to the public. By means of advertising, customer management, product mix, wholesale and retail strategy, it promotes sales and branding. Wholesale activities involve choosing the distribution channels, managing the positions of distribution, as well as the expansion of product ranges in stores.

It is of crucial importance for this sector to locate storage terminals at convenient positions in order to:

- Avoid geographical imbalances between refineries and consumers;

- Improve the level of meeting regulatory requirements related to quality specifications of individual products, for which separate storage is needed;

- Increase the activity of independent retailers, and

- Impact oil trade in terms of complying with mandatory regulations related to reserves.

Oil field service companies (OFS) provide specialized equipment and skills needed for exploitation, drilling, testing, production, maintenance and recovery of oil and gas reservoirs, and the design and construction of pipelines for the transport of oil and gas. Namely, exploring oil fields and reserves and the production and transportation of oil and gas is a complex process, in which each step in the chain of this process requires specific expertise and specialized technology. Moreover, finding oil and gas reservoirs requires numerous and complex research investigations, geological modelling, seismic studies and oil well testing. In addition to the above services, companies within this sector rent equipment required for the extraction or transportation of oil and gas.

Integrated companies apart from being involved in the exploitation-oriented manufacturing sector are active also in at least one of the mentioned sectors, most commonly in refining and marketing, and the transport sector.

2.3 Specificities of the working capital in companies operating in the oil and gas industry

The oil and gas industry has been facing challenges in managing its working capital in recent years. These challenges are related to the characteristic problems significantly impacting cash flows, financing and business operations. The main cause of this is the demand for an increased production that will meet the energy needs, especially in emerging markets. Moreover, issues such as the volatility in pricing trends, particularly in the intervals of relatively high oil and gas prices, divert the attention from a quality management of working capital (Brlečić Valčić, 2014).

In addition to the huge impact of price trends, one of the most influential factors impacting working capital is certainly the development and expansion of capital investments, which have been essential in this industry as it needed to react quickly to the changes in market conditions by either speeding up, slowing down or delaying the execution of ever more complex projects and programs. Therefore, there is a growing awareness of the importance of quality management of working capital in this industry.

Companies in the oil and gas industry have different variations of managing working capital which are built on the different business and operating model types, relationships with customers, degree of vertical integration, the nature of the procurement and production contracts and the infrastructure of distribution.

The working capital is also greatly influenced by the complexities of the industry itself, which include:

- Smoothing investment cycles in periods of price volatility,
- Solving problems of higher exploitation costs and development costs, as well as risks,
- Conducting operations in times of increasingly stringent regulatory requirements, and
- Assessing the impact and opportunities with the emergence of alternative energy sources.

Improvements in the management of working capital within this industry can be achieved by a more quality management of inventory, demand estimates, supply chain planning, debt collection, achievement of good trade conditions as well as quality contracts with contractors, primarily in terms of decisions to contract out individual business segments to external associates.

Research by Ernst & Young-a (EY, 2011) indicates a significant increase in the changes in this industry's working capital in recent years. These changes are observed in cash conversion cycles (Cash-to-Cash, C2C) representing the days of inventory outstanding plus days of sales outstanding minus payables outstanding.

In the observed period from 2003 to 2009, the C2C of this industry was marked by an increase of 7.1 days (from 24.9 to 32.2), which is a 29 % increase. The key factor for this increase can be found in the levels of inventory that significantly increased in the period from 2003 to 2009, which was reflected on the impact of oil prices, the value and the structure of total inventory as well as higher level of share value.

The same source states that the manifested paradox of holding more physical inventory during periods of high oil prices may be explained with the current combination of low interest rates and significant price volatility. Namely, low interest rates reduce the cost of storage and volatility creates a significant price differential between the current price and the expected price in the future. In such a situation, companies can afford to keep oil during long intervals, and market it on more profitable target markets.

The upstream sector has the lowest working capital within the industry as a result of low inventory levels and high levels of payables. The refining and marketing sector as well as integrated majors is in a much better position, while the OFS sector is by nature characterized by complex business activity due to the long cycled business models that are marked by long-term contracts. What is characteristic of these contracts is that they contain within themselves an obligation of significant advance payments and progressive collection requirements.

