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Methods of Future and Scenario Analysis

Overview, Assessment, and Selection Criteria

Hannah Kosow
Robert Gaßner

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German Development Institute (DIE)

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Abbreviations

AS	Active Sum
BMBF	Bundesministerium für Bildung und Forschung / Federal Ministry of Education and Research
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung / Federal Ministry for Economic Co-operation and Development
CIA	Cross-impact analysis
DIE	Deutsches Institut für Entwicklungspolitik / German Development Institute
DP	Development Policy
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit / Association for Technical Cooperation
IZT	Institut für Zukunftsstudien und Technologiebewertung / Institute for Future Studies and Technology Assessment
MA	Morphological analysis
PS	Passive Sum
SRI	Stanford Research Institute
TIA	Trend impact analysis

Summary

The future context that development policy will have to respond to is both complex and uncertain. This study provides an overview and evaluation of methods of futures research and scenario analysis methods in particular in order to identify how these methods might be applied to research and policy advising in the development policy arena. Although scenario analysis methods have been applied in a variety of contexts, the literature on these methods has to date provided limited guidance on how to select appropriate scenario techniques and how to evaluate scenario exercises. This study addresses this shortcoming by outlining three main categories of scenario techniques (scenarios based on trend extrapolation, systematic-formalized scenario techniques, creative-narrative scenario techniques) and discussing common applications and strengths and weaknesses of these varied approaches.

A scenario can be defined as a description of a possible future situation, including the path of development leading to that situation. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments. Many scenario analysts underline that scenarios are hypothetical constructs and do not claim that the scenarios they create represent reality.

This study outlines several functions that scenarios can serve. First, scenarios can be used to generate knowledge about the present and the future and to identify the limits of that knowledge. Second, scenario analysis can serve a communicative function, since scenario development is often based on an exchange of ideas between people with different perspectives. Scenarios may also be used as a public communication tool to draw attention to specific issues. Third, scenarios can aid decision makers in formulating goals. Finally, scenarios can provide a tool for examining the potential effectiveness of organizational strategies.

Although there are many different kinds of scenario analysis techniques, the scenario process unfolds in a broadly similar manner across these varied approaches. The first phase of the scenario process deals with the identification of the scenario field by establishing the precise

questions to be addressed and the scope of the study. In the second phase, researchers identify the key factors that will have a strong influence over how the future will unfold. The third phase then examines what range of outcomes these key factors could produce. This phase is followed by a fourth phase that involves condensing the list of central factors or bundling key factor values together in order to generate a relatively small number of meaningfully distinguishable scenarios. The final phase of the scenario process can be labelled "scenario transfer" and involves applying the finished scenarios for purposes such as strategy assessment.

The techniques used in the scenario process depend on the general orientation of the scenario exercise. Scenario analyses can be distinguished on the basis of whether they are normative or exploratory in nature, with normative scenarios aiming to chart paths to desirable futures and exploratory scenarios aiming to identify possible developments regardless of their desirability. Scenario analyses may also be either quantitative or qualitative in nature. The advantages and disadvantages of these alternative orientations are discussed in this study.

This analysis proposes several criteria that can be used to assess the quality of scenario exercises, many of which can also be used to evaluate other forms of research. Scenarios can be judged by their plausibility, internal consistency, comprehensibility and traceability, distinctness, and transparency.

The choice of an appropriate scenario technique depends on the goals of the research project and the context in which this research takes place. This study outlines a number of key questions that researchers should ask prior to undertaking a scenario analysis and on this basis develops a checklist for the selection of suitable scenario analysis methods in the development policy field.

Researchers should for example be careful to identify whether project goals require the articulation of multiple alternative futures rather than making predictions on the basis of readily available data. At the outset of a scenario process, it is also critical to identify the target audience and to specify the nature of organizational resources that can support the scenario development effort. In the development policy field, there

are several foreseeable goals of conducting scenario exercises. These goals may be exploratory or in contrast related to establishing concrete targets to achieve. Scenario exercises may also serve to encourage networking among actors or to sensitize external actors to critical issues. In some cases, the goal of promoting internal networking suggests that greater attention should be placed on the design of the scenario process, while scenario exercises aimed at sensitizing external actors should pay special attention to the manner of description of the scenarios themselves.

The study stresses that researchers seeking to apply scenario methods should carefully consider how they can best manage the complexity of the subject matter scenario exercises attempt to deal with in a manner that fits with their existing organizational resources. Important decisions that researchers need to take relate to the geographical, thematic, and chronological scope of the scenario project, as well as to the selection of the participants that will be involved in the process.

In conclusion, the study offers a short list of key recommendations for applying scenario methods to examine questions for the future of development policy. The selection of appropriate methods should follow from an exhaustive delineation of goals and priorities of the scenario project. Researchers should avoid a purely quantitative approach and acknowledge the normative elements of questions related to the future of development policy. Rather than conducting a global scenario exercise, it is also advisable for researchers to divide the scenario analysis into a number of smaller, more focused, projects. Finally, the study emphasizes that the ultimate target audience for scenario analyses regarding the future of development policy should be involved in the scenario generation process in order to strengthen the legitimacy and overall effectiveness of such an undertaking.

1 Introduction

The future of development policy – like everything else involving the future – is full of complexity; developments and shifts in mutual interactions at many levels on the world stage follow courses which are at times unbroken, but also at times disruptive. In addition, the future of development policy is of its very nature characterized by uncertainty and unpredictability. Whereas the potential for numerous, fully different paths into the future is always present, it is also the case that final selection of a single future direction and/or the emergence of a single future course automatically excludes certain alternatives while simultaneously, in most cases, opening up a multitude of other possibilities for moving into the future. For this reason it makes sense to speak in the plural of the "possible futures" of development policy. In turn, these "futures" of development policy are themselves marked by ambivalence, inasmuch as different possibilities for development themselves will be – or can be – evaluated quite differently depending on the standpoint of the viewer.

In the field of study and consultation regarding development policy (DP), it has mostly been the case that questions related to the future have received little explicit attention. Nevertheless, a study of the "futures" of DP appears highly relevant in light of the ever-increasing complexity and unpredictability of the framework conditions of DP, including, for example, globalization, climate change, the dynamics of energy and raw materials markets, the risks and conflicts of maintaining political security, and technological revolutions, and in view of the internal transformation processes to which DP itself is subject, it becomes important to reflect on decisions being made today as a means of orienting DP in such a way as to make it viable for the future.

Futurology, i.e. *"the scientific study of possible, probable and desirable future developments, the options for shaping them, and their roots in past and present"* (Kreibich 2007, 181), offers a set of instruments and a rich store of methods for the generation of orientational and future-oriented knowledge. Kreibich names the following methods (Kreibich 2006, 12):

> *"Trend analysis and trend extrapolation; envelope curve analysis; relevance tree techniques; morphological methods; analogy techniques; input-output models; techniques involving questionnaires; surveys of experts and interview techniques; cost-benefit analysis; cross-impact analy-*

sis; innovation and diffusion analysis; construction of models and simulation techniques; brainstorming; Delphi methods; scenario methods; role-playing; creativity methods; future workshops."

The present study will undertake to investigate how this body of methodological knowledge of futurology can be made fruitful for those who carry out research and provide advisory services in the context of DP. In the process, the primary focus here will be on scenario methods. The reason: work with scenarios is central to futurology and one of its most widely used methods (cf. Steinmüller 2002b, 3). It constitutes one of its most comprehensive and complex approaches, and often integrates within itself different methodological manners of tackling issues, such as scientific techniques, evaluation techniques, decision-making techniques, event-shaping techniques, and participative techniques (cf. Grunwald 2002, 226).

Viewed historically (cf. among others Steinmüller 2000, 37 ff.; Mietzner / Reger 2004, 48 ff.), it has been customary since the 1950s to develop scenarios in the context of strategic military planning. At the end of the 1960s, however, companies like General Electric and Royal Dutch Shell began for the first time to use scenarios and, in this context, to develop the first energy scenarios. Scenarios came into the eye of the general public on the basis of computer simulations with the report of the Club of Rome on "Limits to Growth" (1972). Today, scenarios are used in all sorts of contexts. Among their primary fields of application are strategic planning in companies, municipal and land-use planning, political consultancy, and global scenarios concerning the future of energy or the climate. Numerous different scenario techniques have been developed for the various fields of application.

The present study has two goals: first, to present to the German Development Institute (DIE) a qualified overview of methods used in futurology and, in particular, to present scenario methods which could be used in the area of development policy. The intention was to widen the range of possible methods within the DIE for dealing with the future avenues of DP.

The other goal is to present a study which can also serve as a practical "handbook" within the context of the DIE project "Development Policy: Questions for the Future" by making it possible to support the methodological design of this project and/or to concretize the manner in which such scenarios might be applied within the framework of this project.

Against this background, Chapter 2 develops a structured overview of the field of scenario methods. It takes as its point of departure a clarification of concepts, basic principles, along with both the aims and limitations of scenario methods. This is followed by a description of the general process common to many scenario techniques, which in turn leads to an introduction of the criteria used to characterize and evaluate different scenario approaches, namely the basic characteristics of scenarios (including explorative vs. normative, quantitative vs. qualitative), their scope (geographical, chronological, and thematic) and criteria to evaluate their quality. Following that, scenario techniques are grouped into three ideal types with respective pros and cons: scenarios on the basis of trend extrapolation, systematic-formalized scenario techniques, and creative-narrative scenario techniques. The techniques of scenario transfer are also presented in an excursus, along with sample sketches of some hybrid method designs in which scenarios are combined with other methods of futurology: modeling methods and/or simulations, Delphi surveys, and roadmapping techniques.

Chapter 3 in turn proposes a set of criteria and decision-making processes which might make it possible to select appropriate scenario approaches for carrying out research and providing advisory services in the field of DP. To this end, numerous dimensions of selection are discussed and outlined, using DP as an example in each case, thus making it possible to formulate preliminary recommendations for organizing scenario work in this field. In the process, both basic questions and their underlying conditions are taken up with regard to the selection of scenario methods, after which concrete considerations regarding the organization of a scenario process in the context of DP are presented.

Chapter 4 concludes the preceding reflections with a “checklist” type resumé of dimensions for selection, along with the decision-making issues which are involved in the DIE project “Development Policy: Questions for the Future“. It can be used for methodically working out a concrete scenario process, including a determination of targets, resources and scenario contents.

2 Overview of scenario methods

We begin by describing the procedure used in analyzing literature for this study (2.1). Then the basic principles of scenario methods are explained; this involves, among other things, the definition of scenarios and the understanding of the future upon which they are based (2.2). With this as basis, the field of scenario methods is presented in its full range: first common elements in the general phases of the scenario process are identified; then criteria and dimensions which are relevant in characterizing and evaluating different scenario approaches are introduced, i.e. the basic characteristics, the scope, and the criteria of quality (2.3). Following this, three groups are presented in ideal-typical fashion on the basis of their dimensions, each involving different scenario techniques. Additionally, the techniques of scenario transfer are described (2.4). Finally, some examples of method designs are sketched in which the scenarios are combined with other methods of futurology (2.5).

2.1 Procedure and sources

This study is based on a study of the literature published to date concerning (national and international) research and the status of experience gathered with scenario methods. The point of departure of this research project was a very broad understanding of the term "scenario methods", that is, each and every method which deals with scenarios. In the process, it was for the moment irrelevant to the search for source literature whether that literature dealt with the development, analysis, evaluation, or application of scenarios. That is, it was of no great importance what position of importance the scenario occupied within the respective research processes discussed in the literature or, for example, what point of departure was used or what interim or final results were obtained. This broad-based search strategy was expedient, firstly because it embraced all the different individual scenario techniques and secondly because it included conventional combinations of methods as well. In the process, recourse was had to research and literature databases, along with the Internet, library catalogues, and cross-references in the literature. In addition, the search was enhanced by surveys of experts as well as utilization of the resources and experience already present at the Institute for Future Studies and Technology Assessment (IZT).

