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A Bayesian Framework For Strategic Management In The Energy Industry

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Abstract—*The aim of this paper is to utilize Bayesian Networks scenario-building method to create a framework for analyzing the future of Iran's energy industry. This framework helps to develop more resilient conservation policies when faced with uncontrollable, irreducible uncertainty by the ability to prediction and diagnose scenarios. Also this paper aims to quantify the scenarios as well as explaining qualitatively. In this paper, a combination of FMEA for recognition of significant factors and Agena Risk as an uncertainty modeling software were used for modeling. Foreign investment in energy industry, foreign investment and level of energy technology were identified as the three key criteria and critical uncertainties of the Iranian energy industry. Using these critical uncertainties and all the information gathered from experts, three scenarios were developed the validation of the model showed via them: Global reconciliation, Separation aware and good relationships.*

Keywords- Energy; Uncertainty; Scenario building; Bayesian Networks

1. INTRODUCTION

Nowadays every industry is facing critical, and to a large extent, uncertain changes. Industrial boards are collapsing, new forces are emerging and competitiveness dynamics are changing. Due to these changes, suppliers, distributors and consumers are treated in new and unexpected ways. Since it is not possible to eliminate all the uncertainties, we have to identify and manage them for design of a sustainable plan. Neglecting the uncertainties will result in missing valuable opportunities and rendering a company or an industry unable to achieve the resiliency[1]. Using a few contrasting scenarios make it possible to explore the uncertainty surrounding the future consequences of the probable events[2].

1.1. Conceptual framework

Due to the quick and comprehensive change, accurate prediction seems unlikely[3]. Increasing rates of complexity and turbulence make the traditional forecasting and traditional strategic management methods less precise and applicable[4]. Scenario-based planning has been proven to be effective as a strategic management tool[5]. Also it is a well-known foresight method used for developing and planning for possible futures based on the different scenarios[6]. The aim of the technique is not to accurately predict the future, but rather to develop better strategies by overcoming perceptual biases of managers.It is necessary to clarify the uncertainties for better understanding of the scenarios[7,8,9]

1.2. Uncertainty and the scenario

Obviously we don't have any tools to explain how to achieve a plausible future completely, but it doesn't mean we cannot prepare for a number of possibilities[10] Scenarios help us to analyze the uncertainties and trends which is shaping the future[11]. Uncertainty is the unpredictability of the evolution and events of the future[12]. There are a lot of definitions for the concept of scenario in the literature: "An internally consistent view of what the future might turn out to be—not a forecast, but one possible future outcome" [13] ."A tool for ordering one's perceptions about alternative future environments in which one's decisions might be played out" [9]. "A disciplined method for imagining possible futures that companies have applied to a great range of issues" [6]. "Scenario is simply a means to represent a future reality in order to shed light on current action in view of possible and desirable futures" [14]. (1) External scenarios are "internally consistent and challenging descriptions of possible futures"; (2) Internal scenario is "a causal line of argument, linking an action option with a goal," or "one path through a person's cognitive map" [15]. Critical uncertainties are the surrounding factors of a phenomenon that are difficult to predict, but have significant impact on the future[14].

We will analyze a system in energy supply chain using some metrics and analyze energy statue by Bayesian Network (BN) which is capable to predict performance and also diagnose possible scenarios.

This paper is organized as follows. In section 2 we will briefly introduce our methodology and different steps of modeling. Section 3 provides some of scenarios which are possible in Iran. Also the application and validation of the model will be shown through case study scenario analysis in sections 3. Finally it ends with conclusion.

1.3. Bayesian Networks

A BN is a way of describing the relationships between causes and effects, and is made up of nodes and arcs. The nodes represent variables .The arcs in a BN represent causal or influential relationships between variables. Each node has a probability function which consists of initial probability (for nodes without parents) or conditional probabilities related to different combinations of parent nodes.

Bayes' theorem expresses the relation between the dependent variables. Bayes theorem uses a probabilistic knowledge of a hypothesis before any observation, and then presents an estimated number for the hypothesis after the observations.