The outspread of business operations with a sector is higher in OFS and exploration sectors than in the refinery sector, and the greater dispersion in the exploration sector is caused by the differences in the products and buyers as well as the levels of capital investment. On the other hand, in OFS it is conditioned by the nature of its sub-segments which perform certain tasks for the oil and gas industry, because every project within this sector is linked to

the a task related to a certain period in the reserves' life cycle as well as the variations in performing operations based on different business strategies.

2.4 Specificities of the cash flow in companies operating in the oil and gas industry

Free cash flow to firm (FCFF) is a measure of cash flow that remains free after the company has covered all expenses (creditors and capital investors), taxes and needed reinvestments in the company. A positive FCFF indicates that the company is able to pay all required obligations arising from debt and equity (dividend), while a negative value implies a deficit in free cash that will have to be acquired through additional borrowing or by issuing new shares.

According to Damodaran (2012), free cash flow to firm can be expressed as:

FCFF=EBITX[1-(tax rate)]-[(capital expenditures)-(depreciation)]-(changes in non-cash working capital).

$$(1)$$

Closely linked to the features of oil and gas industry's working capital, the specific features of cash flow are also generally linked to (M&I, 2013):

- Massive depreciation, depletion and amortization, which can sometimes be higher than net profit;

- Other non-cash expenses, which are, as in other industries, characterized by accumulated discounts in obligations to write-off of depreciated assets, gains and losses on assets, partnerships, authorized sale, and sometimes incurred costs of unsuccessful exploration wells (dryhole expense);

- Investment activities which are reflected in high capital investments can also overpass net profit and the sale of assets from individual to entire oil fields and gas wells, as well as high expenses for research and the purchase of assets;

- High financial requirements associated with the nature of the work, whose high amounts are often financed, apart from own capital, from external sources which are constantly being paid off and raised, often in form of revolving credits.

All these specificities are closely related to high requirements in technological and financial terms, especially in the execution of large long-term projects. High requirements for capital investments (CapEx) by companies in exploration and OFS sectors which reduce free cash flow may create a decreasing or even a negative cash flow, which is typical of the initial periods of long-term projects. In the refining sector, due to competition, there is a constant need for new technologies which also incurs high financial expenses as well as the equipment itself which, as in other sectors, incurs high amortization costs.

2.5 Other financial specificities in companies operating in the oil and gas industry

In addition to the above, the financial specificities of companies in the oil and gas industry usually occur due to factors associated with the typical contractual relations which the company is subject to, tax treatment, and operational risks associated with the industry. Typical contractual relations are related to the ownership over mineral rights i.e. the fact that they are either privately or publicly owned, depending on the country in which the oil reservoirs are located. Business operations within the exploration and production sector therefore largely depend on the type of contract with the owner of mineral rights. These contracts define bonuses, royalties, tax expenses and the division of production, which directly affect the amount of revenues.

The most common factors having an impact on business risks, which may result in unusual financial fluctuations, that can be singled out are (DBRS, 2009):

- The economic environment, in terms of the oil and gas industry's impact on the economy, business activity and industry development;

- Legal and regulatory environment, in terms of the factors that may help or hinder the relationship between the developments of a company and the industrial environment and regulatory rules, to understand the frequency of changes or stability in industry rules and thus business operations;

- Market structure in terms of the extent of competitiveness and barriers to entry a company my face in individual markets;

- The risk of the country in which the company operates;

- Industry cyclicality which is reflected in factors such as consumer spending;

- Consumers' confidence in the need of the product;

- Strength of the economy;

- Quality of management in achieving business success.

3. Methodology

In order to analyse the impact of certain financial parameters on cash flows, a clustering analysis including 35 parameters was performed using Kohonen self-organizing neural networks (Kohonen, 1987).

The increasing application of neural networks in solving problems of classification and pattern recognition indicates that they have proven to be a very good tool in solving various kinds of problems questioning the relationship between input and output variables, regardless of the level of complexity of this relationship.

Data clustering is a process of grouping data into appropriate groups, i.e. clusters, according to similarities in some of their features. Clustering is crisp if an object belongs to one and only one cluster. In other words, this is a case of a partition of a set of all objects. However, if an object belongs to a cluster to a certain degree, clustering is fuzzy. In combined clustering each object belongs to a particular cluster according to the probability in the distribution of a set of objects.

The Kohonen Self-Organizing Map is one of the most widely used classification neural networks for solving problems related to clustering. The reason for this is not just in excellent clustering characteristics of this network but also in the fact that quite a few excellent visualization tools have been developed which allow for a very simple and effective analysis of the obtained clusters (Kohonen, 2001).

