1   *1. Scenarios, their Characteristics and Uses*
2
3   *1.1   Defining Scenarios*

4   A scenario is a description of potential future conditions, which is developed to inform
5   decision-making under uncertainty. The decisions in question can be by individuals, groups,
6   organizations, or governments, and may pertain to any subject matter. The potential future
7   conditions described in a scenario can also pertain to any subject matter, whatever is judged
8   necessary or useful to probe and inform the decisions at issue. While many writers on scenarios
9   give no explicit definition, others have offered a wide range of definitions, many of them
10 substantially more complex and restrictive than the simple one we offer here. The collection of
11 published definitions gathered in Box 1.1 gives a sense of both the broad commonalities among
12 many analysts' conceptions of scenarios, and the significant differences among them.
13

14 **Box 1.1. Scenarios: a Sampling of Published Definitions.**

15 A scenario is a coherent, internally consistent, and plausible description of a possible
16 future state of the world.[5]

17 A scenario is a story that describes a possible future. It identifies some significant events,
18 the main actor and their motivations, and it conveys how the world functions. Building
19 and using scenarios can help people explore what the future might look like and the likely
20 challenges of living in it.[6]

21 Scenarios are images of the future, or alternative futures. They are neither predictions nor
22 forecasts. Rather, each scenario is one alternative image of how the future might unfold.
23 A set of scenarios assists in the understanding of possible future developments of
24 complex systems. Some systems, those that are well understood and for which complete
25 information is available, can be modeled with some certainty, as is frequently the case in
26 the physical sciences, and their future states predicted. However, many physical and
27 social systems are poorly understood, and information on the relevant variables is so
28 incomplete that they can be appreciated only through intuition and are best
29 communicated by images and stories. Prediction is not possible in such cases.[7]

30 A climate scenario is a plausible representation of future climate that has been
31 constructed for explicit use in investigating the potential impacts of anthropogenic
32 climate change. Climate scenarios often make use of climate projections (descriptions of
33 the modeled response of the climate system to scenarios of greenhouse gas and aerosol
34 concentrations), by manipulating model outputs and combining them with observed
35 climate data.[8]

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[5]   IPCC TAR WG2, p. 149.
[6]   Shell International 2003.
[7]   IPCC SRES, pg. 62.
[8]   IPCC TAR WG1, p. 741.

1   (Scenarios) are created as internally consistent and challenging descriptions of possible
2   futures. They are intended to be representative of the ranges of possible future
3   developments and outcomes in the external world. What happens in them is essentially
4   outside our own control.[9]

5   Scenarios are coherent, internally consistent and plausible descriptions of possible future
6   states of the world, used to inform future trends, potential decisions, or consequences.
7   They can be considered as a convenient way of visioning a range of possible futures,
8   constructing worlds outside the normal timespans and processes covering the public
9   policy environment.[10]

10   Scenarios are plausible, challenging, and relevant sets of stories about how the future
11   might unfold. They are generally developed to help decision-makers understand the wide
12   range of potential futures, confront critical uncertainties, and understand how decisions
13   made now may play out in the future. They are intended to widen perspectives and
14   illuminate key issues that might otherwise be missed or dismissed. The goal of
15   developing scenarios is often to support more informed and rational decision-making that
16   takes both the known and the unknown into account.[11]

17   The historical roots of the use of scenarios for planning and analysis lie in war games,
18 exercises of simulated conflict used for military training, planning, and operational decision-
19 making. Although the first formalized war games were developed for officer training in 19th-
20 century Prussia – and their benefits sometimes credited for the Prussian victory in the Franco-
21 Prussian war of 1870-1871 – the roots of war games and related activities extend to antiquity.[12]
22 In the 1940s and 1950s, exercises resembling war games began to be applied outside the purely
23 military domain, to study potential international crises that included both high-level political
24 decision-making and the potential for military conflict. These exercises were informed by the
25 then-new field of game theory, which promised new formal insights into situations of conflict
26 and strategic decision-making,[13] and motivated by the recognition that the new nuclear age had
27 both raised the stakes of international diplomacy and created profound new uncertainties over
28 how to proceed. In these exercises, principally developed at the Rand Corporation, scenarios
29 provided sketches of challenging but plausible situations to which participants had to respond,
30 allowing exploration of associated threats and opportunities. They adopted the term "scenario"
31 from film and theatre, where it denotes a brief sketch of a story that includes only enough detail
32 to convey broad points of plot and character. As in classic war-games, scenarios in these
33 exercises served to help organizations and their leaders prepare for novel, complex challenges
34 that their normal procedures and planning devices might not anticipate, and which – if they did
35 arise – would likely develop too fast to allow adequate reflection or analysis in real time.[14]

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[9]   van der Heijden 1996, p. 5.
[10] Berkhout et al 2001, pg. i.
[11] MEA 2006. p. xvii.
[12] Brewer and Shubik 1983.
[13] Von Neumann and Morgenstern 1942; Nash 1950
[14] Brewer and Shubik 1983.