Our search of the literature revealed the following preliminary situation regarding sources:

Basically, and first of all, literature was found concerning the various approaches to a discussion of methods (e.g. Mietzner / Reger 2004; van Notten et al. 2003; Greeuw et al. 2000); a second body of literature concerned experiences gathered from practical application (e.g. Shell International 2003). Here there were often detailed descriptions of individual techniques, above all the rather formalistic approaches prevalent in the 1990s (e.g. von Reibnitz 1991; Mißler-Behr 1993). Many of these descriptions were directed above all to the application of scenario methods in companies (e.g. van der Heijden 1996; Gausemeier / Fink / Schlake 1996). In addition, proposals became common from the mid-1990s on for systematic overview reports (e.g. Steinmüller 1997), along with volumes of collected essays which attempted to give an overview of the field (e.g. Wilms 2006a). On the other hand, a nearly endless number of scientific studies were found concerning the actual application of scenarios, together with collections of reports on completed scenarios and scenario texts[1]. There is also a wide spectrum of information on the offer of scenario services provided above all to enterprises.

What is not found, however, is a comprehensive or even consistent, theoretical and methodical substantiation for scenario methods. By themselves, the methodological procedures of many studies are thought through only partially or not at all; moreover, the methodological procedures of existing studies are not always transparent. In addition, comprehensive, detailed "toolkits" for the practical implementation of scenario methods are almost universally absent. Fundamental sets of instructions for the selection of appropriate scenario techniques are nowhere to be found; the same is true of generalized evaluation criteria in the sense of "best practices" (cf. Mietzner / Regner 2004, 60). It is on the whole conspicuous that when scenario methods are discussed they are more a matter of internal experience and knowledge of the ins and outs of advisory services than of detailed and published methods which are available to all (cf. Mietzner / Reger 2004, 60).

1 For example, an updated version of the "State of the Future" Reports appears annually and documents the work of the AC/UNU "Millennium Project" (In 2007: Glenn / Gordon 2006). Among other things, it contains an ongoing annotated bibliography which already contains more than 650 scenario sets.

With regard to source material, this situation leads to the following consequences for this study: The current status of discussion concerning methods will be used together with a study of the status of practical application, mutually supplementing each other in order to permit the most complete overview possible. In the process, the discussion will fall back on "classical" scenario methods and their application on the one hand, while on the other hand frequent use will be made of the knowledge gained by the IZT through practical experience, since this makes it possible here to clearly comprehend the methods and method combinations used.

Nevertheless, a study of the literature yields a good overview of the field of scenario methods; a few fundamental clarifications of this will first be given in the following.

2.2 Basic principles

2.2.1 What is a scenario?

"Scenario" is *"a fuzzy concept that is used and misused, with various shades of meaning"* (Mietzner / Reger 2004, 50). It is also, so to speak, a fashionable word which has come to be widely used in journalistic and everyday language. The term "scenario" is also often used to describe the future course of events regarding a single variable, e.g. "in the scenario of a global warming of 3°C". In the context of futurology, however, scenarios can also represent far more complex products which include the interactions of a plethora of variables (cf. Eurofound 2003, 88). Here too, however, "scenarios" may refer on the one hand to texts (with different degrees of comprehensiveness and detail) (cf. Steinmüller 2002b, 7)[2] while on the other hand the term "scenario" may also refer to modulations of a quantitative model (cf. Steinmüller 2002b, 6). Even within the field of futurology, there is a multiplicity of proposals for definition. This multiplicity is directly connected with the multiplicity of extant scenario methods themselves; this issue will be discussed further during the course of this study.

2 Here the spectrum ranges from textually formulated outlines to quasi-literary descriptions. Also, other medial forms of presentation (e.g. audiovisual, film) are possible (cf. Steinmüller 2002b, 8).

Within the discussion of methods, however, it is possible to identify a basic understanding which is *implicitly* shared – at least by a majority of the authors – concerning that which is to be understood under the term "scenario".

A **scenario** is defined by many authors as[3]

– a description of a possible future situation (conceptual future),

– including paths of development which may lead to that future situation.

In contrast to a conceptual future, which merely represents a hypothetical future state of affairs, a scenario describes the developments, the dynamics, and the moving forces from which a specific conceptual future results (cf. e.g. Greeuw et al. 2000, 7; Gausemeier / Fink / Schlake 1996, 90; Götze 1993, 36).

The aim behind scenarios is to generate orientation regarding future developments through an observation of certain relevant key factors. Three things are to be noted in the process:

Firstly, a scenario is not a comprehensive image of the future; rather, its true function consists in directing attention to one or more specific, clearly demarcated **segments** of reality.

> *"[Scenarios] are hypothetical sequences of events constructed for the purpose of focusing attention on causal processes and decision points."* (Kahn / Wiener 1967, 6)

In the process, various factors and events are deliberately included – and others excluded – and brought into certain constellations in relation to one another. The idea behind this work of "composition" is not to work out a description of the "future" as such; rather, the function of a scenario consists in placing the focus of attention squarely on certain interesting aspects by means of a future-oriented involvement with a specific area of study.

Secondly, it is to be noted that the selection and combination of key factors with regard to a future time horizon is also a **construct**. That is, certain factors and events are deliberately taken to be relevant or are ignored, and

3 This definition is found explicitly for example in von Reibnitz (1991, 14); Gausemeier / Fink / Schlake (1996, 90); Götze (1993, 36); Steinmüller (2002b, 6).

these are then brought into play and set in a context of interrelationship with one other in light of certain assumptions. However, they can also be restructured in another way at any time. In the process, assumptions concerning the relevance of factors for the period under study or even the manner in which they interact with one another are suggested more or less by the available data; however, these assumptions also require on the one hand a well-founded body of knowledge, particularly knowledge of an experiential nature, and are grounded on the other hand for the most part in subjective and thus invariably normative assessments. Quite apart from the fact that scenarios do not represent the future as a whole, they also do not represent the future "as such", but rather as a possible, future-oriented construct of certain key factors.

Connected with this, thirdly, is the fact that every such scenario-construct is based on **assumptions** about how the future might one day look: what direction certain trends might take, what developments might remain constant, and which ones might change during the course of time (UNEP 2002, 320):

> *"Scenarios are descriptions of journeys to possible futures. They reflect different assumptions about how current trends will unfold, how critical uncertainties will play out and what new factors will come into play."*

These assumptions are indicative of comprehensive mental outlines and models of the future, *"**mental maps** or models that reflect different perspectives on past, present and future developments"* (Rotmans / van Asselt 1998, quoted by Greeuw et al. 2000, 7). Such mental constructs are often implicitly present in thoughts about the future; they can – and must – then be made explicit, at least in part, via the building of scenarios.

In the process, attention must be given to the fact that scenarios have no claim to reality and therefore do not provide a "true" knowledge of the future; rather, they merely supply a **hypothetical** construct of possible futures on the basis of knowledge gained in the present and past – a construct which includes, of course, probable, possible and desirable future developments.

With regard to differences in the generalized definition of scenarios, one aspect stands out: the distinction between scenarios and prognoses. The concept "scenario" is often used in contradistinction from the concept of "prog-

nosis" and that of "prognostics", with all its negative connotations (cf. e.g. Greeuw et al 2000, 7; Steinmüller 1997, 49 ff.). Prognoses are statements about future developments which may be expected. In contrast to prophecies these statements are supported by a basis of knowledge, as in the statistical extrapolation[4] of present and past trends (cf. Grunwald 2002, 181). Some authors explicitly exclude prognoses, i.e. predictions based on the expected "extension" of present-day developments into the future, from the concept of a scenario. They emphasize that it is precisely the nature of scenarios not to offer prognoses but rather in essence to take into account the possibility of several alternative futures. In contrast, however, concepts like "prognosis", "outlook", "forecast", "prognostics" and "trend extrapolation" are often equated on the one hand with scenario approaches in the areas of market research and consultation. On the other hand, however, it must also be recognized that classical techniques of prognosis, along with traditional forecasting techniques, have made their way into scenario methods and are enhanced by, although not completely replaced, by the latter. They can well be said to represent a partial aspect of scenario approaches (cf. Steinmüller 2002b, 7).

As already indicated here, different concepts of the future and/or of knowledge of the future underlie the different conceptions of what a "scenario" is. One task of the following reflections will be to depict these different concepts.

2.2.2 Basic assumptions: The understanding of the future which is implicit in scenario methods

Scenario methods are used in the construction of different possible models of the future; their purpose is to generate a body of orientational knowledge which can serve as a compass for lines of action in the present. However, various views or ways of understanding the relationship between the future and the present and past are possible. Stated in ideal-typical form, three different views can be distinguished (cf. Grunwald 2002, 178 ff.). In turn, the respective understanding of the future has a decisive effect on the way in which we attempt to grapple with the future from our present position (cf. van der Heijden 1996, 21 ff.):

4 See Section 2.4.1 for more on trend extrapolation.

The first view: "the future is **predictable**": whatever will come to pass in the future can (in principle at least) be calculated from our knowledge of the present and past. The more knowledge we gather in the present, the more certain is our prognosis of the future course of events. This view of the future leads those who use it to rely above all on a statistical trend extrapolation. According to this paradigm, the future is viewed as predictable and controllable.

The second view: "the future is **evolutive**". In this manner of viewing things, our present knowledge is taken to be inadequate for predicting future developments; the future follows a chaotic, uncontrolled, and random path. This paradigm assumes that a purposeful control of the course of future events is impossible; instead, emergent strategies and an "intuitive muddling through" are the appropriate manner of dealing with future courses of events.

The third view: "the future is **malleable**". In this view, the course of future events is not predictable, but neither is its development fully chaotic. The development of the future is open to intentional manipulation and can thus be influenced (at least in part) by our actions. This paradigm puts its trust in strategies of intervention aimed at shaping the future, with an emphasis on the role of those who take action, along with their goals and decision-making processes in shaping the future.

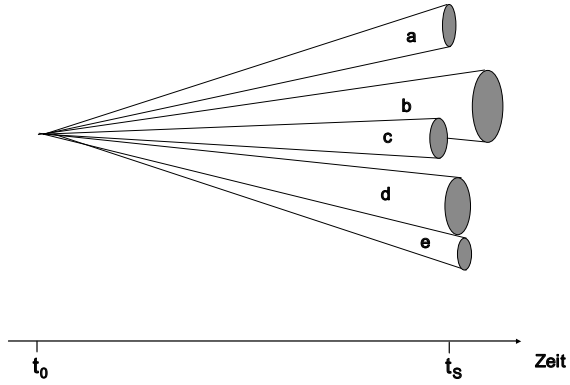
Viewed historically, **futurology** has gone through various phases (cf. Kreibich 2006, 4 ff.) which are closely coupled with these different ways of understanding the future. In turn, a gradual evolution of paradigms has taken place from the origins of futurology to the present day and parallel to the changes which have taken place in our understanding of the future. This evolution has consisted on the one hand in a shift away from purely quantitative techniques to more qualitative and/or combinative techniques which are often more appropriate for dealing with the complexity of future (cf. also Mietzner / Reger 2004, 61). On the other hand, a general shift is also recognizable from "forecasting" (i.e. prediction) to "foresight" (i.e. a look ahead) (cf. Mietzner / Reger 2004, 60; Cuhls 2003).

As these paradigms have continued to evolve, the direction of development of scenario methods has been more and more away from an exclusively analytic-descriptive prognosis with its accompanying optimism to a more complex view of the future (cf. Kreibich 2006, 6 f.). In view of its multi-

plicity, however, the scenario method cannot be univocally ascribed to any one of the above-mentioned three forms of understanding the future. Rather, the understanding of the future which is basic to the scenario technique is marked above all by the fact that its point of departure is *not any single inevitable future* but rather a set of numerous different possible futures. The concept of a "scenario" represents the idea of *a single possible* future and therefore always refers implicitly to the possibility of other *alternative* futures.

The so-called "**funnel model**" has established itself as a means of illustrating this open-endedness and multiplicity of the future and the possibility of anticipating it by means of scenarios (see Fig. 1 and Fig. 2).