In addition to the input and output layer, this network has a hidden, so-called self-organizing competitive layer in which neurons are arranged in an appropriate mesh that determines the so-called

SOM topology. For the purpose of this study, a rectangular 2D topology was used whereas it should be noted that a predefined number of neurons m in the hidden layer defines a typology of a rectangular grid of format. This typology allows the hidden layer to form a visualization of the distribution and two-dimensional approximation of the topology of the input set of vectors. Of particular importance is the visualization of weight coefficients in the weight plane whose number is equal to the number of parameters in the input matrix. Such a graphic display visualizes the weights that connect each input neuron (input parameter) to each of the neurons in the hidden self-organizing layer. Brighter colours represent larger weights while darker, smaller weights. If the sample weights of two monitored parameters are very similar, a strong mutual correlation between these parameters can be assumed (Kohonen, 2001).

A SOM neural network is a network without a supervisor, i.e. without a target vector. Clustering is carried out in such a way that a set of input vectors is classified in as many classes as there are neurons in the competitive layer. In doing so, the process of clustering is carried out according to criterion of distance between samples, i.e. samples whose parameters are in terms of this distance closer are grouped into the same cluster. The characteristics of the network are adjusted to achieve optimal clustering, i.e. that the distances between samples within the same cluster are minimal and the distances between clusters are maximal. A self-organizing neural network is usually trained, i.e. self-organized with the SOM batch algorithm (Hagan et al., 1996). A simplified architecture of the SOM network is shown in Figure 1.

In the hidden self-organizing layer, first a vector $\mathbf{n}^1 \epsilon \mathbf{i}^m$ is formed with components

$$n^1_{\ i} = -||\mathbf{IW}^i\text{-}\mathbf{p}|| \qquad (2)$$

that represent the negative Euclidean distances (ndist) between the presented vector $\mathbf{p} \epsilon \mathbf{i}^n$ and vector $\mathbf{IW}^i$ that is the i-th row of the weighting coefficient matrix $\mathbf{IW} \epsilon \mathbf{i}^{mxn}$.

The competitive activation function (compet) in the hidden layer accepts the input vector $\mathbf{n}^1 \epsilon \mathbf{i}^m$ with the output $\mathbf{a}^1 \epsilon \mathbf{i}^m$ expressed as

$$\mathbf{a}^1 = \text{complet}(\mathbf{n}^1) \qquad (3)$$

returning output neurons equal to 0 for all neurons except for the winning neuron which is associated

with the largest positive element of the vector **n**[1]. The output of the winning neuron is equal to 1.

Figure 1 Diagram of layers in the self-organizing map (SOM)
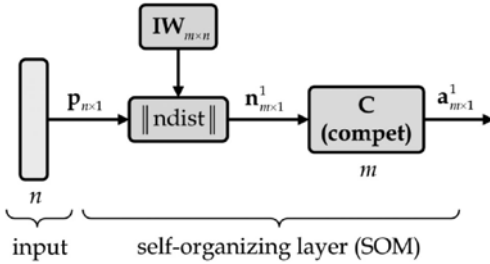
Source: Hagan et al. (1996)

Details about the different topologies of the SOM network, and different approaches for adjusting weight coefficients can be found in (Kohonen, 2001) and (Hagan et al., 1996).

In order to determine the correlation of financial parameters, 186 international companies belonging to different oil and gas industry sectors were analysed: 40 from the exploration and production sector, 40 from refining and marketing, 40 oilfield service companies, 40 transport companies and 26 integrated majors.

The distribution of analysed companies according to world region (North America, South and Central America, Europe and Eurasia, the Middle East, Africa, Asia-Pacific region) and industry sectors (IM, E&P, R&M, OFS, T&S) is presented in Table 1. The analysed data refer to the year 2012, and were collected from a number of professional business Internet sources, mostly (Damodaran, 2013) and (Bloomberg Businessweek, 2013).

The observed parameters were divided into two groups as indicated in Table 2. The first group includes parameters 1 to 20, i.e. the classic financial indicators expressed in monetary value (USD). The second group includes parameters 21 to 35, i.e. financial ratios often used in financial analysis.

In addition to standard financial ratios, the author also observed the index of business excellence BEX as defined in (Belak, 2014) as an overall indicator, and its individual components ex_1, ex_2, ex_3 and ex_4.

