



# Embedding real options in scenario planning: A new methodological approach



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## ARTICLE INFO

### Article history:

Received 11 February 2016

Received in revised form 18 May 2016

Accepted 19 May 2016

Available online 17 June 2016

### Keywords:

Scenario planning

Real options

Organizational learning

Pay-off method

2 × 2 scenario matrix

## ABSTRACT

The main goal of this paper is to explore whether and how we might integrate real options analysis into scenario planning in order to overcome the limitations and enhance the benefits of both techniques. So far scholars have emphasized that the main advantages of scenarios consist in developing the learning and adaptive skills of organizations. We thus investigate how to develop further these learning skills. Our paper contributes to the strategic management literature in three ways. First, it illustrates a new and simplified methodological approach to real option valuation. Second, it embeds this methodological approach into the 2 × 2 scenario matrix technique. Third, it deepens our understanding of the advantages that the combined use of scenarios and real options might bring to each technique.

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## 1. Introduction

The joint effects of globalization, rapid technological changes, and deregulation contributed to the relentless rise of new customer needs and business models and thereby to the growing volatility of the business environment. In a chaotic world in which markets and entire industries continuously emerge, collide, split, evolve, and decline, strategic investment decisions require managers to be able to sense, seize and handle external changes quickly (Teece, 2007).

Various foresight practices and techniques ('strategic - or corporate - foresight') have been developed to support strategic planning in fast-paced environments and thus help decision makers cope with uncertainty (Battistella and De Toni, 2011; Rohrbeck and Schwarz, 2013; Vecchiato and Roveda, 2010a, 2010b). Scenario planning, in particular, has been used for more than 40 years and has clearly emerged as one of the most popular and effective technique (van der Heijden et al., 2002). Scholars and practitioners developed a large number of different approaches to scenario planning. However, all these approaches share a common goal that is not to predict the future but rather to enhance organizational learning (Wright et al., 2013). The primary contribution of scenario thereby is to enable a process for strategic thinking that changes the established mental models of senior managers (Grant, 2003; de Geus, 1997).

Akin to scenarios, real option analysis has become considerably popular among both practitioners and scholars (Krychowski and Quelin,

2010). A real option is the right, but not the obligation, to make an investment in real assets by or at the end of a given period (Dixit and Pindyck, 1994). This method has been borrowed by the financial theory and then developed by strategic management scholars as a way to value investment in fast-paced environments.

Practitioners emphasize that scenarios, on the one hand, and real options, on the other hand, have specific strengths and weaknesses which are likely to complement each other (Cornelius et al., 2005). However, the extant literature offers little indication of how to combine scenario planning with real options so that we can cope with the differences between the qualitative analytical approach of scenarios and the quantitative analytical approach of real options (Miller and Waller, 2003).

This gap in literature represents a great opportunity for scholars and practitioners. The main aim of this paper is to explore how scenario planning and real options might be integrated in order to overcome their limitations and enhance their benefits, particularly in relation to the learning skills of organizations.

Our research efforts and practical experience enabled us to design and apply an innovative methodological approach which takes advantage of a recent technique for real options valuation and embeds this technique into the 2 × 2 scenario matrix. We developed this innovative approach in the specific context of R&D investment decisions of a biotech company. However, the methodology we present might be seamlessly used in similar areas of corporate choices like mergers and acquisitions, investments in new capacity, international expansion. It might be easily extended as well to other business sectors.

One of the authors was directly involved in the application of the method as he served as advisor to the board of the company at the

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time of a critical investment decision for the clinical development of a new drug. Thanks to this privileged viewpoint, we got access to primary data and provided a detailed description of the application of the method and its outcomes. The authors were given explicit consent to the publication of the real inputs that informed the decision model, provided that fictional names were given to the company and its candidate for clinical development.

Our paper contributes to the strategic management literature in three ways. First, it builds on the recent work of financial scholars to refine a new methodological approach to real option valuation. Second, it blends this methodological approach in the  $2 \times 2$  scenario matrix. Third, it deepens our understanding of both scenarios and real options and the benefits and challenges inherent in the combined use of these two techniques. More generally, this research expands our understanding of how firms can cope with increasing volatility and uncertainty (Vecchiato, 2012).

## 2. Uncertainty and strategic decision making: the role of scenario planning and real options

Environmental uncertainty is the inability of decision makers to understand what are the major events or changes in their business environment (Knight, 1921; Duncan, 1972). Uncertainty represents a key challenge for strategic planning and investment decisions, as it affects the foundation of strategic planning itself: the possibility to make accurate forecasts (Ansoff, 1991; Porter, 1980). While relatively reliable in the short term, forecasting accuracy diminishes in the medium and long term as political, economic, social and technological drivers of change interact in novel and unforeseeable ways (Galbraith and Merrill, 1996; Eisenhardt et al., 2010).

The challenge of crafting strategy in a fast-paced business environment has encouraged the design and development of new practices and techniques aimed at identifying external changes and anticipating their possible evolution (Porter et al., 2004). Among these techniques, scenario planning and real options in particular have become very popular (O'Brien and Meadows, 2013; Avadikyan and Llerena, 2010).