1   Over the past few decades, the use of scenarios has broadened further still, moving
2   outside the realm of military and diplomatic activity. Practice extended from Rand to other
3   organizations, particularly developed in strategic planning at Royal Dutch/Shell.[15] Scenarios are
4   now widely used for strategic planning, analysis, and assessment by businesses and other
5   organizations. They have also figured increasingly prominently in planning, analysis, and policy
6   debate for long-term environmental issues, in particular global climate change. Because the total
7   body of experience with scenarios provides useful insights into their use in any particular
8   domain, this section elaborates on the meaning, characteristics, and potential uses of scenarios in
9   general. The next section turns to their specific use for global environmental issues.

10   *Distinguishing Scenarios from Assessments, Models, and Analyses*

11   Confusion is widespread in discussions of scenarios, in part because their form and usage
12   is highly diverse and in part because many writers' uses of the term are often imprecise and
13   occasionally contradictory. To clarify and sharpen meaning of "scenario" beyond the simple
14   definition provided above, scenarios must be distinguished, on the one hand, from the various
15   types of assessment, decision support, or analysis that often use scenarios; and, on the other
16   hand, from other types of statements about future conditions, such as predictions, projections, or
17   forecasts.

18   An assessment is any process that reviews and synthesizes scientific or other expert
19   knowledge to provide information of relevance to policy or decision makers.[16] There are many
20   possible ways of doing assessments. While the most common methods are deliberations of
21   expert panels and formal models, there are also other methods that combine human deliberations
22   with formal analysis or modeling, diverse in their particular forms and names, including
23   simulation games (including war and crisis games), policy exercises, political-military exercises,
24   constructing future histories, backcasting, and others.[17] These methods may use specifications of
25   potential future conditions – i.e., scenarios – as an input to or a component of their work.
26   Scenarios may even be essential for some of these methods. For example, a war or crisis gaming
27   exercise needs a scenario that specifies the nature of the threat or crisis, while a formal model
28   used to represent future development of some issue of concern needs a scenario to specify future
29   values of those inputs not explicitly calculated within the model. But these methods are broader
30   than and distinct from scenarios. For example, models can be used in other modes than
31   representing future developments – e.g., to reconstruct past conditions or study causal processes
32   – in which case they do not need scenario-based inputs. The distinction between assessments
33   and scenarios is perhaps clearest in conventional assessments based on deliberations of expert
34   panels, such as the IPCC, US National Assessment, or Millennium Assessment.[18] Such
35   assessments often construct representations of future development of an issue, usually based on
36   formal models. These representations require scenario-based inputs, and may produce outputs

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[15] Relevant history in: Hausrath 1971; Shubik 1975; Greenberger et al 1983; Schoemaker 1995; Schultz and
Sullivan 1972; Schwartz 1991; Shell International 2003.

[16] Parson 2003, p. 89; Mitchell et al 2006.

[17] NRC 1996; Hausrath, 1971; Brewer, 1986; Shubik 1975; Svedin and Aniansson, 1987; Schultz and Sullivan,
1972; Jones 1985; Parson 1996, 1997.

[18] IPCC TAR, USNA, MEA.

1   that are themselves used as scenarios in other activities. But the scenario-related activities are
2   frequently a small part of the overall assessment, which may also examine the state of knowledge
3   in particular scientific areas, the status of and trends in particular environmental conditions, the
4   evidence attributing particular environmental changes to particular human inputs, or particular
5   policy-relevant scientific questions. Assessments may also include explicit evaluations of
6   proposed actions or proposed criteria for conducting such evaluations. For many of these
7   assessment methods, scenarios may provide required inputs but are distinct from the assessment
8   activities themselves.

