

Looking back on looking forward: a review of evaluative scenario literature

ISSN 1725-2237



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Design and layout: EEA/Pia Schmidt

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Luxembourg: Office for Official Publications of the European Communities, 2009

ISBN 978-92-9167-992-8

ISSN 1725-2237

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Acknowledgements

This technical report is based on a study by Robert Lempert (RAND Corporation) and Michael Hallsworth, Stijn Hoorens and Tom Ling (RAND Europe) for the European Environment Agency (EEA).

The EEA project manager was Axel Volkery. Comments were provided by Hans Vos (EEA). The publication was guided by Teresa Ribeiro (Head of Strategic Futures Group, EEA) and Jock Martin (Head of Programme for Integrated Environmental Assessments, EEA).

Executive summary

Faced with risk and uncertainty, environmental policy-makers are increasingly using scenario planning to guide decision-making. The vibrancy of the field is evident in the numerous case studies conducted using diverse methodologies.

Yet even well-crafted scenarios can fail to have their intended policy impact if they present irrelevant information, lack support from relevant actors, are poorly embedded into relevant organisations or ignore key institutional context conditions. Unfortunately, the shortage of research on scenario planning and its influence means that there is limited guidance on how to optimise scenarios, in terms of both outputs and uptake by policy-makers.

This technical report addresses this lack of information, presenting a review of relevant academic and non-academic literature on the issue. It introduces and analyses a pool of 52 pieces of research on scenario planning, commonly known as 'evaluative scenario literature'. Collectively, these studies provide insights into:

- the types of scenarios that exist and those that work in different contexts, both in the public and private sectors;
- the characteristics that enable organisations to use scenarios more effectively;
- the ways that scenarios influence decision-making processes and robust organisational strategies.

While further research on these topics is needed, drawing on a broader evidence base, this report provides interesting insights, pointing the way for more detailed analysis.

In general, this study finds that there is little compelling evidence to support the significant claims often made regarding the potential benefits of using scenarios. The limited research focusing on impacts suggests that scenarios can improve the robustness of decision-making, organisational performance and individual learning. Scenarios have less impact, however, if they identify threats for which there is no viable response or are based on flawed methodologies. Moreover, scenario planning faces particular challenges in the public sector. Long-term thinking is difficult in the compartmentalised environment of modern government and cannot, in any event, provide a technical 'fix' if a context is driven by short-term concerns. The diversity of government objectives and interests can also make it difficult to establish one single client.

Such challenges notwithstanding, several studies suggest that scenarios can play a useful role in developing robust organisational strategies. In addition, the process of scenario development offers a variety of ancillary benefits, notably raising awareness, learning from past experiences and reconsidering the validity of policy assumptions. Engaging stakeholders and policy-makers directly in development also boosts the validity and credibility of outputs.

The report points to ways that public agencies could be organised to make better use of scenarios and methods to make scenarios more relevant to policy-makers. It concludes by describing the areas where evaluative scenario literature should focus to build up evidence that can ensure that scenario planning is of maximum value in policy-making.

1 Introduction

Policy-makers and business leaders often face strategic decisions with uncertain future results. Such outcomes often depend on a variety of unpredictable factors outside the decision-maker's control. Scenario planning has been developed as a method to represent and deal with deep uncertainty of this sort. Scenarios are not intended to forecast what will happen in the future but rather what might happen.

A scenario can be defined as a consistent and plausible picture of a possible future reality that informs the main issues of a policy debate. The use of the term 'scenario' as a formal tool dates from the late 1950s (Bradfield *et al.*, 2006), when researchers at the RAND Corporation defined states of the world within which alternative weapons systems or military strategies would have to perform (e.g. Kahn and Weiner, 1967; DeLeon, 1973; Deweerd, 1973; Kahn *et al.*, 1976). Since then, scenario planning has been employed by many organisations, public and private, small and large, across the world.

Scenario planning is addressed extensively in academic literature. Numerous studies propose scenario methodologies or report on the application of a particular approach. Only a small fraction of the literature attempts to evaluate critically the factors that allow scenarios to be used successfully and the impacts scenario approaches can have on organisational performance (Harries, 2003; Chermack, 2005). A few 'classic' stories from the corporate world are often cited as proof of the many benefits of developing and using scenarios but little documented information is available on the value of using scenarios to support policy-making in the public sector. Moreover, the growing literature evaluating the impacts of environmental assessments (Clark *et al.*, 2006; NRC, 2007) makes little mention of scenarios.

This technical report briefly surveys research on scenario impacts — so-called 'evaluative

scenario literature'. It has been conducted as a scoping exercise in the context of the European Environment Agency's BLOSSOM project ⁽¹⁾. The project studies the use, impacts and effectiveness of long-term scenarios in environmental policy-making and aims to propose options to help link long-term scenario and strategy analysis and assist organisational capacity building.

While numerous alternative methodologies exist for future strategic planning, this report focuses primarily on scenario planning literature because scenarios provide a potentially very attractive approach to addressing uncertainty and complexity. Furthermore, the focus of this report is on literature that explicitly attempts to evaluate scenario approaches, including comparative studies of the strengths and weaknesses of several different scenario exercises; critical assessments of the impacts scenario approaches can have on decisions and organisations; and studies that describe scenario approaches aimed at evaluating the robustness of strategies over multiple scenarios.

The bibliography in Chapter 4 divides this evaluative literature into five categories (see Table 4.1):

- scenario typologies;
- assessments of what types of scenario work in different contexts;
- assessments of methods and institutional arrangements that enable organisations to use scenarios more effectively;
- reviews of the impact of long-term policy analysis on decision-making processes;
- analyses that evaluate the robustness of strategies over multiple scenarios.

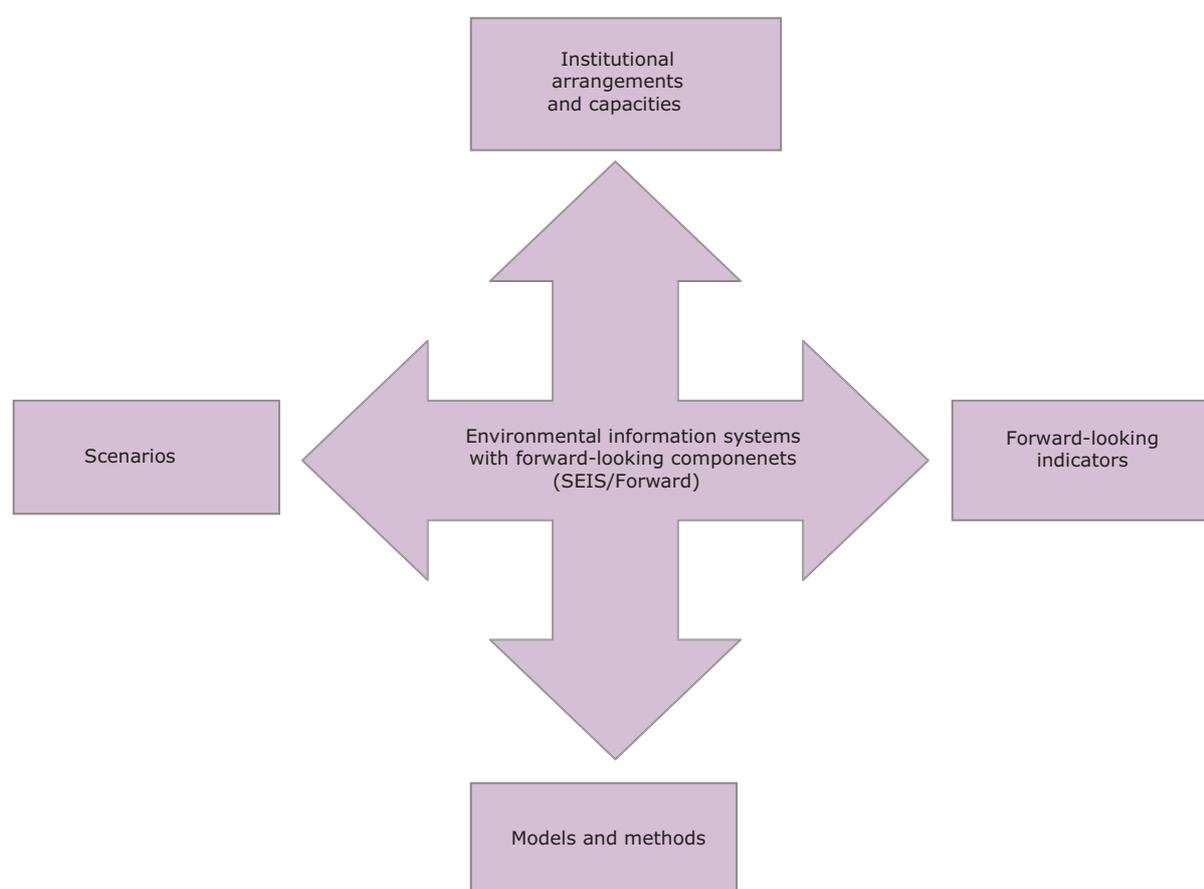
This analysis complements other European Environment Agency reports on improving the information base for future forward-looking

⁽¹⁾ BLOSSOM stands for 'Bridging LOng-term Scenario and Strategy analysis — Organisation and Methods'.

assessments, specifically an inventory of available environmental simulation models and a catalogue of relevant outlook indicators (EEA, 2008a; EEA, 2008b). A catalogue of relevant environmental scenario studies is also planned for publication in 2009. These reports form the building blocks that will ultimately contribute to a Shared Environment Information System (SEIS) ⁽²⁾. SEIS will provide access to up-to-date information on available scenarios, models and indicators, and outline good-practice in using them.