Bayes theory expressed as (1):

$$P(H|E)\frac{P(E|H).P(H)}{P(E)} \quad , \; P(E) \neq 0 \qquad (1)$$

The ability to model and reason about uncertainty is one of the main capabilities of BNs. We can use Bayesian probability to different types of analysis by entering the probabilities. We can enter several number of observations anywhere in the BN and see the probabilities of all the unobserved variables. We can refer to other features of BNs as follows:

1- Explicitly model causal factors: This key benefit is differed from classical statistics because in this case prediction models developed by incomplete data.
2- Reason from effect to cause and vice versa (forward and backward propagation): by entering observed value on every variable, we can see the probability distributions for every unknown variable. So entering an observation in an "effect" node will result in back propagation. In fact, diagnostic ability of BN is not possible in other approaches.
3- Reasoning with incomplete data: Instead of traditional modeling methods, we can use model just by entering some evidence of inputs. As we mentioned before, the model produces revised probability distributions for all the unknown variables when any new observations are entered. If no observation is entered then the model simply assumes the prior distribution.
4- Combining different types of evidence: A BN is "agnostic" about the type of data in any variable and about the way the NPTs are defined. We can combine both subjective beliefs and objective data in modeling.

The first practical application of BN was the classical problem of medical diagnosis[16]. Companies like Microsoft used these networks for fault diagnosis, specially printer troubleshooting[17].

In recent years using of BNs has increased and various applications were created, but its application in suggesting energy policies and energy management is a new problem that we are going to discuss it.

2. METHOD

The best model will be attained when a balance occurs between competencies and weaknesses of a model [18]. In order to define this balance, experts should decide based on situations. Accuracy and number of variables have essential roles in model validation, because few numbers of variables cannot cover all parts of the problem and on the other hand more number of variables can disrupt effectiveness of model [19]. There exist a lot of tools for determining risk. The most common method is Failure Method and Event Analysis (FMEA) which was developed by NASA in 1963. In this method a number between one and ten was assigned for severity and occurring probability of each variable, so that bigger numbers show more criticality and importance. Risk ranking is based on two parameters and calculated using (2):

$$RPN_i = S_i \times O_i \qquad \forall i \qquad (2)$$

The bigger the number, the more critical is the factor. After literature review and several brainstorming sessions held with experts, 31deriving forces determined in 4 groups. Then some of metrics which their RPN were bigger than 60 were selected as a base model for performance metrics. The goal is to prepare a flexible model that is representative of real statue.

Expert opinion can be elicited to create a Bayesian Belief Network. A common technique for validating BNs based on expert opinion in the absence of complete data, is simply asking the experts whether they agree with the model structure, discretization, and parameterization or not [18].

The common cause for the nodes is considered as a 'ranked' variable with three levels: low, Medium, and high. In this study, the new systematic approach in determining the probabilities of a BN, proposed by [20] is used.

Imagine a case that there are n states S1, S2, …,Sn of a prior node N, and we should identify the probability of each state Si, i.e., P(Si). Usually, P(Si) is specified directly by experts opinion which derived from their knowledge and experience, but this became so difficult when we have several number of states.

The prior probability of each state of a node can be determined by the following pair-wise comparison matrix:

Table 1. pair-wise comparison matrix for prior nodes probability

	S_1	S_2	…	S_n	ω
S_1	a_{11}	a_{12}	…	a_{1n}	ω_1
S_2	a_{21}	a_{22}	…	a_{2n}	ω_2
…	…	…	…	…	…
S_n	a_{n1}	a_{n1}	…	a_{nn}	ω_n
λ_{max}		CR		CI	

aij means "which one is more likely to occur and how much more likely?" and the value of aij represents the multiple of the likelihood of the presence of Si over that of Sj. Obviously aji = 1/aij and aii = 1, so there are n(n − 1) different comparisons in the above pair-wise comparison matrix.

