Industrial Engineering
& Management Systems
Vol 15, No 4, December 2016, pp.307-317
ISSN 1598-7248 | EISSN 2234-6473 |
https://doi.org/10.7232/iems.2016.15.4.307

Application of Advanced Impact Analysis in Developing Iran's Gas Industry Scenarios

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(Received: November 5, 2016 / Revised: November 23, 2016 / Accepted: November 25, 2016)

ABSTRACT

According to most of energy sector experts, at least in the next two decades, fossil energy plays important role in fulfilling required energy in the world. Based on these conditions, the investigation of the conditions of major countries providing natural gas in the world can be useful in analysis of future development of this clean fuel. According to the latest estimations of British Petroleum Company, Iran with 18.2% natural gas reservoirs has the first natural gas reservoirs in the world. The main purpose of this paper is developing scenarios of gas industry in Iran. To achieve the mentioned goals, besides investigation of existing methods of scenario design and existing production scenarios, natural gas export and consumption in Iran and the world in 2035, the most important scenarios of gas industry in Iran are formulated by critical uncertainty analysis approach using quantitative advanced time based impact analysis in 2035 horizon.

Keywords: Scenario Planning, Cross Impact Analysis, Natural Gas Industry, Natural Gas production, Natural Gas Future Prices

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1. INTRODUCTION

According to most of energy sector experts, at least in the next two decades, fossil energy plays important role in fulfilling required energy in the world. Based on the wide application of natural gas and increased investment in gas fields development sectors, development of new technologies of operation of abnormal gas and development of gas distribution and transfer network all around the world , we can consider two next decades as the dominance of gas in the global energy market. According to the predictions of energy international agency, natural gas consumption in the world reaches 4.5 trillion m3 in 2035 and this value is increased 35% compared to 2013 (Petroleum, 2013; van der Hoeven, 2013; BP, 2015). Based on the predictions (Figure 1), the paradigm of global consumption and reliance of countries on natural gas is changing. For example, in 2035, US is less re-liant upon natural gas import and is turned into an exporter of natural gas but some countries including China and India will be much dependent on this product and European Union has 20% increase in this regard (van der Hoeven, 2013).

According to the predictions of energy international agency, during 2012 to 2035, natural gas demand is increased about 80% and it is dedicated to non-member

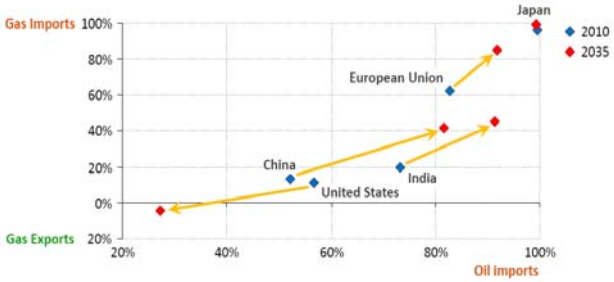

Figure 1. Net oil and gas import dependency in selected countries.

states of Organisation for Economic Co-operation and Development (OECD) (Cozzi, 2012). In a macro view, only 4% of energy demand increase in the world is dedicated to OECD state members. Gas demand in Middle East has considerable growth and with the mean annual growth rate as 2.2% of 335 billion m^3 in 2008 reaches 608 billion m^3 in 2035. this increase in demand is based on the under construction projects operated in power plant and petrochemical factories (van der Hoeven, 2013). Based on these conditions, the investigation of the conditions of major countries providing natural gas in the world can be useful in analysis of future development of this clean fuel.

According to the latest estimations of British Petroleum Company, Iran with 18.2% natural gas reservoirs has the first natural gas reservoirs in the world (P, 2015). In terms of natural gas production, Iran with 166.6 million m^3 in 2014 has the only 5% of total natural gas in the world and this value is reduced 0.2% compared to 2013 (Petroleum, 2014). It is worth to mention that of this value, only about 5% (9.28 billion m^3) is dedicated to natural gas export. As shown in Figure 2, in ranking the major manufacturers of natural gas in the world, Iran has fourth rank with a considerable distance from US and Russia and close distance with Qatar. This shows that despite considerable natural gas resources, Iran didn't produce and operate these resources for different reasons. Based on the growing trend of natural gas production in Qatar, it is expected that the distance between Iran and Qatar is increased for the benefit of Qatar.