9   *Distinguishing Scenarios from Projections, Predictions, and Forecasts*

10   Scenarios must also be distinguished from other types of statement about the future, such
11   as predictions, projections, and forecasts. This is a subtler task than distinguishing scenarios
12   from assessments and models, because all of these satisfy the basic definition above: they are
13   descriptions of potential future conditions whose primary purpose in most cases is to support
14   decisions. Examining the ways scenarios are used and discussed by practitioners and researchers
15   suggests four characteristics that distinguish scenarios from these other types of future statement.
16   Although these characteristics are not essential, they are all more likely to be present in scenarios
17   than in other types of future statement, so they sharpen and delimit what is meant by a scenario.

18   First, scenarios are multi-dimensional: they describe multiple characteristics that
19   collectively make up a coherent representation of future conditions. To achieve this, scenarios
20   assemble and organize available knowledge, information, and assumptions from diverse bodies
21   of research and expert judgment. The elements of a scenario can be of diverse types:
22   quantitative or qualitative, defined precisely or fuzzily, based on well established research or
23   informed speculation. Effective scenarios integrate their diverse elements in a way that is
24   coherent, that communicates a clear theme or organizing principle, and that to the extent present
25   knowledge allows, avoids internal contradiction.

26   Second, scenarios are schematic: that is, they are multidimensional, but not without limit.
27   Scenarios do not seek to describe potential future conditions with complete precision or detail.
28   Rather, they highlight essential characteristics and processes with enough detail that
29   knowledgeable observers perceive them as realistic and relevant, but not so much detail as to
30   distract from large-scale patterns. Since one benefit scenarios sometimes provide is to stimulate
31   creative thinking and insights, they must leave something to the imagination. How much detail
32   and precision is appropriate in each case is a judgment that depends on the particular application.

33   Third, scenarios tend to come in groups. To be a useful tool to inform decision-making
34   under uncertainty, scenarios must represent uncertainty. This is usually done by providing
35   multiple scenarios, each presenting an alternative realization of uncertain future conditions.[19]
36   How many scenarios are appropriate depends on the particular application. Scenario exercises
37   usually use between two and seven, depending on the stakes of the issue being examined, the
38   resources invested in the exercise, and the depth of analysis devoted to each scenario. The most

---

[19]   Crisis-response exercises are often an exception, presenting one scenario at a time showing a novel challenge to
     which participants must respond, and which is implicitly contrasted to the status quo.

1   frequently proposed number is three or four. Three scenarios permit exploring one dimension of
2   uncertainty, perhaps with a surprising or challenging scenario added as a wild card. Four
3   scenarios permit joint exploration of two outcomes for two top-priority uncertainties.

4   Finally, scenarios usually claim less confidence than other types of future statements.
5   Although different authors' usage is not consistent, "prediction" and "forecast" usually denote
6   statements for which the highest confidence is claimed. "Projection" denotes a less confident
7   statement, which may have some specified confidence level and may be explicitly contingent on
8   specified assumptions about other future conditions. Calling a future statement a "scenario"
9   usually implies still less confidence and more associated contingencies. Any use of a scenario
10   for serious planning or analysis does, however, presume some minimal, threshold level of
11   likelihood. The situation described, or something like it, must be judged sufficiently likely to
12   merit attention, and to justify expending resources and effort to study its implications and
13   potential responses to it. There may also be a time ordering among these three types of
14   statements – predictions or forecasts tend to describe nearer-term futures and scenarios longer-
15   term futures – but there are exceptions, and the meaning of near-term and long-term depend
16   strongly on the particular context.

17   *1.2. Creating a Scenario Exercise: Key Characteristics and Choices*

18   Beyond these general characteristics, there is great variation in what scenarios are used
19   for, how they are produced, and what they contain. Usage and understanding is so diverse that
20   extensive scholarly effort has been spent providing alternative scenario taxonomies.[20] Scenarios
21   can be distinguished, for example, by whether they present a snapshot of a future state or a
22   dynamic account of changes over time to reach that state; by their degree of complexity; by the
23   relative balance of deliberation and intuition versus formal analysis used in producing them; or
24   by their temporal and spatial scale. Because the set of characteristics on which scenarios could
25   be sorted is long and open-ended, we do not attempt to define an exhaustive list of categories.
26   Instead, we provide a partial summary of the main dimensions of scenario diversity below in a
27   set of potentially open-ended design choices that must be made in developing a scenario
28   exercise.