Further work under the BLOSSOM project will extend this report's analysis. A number of targeted case studies will provide a more comprehensive overview of existing institutional arrangements, use of scenarios to inform and shape long-term environmental decision-making, respective strengths and weaknesses of institutional arrangements, and overall success conditions. While addressing critical gaps in our current understanding, this analysis also aims to contribute to organisational capacity building.

Figure 1.1 Building blocks of environmental information systems that support integrated assessments



Source: EEA, 2009.

⁽²⁾ The Shared Environment Information System will be a distributed 'system of systems' for environmentally relevant information. Current systems for managing information centrally are increasingly being replaced by systems based on access, sharing and interoperability (COM(2008)46 final Communication from the Commission to the Council, the European Parliament, the European and Social Committee and the Committee of the Regions/Towards a Shared Environmental Information System (SEIS) and EEA Shared Environment Information System Implementation Plan 2008 with Eionet).

2 Short synthesis of available evaluative scenario literature

This chapter provides a short synthesis of the available evaluative scenario literature. Relevant literature and categories were selected on the basis of suggestions from several scenario practitioners and academic experts (see Figure 2.1). Citation indexes and the reference lists included in these texts were used to find relevant earlier and subsequent literature. The review maintained a narrow focus on evaluative scenario literature but the search aimed to be inclusive with regard to what was included under this heading.

The process resulted in a selection of 52 sources, comprising a mixture of academic journals, books and book chapters, working papers, policy papers and research reports. There are sure to be important items missing because time and resource limitations meant that the review could not be exhaustive. Nevertheless, the work included here seems to provide a reasonable survey of the main themes in the literature.

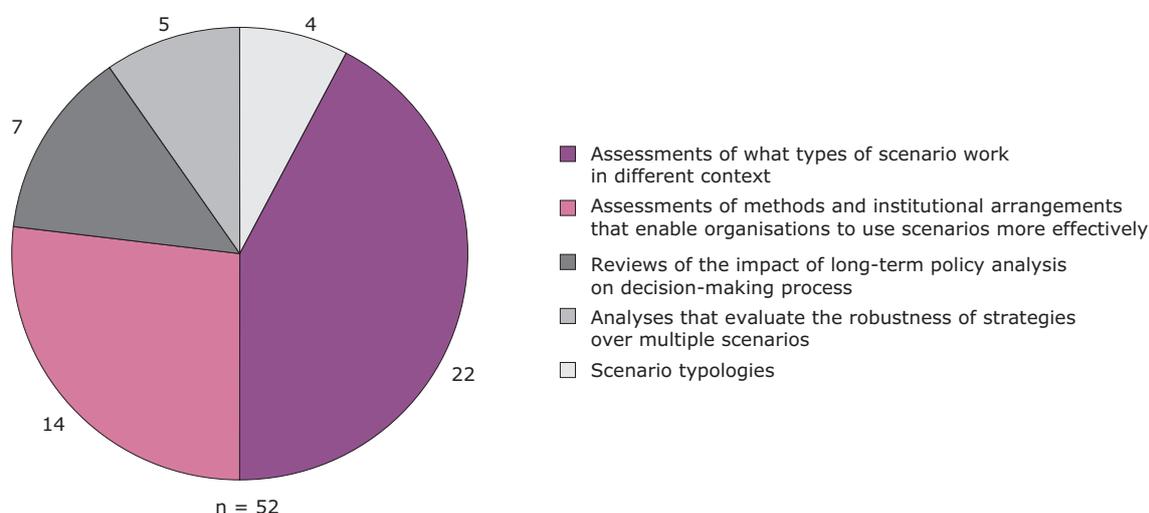
The remainder of this chapter synthesises the findings contained in the 52 studies. The annotated bibliography in Chapter 4 provides summaries of each of the individual sources.

2.1 Types of evaluative scenario studies

The literature assessing impacts of scenarios employs a variety of evaluative methods. Many studies describe the theoretical benefit of scenarios, some drawing on general psychological understanding of human decision processes and biases, some reporting specific laboratory tests of impact on decision-making (e.g. Schoemaker, 1993; Chermack *et al.*, 2006; Garb *et al.*, 2008), and some referring to observations of decision processes within organisations. Some studies (US Commission, 1999; van Asselt, 2000; Oglivy and Smith, 2004; Clark *et al.*, 2006; Parson *et al.*, 2007) provide detailed comparisons of several scenario exercises in order to assess the factors affecting their success. A particular type of work is the ethnographic study examining how scenarios are used within organisations (for example van 't Klooster and van Asselt, 2006).

Surveys addressing workshop settings are useful tools to measure how different types of scenarios can affect decision-makers' understanding of the challenges they face and preferences for response options (Groves *et al.*, 2008). Data are also available on the types of businesses that use scenarios — most

Figure 2.1 Five categories of evaluative scenario literature



Source: EEA, 2009.

often large firms in capital-intensive industries with long (greater than 10 years) planning horizons. However, only a handful of studies, most notably Phelps *et al.* (2001), report empirical results on the central issue of how scenario use correlates with an organisational performance (see Section 2.3).

2.2 Types of scenarios

Most scenario practitioners use the scenario axis approach associated with Shell Oil and the Global Business Network. According to that approach, a set of key driving forces is identified first and the two driving forces regarded to be most important and most uncertain in terms of their future development form the axes of a matrix. They determine the overall logic of the scenario storylines (Bishop *et al.*, 2006). However, numerous scenario approaches exist.

In an attempt to classify the 'methodological chaos' (Bradfield *et al.*, 2006), researchers have developed several typologies for scenarios. One approach is to take an historical perspective, tracing three main schools: the intuitive logics school, which originated with RAND and is now strongly associated with Shell Oil and the Global Business Network; the La Prospective school developed in France by Gaston Berger and Michel Godet; and the Probabilistic Modified Trends school originally developed by Ted Gordon and Olaf Helmer at RAND (Bradfield *et al.*, 2006).

Another approach is to take a functional perspective. Bishop *et al.* (2007), for example, identify eight categories of scenario development techniques⁽³⁾. On the basis of several case studies, van Notten *et al.* (2003) propose a typology that differentiates scenarios according to their goal (either raising awareness or decision support); the process used to create them (either interactive group session or a formal process often employing quantified knowledge); and the scenario content (either complex or simple).

2.3 Impacts of scenarios

The few studies that evaluate the effectiveness of scenarios generally find them to be useful (Glenn

and Gordon, 2001). The only empirical study identified that concretely assesses the effects of scenario use on organisational performance (Phelps *et al.*, 2001) detected a benefit. That study found that in two UK industries (water supply and IT consulting) scenario use correlated with increased profits and returns on capital. Another study comparing four scenario exercises related to global change applications suggests that climate scenarios are mostly used to support further modelling and analysis but can also help frame public debates (Parson *et al.*, 2007).

A review of the broader area of foresight identifies limited relevance for practical decision-making in policy processes (da Costa *et al.*, 2006). Elaborating on the results of a series of workshops at which practitioners and policy-makers jointly reviewed the impact of foresight on policy-making, the authors conclude that new approaches are necessary to increase the relevance and impact of foresight exercises.

Several studies report that scenarios can have positive outcomes in terms of individual learning. Using scenarios can increase participants' perceptions of their strategic communication and conversation skills, as a recent study that gathered data on individual participants in a scenario-planning project demonstrated (see Chermack *et al.*, 2006). Another example can be found in California, where at a series of workshops managers and stakeholders of a California water agency were presented with decision aids incorporating scenario concepts. An increasing understanding of the challenges posed by climate change and their shifting views on how best to respond was noted during the exercise (Groves *et al.*, 2008).

Attempts to use scenarios to help policy-makers can easily fail, however, as literature focusing on the private sector indicates. Managers may reject scenarios that identify threats for which there are no viable responses (Hodgkinson and Wright, 2002).

Several studies highlight potential shortcomings of scenario exercises or emphasise ways in which they deviate from the practice described in the case study literature. For instance, much of this

⁽³⁾ They include judgment, trend extrapolation, elaboration of fixed scenarios (incasting), event sequences (probability trees, sociovision, divergence mapping), backcasting, dimensions of uncertainty (scenario matrix, morphological analysis), cross-impact analysis and modelling.

literature emphasises the need for consensus on the scenario axes in order to foster a common basis of understanding. Examining closely a qualitative scenario project conducted by the Netherlands Institute for Spatial Research, van 't Klooster and van Asselt (2006) identified three different and contradictory interpretations of the scenario axes employed. The project nonetheless proceeded without consensus by producing multiple publications that treated the axes in different ways.

2.4 Handling surprises and discontinuities

A reason often cited for using scenario planning as a tool to analyse future events is its ability to reduce overconfidence about the future. A number of studies argue, however, that it is difficult for scenarios to accommodate or anticipate surprises or discontinuities. The addendum to the Hart Rudman Commission report (US Commission, 1999), which warned of the dangers of a terrorist attack on the scale of 9/11, examined 20 scenario studies of national security in the United States and found that all tended to focus on extrapolations of current concerns and rarely focused on other possibilities that could produce startling emergent behaviour.

Postma and Libl (2005) suggest that standard scenario approaches which follow the axis approach tend systematically to exclude surprising or paradoxical developments as inconsistent or logically impossible. Another analysis comparing the treatment of surprises in 22 scenario studies highlights that seven of the eleven scenarios including discontinuities were exploratory, while four were decision-support exercises (van Notten *et al.*, 2005). All but one exercise with surprises was developed via an intuitive rather than formal process. None of the model-based scenario exercises included surprises.