For the purpose of parameter clustering, MATLAB 2010 with Neural Network Toolbox was used. The two groups of parameters were presented to the SOM network as input matrices, after which they were grouped by SOM into an appropriate number of clusters in line with the number of neurons in the hidden layer. Since the SOM network has no supervisor, the rectangular 2D topology of the network was self-organized during 200 iterations. Adjustments were made to have 20 neurons in the hidden layer.

After training the SOM network, a range of graphic displays of results became available. The visualization of weight planes showing weight values connecting the input and output layer are of special interest. Very similar patterns in the weight planes of observed parameters indicate a very high correlation between these parameters.

Table 1 Distribution of analysed companies according to world regions

World region	OIL AND GAS INDUSTRY SECTOR					
	IM	E&P	R&M	OFS	T&S	Total
North America	4	7	16	19	18	64
South and Central America	3	0	1	0	0	4
Europe and Eurasia	14	21	4	12	13	64
Middle East	1	3	5	0	1	10
Africa	1	1	0	1	1	4
Asia- Pacific	3	8	14	8	7	40
Total	26	40	40	40	40	186

Source: Prepared by the author, according to Damodaran (2013)

Table 2 Selected financial parameters in the analysis

No.	Parameter	Abbrev.
1.	Total assets	TA
2.	Total liabilities	TL
3.	Current assets	CA
4.	Cash and cash equivalents	C&CE
5.	Current liabilities	CL
6.	Book value of equity	BVE
7.	Amortization	AM
8.	Working capital	WC
9.	Changes in non-cash working capital	CNCWC
10.	Net Cap Ex	NCE
11.	Net profit	TR
12.	Total revenue	UP
13.	EBIT	EBIT
14.	EBITx(1-*t*)	EBIT2
15.	EBITDA	EBITDA
16.	FCFF	FCFF
17.	Invested capital	IC
18.	Dividends	DIV
19.	Share price (31 December 2012)	SP
20.	Country Marginal tax rate	TAX
21.	Current ratio	CR
22.	Total assets over total revenue ratio	TATR
23.	Total revenue over non-current assets ratio	TRNCA
24.	Total revenues over short-term assets ratio	TRSTA
25.	Total revenues over capital ratio	TRC
26.	ROA	ROA
27.	ROE	ROE
28.	Net profit margin	NPM
29.	EV/EBIT	EV/EBIT
30.	ex1	ex1
31.	ex2	ex2
32.	ex3	ex3
33.	ex4	ex4
34.	BEX	BEX
35.	Cash / Firm Value	CFV

Source: Brlečić Valčić (2014)

4. Results

The obtained results show that a SOM with only 20 neurons in the hidden layer yielded very satisfactory results in clustering of observed parameters.

Figure 2 shows the weight planes for the first (Inputs 1-20) and the second group (Inputs 21-35) of observed parameters. From that weight plane visualization, the relationship can be observed within three characteristic clusters. Therefore, in observing the impact of each parameter on the individual value component, the author suggests the necessity for determination of the relationship between identified qualitative factors and the above mentioned parameters.

The first group of clustered parameters includes indicators related to FCFF. A significant relationship between FCFF and WC, CNCWC, TRC, ROA, ROE, ex2, ex3 and BEX parameters (Table 2) can be determined. As these parameters have a direct impact on cash flows, the analysis of the business processes should be subjected to exactly this group of parameters. This mainly relates to the effective management of payment terms; the control over contracts with partners, customers and suppliers; improvement and rationalization of supply chains; effective management of procurement; coordination between the engineering, manufacturing and technical support processes; closer cooperation between the participants in the value chain; active management of cash and cost levels of risk and alignment of employee remuneration in line with performance measures (EY, 2013).

Adding the ROE, ROA and BEX parameters to this group directly brings into relation the efficient organization of business operations with value creation. This primarily relates to the efficient management of production processes, production equipment and business operations.

One of the ways to achieve effective monitoring of business processes is to determine the control and corrective measures for these indicators and take them as benchmarks for comparison. Table 3 shows the control and corrective measures for value creation indicators as defined in (Brlečić Valčić, 2015).

The other set of parameters TA, TL, CA, C&CE, CL, BVE, AM, NCE, NP, TR, EBIT, EBIT2, EBITDA, IC, SP, TRNCA and NPM point to an efficient management of revenues and assets that have direct influence on the category of profit.