29   *Variation among Assessments: Three Basic Dimensions*

30   There are, however, three dimensions of scenario variation that are more fundamental and
31   that we discuss separately. These concern the purpose of a scenario exercise, and have far-
32   reaching implications for its design and use. First, the intended use of a scenario exercise can
33   vary from more predictive to more exploratory or heuristic. In the extreme, this distinction can
34   degenerate into a straw man, in that writers on scenarios are far more likely to criticize other uses
35   of scenarios as being inappropriately predictive than to state that they are using them predictively
36   themselves. It is of course a fundamental and potentially dangerous error to take an illustrative
37   description of potential future conditions in a scenario as a confident prediction of what will
38   actually happen – in our terminology above, to take a scenario as a projection or even a

---

[20]   See, e.g., Duncan and Wack 1990; Godet and Roubelat 1996; van Notten et al 2003.

1 prediction.[21] Still, as we argue above, the decision to invest effort into developing a scenario
2 implies some threshold level of judged likelihood sufficient for it to be worth the attention of
3 busy people. Exploratory uses of scenarios may presume no higher likelihood than this low
4 threshold, yet have great value. For example, scenarios can be used to probe and challenge the
5 mental models, thought habits, and unrecognized presumptions of decision-makers, and to seek
6 insights into potentially unrecognized opportunities, risks, causal linkages, or uncertainties.[22]
7 While we have described the primary purpose of scenarios as supporting decision-making under
8 uncertainty, such insights can arise not just from examination of uncertainties, but also from
9 meticulous critical examination of future factors that are essentially certain, e.g., strongly
10 determined demographic trends such as the aging of industrialized-country populations, or even
11 of present conditions whose significance had not been appreciated.[23] For example, in a cold-war
12 crisis exercise on a Soviet invasion of Iran, one participant realized that the supply of jet fuel
13 locally available to support a rapid US response was ten times larger than had been thought,
14 because kerosene – an acceptable substitute – was used for domestic cooking and heating.[24]
15 Still, the predictive confidence or belief accorded to scenarios is a matter of degree, and when
16 carefully developed scenarios are judged to have captured the most important uncertainties, it
17 may well be appropriate to impute some moderate degree of confidence, particularly to a set of
18 scenarios – the appropriate unit of evaluation – and even in some conditions to a particular
19 scenario. The appropriate degree of confidence will vary, and reasonable distinctions may be
20 drawn between scenarios that represent conventional versus surprising futures, the playing out of
21 present trends versus surprising discontinuities, best and worst cases, etc.

22   A related dimension of variation among scenario exercises is their proximity to decision-
23 making – i.e., to decisions not just concerned with other scenarios, assessments, analysis, and
24 research.[25] In some uses, scenario exercises may involve actual decision-makers and seek to
25 directly advise a specific, identified, near-term decision, but more frequently their relationship to
26 concrete decisions and decision-makers is indirect. They may be used for risk assessment,
27 contingency planning, identification of potential threats or actions to be considered, or to provide
28 early characterization of a poorly understood issue. In such applications, the exploratory uses of
29 scenarios discussed above tend to dominate. They can help clarify the importance of an issue,
30 frame a decision agenda, shake up conventional thinking, provoke creative insights, clarify
31 points of agreement and disagreement, identify and engage needed participants, or provide a
32 preliminary structure for advance analysis of potential future decisions – i.e., generally
33 promoting learning about a poorly understood issue and the implications of alternative responses
34 to it. Scenario exercises that are closer to, and expected to contribute to, decisions with
35 significant stakes, operate under quite different requirements, which are likely to be driven by
36 specific user needs. Their uses are likely to be more predictive rather than exploratory –
37 constrained, one hopes, by the limits to available knowledge and uncertainties – so they might be
38 expected, for example, to provide more explicit and complete characterization of major

---

[21] Several such errors are collected and discussed in Bracken 1977 and Brewer 1990.
[22] Brewer 1990.
[23] Shell International 2001, 2003.
[24] Schelling 1964.
[25] This dimension is presented by Van Notten et al 2003 as "exploration" versus "decision support."

1   uncertainties. They are also likely to be more integrated with explicit methods to evaluate
2   alternative courses of action and identify preferred ones.