Building scenarios inductively from sample trends rather than from two key driving forces helps ensure that surprising elements and influence factor combinations are addressed that might appear illogical or inconsistent in the axis framework of the deductive approach. They more easily allow a focus on wild cards and extend the scenario building process to introduce seemingly paradoxical elements. Doing so can help to re-examine claims of inconsistency. Such claims can be highly subjective, following individual assumptions, and might turn out irrelevant in a larger group discussion.

2.5 Differences between public and private sector applications

Much of the literature on scenario theory and practice focuses on business applications. Several evaluative scenario studies therefore examine potential differences between scenario exercises in the public and private sectors. Oglivy and Smith (2004) compare five public sector scenario exercises addressing regional development that were conducted by the Global Business Network. They conclude that there is little difference in the actual day-to-day process of developing scenarios for use in the public and private sectors.

Scenario users in the public sector can, however, face more difficult challenges in establishing a clear client for the exercise. Given the integrated character of many environmental problems, many policy actors either help shape and implement policies or are directly or indirectly affected by environmental policies and thus have an interest in the exercise. Moreover, framing the purpose of the engagement and gaining the participation of all relevant parties can be difficult, given that many policy processes interact and influence each other at different stages. Methods that work well in developing scenarios for small groups, well known to scenario developers, may not work well for large organisations or contribute to broad political debates (Lempert, 2007). Public sector decision-makers may also face particular constraints such as a diversity of legitimate but competing objectives and societal interests.

In their ethnographic study of scenario axis practice, van 't Klooster and van Asselt (2006) conclude that public agencies' diffuse and heterogeneous objectives and interests may make consensus on the meaning of scenario axes impossible. Parson *et al.* (2007) similarly highlight the difficulties applying traditional scenario methods among the heterogeneous stakeholders that must engage in public sector scenario exercises.

The traditional scenario axis approach argues against including probabilistic information with scenarios. In some public sector applications, however, such probabilities may prove useful. Parson *et al.* (2007) summarise the arguments in the climate change community for and against including probabilities with climate scenarios. The study concludes that probabilities may be useful in some situations, in particular when the key variables distinguishing the scenarios are few and quantitative, and the potential scenario users

are numerous and diverse. Probabilities may be less useful when the scenarios are rich, complex narratives, their purpose is heuristic exploration, and the users are few, similar, and known.

2.6 Using scenarios more effectively

Scenario exercises can trigger more impacts if key stakeholders and policy-makers are directly involved in the process of development. In fact, the main impacts like raising awareness, policy-learning and reconsidering the validity of policy assumptions often result more from the process of developing scenarios than from the published record of their output disseminated after the analysis. This is evident in the case of global environmental assessments. A good process design and management is indispensable for improving the salience, legitimacy, and credibility of global environmental assessments (Clark *et al.*, 2006).

The value of close collaboration between scenario developers and users, particularly at the beginning and closing stages of a scenario exercise, is also apparent in the context of scenario exercises related to global change applications (Parson *et al.*, 2007). Process is important because it has implications for the extent to which people trust scenarios and use them. Trust can relate to sources (the people who develop the scenarios) or to content (the information used in the scenarios). Additionally, trust is gained from methodological credibility (the method used to generate the scenarios) or can relate to narrative (the extent to which the scenarios build on existing metaphors and beliefs). Finally, trust in dissemination (i.e. in the stature of the people who present the scenarios) is important (Selin, 2006).

The usefulness of information from scenario exercises is influenced not only by the development process but also by the organisational settings and institutional routines of the final target group. Designing and equipping the process adequately is also crucial.

Long-term thinking cannot provide a technical 'fix' for a context that is driven by short-term concerns, regardless of whether these concerns have political or economic drivers. The compartmentalised structure of modern governments provides another barrier to long-term thinking and decision-making. The heterogeneous nature of government objectives and interests often makes it difficult to establish one single client, especially in the

field of environmental policy, which cuts across several other policy areas, affects a multitude of stakeholders and is multi-disciplinary in terms of the underpinning research and science. The relevance of organisational and institutional factors needs to be more carefully considered.

A number of studies propose ways that government agencies might be organised to make better use of information derived from scenarios. White (2002) recommends several steps that the United States government could take to use long-range forecasts more effectively, including:

- endowing a dedicated centre to become a source for high quality, timely reports for congress;
- changing executive branch and congressional rules to encourage consideration of such forecasts;
- engaging the public and media with such forecasts more effectively;
- establishing credible watchdogs to monitor and report how government responds to forecasts.

In addition, developing networked, small, flexible, task-oriented, managerial teams in government's executive branch overlaid on the existing bureaucracy could significantly enhance the government's ability to analyse and act on scenarios (Fuerth, 2006).

New methods that conform better to the needs of policy-makers can also help to increase the use of scenarios. For example, new quantitative 'scenario discovery' methods could systematise the process of generating scenarios so that watchdog agencies and the public could more easily determine whether or not government officials had sufficiently evaluated the robustness of their plans (Lempert, 2007).

Scenarios can most usefully support decision-making by helping identify robust strategies. A robust strategy performs well compared to the alternatives over a wide range of plausible future scenarios (Lempert *et al.*, 2003). Robust strategies can be identified qualitatively (for example, Rosenhead, 1989; van der Heijden, 1996; Mercer, 1997; Dewar, 2002), or with more formal model-based and other analytic methods (see van Asselt, 2000; Lempert *et al.*, 2003).

Ideally using scenarios to help develop robust strategies in public policy applications should lead to two beneficial outcomes. First, organisations

should adopt strategies less vulnerable to failure due to unforeseen events. Second, communities in disagreement should have enhanced ability to reach consensus because individuals can agree on near-term actions without concurring on long-term expectations. The literature summarizes many empirical findings on the characteristics of high performance organisations (see Light, 2005) ⁽⁴⁾.

However, the literature review for this report did not find any studies that have thoroughly tested claims that scenario analysis favours robust strategies by carrying out *ex-post* assessments of the performance of organisations that have conducted such analysis.

⁽⁴⁾ High performance organisations can be described as robust. Light (2005) distinguishes four key characteristics: alertness (attention to monitoring the outside world for early warning signs that key assumptions are likely to fail and, perhaps more importantly, commitment to monitoring rigorously the organisation's own performance); agility (the ability to react to early warning signs of problems or opportunities); adaptability (the ability to adjust strategies and tactics rapidly to meet changes in the environment); and alignment (the ability to align the whole organisation to its mission).

3 Future needs and directions for evaluative scenario literature

Evaluative scenario literature provides many valuable insights to public officials considering whether and how to use scenarios to support long-term policy decisions. The theoretical literature offers credible claims about the cognitive impacts of scenarios on individuals and organisations. The case study literature offers examples of different types of scenario exercise that apparently proved successful in particular contexts.

The evaluative scenario literature remains nascent, however. Those in charge of scenario planning can draw on only scant empirical evidence to support judgments about the most effective way to proceed. This report examined literature in five categories:

- scenario typologies;
- assessments of what types of scenario work in different contexts;
- assessments of methods and institutional arrangements that enable organisations to use scenarios more effectively;
- reviews of impacts of long-term policy analysis on the decision-making process;
- analyses that evaluate the robustness of strategies over multiple scenarios.

Important work remains to be done in all five categories but efforts in the second, third and fourth would address the most significant weaknesses of our current understanding. If long term scenario planning is to become an effective cornerstone of policy-making, more empirical evidence is needed to demonstrate that scenarios can deliver on their promises.

Significant claims have been made about scenarios' ability to affect the cognition of individuals and groups by reducing overconfidence, improving willingness to consider a range of plausible futures and think innovatively about robust strategies, and helping detect early warnings of important new trends more effectively. There is, however, limited empirical evidence for these claims. Only a handful of studies have tested these claims in laboratory settings and fewer still in actual practice. Numerous case studies suggest that scenarios can improve the

performance of organisations but few studies have tested these claims by comparing the performance of organisations that have used scenarios to those that have not.

Often studies emphasise the importance of the context and process of scenario creation. There is little evidence, however, connecting these insights to a participating organisation's subsequent performance. Finally, there is little work determining the extent to which long term policy analysis brings about policy decisions that effectively address long-term goals.

Much of the case study scenario literature focuses on private sector applications but there are important differences between the public and private sectors. First, it would be useful to better understand whether and how best to use probabilistic information with scenarios. While probabilities may prove a hindrance in many business sector applications, some argue that the large, diverse audiences for public policy scenarios often require some information on relative risks. Second, many public sector applications may require a more systematic connection between scenarios and recommended decisions than do private sector applications. Third, scenario exercises in the realm of the public sector often aim to build consensus or to foster a shared understanding within multi-stakeholder settings, bringing a broader diversity of interests to the table that need to be accommodated.

Scenarios should in principle help organisations to prepare better for uncertain future developments and surprises but in practice they have often failed to do so. Deductive approaches seem to be ill-prepared for this exercise in comparison to other, more inductive methods, which are often considered too time-consuming. Methodological refinements are thus required to improve scenarios' ability to help public sector decision-makers better anticipate, prepare for and respond to shocks and opportunities in our fast-changing world. Improving the link between scenario development and robust strategies is crucial in this regard. There are a number of new

approaches to long-term policy analysis that make intelligent use of scenario analysis. Determining how best to communicate such results to the general public will be an important but complicated task.

Last but not least, the available evidence points to the need to discuss institutional dimensions

more seriously. The context and process of creating scenarios affects their impact and scenario exercises often fail to realise their potential benefits because there is a mismatch between aspiration and supporting capacities. Studies on organisational performance and key drivers that determine positive impacts need to reflect this.

4 Annotated bibliography

Table 4.1 introduces and analyses a pool of 52 pieces of research from the evaluative scenario literature.