Figure 2 Weight planes for a selected group of parameters
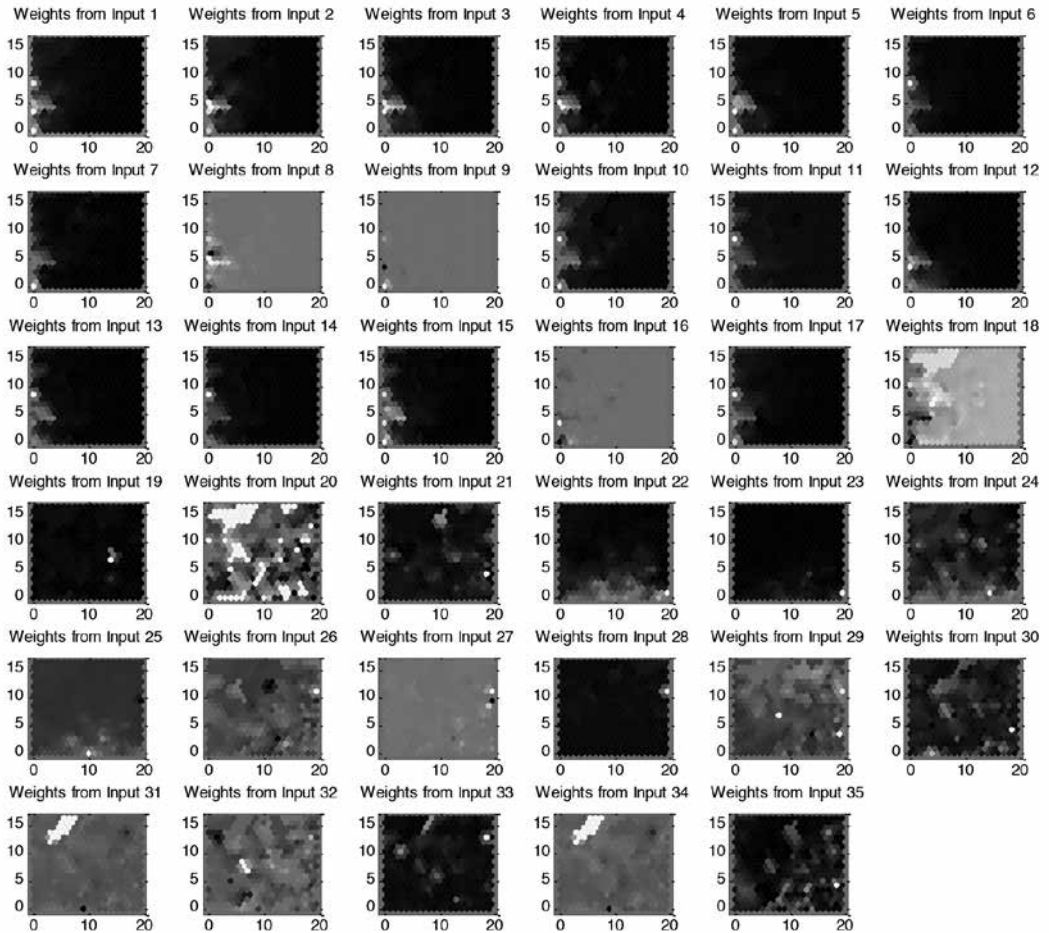
Source: Prepared by the author (using Matlab 2010 with Neural Network Toolbox)

Although this group of parameters cannot be directly brought into relationship with cash flows, one cannot ignore its impact in the value chain. This applies to production and capital investment that should be based on reserves and current prices of oil and gas as well as the efficient prediction of the movements in oil and gas prices in the future, and not only in the exploration sector, but also in all other sectors whose business operations are directly dependent on the exploration sector. Therefore, in all sectors of this industry, it is necessary to analyse and monitor the factors that affect the structural leverage of operations in order to achieve

a more efficient business revenue management. In the E&P sector, this mainly refers to strategic and operational planning, in the R&M sector to asset maintenance, effective strategies, cooperation within the industry and shared-service organization, and in terms of OFS, to predicting demand, supply chain planning and management (EY, 2013).