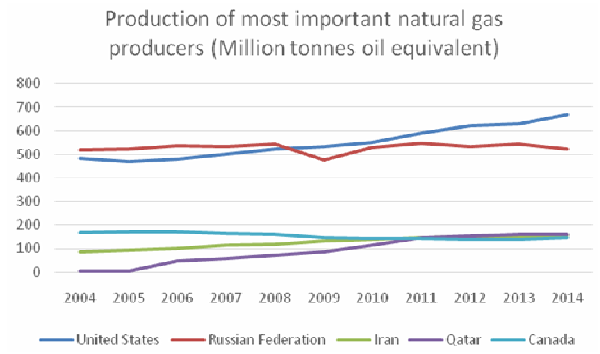

Figure 2. Production of most important natural gas producers.

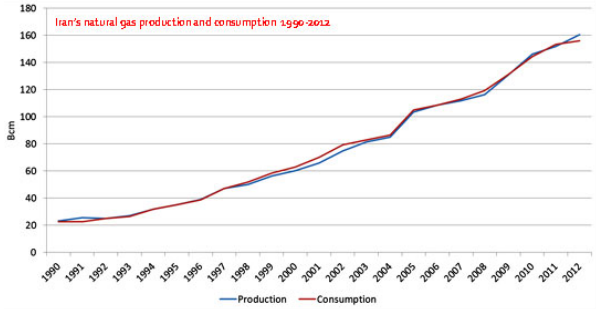

Figure 3. Natural gas production and consumption in Iran (Dudley, 2012; Carter, 2014).

As shown in Figure 3, with production planning in Iran, transfer and distribution network planning and export planning due to unduly consumption and inadequate investment in this field can affect all issues and export is eliminated from the plan and the majority of gas production is dedicated in domestic consumption. In other words, high share of high gas consumption in the country has caused that Iran is not in the list of 20 first countries for natural gas exporting in the world.

Based on the items and resources in the world, if Iran manages consumption optimally in Iran and increases long-term and strategic investment in this field, it can be effective as an important regional and international actor in global level in gas consumption and is important in changes of existing policies. Under such conditions, the investigation of scenarios of gas industry in Iran has important effect on long-term planning of investment at international level.

The main purpose of this study is presenting the future layout of gas industry in Iran by considering effective factors and existing scenarios for gas global consumption and the interaction among the main actors of this industry. This issue is of great importance based on considerable uncertainties in gas industry development in Iran and the great effect of these factors on production, consumption and export of natural gas in the country and global energy market. To achieve this goal, the followings are taken into consideration:

- Recognition of effective internal and external factors on gas industry of Iran
- The analysis of cross impact of factors on each other and selection of key factors
- The evaluation of key factors in existing scenarios of global market of gas in horizon 2035
- Formulating the scenarios of Iran gas industry by resulting key factors

One of the important purposes of this study is formulating the influence map of key factors on Iran gas industry and their prioritization based on their interactions on each other. Thus, the factors are classified and analyzed into key groups, effective, affected and risky. Other results of this study are formulation of long-term strategic scenarios of Iran gas industry and based on the

great need of investment and long-term nature of gas sale contracts can be used in economic estimations and long-term policy making.

At first, besides introduction of Cross Impact Analysis and planning and analysis methods based on scenario, scenario planning method is presented by Cross Impact Analysis. Then, by existing information and to present operating model of existing scenarios of gas industry in I ran during 2035 can be formulated and evaluated.

2. METHODS

To achieve the mentioned goals in the previous section, besides investigation of existing methods of scenario design and existing production scenarios, natural gas export and consumption in Iran and the world in 2035, the most important scenarios of gas industry in Iran are formulated by critical uncertainty analysis approach. By Delphi method and data collection by experts of planning in oil and gas industry in Iran, the most effective internal and external factors on industry are identified and are evaluated by QATIA method as an advanced Cross Impact Analysis tool (Dudley, 2012). By these tool, effective key factors on internal system and relations and direct and indirect cross impact can be identified and evaluated. By the results and scenarios, global bas consumption during time horizon 15 to 20 years, the most important scenarios of Iran gas industry are formulated.

At first, applied methods are introduced to identify effective key factors on Iran gas industry. Besides introduction of scenario planning method, the method of using key factors in formulation of scenarios is presented.

2.1 Advanced Impact Analysis

Determining effective key factors on a system or a decision as a complex system affected by various factors is one of the most important actions to analyze the system. In addition, determining key factors is determining the relations between various factors and the interactions method of each of factors for analysis of system can be unavoidable. Cross Impact Analysis method is one of the most famous methods to recognize the relationship between effective factors on a system and different techniques are used to achieve these relations. This method is based on using a relation matrix among various elements by which relationship, interactions of various factors in the system can be identified (Carter, 2014).