3   A third basic dimension of variation concerns whether scenarios are defined primarily
4   normatively, on the basis of their perceived desirability or undesirability, or primarily on the
5   basis of their perceived plausibility or likelihood. While all scenarios include both positive and
6   normative elements, it is important to avoid confusing the two and keep as clear as possible
7   which elements are included based on perceived likelihood or plausibility, which elements
8   because of perceived desirability or undesirability.

9   The most frequent use of explicitly normative scenarios involves constructing some
10 hypothetical future end-state primarily on the basis of its desirability. Such a future end-state
11 might be constructed to embody participants' general intuitions about desirable social trends, or
12 to achieve specific environmental, development, or other goals.[26] The scenario exercise then
13 consists primarily of "backcasting" – attempting to construct paths that connect present
14 conditions to the specified future target conditions, to elaborate conditions jointly sufficient to
15 either attain or miss the target, examine the feasibility of the target, and identify costs and
16 tradeoffs associated with meeting it.[27] Similarly, one can posit an undesirable future state and
17 then reason through conditions associated with avoiding it. This approach is sometimes
18 proposed to reduce the risks of hidden bias in construction of scenarios which, like any form of
19 assessment or policy analysis, can be misused to provide legitimation for a decision already
20 made for other reasons, rather than to inform a decision not yet made. By bundling normative
21 assumptions into the future target state or boundary conditions, it is hoped to reduce their
22 penetration into the subsequent instrumental reasoning about actions and conditions that are
23 more or less likely to reach the specified target state. (Of course, this approach does not
24 eliminate the possibility for such misuse: if a particular goal or action is strongly desired,
25 scenario developers are at risk of biasing the analysis, whether consciously or not, to make the
26 target appear easy to achieve or the action clearly preferable. Japanese war-games prior to the
27 Battle of Midway provide striking examples of scenarios biased to exaggerate the perceived
28 feasibility of a course of action.[28]

29 *Developing Scenarios: Main Dimensions of Choice*

30   Table 1.1 extends the preceding discussion, summarizing the main areas of variation and
31 choice involved in constructing a scenario exercise. This is a highly simplified representation of
32 a complex process. In any particular scenario exercise some of these choices may be made by
33 default, without explicit consideration, perhaps because the preferred choice is immediately
34 obvious in context. Moreover, although we present these choices in simple sequential order for
35 clarity of exposition, this order is not necessary or normative: choices might be made in some

---

[26] See, for example, the simple scenario exercise in NRC 1999 (pp. 161-176) that posited specific targets to reduce
      world hunger and greenhouse-gas emissions by year 2050, or the scenarios of the Global Scenario Group, which
      included some defined by specified trends and others back-cast from normatively specified targets for 2050
      (Kemp-Benedict et al 2002, Raskin et al 2002).
[27] Robinson 1982, 2003.
[28] Bracken 1977.

1   other order, or repeatedly and iteratively adjusted. But while the process and sequence of
2   choices may be idealized, the set of choices is not: creating a scenario requires a choice, explicit
3   or implicit, on each of these design dimensions.
4
5
6   *Table 1.1   Idealized Sequence of Major Choices in Scenario Development.*
7
8   ▪ Main focus, framing, users, question(s) to be addressed
9   ▪ Process and participation
10   ▪ Key uncertainties to explore: how many, over what range
11   ▪ Narrative, quantitative, or both
12   ▪ Level of complexity (number of quantitative variables, detail of narrative)
13   ▪ Specific variables and factors to specify
14   ▪ Time horizon and spatial extent
15   ▪ Temporal and spatial resolution
16

17   The most basic decision in developing scenarios is identifying the main focus of the
18   exercise: what issues are the scenarios intended to address, or what decisions are they intended to
19   inform, for whom? This basic definition of a scenario exercise includes specifying the three
20   characteristics discussed above. The mere fact that a decision has been made to conduct a
21   scenario-based exercise does not necessarily mean that these matters are clearly understood. The
22   closer a scenario exercise is to concrete decisions, the more likely it is that these definitional
23   issues will be understood clearly, in part through discipline on the process imposed by the
24   involvement of decision-makers. But most often, the coupling of scenarios to decisions is
25   relatively weak.[29] In some applications (e.g., corporate strategic planning, responding to a novel
26   military threat) the relevant decision-makers may be clearly identified at the outset, but the issues
27   to be addressed and relevant decisions may not be. In other applications, scenarios may be
28   developed to address some broad issue or concern (e.g., climate change, emerging infectious
29   diseases, or terrorism), but the potential users and decisions to be informed might both be
30   unspecified. Clarifying the overall focus of a scenario exercise may require broad consultations
31   or scoping workshops involving many potentially interested decision-makers, other stakeholders,
32   and analysts and researchers. But whether the relationship of a scenario exercise to decisions is
33   near or far, direct or indirect, clear understanding of its focus and purpose is important, and
34   infrequently achieved: many scenario exercises muddle through with vagueness, confusion, or
35   disagreement regarding the focus, purpose, and intended user of the exercise.