Table2. Random consistency index

N	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

We derive the probabilities of the wi from Eigen vector w=(w1,w2,..,wn)T of matrix Si. We should accept the pair wise comparison in which the consistency of it(CR=CI/RI) is less than 0.1. CI is the consistency index and calculated by λmax− n/ n-1 and RI is a random index related to n and λmax is the maximum eigen value corresponding to w. Sum of the all elements is 1 and we shows the importance of Si, so P(Si) =wi

Regarding the probabilities of child nodes, they constituted of parent nodes with a special weight. Note that, some of the factors (Energy consumption per capita, Rate of energy consumption growth, Sanction and War/terrorist attack) have a negative impact on energy management, and we considered their states from High to Low.

Over the last 40 years, authors have developed different approaches to scenario planning[21] .The consulting company GBN and the Royal Dutch Shell approaches are the most influential ones among them. In this regard, the Van der Heijden and Shoemaker approaches have the most citations[10]. Although these approaches differ in their details, the majority have common characteristic process steps.

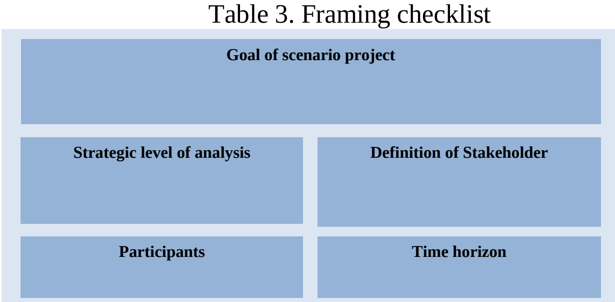
2.1. The basic process

The following description of the basic process is intended to explain what is involved in scenario development. [22]
Phase1: Orient including interviews and focal issues.
Phase2: Explore including Critical uncertainties, predetermined elements
Phase3: Synthesize including Bayesian Network, Scenarios
Phase4: Act including Implications, Strategic agenda
Phase5: Monitor including leading indicators and monitoring system

2.2. Phase One: Orient

The aim of this phase is to clarify the issue at stake and to use that issue as an orienting device throughout the remaining four phases.
For this purpose, we developed the "framing checklist," a tool that specifies the goal, persons involved, and any other key characteristics of the process. The checklist consists of five simple questions for which the answers need to be agreed upon before starting to plan the scenario.

Table 3. Framing checklist



Finally, We used this framing checklist to prepare a scenario-planning process for the Iranian energy industry to envision the possible futures the industry may face. We decided to focus on a time horizon ending in the year 2025 (the time horizon of Iran's 20-Year Perspective Document). Academic members of top Iranian universities such as Sharif University of Technology and Amirkabir University of Technology, as well as experts from the Petroleum and Energy Ministries and the Department of Environment, agreed to participate in the scenario-building phase and in the perception analysis for which they provided the internal view of the industry.

2.3. Phase Two: Explore

In this phase, we explored many driving forces that could shape the focal issue. Driving forces are the forces of change outside the energy industry that will shape future dynamics in unpredictable ways. Driving forces include factors within a closed-in working environment, such as developments related to the stakeholders or the community, or shifts in the broader environment—whether social, technological, economic, environmental, or political.
In our case, we performed two steps to identify what driving forces could shape the future of the Iranian energy industry. First, We created a list of driving forces by brainstorming among our expert panel. Then, We did a comprehensive literature review on the factors affecting the future of the Iranian energy industry (See Table 4).
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Table 4. Driving forces

Type	Driving Forces	Probability (P)	Occurrence(O)	RPN=PxO	Reference
Economical	Rate of energy consumption growth	5	6	30	[23) & EP**
Economical	Energy consumption per capita	3	4	12	[24]
Political	Dependance to energy carriers import	4	7	28	[23]
Technological	Levelof energytechnologies	6	6	36	[23] &EP
Technological	Final energy use vraiety	6	7	42	[24] &EP
Technological	Empty capacity of the energy production	4	8	32	[23]
Technological	Total oil reservoir	5	7	35	[23]
Political	Foreign investment in energy industry	7	8	56	[25] &EP
Economical	Energy intensity	3	6	18	[24]
Political	Foreign policy in relation to other countries	8	8	64	[25] &EP
Political	Geopolitical trends which prevailing in international markets	6	8	48	[25] &EP
Environmental	Environmental regulations regarding the energy consumption	6	7	42	[26, 27] & EP
Economical	Energy exports	3	5	15	EP
Political	Changes in global energy prices	7	7	49	[28]
Social	Changes in energy consumption patterns	8	6	48	[29]
Social	Targeting Energy subsidies	9	8	72	(Ahmadpour, 2011)
Economical	Risks of investment in	4	6	24	[25, 30] & EP

