A hybrid Delphi-SWOT paradigm for oil and gas pipeline strategic planning in Caspian Sea basin

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ABSTRACT

The Caspian Sea basin holds large quantities of both oil and natural gas that could help meet the increasing global demand for energy resources. Consequently, the oil and gas potential of the region has attracted the attention of the international oil and gas industry. The key to realizing the energy producing potential of the region is the development of transnational export routes to take oil and gas from the landlocked Caspian Sea basin to world markets. The evaluation and selection of alternative transnational export routes is a complex multi-criteria problem with conflicting objectives. The decision makers (DMs) are required to consider a vast amount of information concerning internal strengths and weaknesses of the alternative routes as well as external opportunities and threats to them. This paper presents a hybrid model that combines strength, weakness, opportunity and threat (SWOT) analysis with the Delphi method.

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1. Introduction

The oil and natural gas industry is the backbone of the world economy (Balat, 2010). The rapid economic expansion in developed countries coupled with the growing economies in countries such as China and India has precipitated a steady increase in the demand for energy, especially oil and natural gas (Bambawale and Sovacool, 2011a,b; Kun et al., 2011). China has moved to the top spot of energy consumption in 2010 with 20.3% of the global demand, ahead of the U.S.’s 19%, according to British Petroleum’s (BP’s) 60th annual statistical review of world energy (2011). The U.S.’s consumption edged up 3.7% last year compared with an 11.2% growth in China. According to BP, the demand for all forms of energy grew 5.6% in 2010. The consumption growth accelerated by 3.5% in the organization for economic co-operation and development (OECD) countries (which includes 34 countries including the U.S., U.K., France, Germany and Japan) while the consumption grew by 7.5% in the non-OECD countries. The vital importance of energy together with the constant increase in demand for oil and gas necessitates the exploration, development and distribution of new sources of energy.

The Caspian Sea is the world’s largest inland sea and has a significant, but not major, amount of oil and natural gas reserves, based upon estimates by BP Statistical Review of World Energy (2011). The region’s relative contribution to world supplies of natural gas is larger than that for oil. The sea is bordered by five states of Azerbaijan, Kazakhstan, Turkmenistan, Iran and Russia. Most of the proven energy reserves in the region belongs to Kazakhstan and is concentrated in the eastern side of the sea. As shown in Table 1, Azerbaijan possesses both oil and natural gas reserves while Turkmenistan possesses mostly natural gas. Russia and Iran hold inconsequential proven reserves in their respective Caspian sectors.

According to BP Statistical Review of World Energy (2011) shown in Table 2, proven oil reserves for the Caspian Sea region are estimated at 47.4 billion barrels at the end of 2010 (ranked 8th in world), comparable to those in Libya (46.4 billion barrels). Natural gas reserves in the Caspian Sea region are even larger than the region’s oil reserves. Overall, proven natural gas reserves in the Caspian region are estimated at 11.1 trillion cubic meters at the end of 2010 (ranked 4th in world), greater than Saudi Arabia (8.0 trillion cubic meters) and United States (7.7 trillion cubic meters).
Caspian oil and natural gas export projects have become operational in response to increasing global demand for energy resources, only a few other states for moving their energy products. The control of the Caspian Sea basin to world markets. The model integrates strength, weakness, opportunity and threat (SWOT) analysis with the Delphi method and captures the DMs’ beliefs through a series of intuitive and analytical methods. The next section presents the details of the Delphi-SWOT hybrid paradigm followed by its application to the gas and oil pipeline evaluation in the Caspian Sea. The final section presents the conclusions and future research directions.

Table 1
Caspian oil and natural gas proved reserves—at end 2010.

<table>
<thead>
<tr>
<th>Main producers in the Caspian Sea</th>
<th>Oil reserves (billion barrels)</th>
<th>Gas reserves (trillion cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazakhstan</td>
<td>39.80</td>
<td>1.80</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>7.00</td>
<td>1.30</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>0.60</td>
<td>8.00</td>
</tr>
</tbody>
</table>

Table 2
Top world countries with oil and natural gas proved reserves—at end 2010.

<table>
<thead>
<tr>
<th>Country (region)</th>
<th>Oil reserves (billion barrels)</th>
<th>Gas reserves (trillion cubic meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>264.5</td>
<td>Russian Federation 44.8</td>
</tr>
<tr>
<td>Venezuela</td>
<td>211.2</td>
<td>Iran 29.6</td>
</tr>
<tr>
<td>Iran</td>
<td>137.0</td>
<td>Qatar 25.3</td>
</tr>
<tr>
<td>Iraq</td>
<td>115.0</td>
<td>Caspian Sea region 11.1</td>
</tr>
<tr>
<td>Kuwait</td>
<td>101.5</td>
<td>Saudi Arabia 8.0</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>97.8</td>
<td>US 7.7</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>77.4</td>
<td>United Arab Emirates 6.0</td>
</tr>
<tr>
<td>Caspian Sea region</td>
<td>47.4</td>
<td>Venezuela 5.5</td>
</tr>
<tr>
<td>Libya</td>
<td>46.4</td>
<td>Nigeria 5.3</td>
</tr>
</tbody>
</table>