Figure 1: Funnel-shaped span of possible developments of individual factors



Source: IZT description, in accordance with Minx / Böhlke (2006, 19); Gausemeier / Fink / Schlake (1996, 91)

The basic idea behind this description[5] is that the farther we gaze from today's standpoint into the future, the more the number of possible develop-

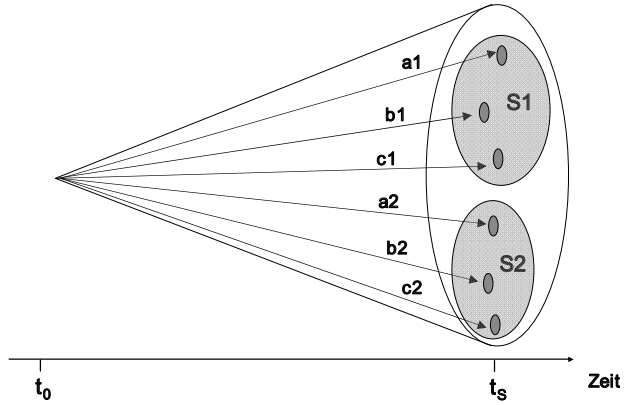
5 These graphical representations go back to von Reibnitz (1991, 38) and have been taken over by many others (cf. e.g. Geschka / Hammer 1984, 242; Götze 1993, 40; Gausemeier / Fink / Schlake 1996, 91; Minx / Böhlke 2006, 19).

ments increases; the room for possibilities opens in funnel fashion into the future. In this way, an expanding *space* emerges for possible future developments rather than merely one single possible future.

Looking from the present into the future, the range of possible developments on the part of individual aspects and/or factors – in this case factors a to e, becomes ever greater. Figuratively speaking, a "funnel" of various conceivable salient characteristics opens out for every individually observed aspect of the future (as indicated by the growing cross-sections as time goes on).

Taken together, all these individual "factor funnels" form the total space of joint possible futures for all these aspects. In the field of scenario methods it is common to speak of the "spread" of the scenario funnel (cf. Fig. 2). This perspective of an infinitely spreading space of possible future developments is the genuine primary characteristic of scenario methods and sets them apart from other methods.

Figure 2: The scenario funnel



Source: IZT description in accordance with von Reibnitz (1991, 38)

The outer limits of the funnel symbolize the range of future developments which are left out of consideration (for example because these developments are regarded as impossible).

In the field of scenario methodology, a specific future point in time on this scenario funnel is chosen for observation (cross-section at time t_s). Various different scenarios – here S1 and S2 – are then used to depict the space within which possible developments may unfold. To this end, possible courses of events for the various factors are selected for each scenario, and these are then "condensed" into larger scenarios (as indicated here by arrows a1, b1 and c1 for the first scenario and a2, b2 and c2 for the second scenario).

The selection of factors and factor values required for the construction of scenarios depends on what the respective researcher is interested in finding out. From the broad range of possible developments, for example, it is possible to single out for description probability scenarios (i.e. those which include probable developments), or to condense scenarios into extreme scenarios (e.g. best-case, worst-case scenarios) or even wish scenarios (cf. Steinmüller 1997, 53 with reference to Godet 1993, 56).

It must be remembered in any case that the scenario concept is based on the fundamental assumption that numerous different alternative futures are always possible and that scenarios have the purpose of spanning the space to be filled by possible futures.

It must also be remembered that there are different schools of thought regarding the use of scenarios, each of which views and applies scenarios differently according to its own understanding of the future. For example various approaches rely with different degrees of emphasis on a certain predictability of the future (and thus on that which we can presume to know). These approaches also differ from one another in the way in which they very randomly include developments and discontinuities (i.e. that which we do not yet know or cannot know) in their thinking. Finally, the approaches differ in the degree to which they take the unpredictabilities of the future as an occasion for shaping the future.

The tension created by these three poles – i.e. the tension between knowledge of the future, the limits of this knowledge, and the possibility of influencing the future – is a constitutive characteristic of scenarios and scenario methods. This field of tension includes and demarcates not only the goals and functions of scenarios but also their limitations.

2.2.3 To what end can scenarios be used?

Scenarios are used to attain different goals and thus meet the need for different functions (cf. e.g. Steinmüller 2002a, 44; Greeuw et al. 2000, 9).[6]

As a whole, it is possible to lay out the range of these functions in ideal-typical manner in four dimensions: first an explorative and/or scientific function, secondly a communicative function, thirdly a function of target concretization and creation, and fourthly a decision-making and strategy formation function.

The explorative and/or knowledge function

Scenarios have a knowledge function and this on more than one level. Above all, they have an explorative function inasmuch as they serve to systematize and deepen the existing understanding of contemporary developments, conditions and influences. Inasmuch as they build upon an assessment of future relevant factors, they force those who use them to make explicit existing (implicit or even subconscious) basic assumptions about future developments (Shell International 2003, 12). They also serve to focus attention on possible paths of development, salient characteristics, and the interactions of key factors, along with the range of possible eventualities (cf. Braun / Glauner / Zweck 2005, 33 f.).

In the process, however, scenarios serve not only to produce and/or to deepen our knowledge but also to reveal the limits of that knowledge, i.e. the unpredictabilities, the gaps, dilemmas, and the points of uncertainty (cf. Greeuw et al 2000, 9; Braun / Glauner / Zweck 2005, 33 f.).

It is possible with the aid of scenarios to achieve a transformation effect (cf. Tegart / Johnston 2004, 35 ff.). That is, an initially unknown future environment which is characterized by a spectrum of possible developments, "*a range of futures"* (Tegart / Johnston 2004, 33 [referring to Courtney 2001]) can be transformed into a future environment in which developments are

6 Greeuw et al. (2000, 9), for example, distinguish between an "information function" and an "advisory function in the decision-making process", and Gaßner / Steinmüller (2006, 134 ff.) and Steinmüller (1999, 696 ff.) differentiate even further and distinguish in addition a communication function and a goal-setting function.

assembled into scenarios, so that clearly distinguishable alternative or "alternate futures" (ibid.) are recognizable.[7]

In addition, scenarios can also widen the scope of our reflections and improve their accuracy concerning alternatives beyond the limits of conventional paradigms (Greeuw et al. 2000, 7):

> *"Scenarios are perhaps most effective when seen as a powerful tool to broaden perspectives, raise questions and challenge conventional thinking."*

Scenarios likewise make a special contribution to science inasmuch as they frequently make it possible to combine qualitative and quantitative knowledge (Greeuw et al. 2000, 9):

> *"Scenarios are in principal powerful frameworks for using both data and model-produced outputs in combination with qualitative knowledge elements."*

"Scenarios allow for looking 'far and wide" (Barré 2004, 116; quotation marks in the original text); they provide support for more long-term and more system-oriented observations than other approaches (cf. Barré 2004, 116).

The communication function

Secondly, scenarios have a communication function, and this in turn on several different levels:

On the one hand, they can themselves be generated as part of communicative processes and thus serve to stimulate a discourse in which they help to promote a common, shared understanding of a problem while also promoting an exchange of ideas and the integration of different perspectives concerning a topic. In this way, they can bring a focus to communication processes while improving them, thus contributing to better cooperation

7 Tegart /Johnston base their thoughts on the classification of Courtney and distinguish on the whole four levels of uncertainty. The task and the possibilities of futurology, argue these authors, is to attempt a reduction of uncertainty by taking the respective degree of uncertainty in each case into consideration (cf. Tegart /Johnston 2004).

while creating a network among the different persons who are actively involved (e.g. among experts from different areas or between theoreticians and those involved in the practical application of ideas) (cf. Gaßner / Steinmüller 2006, 134).

On the other hand, scenarios can also be used to generate communication and to inform about topics and priorities, thus expanding the understanding of topic areas (cf. Eurofound 2003, 88), thus casting light on problem situations and enriching debate about these matters. In particular, the most illustrative scenarios are preferred for use in public communication.

The goal-setting function

Thirdly, scenarios serve as aids in the development or concretization of goals to be kept in mind. They direct attention to the personal positions of those involved (cf. Minx / Böhlke 2006, 18). With the help of scenarios it is possible to deal with the questions "Where do we want to go from here?" and "What do we hope to achieve?" Scenarios can be used to develop normative ideal images of the future or to aid in reflections about the desirability of future developments.

The decision-making and strategy formation function

Fourthly, scenarios are employed in the processes of arriving at decisions and carrying out strategic planning inasmuch as they mediate points of orientation to those carrying out the planning (Braun / Glauner / Zweck 2005, 34). On the basis of scenarios it is possible to work out options and indicators for taking action (cf. Eurofound 2003, 88). Moreover, they also make it possible to evaluate decision-making processes, actions to be taken, and strategies. Usually, this work is done with numerous different alternative scenarios which are then compared with one another (cf. Eurofound 2003, 88) in order to illustrate different future developments and to let the consequences of various developments and/or decision-making processes play out against a virtual backdrop. In this way, scenarios serve to test the reliability, robustness, and effectiveness of policies (cf. Eurofound 2003, 88).

In addition to these variegated functions of scenarios, it also appears advisable to keep in view the limitations of that which can be achieved with them.

2.2.4 When are scenarios inappropriate?

First of all, it is important to emphasize that scenarios are not a kind of universal methodological tool; there is no one scenario approach which can provide all four of the functions described above at one and the same time. On the contrary, scenarios are applied specifically and at times with clearly different points of emphasis in order to reach different goals.

Secondly, it is important to repeat that although it is quite possible for scenarios to be based (among other things) on prognostic knowledge, they are nevertheless not to be viewed as "hard and fast" predictions (e.g. Greeuw et al. 2000, 7). It is much more the case that scenarios are projections which – for example in thought experiments – combine and answer various "What would happen if" questions. The factual prognostic value of scenarios should therefore not be overestimated. Scenarios can at most reveal ranges of developments; in the rule, however, they make no claim to hit the mark with precise predictions. Scenarios in this sense never depict true and necessarily impending futures but always only possible ones. Scenarios also make no claim to be self-fulfilling; rather, their task is to direct attention to the development of various factors and how these interact with one another (Eurofound 2003, 89). It nevertheless occurs time and again that scenarios are misunderstood as representing the only possible future, even when numerous other scenarios are present as alternatives. The fact is that they can only serve as "indicative of a spectrum of possibilities" (Eurofound 2003, 89). The selection and construction of scenarios always implies that other scenarios could have been constructed and selected.

A further limitation of scenarios is to be found in our own cognitive limitations in thinking about the unknown and the uncertain. Even though scenarios should have the function of breaking through old thought structures, human beings nevertheless often tend to follow and extend well-beaten paths. The problem in doing so can be illustrated by the metaphor of a drunkard who, thinking he needs only bright light, searches for his house key under a street lamp at night, even though he has already lost it – in the dark – somewhere else; that is, whenever we are unable to process information because it is lost to us in darkness, we prefer to turn to the "known suspects". For this reason scenarios can run the risk of being marked by thoughts which show little innovation, which in their orientation are very much extrapolations of existing trend vectors, which are allegedly "objective knowledge", and which thus overlook the presence of inconsistencies

and the possibility of less likely developments (cf. Greeuw et al. 2000, 7 and Braun / Glauner / Zweck 2005, 34).

Because of their focus on the future, scenario methods do not use the criterion of the falsifiability of scientific theories; this is because scenarios make no claim to insights in the sense of the natural sciences. At the same time, however – and in spite of ever-present and changing boundary conditions – futurologic research – including scenario methods – always remains subject to the criteria of good scientific work, such as logical consistency, a clear description of scope, an explanation of premises, and transparency (cf. Kreibich 1996).

The following presentation of points common to concrete scenario approaches and points at which they differ from one another is based on the basic principles which are generally understood under the term "scenario", together with a description of the underlying understanding of the future and the aims and limitations of scenario approaches.

2.3 Methodological commonalities and differences

The following Section 2.3.1 begins by sketching and systematizing the field of scenario methods as a spectrum. Then the *general* course of a scenario process will be outlined as a basic foundation common to many scenario approaches (2.3.2). Then the differences within scenario approaches are discussed against the background of their basic characteristics (2.3.3) and their differences in scope (2.3.4.). The picture is then enlarged by introducing the criteria of "good" scenarios and the issue of process criteria (2.3.5.).

2.3.1 The range of the field of scenario methodology

The scenario method does not exist as such; rather, "scenario methodology" is rather a comprehensive term which in actual practice covers the most varied possible assortment of approaches, techniques, and research and workshop designs. The term "scenario methods" represents a methodological concept encompassing a canon of approaches with different degrees of complexity.

For purposes of systematization, it is only logical to carry out a study of different methodological levels (see also with regard to the following Steinmüller 1997, 40 ff.). In the process, scenario approaches can be regarded as

a complex set of methods which invariably consists of numerous different methodological steps or phases.