	energy industry				
Environmental	Increase in use of renewable energies	5	7	35	[29, 31, 32] & EP
Social	Optimizing energy consumption patterns	4	6	24	EP
Political	Replacing countries competing in energy markets	5	6	30	[33]
Political	Increase in military power	7	7	49	[28] & EP
Economical	Membership in WTO	5	8	40	EP
Economical	Facilitating the privatization	8	8	64	[26]
Economical	Stability of monetary policies	5	8	48	[23, 34] & EP
Political	Sanctions	8	9	72	[24, 34] & EP
Economical	Rules of attract foreign investment	6	7	42	[25] &EP
Economical	Liberalization of energy prices	4	6	24	[25] & EP
Political	Probability of war and terrorist attacks	7	8	56	[35]
Economical	Gross Domestic Product	3	8	24	[36]
Political	Political stability	5	7	35	[23] & EP
Economical	Oil price	6	8	48	[23, 28] & EP
Environmenal	GHG emissions	5	7	35	[23]

2.4. Phase Three: Prioritization

In phase three, we synthesized and combined the driving forces that were identified to create scenarios. We identified numerous driving forces, some of them extremely different from one another. While all driving forces have an impact, they are not equally important. Phase three is a narrowing phase in which we cull and refine our driving forces to just a handful. We started prioritizing using FMEA which is based on two criteria: (1) the degree of uncertainty (2) the probability of occurrence. The goal of prioritization was to identify the two or three driving forces that are both most uncertain and most important to the focal issue. These driving forces are our "critical uncertainties," and they are the foundation of our scenario set.
We refined the driving forces that were gathered in the prior phase by performing FMEA. After applying FMEA, the base BNs has showed in Fig. 2.We have considered energy management node as a continuous node between 0 and 1. Like reliability, the bigger this index is, the more it is better and vice versa. For visualizing the result of the analysis, we used Agena Risk software.

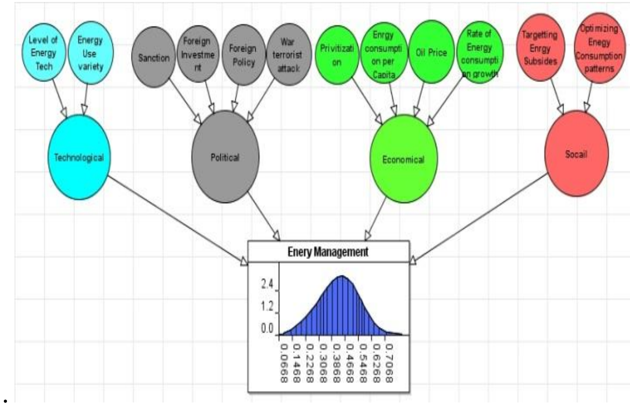

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Figure 2. BN model of Enery management

3. The Scenario-Building

One of the most common and reliable ways to create scenarios is to give scenario on these critical uncertainties and see what will happen.
Prior nodes which do not have parents are sensible criteria for managers. In fact, managers can make changes in prior nodes based on the predictive and diagnostic results. Fig. 3 and Fig. 4 provide a ranked tornado graph for sensitivity analysis and their impact on energy management for factors and prior nodes respectively. As we see political factor is the most important factor for energy management and it can change energy management between 0.3 and 0.63 in different states. As shown in Fig. 6, foreign investment, foreign policy and Level of energy technology were identified as the three key factors and critical uncertainties in different scenarios of the Iranian energy industry.