The third clustered group of parameters CR, TATR, ex1 and CFV, sets in relation asset turnover and liquidity coefficients with excellence measured by the profitability of business (operating) activities (ex_1). Business profitability is the overall business excellence in a time continuum. In addition to price trends and risks, this group also depends on the efficient management of assets and revenues as well as external factors such as the economic crisis, the

Table 3 Control and corrective measures for value creation indicators

Value creation indicator	Referent value	Control/corrective measure
FCFF	> 0	Comparison with companies in the environment by relating FCFF to revenues
	< 0	Urgent measures for improving the relations within the value chain by questioning business processes
Working capital	> 0	Comparison with companies in the environment by relating working capital to revenues
	< 0	Urgent measures for improving the relations within the value chain by questioning business processes; question the non-cash working capital which reflects the reinvestment policy
Changes in non-cash working capital	increase	Causes a negative cash flow as it represents investment; comparison with other companies in the same industry sector
	decrease	Causes a positive cash flow and is built on existing investments; comparison with other companies in the same industry sector
ROE	≥ 12 %	Comparison with companies in the environment
	< 12 %	Comparison of costs of capital in order to see whether the company is creating value
ROA	≥ 5 %	Comparison with companies in the environment
	< 5 %	Urgent measures for improving the management in terms of a more efficient use of assets
BEX	> 4	Satisfactory levels of investment in business processes ; comparison with similar companies in the industrial environment
	2 – 4	Additional investment in business processes is needed
	1 – 2	Additional investment in business processes is needed, especially in terms of learning and growth
	< 1	Significant investment in business processes is needed based on detailed analyses of all phases and factors within the value chain
ex2	≥ 1	The company is creating value; comparison with similar companies in the industrial environment
	< 1	The company is „eating" its own substance; analyses of the value chain are needed as well as significant improvements in business processes
ex3	≥ 25 %	Comparison with similar companies in the industrial environment
	< 25 %	Analyses of the value chain are needed as well as significant improvements in business processes

Source: Brlečić Valčić (2015)

unavailability of distribution channels, inflation, interest rates, foreign exchange, the local and regional market conditions and the like. Moreover, the same as the second group of parameters, this group cannot be directly put in relationship with the FCCF.

5. Conclusion and recommendations for future research

The oil and gas industry is characterized by many specificities and complexities of business operations that directly affect its value components. Although, because of the complexities of its business activities it is divided into five main sectors, the significant external factors influencing oil and gas prices directly impact not only on the exploration sector, but also all other due to their direct dependence on this sector.

Therefore, this paper presents the most important factors affecting the business operations of companies in the oil and gas industry in order to determine the qualitative factors that affect the value components of these companies.

By clustering 35 selected financial parameters using the self-organizing map neural network, the financial factors are clustered into three basic groups. The first is directly connected to FCFF, as the most important indicator of value creation, whereas the other two groups did not show direct connectivity. However, these two groups may be linked to business operation factors, especially the organization and management of assets and revenues, which are also very important components in the value chain. Such clustered groups may serve the management of the companies involved in the oil and gas industry to improve and achieve a more efficient value management.

Recommendations for future research includes longer periods of time (several years), in which oil and gas price trends are more emphasized, as well as analysis of more participants in value creation within the industry. This would provide a more precise construction of such models. Moreover, a similar analysis in other industries is also recommended.

Acknowledgment

References

1. Adelman, M. A., Watkins, G. C. (2005), "U.S. oil and gas reserve prices, 1982-2003", Energy Economics, Vol. 27, No. 4, pp. 553-571.

2. Basher, S. A., Haug, A. A., Sadorsky, P. (2012), "Oil prices, exchange rates and emerging stock markets", Energy Economics, Vol. 34, No. 2, pp. 227-240.

3. Belak, V. (2014). Analiza poslovne uspješnosti. Zagreb: RRiF-plus d.o.o. za nakladništvo i poslovne usluge.

4. Bloomberg Businessweek (2013), Available at: http://www.businessweek.com (Accessed on: December 5, 2013)

5. Brlečić Valčić, S. (2014), "Suvremeni pristup vrednovanju poduzeća naftne i plinske industrije temeljen na računalnoj inteligenciji", doctoral thesis, University of Rijeka, Faculty of Economics.

6. Brlečić Valčić, S. (2015), "Poslovni modeli u going concern konceptu temeljeni na međuovisnosti kategorija stvaranja, očuvanja i zadržavanja vrijednosti", Ekonomska misao i praksa, Vol. 1, pp. 199-216.