Table 4.1 Annotated bibliography of evaluative scenario literature

Category	Author	Title	Year	Source	Description
I. Scenario typologies	Bishop <i>et al.</i>	'The Current State of Scenario Development: An Overview of Techniques'	2007	Foresight 9: 5–25	<p>This paper aims to review all the techniques for developing scenarios that have appeared in the literature and comment on their utility, strengths and weaknesses. The paper notes that most scenario practitioners have latched on to a single method — the Shell/GBN scenario matrix approach — although there are many different techniques for developing scenarios. The study defines a scenario as a product or deliverable from a project that describes some possible future state and/or explains how such a state might come about.</p> <p>The study identifies eight categories of scenario development techniques, namely judgment; trend extrapolation; elaboration of fixed scenarios (incasting); event sequences (probability trees, sociovision, divergence mapping); backcasting; dimensions of uncertainty (scenario matrix, morphological analysis); cross-impact analysis; and modeling. [I]</p>
	Børjeson <i>et al.</i>	'Scenario Types and Techniques: Towards a User's Guide'	2006	Futures 38: 723–739	<p>This scenario typology focuses on the scenario user's need to know what will happen, what can happen, and/or how a predefined target can be achieved. It discusses the applicability of various generating, integrating and consistency techniques for developing scenarios that provide the required knowledge. [I]</p>
	Bradfield <i>et al.</i>	'The Origins and Evolution of Scenario Techniques in Long Range Business Planning'	2005	Futures 37: 795–812	<p>This paper traces the origins and growth of scenarios and the subsequent evolution of the various methodologies. Noting that the multitude of scenario methods has been described as 'methodological chaos', the paper classifies scenario methodologies into three main schools: the intuitive logics school which originated at RAND in the 1950s and is now strongly associated with Shell Oil and Peter Schwartz; the La Prospective school developed in France by Gaston Berger (Berger, 1964) and Michel Godet (Godet, 1979); and the Probabilistic Modified Trends school originally developed by Ted Gordon and Olaf Helmer at RAND.</p> <p>The paper suggests that the adoption of scenario techniques by business is driven by the size of the company (larger firms more frequently use scenarios), the length of the planning horizon (the majority of scenario-using firms have planning horizons longer than 10 years), and capital intensiveness (the majority of scenario users tend to be in capital-intensive industries such as aerospace, chemicals, and petroleum refining). Use of scenarios appears to wax and wane over time, potentially associated with the perceived unpredictability of the corporate environment. Few firms used scenarios before 1974 but the number increased significantly through 1981. Some anecdotal evidence suggests a decline in scenario use during the 1980s, perhaps because practitioners have had only limited success in striking a balance between an excess of technicality and superficiality. The Science Citation Index shows a surge in scenario references between 1992 and 2000. [I, II]</p>
	van Notten <i>et al.</i>	'An Updated Scenario Typology'	2003	Futures 35: 423–443	<p>This paper proposes an updated scenario typology to analyse and compare scenarios. The typology centres on three overarching themes — project goal, process design, and scenario content — and 14 scenario characteristics. A comparative analysis of several case studies demonstrates that the typology is both broad and detailed enough to analyse and compare the diversity in today's scenarios.</p> <p>The case studies are presented in a 'scenario cartwheel' that organises the scenarios according to the theme. The project goal can be exploration (e.g. awareness raising) or decision support (e.g. examining paths according to their desirability and/or identifying actions that lead to desirable paths); process design can be intuitive (e.g. leans strongly on qualitative knowledge and insights) or formal (e.g. relies on quantified knowledge and pre-determined process); and scenario content can be complex (e.g. composed of an intricate web of casually related, interwoven and elaborately arranged variables and dynamics) or simple (e.g. focusing on a particular niche or the extrapolation of key trends). [I]</p>

Category	Author	Title	Year	Source	Description
II. Assessments of what types of scenario work in different contexts	Chermack	'Studying Scenario Planning: Theory, Research Suggestions, and Hypotheses'	2005	Technological Forecasting & Social Change 72: 59-73	This paper notes that there has been insufficient research and theory development to support the practice of scenario planning. It offers a theory of scenario planning and suggestions for research, which include the need for studies that document the increasing use of scenario planning, both successes and failures; empirically examine the claims that scenarios promote learning in organisations; empirically examine the extent to which scenarios help change mental models; use cognitive tests of decision-maker performance to compare their performance before and after a scenario exercise; and use longitudinal studies to track the performance of scenario-using corporations over time to measure the effectiveness and pitfalls of these scenarios. [II]
	Chermack <i>et al.</i>	'Exploring the Relationship Between Scenario Planning and Perceptions of Strategic Conversation Quality'	2006	Technological Forecasting & Social Change 74: 379-390	This study examines strategic conversation in a scenario planning context. After defining key terms and a conceptual framework for the strategic conversation, this study presents data gathered from individual participants in a scenario planning project. Data concerning perceptions of strategic conversation skills were collected before and after the scenario planning project, and then compared with a standard t-test. The descriptive statistics indicate an overall increase in mean scores from pre- to post-intervention assessment. Given the t-values, the findings may represent an accurate assessment of the effect of scenario planning on individual perceptions of communication and conversation skills. The researchers suggest performing other tests that assess the relationship between communication and conversation skills and some objective measures of performance. [II]
	Glenn and Gordon	Factors Required for Successful Implementation of Futures Research in Decision-making. Millennium Project publication	2001	Available at: www.millennium-project.org/millennium/application/exsum.html . [Accessed 16 March 2009]	This report examines the reasons for success or failure in the use of futures research in reaching timely decisions. The report is based on a literature review, the authors' experience and surveys of and interviews with futures planners and scholars. The report identifies the top ten impediments to timely use of early warning as: institutional, financial, disinterest in the future, planning inadequacy, personnel, strategic, complexity, political, information, and lack of consensus. The top fourteen factors that contribute to timely use of early warning information comprise: information that demonstrates unequivocally that a crisis is pending; knowledge about what is possible; education of decision-makers and opinion shapers on issues of long-term significance; simple, clear, precise information in political, cultural, non-technical terms, connected to goals and strategies; sufficient information on what is required to implement various policy options; information about how contemplated information may affect stakeholders; information about the success or failure of other institutions that have similar problems; use of indicators; testimony of eminent scientists; information about probability and risks associate with issues and their policy solutions; attention paid to the issue by the media; accurate projections of computer models; creation and use of accurate simulations and training, which make clear consequences of actions; clarity regarding forecasting the condition without action and the technical feasibility of a proposed action. [II]
	Godet	The Crises in Forecasting and the Emergence of the 'Prospective' Approach	1979	Pergamon Press, Elmsford, New York	In this book, Michel Godet introduces a school of thought for futures thinking developed in France in the late 1950s. La Prospective is a strand of futures thinking originally developed by Michel Berger. The word 'prospective' was used to point out the need for a future-oriented attitude. It included: looking far ahead — La Prospective is a long-term preoccupation; looking breadth-wise and taking account of interactions; looking in depth and find the factors and trends that are really important; taking risks because distant horizons can make us change our long-term plans; taking care of mankind, because La Prospective is primarily interested in human consequences. This book makes the French school of thought more accessible to an Anglo-Saxon audience and introduces refinements on scenario construction through case studies on air transport and energy. [II]
	Godet	'From forecasting to La Prospective: a new way of looking at futures'	1982	Journal of Forecasting 1: 293-301	Godet argues that one of the key characteristics of La Prospective is that it does not look at the future as an incremental continuation of the past but rather as the outcome of the desirable futures of various actors and the constraints imposed on them by the environment. Its purpose is to assist in creating alternative futures and then select alternatives that allow for maximum freedom of action. La Prospective is neither commonly known nor practiced in Anglo-Saxon contexts but it has been widely applied in France and several other (non-Anglo-Saxon) countries. According to Godet, these exercises have been relatively successful. Godet argues that if this approach were applied to some recent forecasting initiatives, it could have addressed forecasting inaccuracies and errors that were experienced. [II]
	Groves <i>et al.</i>	Presenting Uncertainty About Climate Change to Water Resource Managers	2008	RAND Corporation, TR-505-NSF	This report describes empirical measurements made during a series of workshops with managers, technical staff and elected officials associated with Southern California's Inland Empire Utilities Agency (IEUA) that aimed to compare the impact of alternative scenario methods. The workshops addressed the vulnerabilities that climate change may pose for IEUA's long-term water management plans. The workshops used survey research techniques to compare the impact of three different characterisations of uncertainty on the decision-maker's understanding, policy choices, and confidence in those choices: traditional scenarios; probabilistic forecasts; and scenarios derived from the analytic scenario discovery process (Groves and Lempert, 2007). Participants reported that the traditional scenario approach the easiest to understand and to explain to decision-makers. Compared to the other approaches, however, it provided less of the information needed for planning in general and specifically to evaluate the plans of the IEUA region. The scenario discovery approach was rated as providing the most valuable information for planning, comparing climate-related risks and making choices among plans but was the least easy to understand and explain. Interestingly, participants reported traditional scenarios conveyed information in the most objective way while scenario discovery seemed least objective. [II]