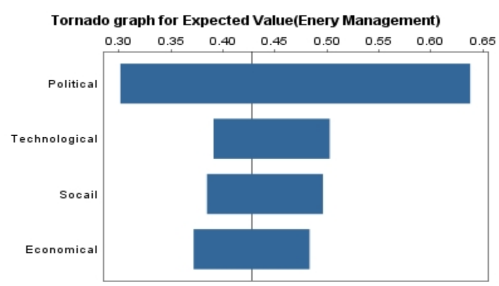

Figure 3. Tornado graphs of factors for expected value of energy management

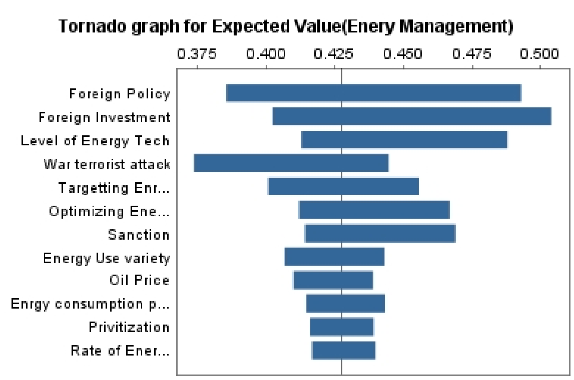

Figure. 4. Tornado graphs of driving forces for expected value of energy management

Using sensitivity analysis by tornado graph, we see that foreign policy and foreign investment have more impact on energy management, so we selected the most important criteria and defined scenario for them.

Basically anything that is not measurable, it is not manageable. The purpose of risk modeling is to get insight into the system performance, represent or express the uncertainties, identify the risk contributors and see the effect of changes. [37] referred to the concept of sensitivity as a method of testing the predictive validity of expert- elicited networks.

Three main scenarios were developed: Global Reconciliation, Separation, and self-sufficiency.

3.1. Global reconciliation is the key

For the first scenario analysis, we have considered a scenario in which foreign investment and foreign policy are in High state, and other variables are in their default state. Energy management is expected to become better comparing to the base state. As we see in Fig. 5., Energy management has skewed to high and became 0.58. See Fig. 5., for the details.

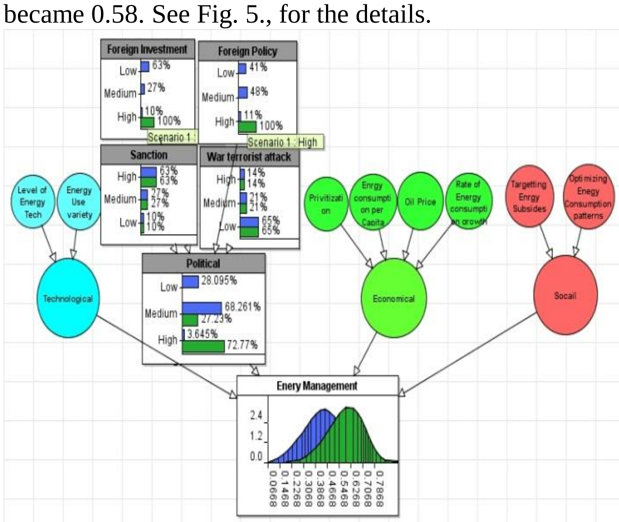

Figure 5.Model statue for the first scenario.

Energy industries in Iran, especially oil and gas, are the main fields in which energy management should be implemented. These industries require development of multiple scenarios and based on appropriate strategies to develop and promote this industry consistent with the world. With this vision, it seems that the realization of Iran's geopolitical potential in terms of foreign policy strategy on the basis of geopolitical and with the aim of providing optimal national interests, needs consideration of the following issues: First, restoring and strengthening the geopolitical, geo-economic and geo-cultural situation of Iran in international interactions to realize the strategic benefits depend on the identity elements of Iranian foreign policy with the component of ''Iranian characteristics''. Because being Iranian is the main component and other aspects of identity are the second. Therefore, by weakening the main component, negative function of its second components are reflected in external relations. Conversely, it leads to higher national and international authority for Iran. Second, since each country's geopolitical importance varies based on the atmosphere of regional and global relationships and trends in international politics, this condition for the Islamic Republic of Iran given its dynamics of internal and external components (both fixed and variable) not only has a broader representation but also given the open geopolitical space, it has a proper field for converting threat factors to opportunities and a favorable context for reaching strategic objectives in the form of designing a comprehensive geopolitical strategy. Third, in order to achieve comprehensive interests in the form of strategic considerations in the international system, Iran should formulate its geopolitical strategy with a careful study of geopolitical strategy in neighboring countries and paying attention to the precedence of Iraq, Turkey, Azerbaijan, Bahrain, Saudi Arabia, United Arab Emirates, Qatar, Kuwait as well as by identifying regional interests of other neighboring countries. In the 21st century, the axes of strategic thinking are based on the collective security arrangements and geopolitical systems. Accordingly, Iran's geopolitical components and axes are in such a way that with coherence and continuity in strategic areas of other countries in the region, observance of conformity with them is also necessary; otherwise, it will lead to threat formation through strengthening of crisis.