The Cross Impact Analysis method was presented in 1966 by Theodore Gordon and Olaf Helmer to investigate the effect of various factors of a system and results of cross impact analysis on each other (Yasser Servati, 2015). Later, various versions of this method are used to do different operating projects by different researchers (Yasser Servati, 2013; Gordon *et al*., 1968; Kane, 1972; Turoff, 1972; Helmer, 1981; Amara, 1972; Bloom, 1977). In the past, only in future studies and design of different scenarios, this method was used (Alter, 1979; Jeong *et al*., 1997; Godet, 1987). Today, this method is used in the investigation of tangible and intangible resources in e valuation of the performance of a system (Vester, 2002; Gordon, 1969).

All the different methods presented for cross impact analysis follow the following common process (Edvinsson *et al*., 2007):

1) Recognition of effective factors on system
2) Determining the direct cross impact of various factors on each other
3) Determining the indirect cross impact of various factors on each other (in case of considering in the model as an example (Müller, 2005).
4) Computation of direct and indirect dependency of each factors upon other existing factors in system
5) Classification and prioritization of factors based on the results for further analyses on system

The difference of above methods is in data analysis and collected data processing method as in some cases, in other cases, indirect effects of factors on each other are investigated (Müller, 2005), in some studies to improve the analysis of other approaches as fuzzification is used beside cross impact analysis (Godet, 1994). This method is used to complete other scientific futuristic tools and systematic analysis. Some items including using it as a complementary for scenario-based planning (Alter, 1979; Edvinsson *et al*., 2007; Chao, 2008; Asan *et al*., 2004; Bañuls *et al*., 2011) or even in promotion of investigation process and evaluation of customer satisfaction (Gausemeier and Schlake, 1998), this issue depicts the wide application of this method.

This study applied Qualitative Advanced Time based Impact Analysis (QATIA) (Dudley, 2012) to analyze cross impact of factors inside system on each other and indirect effects and the effect of time on cross impact of factors on each other. This method is developed based on proposed method by Andrea Fried and Volker Linss in 2005 ADVIAN Advanced Impact Analysis). This method applies two initial matrices as input in which all effective factors are investigated as paired. In the first matrix, the pairwise comparison of factors impact on each other is evaluated and it is called decision matrix or Matrix of Direct Influence. In the second matrix, the required time for the effect of change of first factor on second factor can be evaluated and it is called time matrix. In Reference (Dudley, 2012), the method and classification of effective factors by this tool are presented.

2.2 Scenario Planning

In a definition, a scenario is a set of hypothetical events in the future, constructed to clarify a probable chain of causal events as well as their decision points

(Linss and Fried, 2009). Scenario planning was formed in U.S. Army during the Second World War in order to deal with probable attacks of enemies (Linss Volker, 2010).

Scenarios are considered as valuable tools helping organizations to be prepared for possible eventualities, and making them more flexible and innovative (Kahn *et al*., 1967).Therefore, great emphasis is on the use of scenario planning techniques because of their usefulness in case of uncertainty and complexity (Ghalambor *et al*., 2012).

It should be mentioned that no scenario can give us an accurate description of the future (Hiltunen, 2009) but consideration of scenarios as multiple possible future alternatives helps us to make planned future policies in a holistic manner (Schoemaker, 1991; Varum and Melo, 2010) and improve our ability to deal with uncertainty and entire decision making process (Hiltunen, 2009; Jetter, 2003).

Scenarios are divided in two forms of exploratory or descriptive and normative. Exploratory scenarios depict self-consistent future emerging from the present through credible cause, effect and feedback developments, reaching an end-point that seems plausible.

Normative scenarios represent desirable future worlds. They are also self-consistent and employ credible cause, effect and feedback relationships to get from the present to the future state (Burt and van der Heijden, 2003).

Since using scenario planning, three general methods are proposed to create scenarios. These methods have common factors in execution process and there are some differences in execution details. Bradfield *et al*. in the study evaluated and comapred main tecniques of scenario formulation (Van der Heijden, 1996). Later, scenario planning method by cross impact analysis is presented, then by these tools and stepwise implementaiton of scenario formuation model, the msot improtatn scenarios of gas industry of Iran are formualted.