Category	Author	Title	Year	Source	Description
II. Assessments of what types of scenario work in different contexts	Harries	'Correspondence to What? Coherence to What? What is Good Scenario-Based Decision Making?'	2003	Technological Forecasting & Social Change 70: 797-817	<p>This article reviews the literature on evaluations of scenario planning in business and, finding little, suggests frameworks for structuring such evaluations. The paper describes three ways in which scenario-based planning has been evaluated: case studies, empirical studies, and theoretical analysis. There are many examples of case studies but most focus on a single case and report successful results. Harries found one study that attempted an empirical evaluation that compared the performance of organisations that do and do not use scenario-based planning (Phelps <i>et al.</i>, 2001). Among water companies scenario planning produced mixed results; among IT companies scenario planning seems correlated with better profit and return on investment but less so with customer-related measures.</p> <p>Harries reviews literature on nine theoretical benefits from scenarios, which may be supported by some laboratory evidence, but he finds no empirical evidence. The theoretical benefits comprise: reducing overconfidence and improving any probability estimates (if they are needed); allowing managers to downplay their inability to predict and emphasise their ability to prepare for a range of futures; increasing the potential payoff matrix from planning by reducing the risk of failing to predict an important future; encouraging organisational learning; allowing communication via storytelling, which may prove more effective than other modes of communication; making it easier for decision-makers to distinguish important trends from noise; enhancing decision-makers' ability to think innovatively about new (and robust) strategies; enhancing meta-cognition and thus an organisation's model of its own efficacy; increasing an organisation's ability to implement adaptive strategies. [II]</p>
	Hulme and Dessai	'Predicting, Deciding, Learning: Can One Evaluate the "Success" of Scenarios?'	2008	Environmental Research Letters 3 (2008) 045013	<p>One typology distinguishes between scenarios as either products or processes. These framings yield different expectations about how one might evaluate the 'success' or otherwise of scenario exercises. This paper illustrates three different ways in which scenarios might be evaluated using the example of the series of UK climate scenarios published between 1991 and 2002, namely predictive success (has the future turned out as envisaged?); decision success (have decisions subsequently made turned out to be robust?); and learning success (have scenarios engendered participation and learning?). The paper reflects on the relationship between the different expectations of scenario exercises and the different ways scenarios might be evaluated. [II]</p>
	Morgan and Keith	Improving the Way We Think About Projecting Future Energy Use and Emissions of Carbon Dioxide	2008	Available at: www.ucalgary.ca/~keith/preprints/92.Morgan.Improving.Scenarios.p.pdf [Accessed 16 March 2009]	<p>This paper argues that presenting a modest number of energy emissions scenarios without associated probabilities is not a useful way to support climate change policy-making. The paper reviews findings from the literature on human judgment under uncertainty, discusses their relevance to the task of making probabilistic projections and outlines a strategy by which improved projections, tailored to the needs of specific decision-makers, could be developed. [II]</p>
	O'Brien	'Scenario Planning — Lessons for Practice from Teaching and Learning'	2001	Technological Forecasting & Social Change 74: 379-390	<p>O'Brien introduces a particular scenario development methodology advocated in the 1970s and 1980s, which for a number of years has formed a core component of a strategic development course taught at the University of Warwick. This paper draws from the experiences of a large number of participants who taken the course over a 15-year period and have developed scenarios for real organisations in workshops and live settings. O'Brien identifies a number of common pitfalls concerning scenario development and recommends a revised methodology that addresses them. A selection of scenarios developed by participants are used both to illustrate the pitfalls observed and the improvements achieved. [II]</p>
	Parson <i>et al.</i>	Global-Change Scenarios: Their Development and Use. Sub-report 2.1B of Synthesis and Assessment Product 2.1 by the U.S. Climate Change Science Programme and the Subcommittee on Global Change Research	2007	United States of America Department of Energy. Office of Biological & Environmental Research, Washington D.C.	<p>This report examines the development and use of scenarios in global climate change applications. It considers scenarios of various types, including but not limited to emissions scenarios, and reviews how they have been developed, what uses they have served, what consistent challenges they have faced, what controversies they have raised, and how their development and use might be made more effective. By synthesising available literature and critically reviewing past experience, the report seeks to assist those who may be conducting, using, or commissioning scenarios related to global climate change.</p> <p>The report examines several cases studies, including the IPCC SRES scenarios, the USA National Assessment, the UK Climate Impacts Program, and the Millennium Ecosystem Assessment. It finds that scenarios can make valuable contributions to climate-change decision-making but that there exists a significant gap between current practice and potential contributions. Currently climate scenarios are mostly used to support further modelling and analysis but they can also help frame public debates. The report highlights the value of close collaboration between scenario developers and users, particularly at the beginning and closing stages of a scenario exercise. The report suggests the need for a cross-scale organisational structure to provide the full range of information to serve climate scenario users, including centrally produced climate scenario information, associated tools and support, and a capability to supply additional scenario information. [II, III]</p>

Category	Author	Title	Year	Source	Description
II. Assessments of what types of scenario work in different contexts	Postma and Liebl	'How to improve scenario analysis as a strategic management tool?'	2005	Technological Forecasting & Social Change 72: 161–173	The authors argue that the scenario approach as commonly practiced is not able to deal with complex developments and trends that may be surprising or paradoxical because the approach tends to systematically exclude such developments and trends as logical impossibilities or inconsistent. Scenario planning is well equipped to deal with predetermined factors and uncertainties but it leaves unknowable issues out of the discussion. The authors suggest several approaches to address this shortcoming: building scenarios from trends rather than key driving forces to reduce the combinations excluded because of potential inconsistencies; explicitly focusing on wild cards and asking 'what must happen to make this unlikely future come to pass'; and extending the scenario building process to introduce seemingly paradoxical elements to force a sensitivity analysis on the assumptions underlying claims of inconsistency. The authors also suggest that computer-assisted scenario development may be beneficial. [II]
	Scheraga	The Use of Scenarios in the Provision of Timely and Useful Information to Decision Makers Coping with the Impacts of Climate Change	2007	Paper presented at the Brown University–Watson Institute Global Environmental Futures Workshop, 24 March 2007	The challenge for the climate science community is to provide timely and useful information about climate change to decision-makers and resource managers so they can make more informed decisions about how to adapt to a changing climate. Many different types of scenarios can be used to conduct policy-relevant analyses that support decision-makers and different types are appropriate for informing different policy decisions. Decision-makers must therefore be engaged at the outset of any analytic process, and their information needs (including the timeframe for supplying information) must be elicited from them. This stakeholder engagement also increases the transparency of the analytical process and the likelihood that the results will be used. User-friendly decision support tools are being developed that enable resource managers and other decision-makers to define for themselves the scenarios they wish to consider, conduct policy-relevant analyses and 'own' the results. Examples already exist of adaptation strategies implemented using timely and useful information derived from scenario-based analyses. [II, III]
	Schoemaker	'Multiple Scenario Development: Its Conceptual and Behavioural Foundation'	1999	Strategic Management Journal 14: 193–213	This paper reviews the conceptual and behavioural foundations of scenarios and reports the results of four psychology experiments that test the impact of scenarios on subject's beliefs. The paper defines scenarios as focused descriptions of fundamentally different futures presented in coherent script-like or narrative fashion. Scenarios are Hegelian in their underlying philosophical premise, courting contradiction and paradox, while traditional approaches to decision analysis and forecasting tend to be Leibnizian, seeking a single truth and representation of reality. Scenarios seem to operate using psychological effects called framing, availability and anchoring. Framing refers to the set of concepts and phrases used to interpret events. If people frame events too narrowly, they can miss important warning signs of impending changes. Scenarios may help expand people's frames. Scenarios may also help overcome the availability bias, where people undervalue that which is hard to imagine or recall from memory. Scenarios may also shift the anchor or baseline from which people view the future. Presenting scenarios as possibilities, rather than as firm predictions, may enhance their psychological impact because they become less threatening to those holding different worldviews. Scenarios' impact may also rely on the conjunction fallacy, in which increasing detail makes people perceive a scenario as more credible, while formally such detail makes it necessarily less likely. The paper suggests that scenarios may use one psychological bias, the conjunctive fallacy, to counter other biases such as availability, anchoring, and overly narrow frames. The paper reports on laboratory experiments that tested the effect of scenarios on subject's beliefs. The first experiment found that using scenarios increased subjects' range of estimates for the possible values key uncertainties (that is, reduced overconfidence). [II]
	United States Commission on National Security/21st Century	New World Coming: American Security in the 21st Century. Study Addendum	1999	Available at: http://www.fas.org/man/docs/nwc/addendum.pdf . [Accessed 16 March 2009]	This addendum to the report of the Commission headed by former United States Senators Gary Hart and Warren Rudman national security examines 20 scenario studies. Five followed the Shell methodology very closely and six used variants of the Shell methodology. However, the analysis found that all the scenario studies examined tended to focus on extrapolations of current concerns and rarely focused on the possibilities that produce startling emergent behaviour. (Note: the main report of the Hart-Rudman commission warned of the threat of large terrorist attacks on the United States several years before 9/11). [II, IV]
	van Notten <i>et al.</i>	'The Future Shocks: On Discontinuity and Scenario Development'	2005	Futures 35: 423–443	This study compares the way 22 scenarios studies handled surprises and discontinuities. The study notes that 11 of the studies examined did not address discontinuities. Using the van Notten <i>et al.</i> scenario typology, the authors note that seven of those that did include discontinuities were exploratory scenarios aimed at awareness raising; the other four were agenda-setting scenarios aimed at helping their audience identify areas where the future can be influenced. All but one of the studies with discontinuities were conducted in an intuitive manner rather than with a formal approach. Intuitive approaches rely strongly on interactive group sessions and qualitative knowledge while the latter usually involve a pre-determined process that draws on expert-based and/or quantified knowledge. No model-based studies in the sample included discontinuities. Seven of the eleven studies with discontinuities produced complex scenarios that elaborately demonstrate the action-reaction mechanisms among a broad range of factors, while the other four examples produced simple scenarios. [II]