3.2. Be aware of seperation

In second scenario we evaluated energy management supply chain when both foreign investment and foreign policy are in contrast with scenario one. We set them in Low state and see its effects on the model. In this case, 'Energy management' decreased to 0.35. Note that, neither foreign investment nor foreign policy individually can't decrease 'energy management' performance up to this extent. Fig 6 provide the details for second scenario.

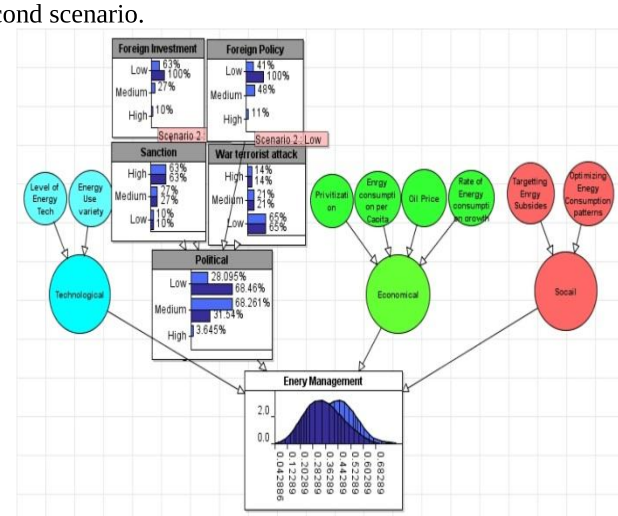

Figure 6. Model statue for the second scenario

As shown in Fig. 6., when the foreign investment and foreign policy are in the low status. This scenario would be appeared when the diplomatic relationships does not have a large priority in the foreign policy. It is obvious weak diplomatic relationships cause to distrust among the investors. Consequently second main factor, foreign investment falls down. In fact, this scenario is a simple simulation indicate how neglecting from diplomacy will affect negatively the energy management performance.

3.3. Good relationship

Predictions of probable happenings help the managers and provide them a better view for management of company. In 3rd scenario we want to know the state of prior nodes of economical and political factors. In what state should the economical and political parents' nodes be, if we know social and technological are in medium state and we want to increase energy management performance to 0.6. After entering observations and running the model, trend of all the prior nodes of economical and political factors goes toward High state. For instance, we see that parent nodes of economical and political factors changed positively. Results of this scenario give us worthy information, in a case that we want to improve energy management and also we have constraint in some variables. We can see other changes occurred in prior nodes and compare them with base state in Fig. 7.

The result could be summarized in two main issues:

Attention to economic and political security with regional and global priorities

1- Iran is able to achieve an economic security with regional and then international priority, by considering the Muslim world geo-economic facilities and its geopolitical position, not only it does not need militarism procedures, but also this actualizes the action capacity of the country, and leads to sustainability and development of excellence in regional power and even its international presence with the lowest cost.

2- Energy sectors cooperation with Ministry of Foreign Affairs of Iran. Given the close relationship between production and energy supply security in Iran and political stability and interactive relationships with countries having technology or energy consumer countries, it seems that more cooperation between oil and gas sector and the Ministry of Foreign Affairs of Iran and decision makers is necessary. Due to security concerns and Iran's nuclear activities and widespread international sanctions against the regime, advancing the industry that has long been tied and will be tied to economy, society and foreign policy of Iran, is a very large art which is given to the experts of international energy area and internal and foreign policy.