Different techniques may be applied within the framework of a practical scenario *process*. The sequence of steps or phases comprising the concrete, salient characteristics of a scenario method is determined by the selection of a specific scenario technique. A synonym commonly used when speaking of scenario techniques is "scenario analysis" (cf. Mißler-Beehr 1993, 8). Another concept sometimes used synonymously is "scenario management", which emphasizes the aspect of the strategic application of scenarios on the part of decision-makers (cf. Gausemeier / Fink / Schlake 1996, 14). The concepts of "multiple scenario analysis" (MSA) and "scenario-writing" are also widespread. Many different approaches are to be found on the level of these scenario techniques (cf. e.g. Steinmüller 1997, 40); for their part, they employ a multiplicity of instruments and/or supplementary techniques in order to work out the inner design of the individual steps.

At the same time, scenario method techniques with all their procedures and instruments do not stand alone in a "methodless" space, but rather have recourse to techniques and instruments which are also applied in other types of methodological design (e.g. trend analysis, actor analysis, cross-impact analysis etc.). In fact, they are often coupled in research designs with other independent methods. As a result, one for example finds method combinations involving modeling methods, Delphi-methods, or road-mapping techniques.

What is the reason for this multiplicity of approaches, and why is there no clearly defined canon of methods for scenario techniques?

– Firstly, many different scenario techniques have been developed due to the growing spread of scenario use in different application contexts (cf. e.g. Blasche 2006, 66; Eurofound 2003, 88). Among the fields of application are e.g. business enterprises, city and land-use planning, and research and advisory services (e.g. global scenarios affecting the environment or energy uses) with their correspondingly different assumptions and standards. Many areas of science and practical application today use scenario techniques. The individual forms of these techniques, however, may vary widely depending on those who commission or instigate the respective scenario and on the respective developmental roots of these techniques.

– Secondly, and this is presumably the primary reason for the multiplicity of methods, the spectrum of goals and functions has grown constantly since the first emergence of the scenario concept.

– Thirdly, different schools of thought and paradigms have influenced work with scenarios and have infused different perspectives into the field of scenario methods by bringing in patterns of thought and creative techniques from the natural sciences.

– Fourthly, scenarios may have widely varying positions of importance in projects and research processes depending on the concrete, salient characteristics involved. Scenarios may not only be end product of a project (scenario generation), but equally also its point of departure (scenario evaluation) or even its interim product (scenarios as an intermediate step toward further processing and transfer) (cf. Eurofound 2003, 90).

– Fifthly, the concept of a "scenario technique" subsumes on the one hand fully different approaches, while on the other hand different labels may also exist for intrinsically similar approaches inasmuch as different "scenario service suppliers" use them merely to give prominence to their own approach and set it off from the others (cf. Steinmüller 1997, 40).

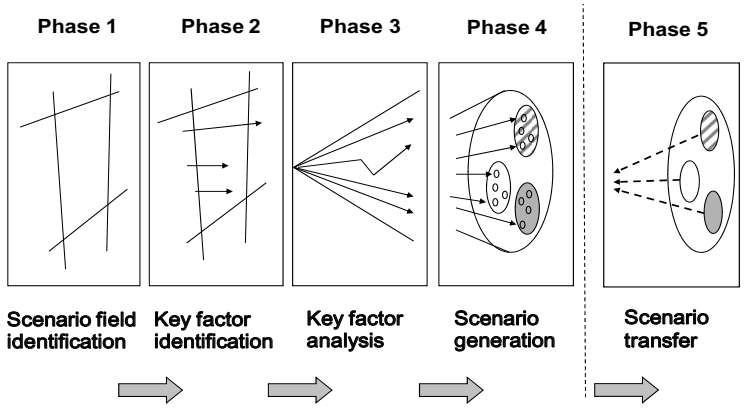
"Scenario methods" are thus a point of confluence for different approaches whose origin is not alone scientific and/or theoretical but rather often – and quite the contrary – deeply shaped by their practical implementation. Above all, scenario methods represent applied knowledge, with theoretical underpinnings which may vary in importance from one situation to another; depending on the concrete practical situation, this knowledge is and must be always adapted practically (and pragmatically as well). For that reason, the present study has the aim of identifying the characteristics of different key variants of scenario methods.

2.3.2 General phases of the scenario process

In spite of all the multiplicity of scenario techniques, it is possible nevertheless to identify a more or less important "lowest common denominator" on the basis of typical phases. This means that there is a widespread common consensus about the general course taken by them. However, the individual phases take on very different shapes in the various techniques.

Various proposals have been made for delineating and designating these phases.[8] The most abstract of these (cf. e.g. Mißler-Behr 1993, 9) is a division into the three phases of analysis, prognosis and synthesis. This division places emphasis on the special characteristic of scenario techniques in that they offer both analytic and synthetic functions. The term "prognosis", however, may be misleading (as already mentioned earlier). For that reason the following, somewhat more concrete division will be used: the scenario process goes in ideal-typical fashion through the five phases of 1) identification of the scenario field, 2) identification of key factors, 3) analysis of key factors, 4) scenario generation, and, if necessary, 5) scenario transfer (cf. Fig. 3).

Figure 3: The general scenario process in five phases



Source: IZT

8 Cf. e.g.
- The five phases of Gausemeier / Fink / Schlake (1996): scenario preparation, analysis, prognostics, formation, and transfer.
- The four phases of Burmeister / Neef / Beyers (2004); Dießl (2006): monitoring, analysis, projection, transformation.
- The four phases of Phelps / Chan / Kapsalis (2001): defining the scope, database construction, building scenarios, choosing strategic options.
- The eight phases of Steinmüller (2002b): problem analysis, scenario field identification, projection, consistency checks, scenario building, analysis of distruptive events, impact analysis, scenario transfer.

Phase 1: Identification of the scenario field

The first step in every scenario process is to define precisely for what purpose scenarios are to be developed. "What specifically is the issue here"? What is the topic? What problem is to be dealt with? How is the scenario field to be defined? What must be integrated? And of equal importance: Where are the limits, that is: what is to be left out of consideration? This thought corresponds for the most part with the definition of the object to be researched and the definition of topics in other research designs; in its degree of concreteness, however, it even goes to some extent beyond them.

This phase sets the perspective to be selected for the period under study (cf. Gausemeier / Fink / Schlake 1996, 132 ff.). At the beginning of the scenario process, comprehensive decisions regarding relevancy are to be made regarding the boundaries of the field which will be taken under study. For example, will a self-contained field of organization – such as a business enterprise, a clearly defined area of technology, or an organization like the Association for Technical Cooperation (GTZ) be observed, meaning its internal factors alone? Or will mostly external factors, that is, the world immediately around it, be taken under study? Such "surroundings" scenarios may well include the widest possible variety of dimensions: environmental, economic, political, technical, and cultural factors. Or will the internal arena and the surroundings, together with their interrelationships be taken for study as a system, resulting quite deliberately in so-called "system scenarios"? One example of this would be: "What impact do contemporary events in politics, the environment, the economy, etc. have on the GTZ, and what impact does the GTZ have on the world immediately surrounding it?" In addition, this phase may also include a "peeling away" of non-essential topics contained in the scenario in order to confine it to certain points of emphasis. To come back to our example, it is not the GTZ which will be observed in this case, but rather, for example, gender issues within the GTZ.

Phase 2: Identification of key factors

The next phase involves working out a description of the scenario field in terms of its key factors, or "descriptors", as they are sometimes called. These are the central factors which together form a description of the scenario field while also having an impact on the field itself and/or serving as means for the field to have an impact on the world around it. Key factors are thus those variables, parameters, trends, developments, and events

which receive central attention during the further course of the scenario process.

Identification of these key factors requires knowledge of the scenario field as such and its interactions with the various key factors.

The process of actually identifying the key factors within the framework of scenario processes differs very much from one case to another. The required information about key factors is sometimes fed into the scenario process through a very intensive preliminary period of empirical and theoretical analysis (often in the form of desk research); sometimes however, it is also generated in participatory fashion through workshops or through rounds of surveys. The first procedure attempts above all to establish a sound theoretical foundation for each scenario and relies upon in-depth analysis; the second focuses above all on establishing a foundation for each scenario via the intuitive and implicit knowledge of those involved while also relying on an ability to overview and the power of synthesis. And whereas in the first case the concrete selection decisions are central (What factors are to be focused on, and why?), the second case focuses more on the synergy which results from the composition of those who participate and on procedural support for the development of a sense of "ownership" among the participants and the resulting interdisciplinary legitimacy of the later scenarios.

Phase 3: Analysis of key factors

This brings us to the step which is especially typical of scenario techniques and sets them apart from other methods: the widening scenario "funnel" in which individual key factors are subjected to analysis to find what possible future salient characteristics are conceivable in each case. An individual "funnel opening into the future", so to speak, widens out for each factor inasmuch as those salient characteristics are selected which are to become part of the budding scenario.

Although this step can be carried out in numerous ways, it always contains intuitive and creative aspects; these are essential for visualizing the various future developments of any key factor.

Phase 4: Scenario generation

Scenarios are generated by singling them out and condensing them from the "cross section" of the scenario funnel whose opening extends to the selected projection point in the future. This is where consistent bundles of factors

are brought together, selected, and worked up into scenarios. However, major differences in method are also found at this step. The process by which the "condensation" into scenarios takes place may extend from narrative literary procedures all the way to formalized, mathematical techniques (cf. Chap. 2.4).

In addition, a sorting out of scenarios is required in many scenario techniques. Even though many scenarios are often theoretically conceivable, the number of scenarios which can be processed cognitively is limited. Practical experience has shown that the number of scenarios which can be meaningfully distinguished from one another and are thus open to interpretive processing lies around 4 to 5 scenarios at a maximum for any one scenario field (cf. Eurofound 2003, 89).

This process of selection may take place, for example (cf. Henrichs 2003), according to the following rule-of-thumb: as many as are required to cover an adequate number of perspectives and possible futures, but as few as possible, in order to avoid fatigue and to ensure that the process remains manageable.

A meta-study of European and global scenario studies (with special focus on the areas of the environment and energy) has shown that in actual practice such research frequently singles out four scenarios according to the categories in the table below (cf. Greeuw et al. 2000, 89). In the process, the intensity of *actions* to be taken and/or policies may be varied on the one hand as a means of studying different future possibilities for taking action or avoiding it; on the other hand, assumptions concerning the possible future development of surrounding factors may be varied in order to anticipate the different *contexts* of such action:

Scenario type	**"Wait and See"**	**"Just Do it"**	**"Doom Monger"**	**"Carpe Diem"**
Underlying logic	No or only few new actions	Many new actions	Negative development of external factors	Positive development of external factors

A further possibility of differences in the construction of scenarios is illustrated by the following example.

The end product of this phase: finished scenarios.

Example: "A tale of four futures"; Outlook 2002-2032 (UNEP 2002, 328 ff.) (Abstracts of Scenarios)

Markets first

... Most of the world adopts the values and expectations prevailing in today's industrialized countries. The wealth of nations and the optimal play of market forces dominate social and political agendas. Trust is placed in further globalization and liberalization to enhance corporate wealth, create new enterprises and livelihoods, and so help people and communities to afford to insure against – or pay to fix – social and environmental problems. Ethical investors, together with citizen and consumer groups, try to exercise growing corrective influence but are undermined by economic imperatives. The powers of state officials, planners and lawmakers to regulate society, economy and the environment continue to be overwhelmed by expanding demands.

Policy first

... Decisive initiatives are taken by governments in an attempt to reach specific social and environmental goals. A coordinated proenvironment and antipoverty drive balances the momentum for economic development at any cost. Environmental and social costs and gains are factored into policy measures, regulatory frameworks and planning processes. All these are reinforced by fiscal levers or incentives such as carbon taxes and tax breaks. International 'soft law' treaties and binding instruments affecting environment and development are integrated into unified blueprints and their status in law is upgraded, though fresh provision is made for open consultation processes to allow for regional and local variants.

Security first

…This scenario assumes a world of striking disparities where inequality and conflict prevail. Socioeconomic and environmental stresses give rise to waves of protest and counteraction. As such troubles become increasingly prevalent, the more powerful and wealthy groups focus on selfprotection, creating enclaves akin to the present day 'gated communities'. Such islands of advantage provide a degree of enhanced security and economic benefits for dependent communities in their immediate surroundings but they exclude the disadvantaged mass of outsiders. Welfare and regulatory services fall into disuse but market forces continue to operate outside the walls

Sustainability first

…A new environment and development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions. A more visionary state of affairs prevails, where radical shifts in the way people interact with one another and with the world around them stimulate and support sustainable policy measures and accountable corporate behaviour. There is much fuller collaboration between governments, citizens and other stakeholder groups in decision-making on issues of close common concern. A consensus is reached on what needs to be done to satisfy basic needs and realize personal goals without beggaring others or spoiling the outlook for posterity.