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II. Assessments of what types of scenario work in different contexts	van 't Klooster and van Asselt	Practicing the Scenario-Axis Technique	2006	Futures 38: 15–30	<p>This paper describes how the scenario-axis technique was actually used in a qualitative scenario project conducted by the Netherlands Institute for Spatial Research (RPB). Employing an ethnographic or participant observation research approach, the authors attended over 20 RPB project and stakeholder meetings and examined project documentation. The paper argues that contrary to what scenario theorists and practitioners often suggest, different and sometimes conflicting and incommensurate perspectives, applications, and rhetoric associated with the scenario axes can co-exist throughout even a successful scenario project.</p> <p>The authors identified three different interpretations of the scenario axes during the course of the project: axes as backbone, building scaffold and foundation. Initially, the project team viewed the axes as the backbone of the scenarios. That is, two driving forces could be identified as the normatively most important to consider and could then be used to define the scenarios. However, even though the team used multiple Delphi rounds with stakeholders to identify these key axes, the stakeholders largely rejected the choice of only two axes. Thus the team portrayed the two axes as a building scaffold, that is, useful social constructs for the purpose of organising the stakeholder workshops which fleshed out the scenarios but which would, like a scaffold, be taken away once the scenarios were constructed. However, some team members were uncomfortable removing the axes entirely, so argued that the axes represented a foundation for the scenario. That is, rather than arguing that the two axes could be identified by objective arguments and data, these team members argued that once the axes were used as a structuring device they ought to be retained to keep the process transparent and because some people would expect to see them.</p> <p>The paper notes that much of the scenario theory literature emphasises the need for consensus on the scenario axes to foster a common basis within an organisation for future action, but argues that in the diffuse and heterogeneous contexts faced by agencies like RPB such consensus may not be possible. Nonetheless, the futurists examined in this paper were able to proceed without such consensus by allowing the publication of multiple documents from the scenario project, which treated the scenario axes in different ways. [II]</p>
	Wack	'Scenarios: uncharted waters ahead'	1985	Harvard Business Review Sep–Oct 1985: 73–89	Wack reports that early versions of scenario planning at Shell Oil, designed to cover a range of possible futures, incited much interest but did not affect managers' decisions. Wack argues that effective scenarios must encourage people to challenge their mental maps of the world and challenge their organisation's mental map. [II]
	Wiek <i>et al.</i>	'Functions of scenarios in transition processes'	2006	Futures 38: 740–766	This study describes the functions scenarios can play in supporting a process of transition management. These functions include representing system knowledge and target knowledge; facilitating backwards planning; integrating qualitative and quantitative data from different fields; and learning by planning. Scenarios do not represent transformation knowledge or contribute to learning by doing. [II]
	Wilkinson and Eidinow	'Evolving practices in environmental scenarios: a new scenario typology'	2008	Environ. Res. Lett. 3 (October–December 2008) 045017	In recent years, the assessment of global environmental change has involved the mapping of alternative futures as a means to explore the scientific uncertainties associated with model-based projections, cross-trends and impact analysis. This contrasts with the production and consumption of scenarios as purposeful interventions for organisational strategy, renewal and planning. The former tends to focus on bridging and reducing informational deficits and building scientific consensus about what is certain and what is not. The latter normally focus on improving judgment and enhancing agency by instrumentally invoking the future to expand the options/response repertoire. Further comparison of the (often implicit) philosophies and practices involved in building and using scenarios in global environmental assessments as compared to those used in scenario planning in organisational settings (such as corporate strategy and planning) reveals deeper epistemological differences, differences in assumptions about how groups and organisations learn, and different conceptions of the links between knowing and action. While many studies tend to focus on methodological differences and similarities, a deeper reflection on the differences in scenario practices is needed to help reveal the theory of what works, when and how — as well as what does not work and why not. [II]
	Wright <i>et al.</i>	'Scenario Planning Interventions in Organizations: An Analysis of the Causes of Success and Failure'	2008	Futures 40: 218–236	Wright <i>et al.</i> present an analysis of a successful scenario intervention and compare it with an unsuccessful one. They demonstrate that analysis of the answers given by workshop participants in a pre-intervention interview can be helpful in determining the receptiveness of an organisation to a subsequent scenario intervention. They theorise that strategic inertia, characterized by coping patterns of bolstering a failing strategy, procrastination (over a strategic dilemma) and passing the buck (the responsibility for the dilemma's resolution), can be caused by the psychological attenuation of the perceived level of environmental threat to the organisation, culminating in unchallenged adherence to the current strategy. The authors question the notion that the expression of such coping behaviour is antithetical to a subsequent successful scenario exercise because if the exercise fails to identify an unchallenged strategic alternative, the sharp focus of the scenarios on futures unfavourable to business-as-usual strategy will reactivate the cognitive stress-reduction mechanisms. Strategic inertia will thus be reinforced. The paper concludes with a review of the implications of the diagnosis for reflective practitioners. [II]

III. Assessments of methods and institutional arrangements that enable organisations to use scenarios more effectively

Category	Author	Title	Year	Source	Description
	Zurek	The Scenarios of the Millennium Ecosystem Assessment: Process, Contents and Uptake	2007	Paper presented at the Brown University-Watson Institute Global Environmental Futures Workshop, 23 March 2007	The Millennium Ecosystem Assessment was a four-year international assessment to evaluate the consequences of ecosystem change for human well-being and establish the scientific basis for actions needed to enhance the conservation and sustainable use of ecosystems. As part of the assessment a scenarios/plausible futures exercise was carried out to assess the consequences of various emerging trends and possible future development pathways for ecosystem services (the benefits people derive from ecosystems) and human well-being. The study discusses lessons learned from the experience especially related to linking scenario efforts across geographical scales, improving the policy relevance of scenarios exercises and tailoring scenarios exercises to various decision-making contexts. [II]
	Colvin <i>et al.</i>	'Strategic Decision Making in an Intuitive vs. Technocratic Mode: Structural and Environmental Considerations'	2001	Journal of Business Research 52: 51-76	Colvin <i>et al.</i> describe how the relationship between decision-making style and firm performance is impacted by environmental technological sophistication and organisation structure. The researchers collected data from 96 manufacturing firms operating in 68 different industries. The data suggest that different combinations of style and structure predict firm financial performance in high-tech and low-tech environments. For example, in high-tech environments, sales growth rates were found to be higher when the technocracy dimension of decision-making style and the dimension of organisation structure (labelled 'organicity') are negatively related. In low-tech environments, on the other hand, sales growth rates were found to be higher when these dimensions were positively related. Different results were observed when firm financial performance was operationalised in terms of return on sales (ROS). [III]
	De Wilde	'Voorspellers, een kritiek op de toekomstindustrie' [Predictors, a critique of the futures industry].	2000	Uitgeverij debalje: Amsterdam	De Wilde observes a trend of corporations and governments increasingly outsourcing planning for and thinking about the future to a separate industrial sector: a growing body of professional futurists. The demand for forecasting, trends analysis and scenario studies has increased dramatically. De Wilde argues that the futures specialists lack historical awareness causing them to repetitively make the same errors. Furthermore, he argues that they often overestimate the ability of emerging technologies to address existing societal problems. A final inadequacy of these exercises is that there is often little in the way of citizen involvement. [III]
	Fuerth	'Strategic Myopia, the Case for Forward Engagement'	2006	The National Interest, Spring 2006: 57-62	The author, national security advisor to former United States Vice-President Al Gore, argues for institutional changes in the United States federal government to improve its capabilities for forward engagement, that is, recognising and responding to major societal challenges sooner rather than later. He advocates developing a networked, small, flexible, task-oriented, managerial 'supra-structure' organised by mission rather than jurisdiction. Networked teams could be overlaid on the existing bureaucracy and would significantly enhance the ability of the government to analyze alternative paths into the future and rapidly move towards desired paths. [III, IV]
	Hodgkinson and Wright	'Confronting Strategic Inertia in a Top Management Team: Learning from Failure'	2002	Organisation Studies 23: 949-977	The authors described their failed attempt to use scenarios to help the senior management of a business change their mental models and address the challenges facing their firm. Drawing on extensive notes and data generated during the exercise, the authors conclude that the challenges facing the firm were sufficiently daunting and their options sufficiently bleak that the management team adopted a series of defensive avoidance strategies to avoid engaging with the message of the scenarios. [III]
	Light	The Four Pillars of High Performance: How Robust Organisations Achieve Extraordinary Results	2005	McGraw-Hill, New York	Paul Light of the Brookings Institute and the Robert E. Wagner School of Public Service at New York University summarises decades of work at the RAND Corporation on what factors create high performance organisations. Light describes high performance organisations as robust organisations, that is an organisation that protects itself against external turbulence, whether by hedging against vulnerabilities or exploiting opportunities as they arise. The four pillars of organisational robustness are alertness (monitoring the external world for early warning signs that key assumptions are likely to fail and perhaps more importantly a commitment to rigorous monitoring of the organisation's own performance); agility (the ability to react to early warning signs of problems or opportunities); adaptability (the ability to adjust strategies and tactics rapidly to meet changes in the environment); and alignment (the ability to align the whole organisation to its mission). How do successful organisations create these four pillars? Light suggests that robust organisations envision multiple futures; organize for flexibility; create the freedom within the organisation to challenge the prevailing wisdom; and focus tightly on their mission by nurturing leaders from within, leading in future tense, communicating through images and stories, anticipating their adversaries through careful study and assessment and ignoring irrelevant issues that impede command. [III]
	Neumann and Øverland	'Planning: The Method of Perspectivist Scenario Building'	2004	International Relations and Policy 5: 258-277	Neumann and Øverland recognise that thinking about the future is an integrated aspect of international relations and associated policy planning. Therefore, they suggest developing a methodology for scenario building as a way to systematize thoughts. They argue that extant work on scenario planning shares a key weakness that is well known in traditional socio-economic planning, namely a tendency to reify current trends. In order to break with this tendency, they set out an approach labelled 'perspectivist scenario building'. They try to illustrate the points made by reflecting on their experience of participation-oriented scenario work with Norwegian bureaucrats and politicians in the framework of a broad scoped national scenario project for the Norwegian Government in the period between 1998 and 2001, called Norway 2030. [III]