### 2.1. Scenarios

Scenarios represented a strong discontinuity from traditional forecasting approaches, the limits of which – i.e. the inability to make accurate enough predictions in the more and more volatile business environment – have been widely emphasized by strategic scholars (Doz and Kosonen, 2008; Mintzberg, 1990).

Instead of predicting the future, the main rationale of scenario planning is to envisage alternative views of the future in the form of different (but internally consistent) configurations of key changes in the business environment (Schoemaker, 1993). The most common school or methodology of scenario planning in corporate organizations is usually labeled as the 'Intuitive Logics' (Wright et al., 2013). This methodology requires to focus on arising uncertainties (i.e., new events or drivers of change) in the business environment and then to select, among all these arising uncertainties, the most critical ones to be used as the basic premises of a small number of scenarios. Here practitioners distinguish between two main approaches: the inductive method and the deductive method (Schwartz, 1991). The first one is loosely structured and relies on the ability to reach a broad consensus among a group of experts and decision makers. The deductive approach uses instead simple techniques of prioritization to build a  $2 \times 2$  scenario matrix based on the two most critical sources of uncertainty (i.e., drivers of change) in the business environment. Both the inductive and the deductive approach are subjective and qualitative in nature.

The origins of the intuitive school of scenario planning date back to the 1950s, as the effort of the US Department of Defense to select the most critical projects (development of new weapons systems) led to the development of an approach known 'as system analysis'. Later on system

analysis turned out to be the basis of the intuitive scenario methodology (Bradfield et al.: p. 33). The first scenario exercise described in literature on strategy is the "Year 2000" study that Royal Dutch Shell (hereafter Shell) carried out in 1967: this scenario exercise enabled the company to anticipate the discontinuities the oil industry was going to face in the early 1970s, namely the impending scarcity of oil and the increase in its price (Wack, 1985). Shortly afterwards, scenarios were widely adopted throughout Shell. In the 1970s, scenarios originally focused on the key variables relevant to the oil business, namely oil demand and price. Later on their focus gradually broadened to include the macro economic and political landscapes. In the 1980s a deeper analysis of social and environmental (ecological) changes was added, so that by 1987 Shell's scenarios filled three separate volumes on oil, energy and global trends in the macro environment. Afterwards, in the early 2000s Shell's scenarios started being framed around three different levels, from 'global' to 'focused' and 'project' scenarios. Shell global scenarios investigated major forces in the macro environment of the energy industry, i.e., the political, economic, ecological, social, and technological (PEEST) landscapes. Based upon global scenarios, Shell 'focused' scenarios' specifically addressed each business sector of the energy industry and each major country or region where the company was carrying out its operations. Finally, 'project' scenarios considered major strategic investment decisions by drawing the implications of global and focused scenarios and by processing more detailed data on direct rivals, profitability, and technical and managerial issues. The main objective of these changes in Shell's scenario planning approach was to devolve strategic transparency and accountability from the corporate level to the over 50 strategic planning units of the company (Davis, 2002). Scenarios offered these units a tool and process for scrutinising the resilience of their strategic decisions: in the early 2000s, the Shell group committee of managing directors requested every strategic planning unit to prove the robustness of their strategy against the global scenarios and the supporting focused and project scenarios.

While Shell is largely recognized as the foremost user of scenarios among corporate organizations, a survey of US top firms revealed that in the early '80s almost half of the US Fortune 1000 industrial companies were also using this planning approach (Linneman and Klein, 1983). For instance, GE began to experiment with scenarios at about the same time of Shell and in 1971 produced four alternative scenarios of global and US economic and socio-political conditions. Scenarios were very popular also among European firms (Malaska, 1985). More recently, BASF in the chemical sector, Daimler in the automotive industry, and Morgan Stanley in the financial sector provided further compelling examples of companies that have been largely applying scenarios (Vecchiato and Roveda, 2010a; Vecchiato, 2012). Similarly to Shell, scenarios in these companies were built via a top-down process that started at corporate level, by firstly taking into account the global economy, and then elaborated more focused scenarios regarding specific business areas and investment projects.

### 2.2. Real options

Akin to scenarios, real options have become a very popular forward-looking technique among business executives. Real options are based on a quantitative approach rooted in the finance research: after their first introduction in the early 1990s, the literature quickly expanded and now offers a large number of increasingly complex models for the analysis and valuation of real options (Smit and Trigeorgis, 2006, provide a comprehensive review of the literature on this subject).

Before the development of real options theory, executives have based their understanding of the long-term profit of strategic investments on the discounted cash flow (DCF) approach. For instance, the net present value (NPV) of an investment project is calculated by focusing on the present value of expected streams of cash inflows and the present value of expected streams of cash outflows (Dixit and Pindyck, 1994). However, the traditional NPV approach has clearly a relevant limit: it ignores the benefits due to the ability to delay (or stop) irreversible investment

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