In the narrower sense, the scenario process is completed after these four phases. Of central importance in all four phases, however, is that a series of selection steps be taken and backed up with reasons.

Optional: Phase 5: Scenario transfer

This phase involves a description of the further application and/or processing of scenarios which have been generated. However, it is counted explicitly as part of the scenario process proper only in the case of a certain few scenario techniques. Here again, there is a wide range of possibilities for using finished scenarios, e.g. in impact analyses, actor analyses, strategy assessment and development, etc. (cf. Section 2.4.5 for a discussion of the techniques of scenario transfer.)

Following this description of general points in common in the scenario process, the focus will now be directed to points of difference among the various scenarios, and criteria will be presented for distinguishing and characterizing the various scenario approaches.

2.3.3 The basic characteristics of scenarios

The literature contains some proposals for identifying characteristics and typologies among the multiplicity of scenarios.[9] However, no typology has yet been presented which covers all approaches, that is, none which can be detailed enough to clearly and simultaneously characterize the widest variety of approaches in depth. Most of the existing characterizations thus remain either very generalized or are so specialized that they fail to cover the entire spectrum of different approaches (cf. van Notten et al. 2003).[10] They take the form of pragmatic categories rather than well-founded typologies (see Mietzner / Reger 2004, 52 for a discussion of this deficit).

For this reason, only a few basic features which permit a *basic* characterization of many approaches and are regularly used in the scenario literature will be presented here. They are, to begin with, the contrary pairs of "explorative" vs. "normative" and "qualitative" vs. "quantitative". An additional important aspect is the question to what extent scenarios can include possible future actions to be taken (i.e. "reference" scenarios vs. "policy" scenarios) or can integrate "surprises" and/or discontinuities.

9 See e.g. Steinmüller (1997) or Mietzner / Reger (2004) for an overview and discussion of the various attempts at identifying typologies.

10 Van Notten et al. (2003) have presented an "updated scenario typology" in an attempt to fill this gap with a new typology. They classify the different characteristics of scenarios into three main groups: 1) Target, 2) Process design, and 3) Scenario content.

Explorative vs. normative approaches

The literature frequently divides scenario techniques basically into the "explorative" and the "normative" (cf. e.g. van Notten et al 2003; Alcamo 2001; Greeuw et al. 2000; Steinmüller 1997 etc., etc.). These two poles also stand for two basic, ideal-typical stances regarding scenario method techniques.

When used in connection with techniques, the appellations "**explorative**" and/or "**descriptive**" designate sets of possible events regardless of their desirability (Greeuw et al. 2000, 8). Such techniques pose *"What-would-happen-if" questions* and take the present as their starting point. They then use considerations regarding developments, driving forces, and possible consequences to work out a conceptual future (cf. Eurofound 2003, 8). The primary function of such techniques is to lay bare the unpredictabilities, the paths of development, and the key factors involved: "What do we know and what do we not know"? (the "explorative" and/or the "knowledge" function). They are employed, for example, like "simulators" in order to go through the consequences of possible decisions and actions which might be taken.

Normative scenarios, on the other hand, assimilate values and interests (cf. Greeuw et al. 2000, 8). They pose questions either about the desirability of conditions in the future "*What do we want the future to be like? Where do we want to go with it?"* and/or questions which take possible futures as their point of departure: "*How can we get there? What must happen in order for it to become reality?"* (cf. Eurofound 2003, 88). This second type of normative scenario clearly looks back from a future point in time toward the present. Its function is to work out the process by which a specific (desired) state of affairs can be attained. It is used to demonstrate how certain goals can be achieved. Normative scenarios have a goal-setting function and a strategy-developing function.

However, scenario techniques differ from one another not only in whether they are "unprejudiced" in their study of possibilities or (preferably) attractive objects of desire, but also and in addition in whether they attempt to determine the probability of future developments (cf. Steinmüller 1997, 53). This is sometimes attempted in explorative scenarios, but only seldom in normative scenarios, since the latter assume that the probability of developments can be influenced to a major degree by taking an active part in

Table 1: Schematic comparison of explorative and normative scenarios

	Explorative	**Normative**
Procedure	Explores possible future developments with the present as point of departure	Identifies desirable futures or investigates how to arrive at future conditions
Function	Explorative and/or knowledge function	Target-building function and/or strategy development function
Implementation	Study of factors and unpredictabilities, test of possible actions to be taken and/or decision-making processes	Definition and concretization of goals and/or, if appropriate, identification of possible ways to reach a goal
Central question	What? – What if?	How? – How is it to come about? – How do we get there?
Inclusion of probabilities	Possible	Indirect, part of plausible shaping and planning

Source: The IZT with elements borrowed from Henrichs (2003); Greeuw et al. (2000); Steinmüller (1997)

shaping future developments. The following table summarizes explorative and normative scenarios by placing them in juxtaposition with one another (cf. Table 1).

However, this dichotomous characterization of scenario approaches also has its difficulties. Firstly, selective decisions must be made at many points of the scenario process when a scenario is being constructed (i.e. decisions regarding not only the definition of the scenario field, but also the relevance of key factors, the determination of key factor characteristics to be studied, and the condensation of factors into individual scenarios). For this reason, scenarios are *always* – at least implicitly – normative. However, the different approaches either view this normativity to varying degrees as open or deal with the scenarios reflexively (cf. van Notten et al. 2003). Secondly, it has become common in actual contemporary practice to use both explorative and normative scenarios in combination, especially when the aim is to develop strategies (ibid. and Steinmüller 2002b, 13).

Qualitative vs. quantitative approaches

Scenarios and scenario techniques are also distinguished by the type of information which they can and should assimilate and/or transport. Are qualitative descriptions alone used, or are quantitative data employed? Or will the users use estimates to quantify qualitative data? Different instruments of analysis are used for the identification and analysis of key factors, and different techniques are employed for the generation of scenarios depending on whether quantitative or qualitative data are required, meaningful, and available. Quantitative knowledge is used, for example, in topic areas like demography and economics, whereas on the other hand cultural, institutional or political dimensions often tend to be recorded qualitatively.

The methodological decision for proceeding either qualitatively or quantitatively has direct consequences regarding the possible degree of formalization of the scenario technique to be used. To put it provocatively and ideal-typically, quantitative approaches have recourse to mathematical models, qualitative approaches on the other hand have recourse to narrative and/or literary techniques.

The two approaches also differ in the manner in which they select and study the respective key factors. Quantitative scenarios make it necessary to arrive at a firm definition of a reduced number of factors, whereas qualitative scenarios make it possible to achieve an intrinsically more meaningful observation of details and nuances without the need of definitively including or excluding key factors.

Another difference between these approaches is the chronological horizon which they are capable of describing meaningfully. Quantitative approaches can be used above all for short, at most medium-term perspectives; qualitative approaches, on the other hand, can be employed especially when allegedly "hard" quantitative knowledge suffers a loss of plausibility during the course of longer-term observation.

In actual scenario practice, however, this dichotomous characterization of scenario approaches has only conditional relevance, since scenarios today are often based on a hybrid approach in which both qualitative and quantitative data are gathered and translated from qualitative to quantitative knowledge (quantification) or from quantitative to qualitative narrative knowledge (as in the textualization of key bundled key factor characteristics into scenario texts).

Table 2: Comparison between quantitative and qualitative scenarios

	Quantitative	Qualitative
Implementation	When quantitative knowledge – is required – and present – and/or quantification is possible	When qualitative knowledge – is required – or quantitative knowledge is not present – or quantitative knowledge is not present
Topic areas	e.g. demography, economic development	e.g. institutions, culture, politics
Impact on the degree of formalization	Tendency to a high degree of formalization	Tendency to a low degree of formalization
The ideal-typical scenario technique	Modeling methods	Narrative and/or literary techniques
Manner of selecting key factors	Firm definition of a narrowly limited number of factors	Intrinsically sensory observation of details and nuances, possible without a stringent selection of factors
Chronological projection space	Short to medium-term	Medium to long-term

Source: IZT description with reference to van Notten et al. (2003); Alcamo (2001, 10); with additions by the IZT

The following two distinctions of types of scenarios lie on quite another level; common to both, however, is the basic question of how to deal with future changes, that is, with change and unpredictability: 1) Is it also the aim of scenarios to study possible new actions to be taken, along with decision-making processes? 2) Are surprises, i.e. unexpected, sudden and possibly even dramatic events also to be taken into consideration in the development of scenarios?

"Reference scenarios" vs. "Policy-scenarios"

Reference scenarios and/or "baseline-scenarios" (Gausemeier / Fink / Schlake 1996; Steinmüller 2002b) project contemporary developments continuously into the future, i.e. they assume that no new decision-making processes or actions whatever are to be initiated. Their logic is "Business As Usual", and for this reason they are often described in brief as "BAU-

scenarios“. Their goal is first to explore what will happen “If we continue as up to now“. Secondly, these scenarios serve as reference-scenarios in comparison with scenarios which study the possible alternatives for deciding on how to act and what actions are to be taken. Such “policy-scenarios“, as they are called, or “alternative scenarios” explicitly integrate new decision-making processes or actions to be taken in order to simulate and test the possible options for action and their consequences.

Integration of discontinuities

However, the manner of proceeding with reference-scenarios and alternative scenarios also involves the danger of failing to take the unexpected into account and, as a result, tending to develop more “conservative“, i.e. less creative conceptual future. Greeuw et al. (2000, 8) and van Notten et al. (2003) come to the conclusion that most current scenario studies take only incremental changes into account while overlooking discontinuities almost completely.

For this reason, it is important to seek methodological possibilities for integrating the element of chance and/or discontinuities into future developments. Among the approaches which integrate the improbable, the undesirable, or even the “unthinkable” aspects of development are Problem Event Analysis (cf. e.g. Gausemeier / Fink / Schlake 1996) or the so-called “wild cards” (cf. e.g. Steinmüller / Steinmüller 2003 and Section 2.4.5, with the Excursus: Techniques of Scenario Transfer).

2.3.4 Scope

Scenarios can differ widely in scope. This affects, for example, their selection of a chronological horizon, their geographical scope, and their coverage of themes.

In general scenario techniques are faced with the fundamental challenge of reducing complexity sufficiently to permit a process of synthesis. Their aim, after all, is to keep numerous different factors simultaneously in view in order 1) to observe their interactions and 2) to be able to develop overall images of future situations. This process of synthesis, however, is always limited by the cognitive abilities of those involved in the scenario. This also means, for example, that global scenarios cannot include hundreds of key factors since processing them cognitively in a meaningful way would then be impossible. In many respects, interrelationships are to be found in

the process of weighing pros and cons between the various scopes and between the scopes and the degree of abstraction and/or depth of detail in scenarios.

The chronological horizon and/or observation period

Scenarios are constructed with chronological horizons of varying breadth. The periods to be studied may be short-term (up to 10 years), medium-term (up to 25 years) and long-term (more than 25 years) (cf. Kreibich 2006, 3; van Notten et al. 2003).

In addition (cf. Blasche 2007, 89), static observations from a point in time in the future are possible; we then speak of "static scenarios" and/or "end state scenarios" (van Notten et al. 2003). Again, the dynamics of development throughout a number of different stages in time in the future may be observed, in which case the scenarios are dynamic / sequential scenarios and/or "chain scenarios" (van Notten et al 2003). In this case, numerous different stages may be selected during the study of very long periods of time, for example in the case of developments up to the year 2100, and then scenarios may be developed extending first up to 2020, thereafter on this basis up to 2050, and only subsequently up to 2100.[11]

Geographic scope

Scenario concepts may be formed with varying geographical scopes. Greeuw et al. (2000, 9 f.), for example, distinguish four different geographical points of reference for scenarios:

– The global level
– The international and regional level
– The national level
– The sub-national and regional level

In addition, the local level may be adduced as a fifth level.

Thematic coverage

Scenarios may of course also be distinguished – depending on the problem to be dealt with – by their thematic pattern (cf. Greeuw et al. 2000, 9 f.).

11 As, for example, in the IZT project "Forest Visions 2100".

Some, like "issue-based scenarios" (van Notten et al. 2003), focus on individual themes (e.g. "sustainability"); others observe individual sectors and/or social fields (e.g. "the environment", "energy" or "water"), while "institution-based scenarios" direct their attention to the special area of interest of an organization or institution (van Notten et al. 2003). In addition to a generalized classification of the levels of observation and viewpoints of scenarios, a classification into macro-, meso- and microlevels is sometimes also used (cf. e.g. Mietzner / Reger 2004, 52).

