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An integrated scenario-based robust planning approach for foresight and strategic management with application to energy industry

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ABSTRACT

Energy industries face major future challenges related to environment, security, and economics. Here we present a scenario-building framework based on the Global Business Network (GBN) method to help energy industries to develop more resilient conservation policies when faced with unpredictable and external uncertainties. The approach combines several foresight methods such as Delphi; Political, Economical, Social, and Technological (PEST) analysis, and Cross-Impact Analysis (CIA). In addition, a strategic foresight software program (MICMAC) was applied in the scenario-building phase. The proposed integrated scenario-based robust planning approach builds on the strengths of traditional scenario planning, but overcomes its weaknesses by offering a systematic process for scenario creation and easy implementation. The outcome of this approach is a limited range of core strategies. We use Iran as the case for a more detailed application of the method. Foreign investments in the energy industry, external economic sanctions, and the domestic energy consumption growth were found as the key drivers and critical uncertainties in the Iranian energy industry. Three scenarios based on these critical uncertainties and expert information were developed: Technology-driven, Stagnation, and Self-sufficiency scenario. For these scenarios, a range of robust strategies was determined. National energy efficiency and productivity increases emerged as the key factors for robustness. The main macro-level result was that economic and political drivers will be the most important factors for Iran's energy futures followed by technological and social factors.

1. Introduction

Energy is one of the most strategic resources in our society enabling a high living standard in industrialized countries. Energy is subject to several uncertainties in the future linked to climate change, geopolitics, resource availability, technology innovations, etc. which will also affect the industries delivering the energy products and services. Moreover, political decisions may totally reshape the energy business as happened in Germany in the aftermath of the Fukushima nuclear accident in 2011 when the German government decided to abandon nuclear power after the "Energiewende" decision (Federal Ministry of Environment, 2010; Federal Ministry of Economics and Technology, 2010) forcing major utilities such as E.ON and RWE to completely change their strategies (Renewable Economy, 2014; GreenTech Media, 2015). Expanding to a global level, if a global agreement on reducing carbon emissions will be reached in a near future, most of the hydrocarbon energy sources would become obsolete thus causing huge stranded assets in the energy industries (Caldecott et al. 2015). Single events could also cause major changes in the energy scenery such as the breakthrough in the fracking technology in the USA, which has led to booming shale-gas and shale oil industries increasing the U.S. oil and gas reserves, but also causing shale-gas to replace coal in power production and reducing energy imports (U.S. Energy Information Administration, 2013).

The energy industries increasingly face such critical uncertainties described above that are difficult to predict, but may have significant impact on the future. In practice, these could lead to major changes in their business and in the whole supply chain from producers to consumers. It is impossible to eliminate all such uncertainties, but the energy industry needs to better manage these meaning also better capabilities to identify change factors and to design sustainable strategies and operations. Ignoring the uncertainties could in worst-case lead to vanishing business or failing in grasping the new opportunities opening up during large changes or socio-technical transitions (Godet, 2000). The main idea of this paper was to develop an improved planning approach for foresight and strategic management, which can deal with these uncertainties. This is highly motivated considering the

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huge challenges that the energy industries will encounter in the coming decades.

In general, to respond to uncertainties, industries often employ contrasting foresights to explore the uncertainty surrounding the future consequences of probable events (Peterson et al. 2003; Walker et al., 2013), but due to the pace and magnitude of changes, accurate prediction is unlikely (Mintzberg, 1991). Increasing rates of complexity and market turbulence make the traditional forecasting and strategic management methods less precise and applicable to cope with uncertainties (Lindgren and Bandhold, 2002). Scenario-based approaches have, however, proved to be quite effective as a strategic management tool in this context (Bood and Postma, 1998). It is a well-established foresight method for developing and planning for possible futures (Schoemaker, 1995; Amer et al. 2013; Curry and Schultz, 2009). The aim of the scenario technique is actually not to accurately predict the future, but to establish a dialog between key stakeholders and to provide a framework for communication and for the consideration of possible future developments (Barker and Smith, 1995). It is also necessary to clarify the uncertainties to better formulate and understand scenarios (Porter, 1985; Schwartz, 1996; Wack, 1985). The future is seldom deterministic, but one needs to prepare for a number of possibilities (Varum and Melo, 2010). The literature deals with the uncertainty issue in defining the concept of a scenario in different ways, e.g. "an internally consistent view of what the future might turn out to be" (Porter, 1980), "a tool for ordering one's perceptions about alternative future environments" (Schwartz, 1996),"a disciplined method for imagining possible futures" (Schoemaker, 1995), "means to represent a future reality in order to shed light on current action in view of possible and desirable futures" (Godet, 2000), "internally consistent and challenging descriptions of possible futures (external scenario); a causal line of argument, linking an action option with a goal, or one path through a person's cognitive map (internal scenario)" (Van der Heijden, 1996).