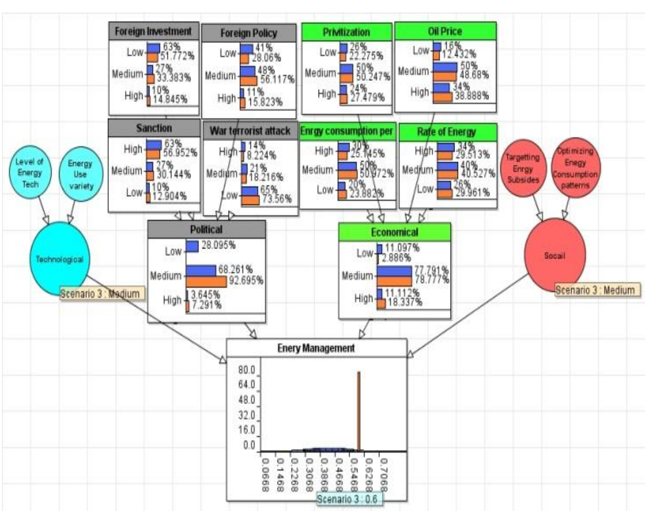

Figure 7. Model statue for the third scenario.

4. Conclusion

In this paper we used a BN framework for modeling foresight and strategic planning in Iranina energy industry. We used Agena Risk software for modeling uncertainties. After clarifying the main issue, we gathered 32 driving forces by comprehensive literature review and a brainstorming process. Then we identified critical uncertainties among these driving forces by FMEA. Also we identified the importance of each criteria and its impact on Energy Management performance by criticality analysis. We developed three main scenarios for visioning the plausible futures which Iranian energy industry will be faced. Foreign investment in energy industry, foreign investment and Level of energy technology were identified as the three key criteria and critical uncertainties of the Iranian energy industry.

References

i. W. E. Walker, M. Haasnoot, and J. H. Kwakkel, "Adapt or Perish: A Review of Planning Approaches for Adaptation under Deep Uncertainty". Sustainability, 2013. Vol. 5: pp. 955-979.

ii. G. D. Peterson, G. S. Cumming, and S. R. Carpenter, "Scenario Planning: a Tool for Conservation in an Uncertain World". Conservation Biology, 2003. Vol. 17: pp. 358-366.

iii. H. Mintzberg, "Learning 1, planning 0 reply to Igor Ansoff". Strategic Management Journal, 1991. Vol. 12: pp. 463-466.

iv. M. Lindgren and H. Bandhold, Scenario Planning: The Link Between Future and Strategy2002: Palgrave Macmillan.

v. R. P. Bood and T. J. B. M. Postma, Scenario Analysis as a Strategic Management Tool1998: Graduate School/Research Institute Systems, Organisation and Management.

vi. P. J. H. Schoemaker, "Scenario Planning: A Tool for Strategic Thinking". Sloan Management Review, 1995. Vol. 37: pp. 25-40.

vii. M. E. Porter, Competitive Advantage: Creating and Sustaining Superior Performance1985, New York: The Free Press.

viii. P. Wack, "Scenarios: Uncharted waters ahead". Harvard Business Review, 1985. Vol. 63: pp. 73-89.

ix. P. Schwartz, The Art of the Long View. Planning for the Future in an Uncertain World1996, New York: Doubleday Publishing.

x. C. A. Varum and C. Melo, "Directions in scenario planning literature - A review of the past decades". Futures 2010. Vol. 42: pp. 355-369.

xi. B. Marsh, Using scenarios to identify, analyze, and manage uncertainty, in Learning from the Future, L.R. Fahey, R., Editor 1998, John Wiley & Sons: New York. p. 39–53.

xii. B. Ralston and I. Wilson, The Scenario-planning Handbook: A Practitioner's Guide to Developing and Using Scenarios to Direct Strategy in Today's Uncertain Times2006: Thomson South-Western.

xiii. M. E. Porter, Competitive strategy1980, New York: Free Press.

xiv. M. Godet., "The art of scenarios and strategic planning: Tools and pitfalls". Technological Forecasting and Social Change, 2000. Vol. 65: pp. 3–22.