2.3 Scenario Planning Using Advanced Impact Analysis

The following Figure indicates 5-stage process of scenario formulation:

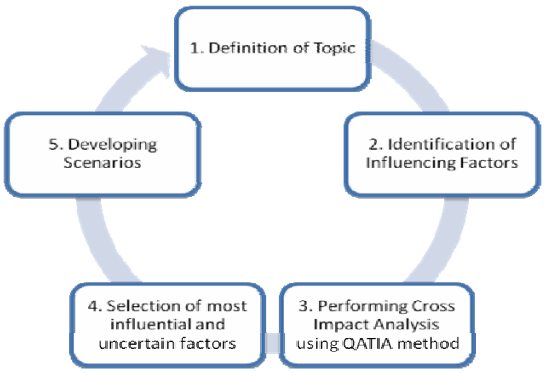

Figure 4. Scenario planning process.

As shown in Figure 4, scenario formulation process is started with the definition of problem and duration and subject of scenarios are defined.

Then, effective factors on system are identified. These factors can change the general system or the direction. The general recognition of these factors and their interaction can help us in systematic analysis of problem. In the next step by QATIA method, the direct and indirect cross impact of all effective factors on system are identified and anally zed and finally the most important factors are defined to formulate the system scenarios. In the next stage, by key factors on system by influence matrix and uncertainty, two first factors as the most effective and unreliable factors are selected for initial scenario formulation. In the next stage by the factors and in 4 probable futures as achieved by cross of conditions for selected factors, the scenarios of system are formulated.

By the presented model above and using industry experts opinion in Gas of Iran and Delphi model and achieving information by questionnaire method, scenarios of Iran gas industry are formulated.

3. RESULTS

3.1 ScenariosinIran's GAS Industry

3.1.1 Definition of Subject

In this study, scenarios of Iran gas industry in 2035 are formulated based on scenarios formulated in this field. Thus, the topic is investigated in three sections of scenarios of production, consumption and export and the data is collected by Delphi method and among the managers and policy makers of gas industry of Iran.

3.1.2 Identification of Effectivefactors

By questionnaire, the most important effective factors on gas industry of country are identified by managers and policy makers of this field. Based on the identified factors, the first 20 factors with the highest effect based on the experts' opinion are selected. The identified factors are presented in Table 1.

3.1.3 Performing Cross Impact Analysis Using QATIA Method

By effective factors in Table 1 by QATIA method, the effect analysis of these factors on each other and classification of the role of these factors on the future of system is considered. To do this, at first cross impact effect matrix and time matrix are created and by experts questionnaire, the effect of these factors on each other and time for the influence of each factors on other factors are defined. Then, by the present model in (Dudley, 2012), Revised cross impact matrix is created. Table 2 indicates Revised cross impact matrix by experts' opinions. Showing the acceptable opinions calculated by geometric mean.

Table 1. A list of most important impact factors

1	Country's security	11	Industry fuel storage capacity
2	Sanctions and international pressures	12	Power plant demand
3	Gas prices	13	Alternative fuel prices
4	Government's income level	14	Renewable energy market share
5	Private sector investment capacity	15	Discovering new resources
6	Storage capacity	16	Iran's position in the OPEC
7	Gas distribution capacity	17	Regional crises
8	Domestic and commercial demand	18	Environmental pollutions
9	Industrial demand	19	Export capacity
10	Financing costs	20	Foreign Investment in the gas industry