Despite its modest volumes, Caspian energy has attracted extensive global policy interest during the past two decades. The intense international focus on the region is driven by its geopolitical significance and its unique landlocked location. The Caspian Sea region is on a major junction between Europe and Asia and positioned nearby Russia and China. In addition, due to its landlocked location, the Caspian exporters are dependent on other states for moving their energy products. The control of the oil and gas pipelines in the region provides significant influence over the security and policies of the Caspian states. Thus, the recent intense interest in the Caspian region and the battle over the pipeline routes has been more about determining the geopolitical orientation of the region and had little to do with the control of the Caspian states' modest volumes of oil and gas. Delimitation of the sea borders has been a contested issue in the last two decades among the Caspian states. However, legal disputes have not been an obstacle to the production and export of oil and gas (Shaffer, 2010). The major obstacles to the development of new supplies were not related to underground resources but what happens above the ground such as international relations, governmental affairs and investment in energy and new technological development (Umbach, 2010).

In spite of the potential for the Caspian states to meet the increasing global demand for energy resources, only a few Caspian oil and natural gas export projects have become operational in the region over the last decade (Shaffer, 2010). Bilgin (2007, 2010), Guliyev and Akhrarkhodjaeva (2009), Kakachia (2011), Newnham (2011), Pasquaré et al. (2011), Shaffer (2010) and Umbach (2010) have introduced a large number of factors that has played a significant role in shaping the Caspian energy developments. These factors take into consideration political (Russian influence in the region), economical, social and geological issues.

In this study, we identify and quantify a total of 79 factors that will shape the future of Caspian oil and natural gas export. In doing so, we propose a hybrid model for evaluating five potential pipeline routes for transporting the oil and gas from the Caspian Sea region to the world market. The model integrates strength, weakness, opportunity and threat (SWOT) analysis with the Delphi method and captures the DMs’ beliefs through a series of intuitive and analytical methods. The next section presents the details of the Delphi-SWOT hybrid paradigm followed by its application to the gas and oil pipeline evaluation in the Caspian Sea. The final section presents the conclusions and future research directions.

2. The Delphi-SWOT hybrid paradigm

Strategy development is a complex and uncertain process that identifies and evaluates alternatives for utilizing an organization’s resources to achieve its mission (Li et al., 2002). Because of actual uncertainty and perceived ambiguity, the process of strategy development requires input from and cooperation of many organizational functions and DMS (Li et al., 2000; Mintzberg, 1994a,b; Eden, 1990; Porter, 1987). The hybrid Delphi-SWOT paradigm proposed in this study is used to identify and evaluate strategies for locating a pipeline to transport oil and gas from the Caspian basin to world markets.

The Delphi method was developed at the RAND Corporation to obtain the most reliable consensus of opinion from a group of knowledgeable individuals about an issue not subject to objective solution (Dalkey and Helmer, 1963). It is a structured group interaction that proceeds through multiple rounds of opinion collection and anonymous feedback. Although Delphi dates back to early 1950s, the most recognized description of the method was offered by Linstone and Turoff (1975), Fischer (1978), Schmidt (1997), Okoli and Pawloski (2004) and Keeney et al. (2006) also provide excellent reviews.

Each round in Delphi involves a written survey of the participants followed by statistical feedback to them for each survey question. After seeing the results from the previous round, the participants are asked to reconsider their opinions. Generally, there is a convergence of opinions after three or four rounds, and a stabilized group opinion emerges. This group opinion may reflect agreement, disagreement or some of each. The optimum number of participants depends on the number needed to have a representative pooling of views (Ndour et al., 1992).

Since its inception in the early 1950s, SWOT analysis has been used with increasing success as a strategic planning tool by both researchers and practitioners (Learned et al., 1965; Panagiotou, 2003). The technique is used to segregate environmental factors and forces into internal strengths and weaknesses and external opportunities and threats (Valentin, 2001; Duarte et al., 2006). The SWOT matrix developed by Wehrich (1982) for situational analysis is one of the most important references in the field. Even with its popularity, Novicevic et al. (2004) observe that SWOT is a conceptual framework with limited prescriptive power. However, SWOT remains a useful tool for assisting DMs to structure complex and ill-structured problems (Hitt et al., 2000; Anderson and Vince, 2002).

3. Delphi-SWOT pipeline planning process

This study was conducted for the Horizon Oil Company, a multinational oil and natural gas producer. The mission of the company is the exploration, development, production and marketing of crude oil and natural gas. Horizon established a group of participants followed by statistical feedback to them for each survey question. After seeing the results from the previous round, the participants are asked to reconsider their opinions. Generally, there is a convergence of opinions after three or four rounds, and a stabilized group opinion emerges. This group opinion may reflect agreement, disagreement or some of each. The optimum number of participants depends on the number needed to have a representative pooling of views (Ndour et al., 1992).

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