In our research approach, outgoing from the underlying uncertainties with the future and how to deal with those in the scenarios as highlighted above, we laid emphasis on robustness and on overcoming the weaknesses of traditional scenario planning in energy industries. This leads us to propose an improved method integrating scenario-based and robust planning methods by combining several foresight and strategic planning methods together under the so-called Global Business Network (GBN) technique. We demonstrate the usefulness of the new method in elaborating the future paths of the Iranian energy industries.

Iran is a quite challenging, but a versatile case because of its importance as a global oil and gas producer. Iran has the 4th largest oil reserves in the world (almost 10% of the world's crude oil reserves and 13% of OPEC[1] reserves) and the 2nd largest natural gas reserves after Russia, with 17% of world's proven natural gas reserves and more than one-third of OPEC's reserves. Furthermore, the Strait of Hormuz, close to the southeast coast of Iran, is a significant global route for oil exports from Iran and other Persian Gulf countries. Through the Strait of Hormuz some 17 million barrels of crude oil and refined products flowed daily through it in 2013, which is roughly 30% of all seaborne traded oil and almost 20% of global oil. Over 30% of all liquefied natural gas (LNG) in 2013 was transported via the strait (EIA, 2015). Iran thus has a quite exclusive geopolitical position globally in energy, which makes the country a highly justified case.

The paper starts with a presentation of the improved planning method and its elements, following by an in-depth application of the method to Iran's energy industries to demonstrate the methods, but also better understand factors affecting Iran's energy future. We end up with a discussion of the results and conclusions.

[1] OPEC (Organization of the Petroleum Exporting Countries) is a permanent, intergovernmental organization, created in 1960.

2. Method

For close to half a century, scholars have developed different approaches to scenario planning (Bishop et al., 2007). In this regard, the approaches by Van der Heijden and Shoemaker have obtained the most citations (Varum and Melo, 2010). However, the consulting company GBN (Schwartz, 1996) and the Royal Dutch Shell approaches are the most influential and among the most popular ones (Wulf et al., 2010; Bishop et al., 2007). Their technique, which is called the Royal Dutch Shell/Global Business Network (GBN) approach was created by Pierre Wack in the 1970s and popularized by Schwartz (1996) and Van der Heijden (1996) for scenario building. In fact, Millett (2003, p. 18) calls it the "gold standard of corporate scenario generation". In addition, various other attempts have been made to integrate scenarios and roadmaps (Strauss and Radnor, 2004; Saritas and Oner, 2004; Saritas and Aylen, 2010).

Scenarios are used to set visions for the robust planning process by considering future options. However, the robust planning exercise usually follows a prior scenario planning exercise, meaning that scenarios have not been truly embedded in the robust planning process. The methodological approach presented in this paper incorporates the use of scenarios from the beginning to the end of the robust planning exercise as part of the GBN method (Schwartz, 1996; Millett, 2003; Bishop et al., 2007).

Concerning the Iranian case study in our paper, the proposed method has several merits compared to the currently used methods in Iran. The present energy scenarios issued by Iran's Parliament examine oil scenarios through three alternatives, namely optimistic, base and pessimistic (Abbaszadeh et al., 2013), which include several shortcomings. The primary drawback is the very limited number of driving forces considered in developing the scenarios, which only address amounts of energy consumption and production. Another weakness is fully neglecting the potential of alternative energy resources, in particular renewable energies, in which Iran could have a large potential, which in turn could decrease the pressure of using hydrocarbons for domestic needs (Chaharsooghi et al., 2015). An additional disadvantage of the current Iranian methodology is the lack of a standardized process to couple the scenarios to strategies, which in turn would be linked to implementation. In our approach these drawbacks are overcome.

Governments globally employ integrated scenario-based planning approaches to envision future directions in important issues. For instance, in Germany a 6-phase integrated scenario-based robust planning method was used for the photovoltaic sector (Wulf et al., 2010). Recently, an integrated scenario-based planning and roadmapping approach was developed by (Saritas and Aylen, 2010) for clean manufacturing in United Kingdom, later expanded to a European scale. The Australian government utilized integrated scenario planning methods in envisioning alternative transport fuels to 2050 (Graham and Smart, 2011), though also employing traditional scenario-based planning tools (Barber and Conway, 2014).

2.1. The basic process of the GBN approach

In the following, a description about how the Global Business Network approach is applied in this paper is given. The process is illustrated in Fig. 1.

2.2. Phase 1: orient

The aim of the first phase of the process is to clarify the issues at stake, and to use these issues as an orienting tool and guidance throughout the remaining four phases.

For this purpose, we defined a 'Framing Checklist', a tool that specifies the goal, the involved persons as well as other key characteristics of the process. The checklist consists of five simple questions for

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