Table 2. Revised cross impact matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Country's security	0	0.8	2	1	0.5	1	0.25	0.5	1	1	0.75	0.8	2	0.6	0.67	1	2	0	1	2
2	Sanctions and international pressures	1	0	1	2	1.5	1	0.75	0.4	1	2	0.75	0.7	1	0.25	0.67	1	1	0	4	2
3	Gas prices	1	0.8	0	2	1.5	2	1.33	1.5	2	0	1.33	1.3	1.5	0.75	1	0.7	0	1	1	2
4	Government's income level	1	0	0	0	0.7	1	1	1.5	1	0	0.4	0.8	0.5	0.6	2	0.4	1	0	1	1
5	Private sector investment capacity	0	0	0	0.7	0	1	1.33	0.5	1	0	1	0.7	0.4	0.75	0.75	0	0	0	1	1
6	Storage capacity	2	0.4	0	1	0.4	0	2	0.67	1	0	2	1.5	0.8	0.01	0.4	0.4	1	2	4	1
7	Gas distribution capacity	2	0.8	1	0.5	0.7	1	0	1.5	2	0	1	0.8	1.5	1.5	1	1.3	0	0	1	1
8	Domestic and commercial demand	1	0.5	1	2	1.3	1	5	0	2	0	2	2	2	0.75	1.33	0.5	0	1	2	1
9	Industrial demand	1	0.5	1	0.8	1.3	1	1.33	0.01	0	0	2	1	0.6	0.4	1	0.2	0	1	1	1
10	Financing costs	0	0	0	0.5	2	1	0.6	0.5	0	0	0.4	0.4	0.6	0.6	0.75	0	0	0	1	1
11	Industry fuel storage capacity	1	0.4	0	0.4	0.8	2	2	1.33	2	0	0	0.4	0.4	0.01	0.01	0	0	0	1	0
12	Power plant demand	0	0.2	0	0.4	0.6	0	1	1	1	0	1	0	0	0.4	0.4	0	0	1	1	1
13	Alternative fuel prices	0	0	2	0.8	2	1	1	1.33	2	0	2	1	0	1	0.8	0.4	0	1	1	1
14	Renewable energy market share	0	0	1	1	1.3	1	0.75	1.33	1	0	1	1	0.4	0	0.6	0	0	1	1	1
15	Discovering new resources	0	0	1	1.3	1.3	1	1	0.2	0	0	0.01	0	0.6	0.4	0	0	0	1	3	1
16	Iran's position in OPEC	2	0.8	1	1.5	0.7	1	0.01	0.01	0	0	0.01	0	1	0.01	1	0	1	0	2	2
17	Regional crises	2	0.8	2	0.7	1	0	0.6	0.4	0	0	0.5	0.5	1	0.4	0.6	0.4	0	0	1	1
18	Environmental pollutions	0	0	0	0	0.7	0	0.6	0.4	0	0	0.4	0.5	0.8	0.75	0.5	0	1	0	0	0
19	Export capacity	1	0.8	2	2	1.5	2	1.5	1	0	0	0.01	0	0.6	0.4	1	2	0	1	0	1
20	Foreign investment in the gas industry	1	0.7	1	1.3	1.3	1	1.33	0.4	1	1	0.8	0.8	1	0.4	1.67	1.7	0	1	3	0
		5: very strong, 4: strong, 3: average, 2: weak, 1: very weak, 0: no relationship																			

As shown in Table 2, the effect of factors on each other is divided by a 6-item Likert scale ranging no relation to strong influence. In this Table, the influence of each of variables is questioned in case of the change of a specific variable. After identification of direct and indirect effect of each of factors on each other by QATIA method, Table 3 indicates direct and indirect effect of identified factors:

Figure 5 show the results of charts analysis for the given illustrative example. There are 6 key factors, 2 influential factors and 4 dependent factors in the system. Impact factors of 20, 9, 6, 19, 13, 3, 8 and 1 can be used for scenario planning purposes depending on the degree of uncertainty and importance. Impact factors of 7, 5, 11 and 4 can be used as a monitoring tool to observe the system's changes. Signals of changes in dependent factors refer to full changes in influential factors and other dependent factors with time lag. Policy-makers can use this signal as a tool for hedging the system from ongoing risks.

Table 3. Active and passive sum of impact factors

IF number	IF name	Active sum	Passive sum	IF number	IF name	Active sum	Passive sum
1	Country's security	48.57	35.67	11	Industry fuel storage capacity	30.73	64.99
2	Sanctions and international pressures	62.47	24.26	12	Power plant demand	25.2	50.52
3	Gas prices	58.68	59.35	13	Alternative fuel prices	51.94	54.71
4	Government's income level	28.58	72.87	14	Renewable energy market share	37.83	27.83
5	Private sector investment capacity	34.7	69.99	15	Discovering new resources	38.26	52.88
6	Storage capacity	61.03	54.74	16	Iran's position in OPEC	38.04	32.18
7	Gas distribution capacity	42.54	88.61	17	Regional crises	39.03	21.57
8	Domestic and commercial demand	93.84	42.98	18	Environmental pollutions	19.12	43.81
9	Industrial demand	48.56	59.4	19	Export capacity	48.57	100
10	Financing costs	27.16	14.87	20	Foreign investment in the gas industry	55.54	77.13