Integration

With regard to the chronological, geographical and thematic scope of scenarios between the poles of depth of detail and degree of abstraction, there exists a basic problem: a very wide chronological, geographical or thematic scope is achievable only through a high degree of abstraction, generalization, or aggregation. Theoretically, on the other hand, various possibilities exist for achieving a wide range through the integration of different levels; these possibilities are currently being tested more and more in actual practice (cf. van Notten 2003).

For example, some researchers attempt on the geographical level to integrate the global, regional and local levels, rather than regarding them in isolation from one another. Numerous different approaches exist for achieving such integration:

– All three levels are observed concurrently (i.e. parallel or iteratively).
– Beginning with global scenarios, top-down regional and, ultimately, local scenarios are developed (including feedback loops to the next highest level, as the case may be).
– Beginning with local scenarios, bottom-up regional and global scenarios are developed (including, as the case may be, feedback loops).
– Double integration: for example, European scenarios constructed in the European Commission's VISIONS Project („Integrated visions for a Sustainable Europe") included global trends on the one hand while also being linked with scenarios on the level of the European regions (bottom-up and top-down integration) (cf. Greeuw et al. 2000, 9 f.).[12]

12 See e.g. Rotmans et al. (2000) for further information about this project and the integration techniques used in it.

It is conceivable that these integration strategies might be used analogously for the integration of different chronological dimensions and different thematic fields.

2.3.5 Criteria of quality and process criteria

The standards taken as a basis for evaluating scenarios and scenario techniques are often based on the same criteria as those of good research. But there are also more scenario-specific criteria for the evaluation of scenarios. In the following, some process criteria will be mentioned.

The literature proposes some criteria as central in evaluating the quality of scenarios and scenario processes, independently of the respective goal and type of the scenario process. Although scenarios are always hypothetical in nature, this by no means makes them arbitrary. Therefore a good scenario should have the following characteristics:[13]

Plausibility

In relation to scenarios (cf. e.g. Greeuw et al. 2000; Wilson 1998), plausibility means that the possibilities of development which are presented must at least be regarded as *possible* developments. That does not mean, however, that these developments are also probable or desirable (the manner of proceeding differs here depending on the respective goal and technique).

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13 Concerning the criteria for judging the quality of scenarios, Greeuw et al. (2000, 7) among others name the following: internal consistency, plausibility, and sustainability. Kreibich (2007, 183) names the following general criteria of quality in futurology: logical consistency, openness to evaluation, terminological clarity, simplicity, definition of range, explanation of premises and boundary conditions, transparency, relevance, practical manageability, and fruitfulness (i.e. in terms of gain in knowledge, orientation, innovation, motivation etc.) .
Wilson (1998) names the following: plausibility, differentiation, consistency, decision-making utility, and challenge.
Heinecke / Schwager (1995) name the following: tangibility (clearness, cohesion with the object of investigation, suitability, transparency), closeness of the content (flawlessness: no invalid assumptions, plausibility, completeness, finding of cohesions, description of development, information content: precision, universality, utility), relevance (function of decision, function of orientation, relevance in different planning processes and analysis of problems, forecast, assessment and decision); constitution and proportion of scenarios among themselves (dissimilarity, registration of all future situations, homogeneous forms and statements, stability).

The path to the futures and images which are described must thus be conceptually feasible and may not be regarded as impossible.

Consistency

"Consistency" with regard to scenarios (cf. e.g. Greeuw et al. 2000; Wilson 1998; Gausemeier / Fink / Schlake 1996; Steinmüller 1997) means that paths to the futures and images within a scenario must be consistent with one another, i.e. their aspects may not be mutually contradictory or even go so far as to exclude each other for reasons of logic and plausibility. A scenario on the topic of water, for example, is therefore inconsistent if it assumes an abatement of research and developmental efforts in the area of drinking water technology while simultaneously assuming major technical progress in the processing of drinking water.

Consistency and plausibility are the decisive conditions for assessing scenarios as *credible* (cf. Steinmüller 1997, 62).

Comprehensibility & traceability

In relation to scenarios (cf. e.g. Greeuw et al. 2000; Heinecke / Schwager 1995), comprehensibility means that the developments and conceptual futures which are presented must be traceable. This in turn means on the one hand that they must be detailed enough to be comprehensible, while not combining so many dimensions and key factors on the other hand that they suffer a loss of comprehensibility due to their complexity.

Distinctness

Distinctness, i.e. the quality of being clearly distinguishable (cf. e.g. Wilson 1998; Heinecke / Schwager 1995), means that the selected, alternative scenarios differ from one another clearly enough that they can be interpreted and compared with one another as separate and distinct sketches of the future.

Transparency

During the process of their development, scenarios go through an entire series of assumptions and choice decisions, e.g. in answer to the central question of which key factors are to be studied and how possible salient characteristics in future are to be defined and determined. As a means of increasing the degree of verifiability and legitimacy, the assumptions made and the processes by which decisions are reached should be laid open: Who

decided or carried out what, why, how? (cf. e.g. Greeuw et al. 2000; Steinmüller 1997; Kreibich 2007)

The criterion of transparency appears particularly important for doing justice to the criteria of qualitative science. While it is true that such processes are neither reproducible nor falsifiable, such process reflexivity can ensure that a considerable degree of intersubjective verifiability is attained.

In addition, the following applies: "*Scenarios always, either implicitly or explicitly, embody perceptions and judgements."* (Greeuw et al. 2000, 9) This means that a reflexive manner of proceeding which incorporates its own value-stamped, normative positions can greatly increase the transparency of scenarios even in "descriptive-analytic" procedures.

It is also important here to note that this transparency can differ among the persons or groups for whom the scenario is intended (cf. Braun / Glauner / Zweck 2004, 34). For example, a scientific presentation of lists of variables will be transparent for a specialized audience but may possibly be opaque for the general public. Vice versa, scenarios formulated in a more "popular" way are sometimes rejected by groups of specialists as being too deficient in "transparency".

Above and beyond these generalized criteria, individual authors also propose more scenario-specific criteria; of these, the following two appear relevant for certain scenario approaches.

Degree of integration

Since scenarios generally do not focus on detailed issues but are rather employed to study the causal relationships between different dimensions and factors, a further criterion of a good scenario is the question of the extent to which it integrates the interactions of developments on different levels (cf. Greeuw et al. 2000, 10). For example, does it take note of and study the causal relationships between social, economic, ecological and institutional developments? Important in this regard is not only vertical integration, that is, the chain of cause and effect within a topic area and/or sector, but also horizontal integration, that is, the interaction of different sectors and themes. In most scenario fields, moreover, an interdisciplinary approach is indispensable in the process of scenario development in order to achieve a certain degree of integration (ibid.).

Quality of reception

In addition to the above-mentioned criteria of quality, with their heavily scientific bent, it is also to be noted that a good scenario should also be "readable"; it should not become a "torture" for the reader to fight his way through it (cf. Gaßner 1992, 230 f.). For this reason it is also important in working out the concrete formulation of scenarios to pay heed to their more unobtrusive building block factors. For example, Gaßner names "*the power of fascination [...], of implication, of esthetic dimensions, and 'enjoyment qualities' like suspense and humor"* (Gaßner 1992, 230) as possible means for improving the readability of scenarios and increasing their creatively stimulating impact (Gaßner 1992, 230).

"Process criteria" which are directed toward developmental interrelationships thematize questions such as those of participation and the time and effort involved.

Participants

Scenario processes also differ in the types of persons who participate in their development or evaluation. Depending on the degree of involvement, three rough types of participants may be distinguished:

– Scientists / consultants

– (Internal and/or external) experts or persons actively involved, stakeholders with a personal interest

– "Those affected": citizens, consumers, employees, etc.

Some scenarios are created through "desk research" (van Notten et al. 2003) by individual scientists or teams of scientists. In such cases, the degree to which the groups have an interdisciplinary composition is of importance. Other, more "participative" scenario processes, make sure to get different directly or indirectly affected stakeholders and experts involved, such as the person commissioning the scenario or even external persons with practical expertise in the widest sense. Again, other scenario processes, for example, involve the "man on the street" as the one "potentially affected", with the knowledge gained from his or her daily experience of life (in the sense of the "everyday expert") and the goals which he conceives of as normative.

Time and effort involved

In general it must be concluded that scenario processes are work-intensive and time-consuming; that is, they require time, money and personnel resources (cf. Mietzner / Reger 2004, 61 f.; van Notten et al. 2003). Whereas it may be possible to manage the evaluation of an already finished scenario in half a day, the generation of scenarios requires in the rule at least a number of days, if not months. The time and effort involved in a scenario process increases proportionately to the degree of inclusion and integration; this in turn has to do with the number of developments and key factors under study, the breadth of the geographical space, the chronological horizon, and the number of participants. In addition, scenario processes also differ very much in the quantity of materials and the number of techniques which find implementation in them (ranging from pencil and paper to computer software). A further central factor is the question of how much prior work and knowledge has already been carried out or established and how much is still required.

2.4 Three ideal-typical scenario techniques

Three ideal-typical groups of scenario techniques which basically differ from one another and, in doing so, are good representatives of the entire spectrum of scenario techniques, will be presented in the following. In the process, widely accepted variants of one and the same basic type will also be treated.[14]

Taking the general course of scenario processes as a background, we will systematize the different scenario types here in the form of five phases (cf. section 2.3.1). The first phase of the scenario process, i.e. "selection of the

14 There is a much larger group of variously named scenario techniques. Götze (1993), for example, describes twelve approaches. However, these approaches clearly differ only partly in their manner of proceeding. Different proposals have been made in the literature for the typological features of scenario techniques, e.g. "hard" vs. "soft", "deductive" vs. "inductive" (cf. e.g. Götze 1993, 385 ff.; Heinecke 2006, 187 ff.; Heinecke / Schwager 1995, 17). The classification into three ideal-typical groups selected here is rooted in the basic division into "formal" and "intuitive" scenario techniques (cf. e.g. van Notten et al. 2003; Götze 2006). This classification in turn can be broken down even further – in our opinion – through the inclusion of a quite independent group of scenarios on the basis of trend extrapolation.

scenario field" takes a very similar course in most cases, quite independently of the concrete scenario technique which is applied. For that reason, this step will be excluded from the description of the different techniques. Nevertheless, the importance of this phase must again be emphasized, since the entire subsequent focus and course of the scenario process, including in some cases selection of the scenario technique which will later be applied, depends upon it.

An evaluation of different scenario techniques with regard to their respective strengths and weaknesses is possible only in relation to an evaluation criterion. Strengths and weaknesses are always dependent upon the function and goal of a methodological approach. It is thus possible to evaluate in particular the appropriateness of an approach either within a specific knowledge context or in relation to a concrete goal of the respective scenario approach. For this reason it is imperative to clarify the following prior to every scenario process:

– Whether the scenario technique reflects the most appropriate selection of methods,

– what goals and functions are to be achieved or carried out with scenario techniques,

– what basic assumptions about the predictability and unpredictability of the future and our ability to shape it are taken as a foundation.

When compared directly with one another, individual scenario techniques prove to be different in what they are capable of and in their respective limitations. These will be discussed in the following as the "advantages" and "disadvantages" of the individual techniques.

Scenarios constructed on the basis of trend analysis and trend extrapolation will first be presented as fundamental techniques (2.4.1). Then the group of systematic-formalized scenario techniques will be presented (2.4.2), followed thirdly by a discussion of the group of creative-narrative scenario techniques (2.4.3). Such a tabular juxtaposition of ideal types has the advantage of clearly showing their basic form of approach. In actual practice, however, these techniques are often characterized by a plethora of crossover areas and hybridization (2.4.4). Therefore a subsequent excursus will go into some of the techniques of scenario transfer and show how it is possible to implement it as a follow-up to the creation of a scenario (2.4.5).

2.4.1 Scenarios on the basis of trend extrapolation

The first scenario techniques to be treated here as examples are those in which the respective scenario is supported primarily and even exclusively by trends which already exist or have already existed and by their projection into the future. The heart of this technique consists of trend analysis and trend extrapolation. This will be followed by an explanation of how these techniques are normally used within the respective scenario technique in order to work out the "most probable" scenarios or reference scenarios as a basis for contrasting one alternative scenario with another. Additionally, the technique of trend impact analysis (= 'TIA') will also be presented; it can be employed to examine the alternative courses which events may take during a trend.