Category	Author	Title	Year	Source	Description
	Oglivly and Smith	'Mapping Public and Private Scenario Planning: Lessons from regional projects'	2004	Development 47: 62-72	This article examines similarities and differences between public and private sector scenario exercises. It describes five Global Business Network (GBN) run scenario exercises involving regional development in five areas in USA: Flint, Michigan; Oklahoma; downtown Chicago; South Florida; and the California Central Valley. Some exercises succeeded while others failed. The authors conclude that the actual day-to-day work of creating scenarios is similar in the public and private sectors. But public-sector scenario exercises can face more difficult challenges than private sector ones in establishing the client, framing the purpose of the engagement and gaining the participation of all the relevant parties. The exercises that failed less well generally suffered from the absence of a clear client with decision-making authority and/or the inability to engage the full range of necessary constituencies. [III]
	O'Neill and Nakicenovic	'Learning from Global Emission Scenarios'	2008	Environmental Research Letters 3 (2008) 045014	<p>Much more effort has been expended on producing climate change scenarios than on documenting their assumptions and outcomes and on extracting and communicating lessons from them. In some cases, this has led to confusion about even quite basic questions that scenarios have addressed, such as whether stabilising atmospheric concentrations is possible with existing technologies. Improving the capacity to assess scenarios more thoroughly and better communicate their results is critical at this point given the growth in the scope, complexity and variety of purposes that scenarios serve within the climate change area.</p> <p>This improvement can be facilitated through: improved archiving of scenario assumptions and results, with consistent documentation of narrative storyline assumptions, quantitative drivers, model structure and assumptions, and results, at sufficient levels of temporal and spatial disaggregation; a larger number of organised model comparison exercises focused on specific research or policy questions, with substantially more effort put into identifying robust insights; improved understanding of how scenarios are actually used in various communities, including the IPCC and other assessments, so that scenario analyses can be well targeted; a continued process of reviewing widely used scenarios and their production process, so that scenario development can learn from and adapt to past experience and changing user needs. [III]</p>
	Phelps <i>et al.</i>	'Does scenario planning affect performance? Two exploratory studies'	2001	Journal of Business Research 51: 223-232	The authors report on surveys of firms in two industries designed to measure the effect of scenario planning on company performance. The surveys focus on the UK water industry and the UK IT consultancy industry. Twenty-two of the UK's 28 water companies responded to the authors' surveys. Of those 22, only 5 used no scenario planning. The results are only weakly statistically significant but suggest that larger firms are more likely to use scenarios and that scenario use is correlated with increasing return on capital. However, scenario use is also correlated with decreasing levels of customer service. The authors suggest this may be because customer service and return on capital are contradictory goals and scenario use allows firms to focus more successfully on the later. The authors report that of the approximately 2000 IT consultancy firms in the UK, only 104 use scenario planning. The authors conducted detailed surveys with 50 firms that used scenarios and 50 firms that did not. Firms using scenario planning had statistically better performance measured by both profit and return on capital. In addition, scenario-using firms report higher levels of internal efficiency than those not using scenarios, a finding the authors regard as surprising because scenarios focus on external factors. Finally, scenario-using firms report higher levels of satisfaction with their strategic planning processes than firms not using scenarios. [III]
	Garb <i>et al.</i>	'Scenarios as Social Processes'	2008	Environmental Research Letters 3 (2008) 045015	Scenarios are social products and social processes. For example, they reflect and 'fix' certain framings and assumptions (such as which aspects of the future are fixed and which changeable), often implicitly. Despite their growing ubiquity and consequence for science and policy, too little attention has been given to the social analysis of scenarios. This essay reviews several analytic tools from sociology, political science and science and technology studies that can illuminate the generation, reworking, uptake or rejection, and consequences of scenarios. These tools suggest ways to sharpen the critical awareness of those who produce and consume scenarios, and, perhaps, thereby to enhance their robustness and credibility. [III]
	Sardar	Rescuing all our futures: The future of futures studies	1999	Praeger. Westport, Connecticut	The nineteen contributors to this book represent a variety of disciplines. The chapters address the issues of decolonizing the future from the authors' diverse perspectives, including feminist, non-Western, spiritual, ecological, republican science, progressive globalism, aesthetic and prophetic viewpoints. The book encompasses a compendium of critical enquiries into the state of future studies and the essays cast doubt on the dominant Western paradigm of reducing the future to a linear science-based trajectory. [III]
	Slaughter	'The knowledge base of future studies as an evolving process'	1996	Futures 28: 799-812	While the field of future studies is known for its breadth, geographical scope and range of disciplinary paradigms, Slaughter observes a lack of a common knowledge base. Accordingly, the development of such a common knowledge base becomes a priority for research, in order to correspond to the obvious need for greater clarity about what might constitute the core concerns and features of future studies. The article considers a rationale for the development of a knowledge base, the evolution of the present model and some ways in which the model will be further altered through critique, innovation, synthesis and the emergence of new voices. It is suggested that far from being a monolithic entity driven by Western interests, the knowledge base is a dynamic process that will evolve over time. In so doing it will become less Western and more truly global. [III]

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Category	Author	Title	Year	Source	Description
	Selin	'Trust and Illusive Force of Scenarios'	2006	Futures 38: 1-14	This paper examines five elements that influence whether and if users gain trust in a set of scenarios. Since scenarios intend to represent possible futures, trust in scenarios cannot be based on appeals to truthfulness. Trust is also important because any set of scenarios represents a small sample from innumerable possibilities and thus the selection of the scenarios always serves some particular end(s). The paper suggests that scenarios can gain trust based on: trust in sources, that is, in the people who develop the scenarios; trust in content, that is, the reliability of the information known to be used in constructing the scenarios; methodological credibility, that is, confidence in the method used to generate the scenarios; trust in narrative, that is the extent to which the scenarios build on existing metaphors and beliefs; and trust in dissemination, that is the stature of the people who present the scenarios. [III]
	van Notten	Writing on the Wall: Scenario Development in Times of Discontinuity	2005	Dissertation.com, Boca Raton, Florida	In theory, scenario development is a way to consider future discontinuity. However, the research described in this thesis shows that, in practice, scenarios do not consider the idea of discontinuity as a matter of course. The research builds on this finding by investigating factors that influence how discontinuity is addressed in contemporary scenario studies. The thesis concludes that scenario studies would benefit from efforts to create a foster a 'culture of curiosity' for exploring possible discontinuity rather than relying primarily on the use of scenario 'tools' and 'toolboxes'. [III]
IV. Reviews of impacts of long-term policy analysis on the decision-making process	Clark <i>et al.</i>	'Evaluating the Influence of Global Environmental Assessments'	2006	Mitchell, R.B.; Clark, W.C.; Cash, D.W. and Dickson, N.W. (eds), Global Environmental Assessments: Information and Influence; MIT Press; Cambridge, USA	<p>This book chapter introduces a volume that presents results from the Global Environmental Assessments (GEA) Project (http://www.hks.harvard.edu/gea/) — a multiyear, interdisciplinary, international research programme that compared a range of environmental assessments, from climate change to water management and biodiversity, in an effort to better understand how global environmental assessments operate, when and how they influence policy-making and decision-making, and how they can be made more effective. The authors note that scholars in the field of international relations have been particularly sceptical that scientific information has any significant influence over governments' choice of international policy. But scientific information can prompt intergovernmental negotiations to resolve transnational environmental problems, and the discussion of relevant science in such negotiations can promote shared understandings, trust and political consensus that leads, relatively directly, to policy and behaviour changes.</p> <p>The authors argue that GEAs are better conceptualised as social processes rather than published products. That is, the process by which scientists, policy-makers and other stakeholders come together to debate and to generate information is more important than the resulting report that records the information. The chapter also finds that in order to be influential GEAs must be relevant to potential users, legitimate (i.e. produced by a process that all stakeholders believe is fair and includes their concerns and insights) and credible (i.e. scientifically sound). The chapter concludes with lessons for practitioners, recommending that GEAs focus on the process, not the report; focus on salience, legitimacy and credibility; make their assessments with multiple audiences in mind; involve stakeholders and connect with existing networks; and develop influence over time. [IV, II]</p>
	da Costa <i>et al.</i> (2006)	The impact of foresight on policy-making: Insights from the FORLEARN Mutual Learning Process	2006	Institute for Prospective Technological Studies, Joint Research Centre/ European Commission	<p>This report by the Institute for Prospective Technological Studies at the Joint Research Centre of the European Commission presents recent insights from a study that develops foresight theory and practise by helping share experience ('mutual learning') in Europe. The document elaborates upon the results of a series of workshops where practitioners and policy-makers have been reviewing the impact of foresight on policy-making.</p> <p>The authors identify six functions of foresight for policy-making: informing policy (generating insights regarding the dynamics of change, future challenges and options, along with new ideas, and transmitting them to policy-makers as an input to policy conceptualisation and design); facilitating policy implementation (enhancing the capacity for change within a given policy field by building a common awareness of the current situation and future challenges, as well as new networks and visions amongst stakeholders); embedding participation in policy-making (facilitating the participation of civil society in the policy-making process, thereby improving its transparency and legitimacy); supporting policy definition (jointly translating outcomes from the collective process into specific options for policy definition and implementation); reconfiguring the policy system in a way that makes it more apt to address long-term challenges; a symbolic function (indicating to the public that policy is based on rational information).</p> <p>The relationship between these functions and the tensions that can arise when a foresight exercise attempts to address more than one function are discussed. Towards the end of the report, the authors outline several guidelines for improving foresight practice and enhancing its impact on policy-making. [IV]</p>