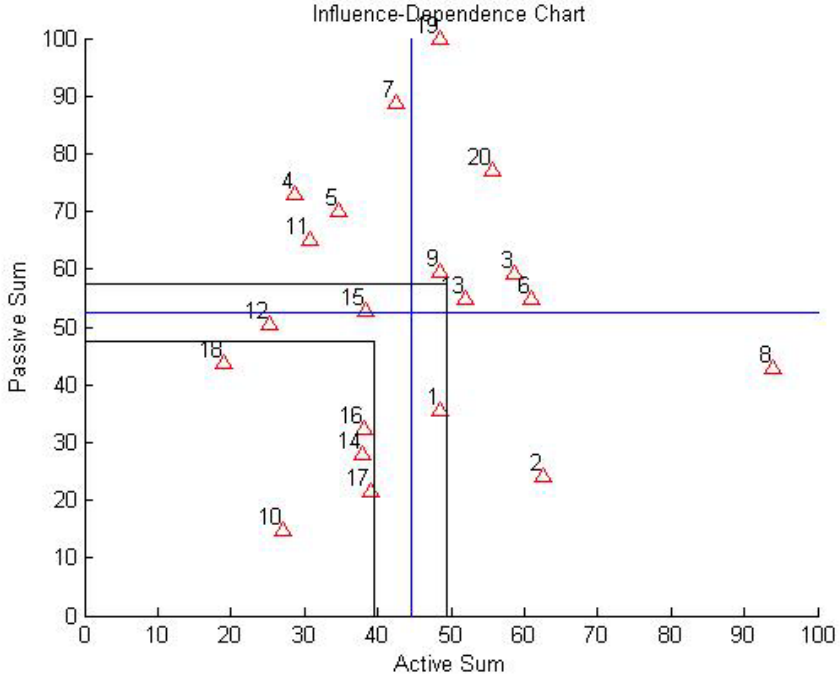

Figure 5. Chart analysis results.

3.1.4 Selection of Most Influential and Uncertain Factors

After defining key factors, influence-uncertainty matrix is formed. This matrix helps us to select the most effective factors with high uncertainty as candidate to design future scenario of system. Relative criticality values are used in this paper (Fried and Linss, 2005).

Relative criticality values are computed by Eq. (1), Eq. (2). Also, uncertainty of each factor is obtained by geometry averaging of the results of questionnaire of experts. In this questionnaire, each of experts was asked to use Likert scale 1-5 for the lowest uncertainty as 1 and for high uncertainty value 5 is given.

$$Criticality_i = \sqrt{AS_i \times PS_i} \quad (1)$$

$$Relative\ Criticality_i = \frac{Criticality_i}{Max(Criticality)} \quad (2)$$

Table 4 shows influence/uncertainty matrix of effective factors on gas industry of Iran. As shown, three factors of global price of gas, alternative fuel price and Sanctions and international pressures are the most effective factors with the highest uncertainty. Based on high correlation of gas price with the price of alternative fuel by gas global price and sanction and international pressures in the next stages, scenarios of gas industry of Iran are formulated.

Table 4. Criticality and uncertainty of impact factors

IF number	IF name	Active Sum	Passive Sum	Criticality	Uncertainty	Final score
1	Country's security	48.57	35.67	41.62	2	83.24
2	Sanctions and international pressures	62.47	24.26	38.93	5	194.65
3	Gas prices	58.68	59.35	59.01	4	236.06
6	Storage capacity	61.03	54.74	57.80	2	115.60
8	Domestic and commercial demand	93.84	42.98	63.51	2	127.02
9	Industrial demand	48.56	59.4	53.71	3	161.12
13	Alternative fuel prices	51.94	54.71	53.31	4	213.23
19	Export capacity	48.57	100	69.69	2	139.38
20	Foreign investment in the gas industry	55.54	77.13	65.45	2	130.90

Figure 6. Natural gas historical price.

3.1.5 Developing Scenarios

In this stage, for each of factors, the highest positive and negative possible and logical range are formulated and based on intersection of these two pairs of ranges, 4 scenarios of system are used. Then, the conditions of each of factors in cross impact analysis are investigated and formulated scenarios are completed. To do this, resistance and supportive levels are predicted on global chart of gas price by technical analysis principles (Ratcliffe and Sirr, 2003).

The following Figure indicates global monthly price of natural gas in dollar from the beginning of 2003 to October 2015.

As shown in Figure 6, gas global price in a 12-year period is increased from 5 dollars mmBTU at the beginning of period to prices above 15.8 $/mmBTU. By forming a double top around prices 13.7 $/mmbtu with neckline 8 $/mmbtu and price falling can move to classic target 2.3 $/mmbtu and finally at 2 $/mmbtu price, with the intersection of RSI chart with support line 30 units, gas price is supported and price increase continues to the first resistance points, the level 6 $/mmbtu, then with the price falling to 2.5 $/mmbtu, formation potential creates an inverted reversal head and shoulder pattern with neckline about 5 $/mmbtu. Based on the above analysis and positive convergence in price trend with RSI chart, the most important supportive levels for global price of gas in future can be 2 $/mmbtu and the most important

resistance levels in the first stage is 6 $/mmbtu and in case of breaking this price level, the other levels of target classic price of inverted head and shoulder pattern is 8$/mmbtuand finally 13.7 $/mmbtu. Figure 7 indicates the predictions for final price of gas by US energy information institute (Bradfield *et al*., 2005).