This technique is based on the basic assumption that the most appropriate way to visualize future developments is the extrapolation of existing developments.

Trend analysis and trend extrapolation

A "**trend**" in this causal relationship is to be understood as a development over a period of time, that is, a long-term vector of development in which the waxing or waning of an interesting factor takes place (e.g. the development of average life expectancy). When understood in this way, "trend" is firstly not congruent with the everyday use of the word, in which (short-term) in-vogue phenomena are termed "trends". Secondly, it is also necessary to distinguish this understanding from so-called "trend research", which sees trends as "economically relevant manifestations of the new" (Pfadenhauer 2006).

The point of departure for trend analysis is an observation of trends which is supported by the collection of – as far as possible – long-term information and data.

Once identified, trends are projected into the future, that is, future courses of events within the individual trends are subjected to calculation by means of statistical techniques (given the availability of quantitative data) or described (given the availability of qualitative data). The instrument which serves as a basis for this is referred to as "**trend analysis**" and represents an independent, frequently employed method of futurology (cf. Strategic

Futures Team 2001, 5). Trend analysis is used within a plethora of application contexts, even independently of work with scenarios.

Quantitative trend analyses are used above all in areas like demography, economics, and technology, provided that solid collections of data which extend far enough into the past are available (cf. Strategic Futures Team 2001, 5).

A typical procedure is the collection and processing of data, the identification of logical or systematic processes of development, and the statistical projection of these into the future (cf. Steinmüller 2002b, 26). Such **extrapolations** can take place as calculations ranging in form from processes of linear logic to complex S-curves (Gordon 1994a, 3).

Such calculations have the **advantage** of being relatively uncomplicated and requiring little effort; they are verifiable on the logical-intersubjective plane, and it is possible to subject them to statistical reliability validity testing (cf. Strategic Futures Team 2001, 6).

However, a major **disadvantage** of such quantitative extrapolations is that they communicate a sense of greater objectivity than they are capable in fact of delivering (cf. Gordon 1994a, 3). Their identification of trends is therefore always based upon interpretation and decisions of selection. In a data series, for example, they often arrive at numerous different possibilities concerning how a trend, that is, the structure of a development, may be visualized. This in turn has consequences for the projection of the respective trend into the future. Moreover, selection of a period for observation and analysis (short time period vs. longer time period, i.e. the “day trader” vs. the “historian” perspective) and the criteria for visualization and analysis can have considerable influence on proper recognition of the trend: when the analysis period is too short or the increments used to measure a long wave movement are too detailed, for example, the result may be erroneous interpretation of a factor which in turn may then mistakenly be shown in a model as either constant or continuously rising.

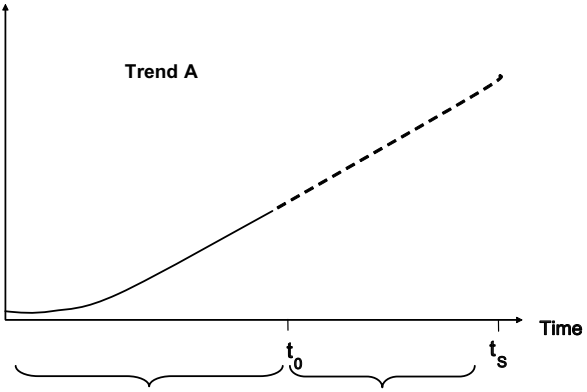
On the other hand, there are also many developments which cannot be meaningfully operationalized and projected in quantitative fashion; for this reason qualitative trend analysis is often used in combination with and as an adjunct to quantitative analysis.

Qualitative trend analysis (cf. Strategic Futures Team 2001, 7 f.) is employed when no quantitative data are available and/or quantitative delineation of the respective trends is possible but inadequate. This is often the case when the development of "softer" factors such as social aspects (standards and values) or institutional and political aspects is to be followed. One example of such a qualitatively delineated trend is the change in values in western industrialized societies. The typical procedure is to define factors which are important because of their influence and to provide them with a theoretical underpinning as a means of arriving at the most thorough possible understanding of these factors and then to further strengthen this foundation of support with all available information in order to accurately describe future developments as such.

"Most probable" scenarios and reference scenarios

When scenarios are constructed on the basis of trend extrapolation, this does not automatically mean that a scenario funnel opens up; in many instances, on the contrary, only a single development comes under observation, namely that which is assumed to be most probable (cf. Fig. 4).

Figure 4: Trend extrapolation, forecast, "business as usual" (BAU)



Source: IZT

The result of such extrapolations, especially those carried out on the basis of quantitative trend analysis, may therefore be a single scenario, the "trend

scenario" (cf. Gausemeier / Fink / Schlake 1996, 114). Such a scenario is often called an "outlook", a "prognosis", a "forecast" or a "spotlight" rather than a "scenario".

One **example** of a current study which is based on numerous different trend extrapolations and which has drawn up a single reference image of the future in "spotlights" for each of the many different factors is "2018 – The 10-Year Future" (Rodenhäuser / Daheim / Uerz 2008). In this case, this approach is implemented with the specific goal of generating not alternative scenarios but rather individual trend scenarios. Also typical of this kind of sample study is the relatively narrow chronological time horizon which is taken under observation with this approach.

Within the field of scenario methods, this manner of proceeding is criticized by many authors as inadequate, since it assumes too strongly that the future consists merely in a prolongation of the past, thus making it completely calculable; it is the height of implausibility, they assert, merely to assume a continuation of existing trends for the decades to come (cf. Greeuw et al. 2000, 8; Gordon 1994a, 1). Minx and Böhlke compare this to the attempt to drive an automobile merely by looking into the rear view mirror (cf. ibid. 2006).

For this reason, although mere trend extrapolation does indeed provide a possible basis of knowledge, it is frequently flanked by other approaches and techniques (cf. Strategic Futures Team 2001, 5). Thus quantitative trend analysis often forms only the point of departure for scenario work; it is then first the inclusion of qualitative trend analysis which brings the possibility into view of thinking in terms of numerous different alternative developments.

It is often the case that a *most probable* trend scenario is constructed as a **reference scenario** with which other scenarios can be compared. Taking the contemporary status of knowledge of trends, actions, and developments as a starting point, this scenario is then used to paint a future in which no new developments or actions whatever are assumed.

However, this practice, too, is not without problems regarding the construction of "reference" scenarios. The interpretation and operationalization of contemporary developments and actions is always selective, meaning that it runs the danger of ignoring new developments which, although difficult to perceive, nevertheless do in fact exist. In addition, such a scenario,

with its policy of "take no action" and its assumption that there will be no major changes, suggests greater certainty about the future course of events than can actually be attained due to the fact that it is often termed "most probable" (cf. Greeuw et al. 2000, 8). One need think only of still unrecognized saturation effects or ceiling effects.

The exclusive implementation of scenarios which are based on trend extrapolation is appropriate only in the observation of very stable trends which can be extrapolated with a relatively high degree of certainty (e.g. geological or demographic developments) or in the case of relatively short horizons of study (1–3 years) (cf. Strategic Futures Team 2001, 4). This technique emphasizes those aspects of the future concerning which relatively certain knowledge exists.

Trend analysis and trend extrapolation can yield interesting pointers for scenario techniques while also serving as basic principles. However, they fail to do justice to the basic idea of scenarios whenever they take only a single possible salient characteristic of a future trend into consideration. This disadvantage of scenarios based on trend extrapolation can, however, be improved, e.g. via trend impact analysis, which makes it possible to study the different possible courses of events within a trend.

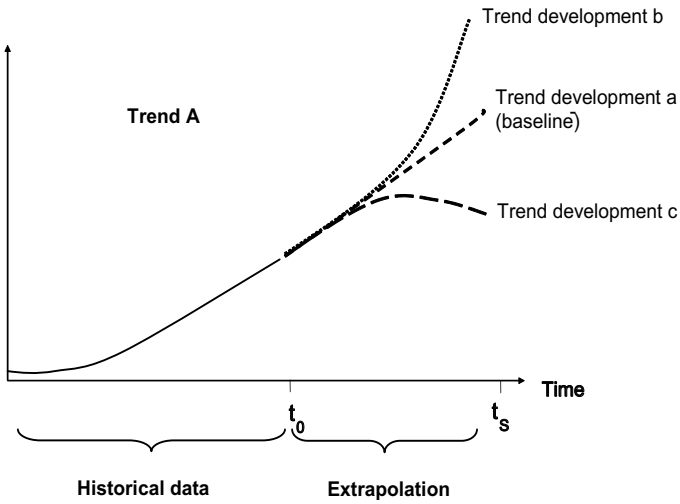
Trend impact analysis

Trend impact analysis (TIA) originated in the 1970s and was developed in order to compensate for a weakness of extrapolations in that they fail to take unexpected future events into account.

The method was originally quantitative in character; it served as a means of analyzing the influence of future events on the development of trends (cf. Gordon 1994a, 1). This technique can be implemented in scenario methods in order to carry out an outward unfolding of individual key factors, i.e. to define the different possible values of various factors.

In its classical form (cf. Gordon 1994a, 2), the method starts by calculating a "surprise-free" course for a trend (extrapolation) (cf. Fig. 5, "Trend development A"). Then a survey of experts is used to define a set of future events, each of which, should it come to pass, can bring about a significant change in the course of the trend. Finally, alternative courses of events within the trends are calculated by taking these possible future events into account along with their (estimated) probabilities and the strength of their

Figure 5: Diagram of a trend variation with TIA



Source: IZT

respective influences. The result is, so to speak, an expansion of the "funnel into the future" of individual trends. This technique combines a very formalized manner of proceeding with explicitly creative elements (cf. Mietzner / Reger 2004, 54).

Within the framework of comprehensive scenario processes, this technique is well-suited for creating variations in development with respect to individual key factors with the aid of an assumption of future events, thus determining different salient specifications. Following that, the key factors which have been thus varied can be combined with other factors which have remained constant in order to see what might/could happen in the scenario field given different courses of events for central key factors.

The **advantage** of TIA is that it displays a spectrum of possible future developments for individual factors rather than merely a single, individual possible development as in the case of pure extrapolation. This procedure makes it possible to anticipate future events and to study their impact on the path taken by trends. It then becomes possible to estimate which of the

events assumed to occur in future might have the (relatively) greatest impact.

The main **disadvantage** of TIA is that any definition of the sets of future possible events is always subjective and cannot pose any claim whatever to reliability. The reason: the probabilities and effects of these events always remain merely estimates and are dependent upon the assessments of experts. In addition, the individual future events in question are regarded in isolation from one another, as if no mutual influence would exist between different events and trends.[15] In particular, this method requires a solid basis of data; it cannot be used in its classical form if detailed and reliable time series are unavailable (cf. Mietzner / Reger 2004, 54).

These disadvantages are perhaps the reason why TIA tends to be used only rarely in scenario work (cf. Bradfield at al. 2005, 801). One **practical example** named by Gordon (1994, 8) is the calculation of different possible developments in the area of crude petroleum consumption.

In summary, the following may be said: scenarios which are based on (quantitative) trend extrapolation often form the point of departure for other, more comprehensive scenario techniques. TIA can be used to form an estimate of the relative influence of different events on the paths taken by trends as well as on the respective scenario field.

In the following, a closer look will be taken at comprehensive scenario techniques which take trend extrapolation and their variation as a basis for carrying out a spread of the future environment by varying the course of events of numerous different key factors rather than merely individual trends. In the process, the different salient characteristics of key factors will be selectively combined with one another.

2.4.2 Systematic-formalized scenario techniques

This group of scenario techniques is basically characterized by the fact that it begins with a clear definition of key factors, then varies them and combines them with one another in order to arrive at a widening scenario funnel and generate different scenarios within it. This is all carried out in a sys-

15 In contrast, consistency analysis and cross impact analysis are well suited for the analysis of interactions, see Section 2.4.2.

tematic and formalized manner.[16] These are in general explorative scenario techniques which acquire their data in part both quantitatively and qualitatively. On the basis of these techniques, however, it is also possible to develop normative scenarios.