Category	Author	Title	Year	Source	Description
IV. Reviews of impacts of long-term policy analysis on the decision-making process	Lempert	'Can Scenarios Help Policymakers Be Both Bold and Careful?'	2007	In Fukuyama, F. (ed.), <i>Blindside: How to Anticipate Forcing Events and Wild Cards in Global Politics</i> . Brookings Institution Press, Washington DC, 109-119	This essay notes that traditional scenario approaches can have significant impacts when used with small groups of decision-makers known well to the scenario planners. But these same methods can prove harder to apply when conducted to inform broad public debates. The essay argues that scenarios derived from analytic scenario discovery approaches (Groves and Lempert, 2007) may help turn the scenario art into more of a systematic method that can enable even committees and bureaucracies systematically to justify the choice of a small number of scenarios. The essay suggests that turning scenario practice into a reproducible, operational procedure similar to budgeting and accounting would make it easier for the public and watchdog agencies to demand the consideration of a wide range of scenarios, including wild card ones, as part of regular bureaucratic due diligence, and thus help improve the ability of the USA government to anticipate and avoid the unintended consequences of its policies. [IV]
	Lempert, Popper, Bankes	Shaping the Next One Hundred Years: New Methods for Quantitative, Longer-Term Policy Analysis	2003	RAND Corporation, MR-1626-RPC	This book describes robust decision-making (RDM), an approach for supporting decisions under conditions of deep uncertainty. Deep uncertainty arises when the parties to a decision do not know or do not agree on the system model that relates actions to consequences, the probability of different future states of the world, or how to value the desirability of alternative outcomes. In contrast to traditional decision analytic approaches, RDM characterizes uncertainty with multiple representations of the future and uses robustness rather than an optimality criteria to assess alternative strategies. A robust strategy is one that performs reasonably well compared to the alternatives over a wide range of plausible futures. A strategy often achieves robustness by evolving over time in response to new information. RDM aims to exploit the increased capabilities of modern information technology by combining some of the best features of traditional scenario-based planning with a quantitative decision analytic framework. RDM can be implemented by running one or more simulation models thousands to millions of times over many different combinations of values for the uncertain input parameters to create databases representing a large ensemble of plausible futures. Employing statistical analysis and interactive visualizations of 'scenario landscapes', users can then use the futures ensemble to identify, evaluate, and choose robust strategies. Similarly to traditional scenario planning, RDM presents alternative futures as possibilities, rather than predictions, so that any specific future becomes less psychologically threatening to those inclined towards a different worldview. This, combined with the robustness criterion, helps RDM build consensus among contentious groups because it allows people to agree on desirable actions without agreeing on expectations about the future. This book demonstrates RDM in the context of the long-term policy challenge of identifying near-term actions that can foster sustainable development over the 21st century. [IV]
	Skumanich and Silbernagel	Foresighting Around the World: A Review of Seven Best-In-Kind Programs	1997	Batelle Seattle Research Centre, Seattle, WA, USA	This report provides a review of seven best-in-kind foresighting programmes conducted by organisations worldwide. The report finds that each programme emphasises imaging a range of possible futures because the future is unpredictable and most programmes find that the process of conducting the foresighting activity is as important as the outcome. The seven best programmes employ a variety of foresighting methods and the method used does not clearly align with the goals of the programme. Rather the method selected often derives from a desire to leverage the experience of others, to evolve from existing practices, a pre-commitment to a specific method and the culture in which the foresight is occurring. Finally, foresighting activities impact organisations and societies in a variety of ways that are very difficult to measure. Thus, foresighting organisations tend to rely on high-level buy-in and public legitimisation as signs of their effectiveness. [IV]
	White	Will Policy Makers Use Long Range Forecasts?	2002	Woodrow Wilson International Center for Scholars Foresight and Governance Project	This paper argues that long-range forecasts have sufficient accuracy to inform policy-making, but that policy-makers fail to act sufficiently on such forecasts. The author argues that policy-makers are aware of long-range forecasts, claiming for instance that most bills before the United States Congress contain reference to the long-range trends that the legislation is seeking to affect. Action is difficult, however, because the policy responses required by long-range forecasts are often complex and costly, difficult to explain to the public and thus difficult to justify in a political context that maximises current impact and rarely seeks to endure political pain in the present in order to prevent future problems. The author recommends several steps that the United States Government could take to increase pressure to act on long-range forecasts, including endowing a centre to become a source of high quality, timely forecasts for Congress; changing executive branch and congressional rules and procedures to increase the pressures to consider long-range forecasts; engaging the public and media with forecasts more effectively; and establishing credible watchdogs to monitor and report how government responds to long-range forecasts. [IV, III]

Category	Author	Title	Year	Source	Description
V. Analyses that evaluate the robustness of strategies over multiple scenarios	Dewar	Assumption-Based Planning: A Tool for Reducing Avoidable Surprises	2002	Cambridge University Press. Cambridge and New York	Organisations often face unwelcome surprises because of the unanticipated failure of some key assumption made by the organisation's leadership or, in many cases, the failure of an assumption that the leadership never realised it had made. Assumption-based planning (ABP) is a tool for identifying as many assumptions underlying the plans of an organisation as possible and bringing them explicitly into the planning process. ABP begins with an organisation's plan and uses a variety of techniques to identify its vulnerable, load-bearing assumptions. Once such key assumptions are identified, ABP suggests steps that the organisation can take to modify its plan to make it more robust. These steps include observing signposts; early warning signs that an assumption is failing; shaping actions that reduce the likelihood as assumption will fail; and pursuing hedging actions that limit the consequences if an assumption fails. [V]
	Groves and Lempert	'A New Analytic Method for Finding Policy-Relevant Scenarios'	2007	Global Environmental Change 17: 73–85	This paper presents a new approach to computer-assisted scenario development called Scenario Discovery. The paper argues that current scenario practice has had difficulty summarising all the relevant uncertainty with a small number of scenarios that prove meaningful and acceptable to diverse policy audiences and leaves unresolved the best means to incorporate probabilistic information with scenarios. The paper argues that scenario discovery can address these issues. Building on Assumption-based Planning (Dewar, 2002) and on robust decision-making methods (Lempert <i>et al.</i> , 2003), scenario discovery involves running one or more simulation models many times over different combinations of the uncertain model input parameters in order to create a large database of results. Statistical cluster-finding algorithms then help users identify concise descriptions of the combinations of input parameters to the model that are strongly predictive of those results most important to the policy choices facing the organisation. The resulting clusters can be used as scenarios by the organisation to help identify robust strategies. The key uncertain inputs defining these clusters represent the scenarios' key driving forces. This analysis can also relate probabilistic information to the scenarios, not by predicting the likelihood of the scenarios but by identifying the threshold likelihood that decision-makers must ascribe to these scenarios before they consider a change in their strategy. The paper demonstrates this approach in the context of work for the California Department of Water Resources. [V]
	Rosenhead	'Robustness Analysis: Keeping Your Options Open'	1989	Rosenhead, J. (ed.), Rational Analysis for a Problematic World: Problem Structuring Methods for Complexity, Uncertainty, and Conflict. Wiley, Chichester, United Kingdom	Rosenhead offers a semi-quantitative approach for evaluating robustness over many plausible futures, based on a definition of robustness as keeping options open. The approach views planning under deep uncertainty as a series of sequential decisions. Each decision represents a commitment of resources that transform some aspect of the decision-maker's environment. A plan foreshadows a series of decisions anticipated over time. The decision-maker has one or more criteria that determine the desirability of futures. Rosenhead's robustness analysis assesses initial resource commitments according to the total number of desirable future end states that are reachable once the initial decision is taken. [V]
	Mercer	'Robust strategies in a day'	1997	Management Decision, 35: 219–223	This paper describes a simpler scenario format that allows a facilitator to take a group through a full scenario planning process — from creating the scenarios to developing strategies robust across those scenarios — in a single day. [V]
	van Asselt	'Perspectives on Uncertainty and Risk: The Prima Approach to Decision Support'	2000	Springer, Berlin	This study advocates an interdisciplinary approach to decision support centred on both social and natural sciences, both theory and practice. It addresses the issue of analysis and management of uncertainty and risk in decision support corresponding to the aims of integrated assessment and emphasises the need for a pluralistic method to account for legitimate plural interpretations of uncertainty and multiple risk perceptions. The study presents an approach where the performance of three different management approaches is compared over three different worldviews. This approach explores the robustness of the three management approaches. [V]
	van der Heijden	Scenarios: The Art of Strategic Conversation	1996	John Wiley and Sons, Chichester, United Kingdom	This book describes how scenarios can be used to support a robustness analysis. Scenario planning aims for the invention of strategy and the testing of related organisational characteristics against multiple representations of future business environments. After creating a set of scenarios to describe potential future conditions, managers can use a scenario/option matrix to examine the comparative performance of the alternative options across those futures. Van der Heijden also describes five objectives of scenario planning: development of robust strategies, better understanding of the future, better perception of patterns and change, transmission of management ideas by using these scenarios throughout the organisation, and leadership. [V]

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European Environment Agency

**Looking back on looking forward:
a review of evaluative scenario literature**

2009 — 28 pp. — 21 x 29.7 cm

ISBN 978-92-9167-992-8

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ISBN 978-92-9167-992-8