Thus, in this paper, at prices 2 $/mmbyu as bottom price and 8 $/mmbtu as top global price of gas to 2035 are considered. In this analysis, the relationship between gas price and oil price in 2035 is equal to the present equation. Thus, the division of moving mean 100 days of oil price is used based on each crude oil barrel and gas price based on $/mmbtu.

Figure 8 indicates four scenarios of intersection of effective factors.

- Scenario 1, futurism time

In the first scenario, based on the needs of global markets, oil and gas price is increased as levels 8 $/mm BTU are used for gas and 135 $ for each oil barrel. The discussions between Iran and global power didn't reach any good result and the sanctions are remained. Under these conditions, based on previous economic experiences and much reliance on domestic capabilities and domestic security, no problem is created based on existing revenues. This issue can be used based on considering the effect of oil and gas price on consumer countries and Russia operation as the competitive gas producer country from gas diplomacy to improve national security and economic power of country. In this scenario, oil revenue level is 1 million barrels per day based on the existing limitations at present level and this can bring revenue 130 million $ to Iran economy. By previous experiences and resources for re-investment in oil and gas industry, we can fulfill a hart of operating plan of industry development. By completion of new lines of gas export, export capacity of gas exceeds 100 million m^3 in year. As shown in Figure 3, based on growth of consumption of country in recent years, if consumption is increased in current trend, achieving this export value is unclear. In this scenario, based on the increase of global price of gas, economic value of investment in this industry is increased and competitive countries of Iran as Qatar based on the lack of limitation in absorption of foreign investment are encountered with the increase of production capacity and this can lead to the reduction of collection level of common reservoirs at the loss of Iran and reduction of effect of Iran on OPEC.

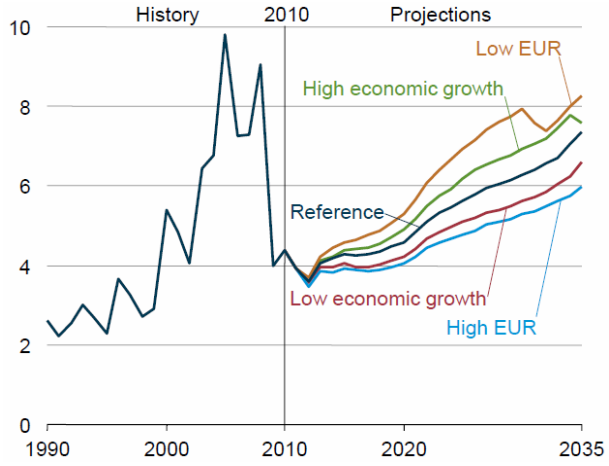

Figure 7. Annual average henry hub spot natural gas prices in five cases, 1990-2035 (dollars per million Btu).

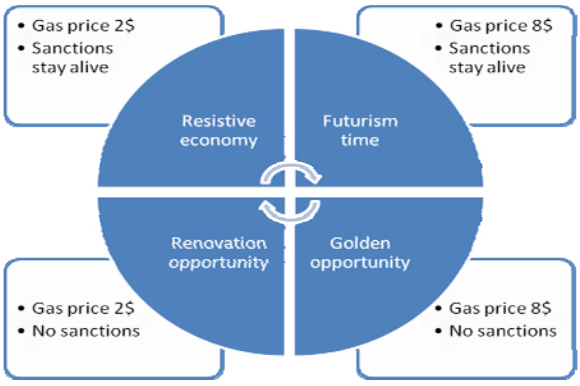

Figure 8. Developed scenarios.

- Scenario 2

In this scenario, based on the increase of production and export of oil and gas exporting countries, gas global prices are decreased to 2 $/mmBTU and global price of crude oil is fixed at 34$ in each barrel. In addition, there are international sanctions in the country and it is not possible to use financial resources of oil sale for country. In this scenario, based on the decreasing reliance of budgets on oil and considering the internal factors of economy and reduction of other revenues of regional countries, the country has no problem in case of internal security. Thus, oil revenues of government is reduced with the assumption of stability in current export (about 1 million barrels per day) to 35 million $ per day of crude oil export. Based on the state economy of country and investment in civil projects including domestic investment in oil and gas industry is reduced and storage capacity and lines transfer are stopped at current levels. With this approach, gas export is reduced based on increase of internal consumption of natural gas and export current commitment is reduced. On the other hand, reduction of global price of oil and gas has caused non-economic nature of most of exploration and oil and gas projects and various projects of oil and gas extraction in other areas in the world including US. This causes that the countries with low cost have competitive advantage and relative power of Iran is increased in OPEC. It is worth to mention that in this scenario based on the reduction of intention of foreign investors in oil and gas projects of neighboring countries, competition is possible at equal conditions and balanced collection of common reservoirs.