xv. K. Van der Heijden, Scenarios: The art of strategic conversation1997, New York: Wiley.

xvi. R. E. Patterson, C. Eng, S. F. Horowitz, R. Gorlin, and S. R. Goldstein, "Bayesian comparison of cost-effectiveness of different clinical approaches to diagnose coronary artery disease". Journal of the American College of Cardiology, 1984. Vol. 4: pp. 278-289.

xvii. *D. Heckerman, A. Mamdani, and M. P. Wellman, "Real-world applications of Bayesian networks". Communications of the ACM, 1995. Vol. 38: pp. 24-26.*

xviii. *J. Pitchforth and K. Mengersen, "A proposed validation framework for expert elicited Bayesian Networks". Expert Systems with Applications, 2013. Vol. 40: pp. 162-167.*

xix. *A. Gunasekaran, C. Patel, and R. E. McGaughey, "A framework for supply chain performance measurement". International journal of production economics, 2004. Vol. 87: pp. 333-347.*

xx. *K.-S. Chin, D.-W. Tang, J.-B. Yang, S. Y. Wong, and H. Wang, "Assessing new product development project risk by Bayesian network with a systematic probability generation methodology". Expert Systems with Applications, 2009. Vol. 36: pp. 9879-9890.*

xxi. *P. Bishop, A. Hines, and T. Collins, "The current state of scenario development: an overview of techniques". foresight, 2007. Vol. 9: pp. 5-25.*

xxii. *D. Scearce and K. Fulton, What if? : the art of scenario thinking for nonprofits2004, California: Global Business Network.*

xxiii. *K. Bert., "Indicators for energy security". Energy policy, 2009. Vol. 37: pp. 2166-2181.*

xxiv. *Joint Research Center (JRC), "Energy Security Indicators", European Commission: Belgrade. 2010.*

xxv. *G. Torabi, "China's actions and investments in the energy market ". Bahar, 2011. Vol. 14: pp. 61-88.*

xxvi. *M. Hajiheidari and L. Hajihashemi, "Privatization and foreign investment in global oil and gas industry ". Misaghe Modiran, 2011. Vol. 7: pp. 23-36.*

xxvii. *D. Behboodi and E. Barghi, "Environmental impact of energy consumption and economic growth in Iran". Economic surveys, 2008. Vol. 5: pp. 35-53.*

xxviii. *H. Shahbazfar, "Sanction and Oil price". Energy economics, 2006. Vol. 38: pp. 21-33.*

xxix. *A. Ahmadpour, "Energy consumption patterns reform ", in First national conference on energy management in oil and gas industries: Tehran. 2011.*

xxx. *N. Mahmoudi, "Investment, consumption and energy polution in developing countries", in 8th conference on agriculture economy: Tehran. 2010.*

xxxi. *M. Dolatshahi and H. Ashtiani, "Human, Energy and Future vision". Strategy, 2010. Vol. 56: pp. 313-343.*

xxxii. *L. Olmos, "On the selection of financing instruments to push the development of new technologies: Application to clean energy technologies". Energy Policy, 2012. Vol. 43: pp. 252-266.*

xxxiii. *33. E. Ezzati and S. Nanva, "Iranian foreign policy and uncomming challenges by changs in political structure in Iraq ". Daneshnameh, 2011. Vol. 3: pp. 16-29.*

xxxiv. *S. Shahabi, "Direct and indirect impacts of sanctions on Economic issues". Foreign policy, 2007. Vol. 41: pp. 25-37.*

xxxv. *H. Pourahmadi and Zolfaghari M., "Energy Diplomacy and benefits of the Islamic republic of Iran". Political knowledge, 2009. Vol. 10: pp. 31-46.*

xxxvi. *M. Hasani., "Investigation of the relation between the energy consumption and Gross Domestic Product ". Bahar, 2007. Vol. 24: pp. 29-33.*

xxxvii. *C. A. Pollino, O. Woodberry, A. Nicholson, K. Korb, and B. T. Hart, "Parameterisation and evaluation of a Bayesian network for use in an ecological risk assessment". Environmental Modelling & Software, 2007. Vol. 22: pp. 1140-1152.*