36   Once the principal focus and purpose of a scenario exercise is well enough established, a
37   second basic set of decisions concerns the process by which the scenarios will be developed. As
38   with deciding the focus of the exercise, decisions about the process of developing scenarios often
39   receive little thought, or are not even explicitly recognized as choices, but they are nevertheless
40   highly consequential. What range of expertise must be included to ensure the scenarios

---

[29] E.g., note the predominance of scenarios on the "exploration," rather than the "decision support" side in the
      survey of Van Notten et al 2003.

1   adequately reflect the best available scientific knowledge, data and models? What range of
2   decision-makers, stakeholders, or surrogates for these must be involved to keep the scenarios
3   relevant, plausible, and credible? For scenario exercises that must integrate knowledge across
4   diverse domains, choosing individual participants for their knowledge, flexibility, and boldness
5   of imagination can be as important as the disciplines or stakeholder groups they represent. How
6   intensively, for how long, and by what means will these participants interact? Will the scenario
7   development process be open to outside observers or participants? How and when will feedback
8   and criticism on the scenarios be sought, and how will it be used? How and to whom will the
9   scenarios, and information about the process and reasoning underlying them, be communicated?
10   And crucially, how will be process be led, and how will disagreements be resolved? With good
11   process management, resolving differences in a scenario exercise can be more illuminating and
12   less arbitrary than in other collaborative tasks, because when disagreements persist after careful
13   critical examination, these can be treated as important uncertainties to be retained as alternative
14   scenarios, not suppressed by picking a winner, splitting the difference, or retreating to vague
15   language.

16   Through whatever process is decided, those engaged in scenario development face a
17   series of substantive choices about what goes into the scenarios. The largest of these concern
18   what key uncertainties will be explored using the scenarios, and the degree of richness and detail
19   that should be included in the scenarios in order to usefully illuminate these.

20   What uncertainties are to be explored, and how? There may be many dimensions of
21   uncertainty relevant to the issue being examined, but only a few can be examined explicitly in
22   any scenario exercise. The selection and definition of these few is a crucial act of framing and
23   judgment that shapes much of what follows in a scenario exercise. For those uncertainties
24   judged most important, alternative outcomes are usually represented in alternative scenarios. For
25   example, scenarios might represent high-growth and low-growth futures, or alternative forms
26   that a competitive threat might take. Other uncertainties judged to be less crucial are typically
27   represented by a single "best guess" or "reference case." For the few uncertainties explicitly
28   represented by alternative scenarios, how they are represented – as realized in the number and
29   character of the scenarios based on them – also depends on the intended use. A particular
30   uncertainty might be represented by high and low values of some quantity, or by a middle or
31   reference case supplemented with high and/or low variants. If two or more uncertainties interact
32   with each other, they can be represented by scenarios that combine different outcomes of each:
33   in the simplest form, the interaction of two realizations of two key uncertainties can be
34   represented by four scenarios, presented as a two-by-two matrix.[30] Several alternative scenarios
35   might seek to span the plausible range for some key quantitative variable, or present distinct
36   qualitative outcomes for a single uncertainty, e.g., three different types of competitive threat, or
37   three alternative political futures for a region in turmoil. Alternatively, scenarios can represent
38   plausible extreme or "worst-case" scenarios, to assess the robustness of decisions or strategies.
39   These choices are discussed in Section 4.2.

---

[30] Alternative interpretations of this matrix structure are discussed in van't Klooster and van Asselt 2006.