• Scenario 3

In this scenario, based on global market conditions and increase of crude oil demand, the price of crude oil is about 135$ in each barrel and global price of gas in 8 $/mmBTU can be fixed. This issue is at the same time with the lift of international sanctions and increase of foreign investment can provide a good opportunity for Iran economy. In this scenario, based on releasing foreign assets and resources in Iran as 100 billion $ and daily income of more than 500 million $ (with the assumption of increase of production maximum value to 4 million barrels per day), by suitable use of available resources of predicted projects in upstream plans including Iran development perspective in 2025 horizon and five-year development plans can be fulfilled. We can expect that by releasing investment space in the country, the investment of private sector in gas industry is increased and the capacity of transfer of gas lines for export exceeds based on predicted plans of daily 200 million m^3 in a year. In this scenario, based on using international finance, financing costs are reduced and by rapid operation of new gas fields, export gas is provided beside consumption need fulfillment. In these conditions, based on high capacity of production of country and traditional customers of oil in Iran, the position of Iran in OPEC is increased and a new role is provided for effective management of global energy markets. It can be said that in this scenario, the simultaneous incomes of competing commercial countries are increased and operation of common resources is of great importance.

• Scenario 4

In this scenario, oil war and extra international production can reduce oil price at 34$ per barrels and gas price about 2 $/mmBTu. New technologies of collection of shale oil and gas reservoirs can have important role in increase of oil and gas. By removing international limitations, blocked financial resources can be available. By providing suitable infrastructures to absorb foreign investment with the reduction of financing costs, international finances can be used to develop extraction and processing and export of gas in the country. It can be said that based on low cost of extracted gas in Iran, investment in this industry is a great opportunity for great international companies in this field as based on the reduction of global gas price, most of extraction projects in the world are not economic-based. In this scenario, based on reduction of dependence of budget on oil, the government share of civil projects is reduced and the investment in private sector in oil and gas industry is provided. In this scenario, the export power of gas is increased to daily 150 million m^3 in a year. In this scenario, gas export is increased to maximum daily 150 million m^3 in a year. In this scenario, based on the increase of maximum production in Iran, the export increase and competition power can be increased based on the low cost of production, also position of country is increased in OPEC and high effect in management of global price of oil and gas can be provided. Also, the reduction of oil and gas global price has made most of new alternative energy as non-economic and increased the dependency of main consuming countries including European countries to cheap resources of gas for consumption in various domestic, commercial and production sectors. Based on the facilities in international relations, new export contracts can be concluded with foreign investment.

4. CONCLUSION

In this study, different futurism tools are used by quantitative and qualitative techniques as simultaneous to formulate scenarios of system. Also, for exact determination of high and bottom limits of key factors in scenarios formulation, technical analysis tools and time data are used and this is one of the innovations in this study.

In this study, by QATIA model, 20 factors are identified as effective factors on gas industry in Iran and by chart analysis and evaluation of key factors of system, 2 factors of global price of gas and international sanctions are identified as the most important key factors. These factors are investigated to formulate the scenarios and their effects on other factors. To achieve high and low limit of global price of gas by technical analysis and the investigation of most important resistance and supportive levels of global price of crude oil during 2003 to 2015, low and high limits of price factor were defined. By achieving border limits for two key factors and sensitivity analysis results, the scenarios of system are formulated. After formulation of scenarios of system, the policy maker can evaluate the effect of his decisions in various scenarios and takes the best decision.

Based on the results and scenarios, we can say the conditions to develop gas industry are important and based on the effective factors and existing limitations, we can use the most of resources to use the common fields and increase national revenues from this section. The internal consumption has the highest effect on revenue of gas industry in Iran and based on the increase of gas consumption in the country, time-consuming of development projects and high investment for projects, cannot lead to the outperforming of production compared to internal consumption. Based on the existing limitations and considering the best scenarios, exact and long-term planning can be on priority to increase consumption productivity.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to the National Iranian Gas Company (NIGC) for their funding of this research and thanks to NIGC research staffs for giving us required data.

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