7. Chatain, O., Zemsky, P. (2009). Value Creation and Value Capture with Frictions, INSEAD, France, Available at: http://www.insead.edu/facultyresearch/research/doc.cfm?did=42344 (Accessed on: February 2, 2015)

8. Cormier, D., Magnan, M. (2002), "Performance reporting by oil and gas firms: contractual and value implications", International Accounting, Auditing and Taxation, Vol. 11, No. 2, pp. 131-153.

9. Damodaran, A. (2012). Investment Valuation Tools and Techniques for Determining the Value of Any Asset. 3rd edition. New Jersey: John Wiley & Sons.

10. Damodaran, A. (2013), "Damodaran Online", Available at: http://pages.stern.nyu.edu/~adamodar (Accessed on December 2013)

11. DBRS (2009), "Rating Oil and Gas Companies", Available at: http://www.dbrs.com/research/228875. (Accessed on: May 17, 2012)

12. EY - Cash in the Barrel (2011), "Working capital management in the oil and gas industry", Available at: http://www.ey.com (Accessed on: December 7, 2012)

13. EY - "Global oil and gas transactions review 2013" (2013), EYGM Limited, Available at: http://www.ey.com/oil and gas (Accessed on: December 12, 2013)

14. Hagan, M. T., Demuth, H. B., Beale, M. H. (1996). Neural Network Design. Boston: MA: PWS Publishing.

15. Johnston, D. (2006). Oil Company Financial Analysis. Tulsa: PennWell Corporation.

16. Kohonen, T. (1987). Self-Organization and Associative Memory. 2nd edition. Berlin: Springer-Verlag,

17. Kohonen, T. (2001). Self-Organizing Maps. 3rd edition. Berlin Heidelberg: Springer.

18. Misund, B., Asche, F., Osmundsen, P. (2008), "Industry upheaval and valuation: Empirical evidence from the international oil and gas industry", The International Journal of Accounting, Vol. 43, No. 4, pp. 398-424.

19. M&I, "Mergers and Inquisitions" (2013), Available at: http://www.mergersandinquisitions.com/oil-gas-modeling (Accessed on: December 12, 2013)

20. Osmundsen, P., Asche, F., Misund, B., Mohn, K. (2006), "Valuation of International Oil Companies", The Energy Journal, Vol. 27, No. 3, pp. 49-66.

21. Raymond, M. S., Leffer W. L. (2006). Oil and Gas Production in Nontehnical Language. Tulsa: PennWell Corporation.

22. Tichy, E. G. (2009). Procjena vrijednosti poduzeća – osnove, metode, praksa, 2nd edition. Zagreb: Zgombić & Partneri – nakladništvo i informatika d.o.o.

23. Zott, C., Amit, R., Massa, L. (2011). The Business Model: Recent Developments and Future Research, Journal of Management, Vol. 37, No. 4, pp. 1019-1042.

24. Wall Street Prep (2009), "Oil & Gas Financial & Valuation Modeling Training Program", Wall Street Prep Financial Training Solutions.

Sonja Brlečić Valčić

Odnos između različitih komponenti poslovne vrijednosti u naftno-plinskoj industriji

Sažetak

Naftno-plinska industrija obilježena je mnogim kompleksnostima i specifičnostima u poslovanju. Navedeno se očituje i kod identifikacije vrijednosnih komponenti, te razumijevanja njihovoga međusobnog odnosa. U svrhu kvalitetnoga upravljanja vrijednošću, posebno je važno pratiti kretanje bitnih financijskih pokazatelja, kao i svih kvalitativnih čimbenika koji utječu na stvaranje financijskih rezultata. U radu je izložena teorijska osnova kako bi se utvrdile najvažnije kvalitativne vrijednosne komponente u poduzećima naftno-plinske industrije. Istaknute su specifičnosti svih sektora ove industrije, kako bi se mogle povezati s bitnim financijskim čimbenicima koji utječu na stvaranje stabilnih novčanih tijekova. U tu svrhu izvršena je i klasterizacija odabranih financijskih čimbenika pomoću samoorganizirajuće neuronske mreže. Spajanjem identificiranih kvalitativnih vrijednosnih komponenti koje utječu na novčane tijekove i financijskih parametara preko kojih se očituju, stvara se okvir za kreiranje modela za učinkovito upravljanje vrijednošću.

Ključne riječi: naftno-plinska industrija, komponente poslovne vrijednosti, slobodni novčani tijek, samoorganizirajuće neuronske mreže