1   How rich and complex should each scenario be? Defining scenarios as multivariate but
2   synoptic, as we have done above, still leaves a vast range of levels of complexity to choose from.
3   At one extreme, many scenarios only specify time-paths for a few quantitative variables, or just
4   one. This is by far the most frequently used type of scenario, common in such applications as
5   analyzing a firm's profitability under alternative scenarios for oil prices, or projecting tax
6   revenues under alternative scenarios of productivity growth and inflation, often in a standard
7   "high, middle, low" format. A scenario can accommodate more complexity by projecting
8   additional quantitative variables, but as the number of variables increases, so also does the need
9   for an organizing principle or gestalt to tie them together in a non-arbitrary way.

10   At the other extreme, the core of a set of scenarios can be a set of rich, coherent
11   narratives. This approach is frequently called the Shell approach, because its methods have been
12   extensively developed since the 1960s in the corporate strategic planning offices of Royal
13   Dutch/Shell, extending earlier work at the Rand Corporation and elsewhere.[31] Each narrative,
14   described principally in text, reflects a distinct conception of how the world might develop with a
15   persuasive underlying causal logic. A narrative scenario can stand alone without any
16   quantitative variables, but may also include specifications of time-paths of important quantitative
17   variables, e.g., of population or economic growth, that are consistent with the broad causal logic
18   underlying the scenario. The narrative provides the context and explanatory logic that tie
19   together the time-paths of quantitative variables and relations among them, although the
20   particular time-paths are regarded as illustrative quantifications of the scenario, not the scenario
21   itself. While particular time-paths need to be specified, somewhat different paths would still be
22   consistent with the scenario. A different scenario would imply substantial differences in trends
23   of, and relationships among, the quantitative variables.

24   The choice of how rich and complex to make scenarios has far-reaching implications for
25   the process of developing the scenarios, what can be done with them, and the uses they can
26   serve. The two extreme approaches imply large differences in how uncertainty is treated, what
27   aspects of the problem receive attention, and the relationship between scenarios and their users,
28   which we discuss for climate-change scenarios in Section 4. In addition, many practical aspects
29   of running a scenario exercise depend on this choice. For example, richer and more complex
30   scenarios require more time and effort to develop, so fewer can be produced. Complex
31   narrative-based scenarios may require many person-months to develop realistic and persuasive
32   narratives, to test whether relationships among scenario elements are persuasive and consistent
33   with present knowledge, and to repeatedly check for plausibility and relevance to users.[32] In
34   return for the extra effort, this approach allows much more flexibility in the way potential futures
35   are described. Narratives can convey different aspects of a future situation with varying degrees
36   of salience or specificity, and they can compactly convey the tone or character of a future
37   situation by allusion, where a precise specification would appear arbitrary or labored. The
38   narrative approach avoids limiting the defining characteristics of a scenario to any particular set
39   of pre-specified variables, but attempts to be alert to a wide range of potentially important

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[31] Van der Heijden 1996; Wack 1985a, 1985b; Schwartz 1991; Shell International 2003.
[32] Note that quantitative scenarios are not necessarily cheaper or easier to develop. The complex models used to
     develop quantitative scenarios may embody many years of work.

1   characteristics and mechanisms of causal influence. Proponents of this approach argue that a
2   coherent narrative at the core of a scenario is necessary to avoid arbitrariness in specifying
3   multiple variables, and to make the exercise useful to decision-makers: e.g., "Most scenarios
4   merely quantify alternative outcomes of obvious uncertainties (for example, the price of oil may
5   be $20 or $40 a barrel in 1995). Such scenarios are not helpful to decision makers".[33]

6   The remaining substantive choices in specifying a scenario follow from the preceding
7   large-scale choices. They include specifying the time horizon and spatial extent of the scenarios;
8   deciding the particular elements to include, whether these are specified as quantitative variables
9   or as components of a narrative; and the temporal and spatial resolution at which scenario
10   outputs are stated. Decisions about temporal resolution (e.g., hourly to multi-decadal) and
11   spatial resolution (e.g., regional, national, continental scales) are particularly important when –
12   as is often the case in global-change applications – scenarios are produced or used by
13   quantitative models. Such models may have very precise requirements for the specification and
14   resolution of inputs and outputs, creating the possibility for serious mismatches between what
15   users need or expect, and what scenario developers feel comfortable and competent providing.

16   The discussion in this section has concerned the uses, types, and characteristics of
17   scenarios broadly, in any application area. The next section narrows the focus to climate change
18   and related areas of global environmental change, summarizing the types of scenarios that have
19   been used and proposed, and that might be required, to explore and inform decision-making in
20   this area.

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[33] Wack 1985a, p. 74.