Within the framework of these techniques, the **identification of key factors** (Phase 2) is as follows: 1) The influencing factors are identified. These may be trends in the sense described above or qualitatively described developments and events, actions or persons actively involved. 2) Then these influencing factors are regarded as a whole, i.e. with regard to their combined effect. For this purpose the individual factors are juxtaposed in order to identify their respective mutual interrelationships. The central question during this whole process is: "How do the different factors behave in relation to each other?"

Impact analysis

Often the so-called "paper computer"[17] of Vester is used as a means of systematically identifying the interactions and the dynamics of factors Vester (2002, 226 ff.; cf. also Wilms 2006, 51 ff.; Blasche 2006, 74 ff., and Table 3).

This is done by listing the factors already identified in a matrix of columns and rows, in both cases in the same order of succession; in this way, each factor is juxtaposed with each of the others. For each pair of factors, the question is then asked, "*To what extent does a direct relationship take effect between these factors?"* (cf. Wilms 2006b, 51). To quantify the influence, the following scale is often used: 0 = No influence; 1 = Weak relationship; 2 = Medium relationship; 3 = Strong relationship. All combinations are

16 The term "systematic-formalized scenario techniques" is found e.g. in Heinecke (2006, 187 ff.) and Heinecke / Schwager (1995, 17), where this group is juxtaposed with the more "intuitive" techniques. These techniques go back, for example, to the tradition of the Batelle Institute (Frankfurt) and are linked among others with the names of von Reibnitz (1991) and Geschka / Hammer (1984); the techniques are presently employed, for instance, in the scenario techniques of SCMI (Gausemeier) and Z_Punkt (Burmeister).

17 This technique for the identification of key factors can – in contrast to its description as "paper computer" – also be supported by software such as the program MICMAC (primarily developed, among others, by Michel Godet).

evaluated, and the center diagonal of the matrix remains empty. It is then possible to calculate the sums of the lines and columns (regarding what follows cf. also Blasche 2006, 75 f.), which then serve as a measure of the degree of networked interrelationships. The "line sum" of any factor represents the so-called "Active Sum" (AS) and indicates how strongly that factor affects other factors. The "column sum" of a factor, on the other hand, represents the so-called "Passive Sum" (PS) which shows how strongly that factor is influenced by other factors.

Table 3: Tabular explanation of the influence matrix

Impact **Of** **On**	Factor A	Factor B	Factor C	Factor D	Active Sum (AS)
Factor A		3	3	1	7
Factor B	0		3	2	5
Factor C	1	1		2	4
Factor D	3	3	1		7
Passive Sum (PS)	4	7	7	5	

Source: the authors following Blasche (2006, 74)

In this way, every factor is evaluated according to the relationship between its active and its passive sum. It is customary in this regard to make a division into:

– Active and impulsive factors (high AS, low PS)[18]. That is, the factor influences the problem field more than it itself is influenced. Such factors are termed effective "**levers**" or "switches" provided they are concurrently steerable factors upon which it may be possible to have an effect through intervention.

18 AS>PS

– Reactive or passive factors (high PS, low AS)[19]. That is, the factor is influenced more strongly than it itself influences. These factors represent useful indicators for the observation of a situation.

– Critical or. dynamic factors (high AS, high PS)[20]. That is, the factor has a strong influence on the field but is itself subject to a strong influence. These factors are linked with a network of other factors and are not to be lost sight of at any time.

– Buffering or lazy factors (low AS, low PS)[21]. That is, the factor has only a weak influence on the field and is itself influenced only weakly. Such factors have only a relatively inconsequential link with the network of other factors; on the whole, they are rather isolated.

On the basis of this description and with the help of a so-called "priority matrix", it later on becomes possible, among other things, to calculate effective points of intervention as well (cf. Wilms 2006b, 54 ff. for details of the procedure); that is, a search is made for active factors which can also do justice to the criterion of openness for direct change by a person actively involved (steerability) with only a brief period for change.

This manner of evaluating factors makes it possible to "filter out" those which are to be tracked during the further course of events of the scenario process, thus permitting a visualization of key factors in the narrower sense, i.e. those factors assessed as active or critical in character. The basic assumption behind this is that "lazy" and passive factors are to be assumed to be either stable or that – precisely as functions of the active factors – they need not be individually studied because they are linked only at second hand with the network of other factors via the critical factors. A further basic assumption which is required is that the network of relationships among the key factors at the moment of projection of the scenario will remain precisely as it is at present.

This process of characterization is used to select central factors which represent key factors in the narrower sense, often with the pragmatic goal of

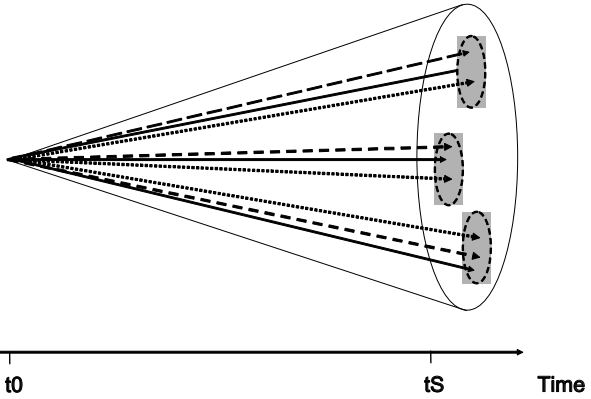
19 AS<PS
20 AS*PS> (n-1)/2
21 AS*PS< (n-1)/2

observing from ca. 10 to a maximum of 20 factors during the further course of events.

One **example** of such impact analysis is found, for example, in Gausemeier / Fink / Schlake (1996, 191 ff.) concerning the future of individual consumption behavior.

The next step, i.e. **the analysis of key factors** (Phase 3), begins by determining alternative possible future values of the selected key factors. Formalized and mathematical as the procedure may be otherwise, this step always includes subjective elements. The scenarios may appear more "conservative" and/or "creative" later on, depending on how broad or narrow the range of salient characteristics is assumed to be. (To take as an example the key factor "development of the oil price": possible future developments might be 100 dollars and 150 dollars – or should we even visualize an oil price of 200 dollars and more?). Via this step, the boundary lines of the "funnel into the future" are then defined: which values are conceivable, which others are unthinkable?

Figure 6: Constant expansion of the "funnel into the future" through systematic-formalized scenario techniques (shown here in simplified form)



Source: IZT

Various instruments are available for the following step of variation, and in particular, the combination of salient characteristics. Two frequently employed techniques are consistency analysis and cross-impact analysis; these two will be briefly described in the following

Consistency analysis

Consistency analysis (cf. Heinecke 2006, 190 f.) is used to unfold the range of possibilities regarding the different conceivable values of all key factors and to decide which combinations behave consistently toward one another and may thus play a role in the construction of consistent scenarios. This is decisive for the credibility and in particular for the interpretation of (cf. Gaßner 1992, 230) of any scenario.

The technique begins by determining the various possible values of all key factors; in the process, at least two possible values are assumed in the rule for each factor: e.g. a rise in average temperature due to a climatic change of one degree and another change of 4 degrees. The probability of this occurring is, however, not explicitly taken into consideration in the process. It may then be possible to construct a very large number of different sets of "bundled" characteristics in the sense of so-called "raw scenarios" when all factors with their different values are taken together. Depending on the number of key factors and the selected number of respective values, a very large number may be reached very quickly. For example, a total of 1,048,570 combinations is possible in the case of 20 factors with 2 values each (cf. Heinecke 2006, 191). However, not all combinations of values are equally credible, so that a ranking procedure can be used to select those sets of factor characteristics which are particularly consistent.

A consistency evaluation is first carried out **for each pair** (cf. Gausemeier / Fink / Schlake 1996, 255 ff). All factor values are juxtaposed in each case with all other factor values. That is, simply put, key factor "A" is compared with key factor "B" regarding both a) and b), etc. As in the "paper computer", this is achieved by combining each value of each factor with each value of every other factor (cf. Table 4). The consistency of each combination is often assessed on a scale of 1 to 5 where 5 = Strong consistency (strong mutual support); 4 = Weak consistency (mutual support), 3 = Neutrality or independence from one another, 2 = Weak inconsistency (mutual opposition) and 1 = Strong inconsistency (complete opposition).

Table 4: Consistency matrix

How do lines and columns (i.e. "a" and "b" characteristics) interrelate?		Factor A		Factor B		Factor C		Factor D	
		Value Aa)	Value Ab)	Value Ba)	Value Bb)	Value Ca)	Value Cb)	Value Da)	Value Db)
Factor A	Value Aa)								
	Value Ab)								
Factor B	Value Ba)	2	4						
	Value Bb)	5	2						
Factor C	Value Ca)	5	2	2	5				
	Value Cb)	3	4	5	2				
Factor D	Value Da)	4	3	1	3	5	2		
	Value Db)	3	4	3	4	4	2		

Source: Abstracted from Gausemeier / Fink / Schlake (1996, 258)

It is then possible to carry out an evaluation of the consistency of various "**bundles**" (cf. Gausemeier / Fink / Schlake 1996, 257 ff.), i.e. a calculation of the consistency of all theoretically possible bundles of factor characteristics. For this purpose, a consistency "unit of measurement" is calculated (that is, a sum of consistency values for the individual pairs of characteristics), which in turn makes a ranking procedure possible for the various "bundles". In addition, it is also possible to exclude those bundles which are either completely inconsistent or contain too many weakly inconsistent pairs.

Consistency analysis is used, for example, by the Department of Future Analysis at the German Army Center for Transformation as a means of generating scenarios regarding topics related to national security. It is also frequently recommended and employed for the implementation of scenarios within enterprises (cf. e.g. Gausemeier / Fink / Schlake 1996).

The **advantage** of this instrument is that inconsistent pairs of factors can be excluded from consideration, thus reducing the total number of possible future factor "bundles" (cf. Gausemeier / Fink / Schlake 1996, 260).

On the other hand, this type of consistency check does not take probabilities into account. Their consideration is often not desired at all in the scenario process, for example when extreme event developments are to be studied (see above and also Gausemeier / Fink / Schlake 1996, 260).

The **disadvantage** of this instrument is that the calculation of units of measurement for the consistency of factor "bundles" is possible only with the help of computers (except in the case of a very small number of factors and values (5 factors, each with 2 values, result immediately in 320 possible bundles) (cf. Gausemeier / Fink / Schlake 1996, 257). This of course reduces the transparency and visual validity of the procedure. In addition, the number of factors and values which can be taken into account is significantly reduced.

When probabilities are also to be studied with this technique, a plausibility check is also added in the rule. Here cross-impact analysis is appropriate (see below).[22]

Cross-Impact Analysis

Cross-Impact Analysis (CIA) was developed in 1966 Theodore Jay Gordon and Olaf Helmer, initially as a game ("Future") (cf. Gordon 1994b, 1).[23] Today this instrument has a plethora of uses, alone or in combination with other methods, and it has also advanced – e.g. in the tradition of Michel Godet and the Batelle-Institute – to the status of a typical scenario technique (cf. Mietzner / Reger 2004, 54).

Cross-Impact Analysis is used to present the causal relationships among probabilities of different possible future events, to analyze them, and to take into account their mutual consequences. It is used in the scenario technique above all to analyze plausibility. "Plausibility" here means that **probabilities** are taken into account additionally on the basis of the consistency check (cf. Gausemeier / Fink / Schlake 1996, 259).

The basic logic followed by this analysis is that future developments depend on the interaction of future events. Much as in the case of consisten-

22 In order to avoid a confusion of terms: Consistency Analysis today is itself already being called "Cross-Impact Analysis", even when no probabilities are taken into consideration.

23 It was first used as a promotional gift from the Kaiser Aluminum and Chemical Company.

cy analysis, described just above, the different values of future developments are observed and their interactions are examined.

At the beginning, the future possible values of the key factors are determined. In cross-impact "language", these are called "events".

Then an "event" probability (**initial probability)** is *estimated* for each event. This is done by regarding each event in isolation from, i.e. independently of, other events.

In a third step, **conditional probabilities** are calculated on the basis of the following central question: "If event A occurs, how great is the probability, possibly influenced by it, that event B will occur?" The result is then displayed in a cross-impact matrix (see Table 5).

Table 5: A cross-impact matrix[24]

If this event occurs ...		... Event probability changes as follows:		
	Initial probability	Event A	Event B	Event C
Event A	0.25		0.50	0.85
Event B	0.40	0.60		0.60
Event C	0.75	0.15	0.50	

Source: The authors according to Gordon (1994b)

The conditional probability (for the following cf. Gausemeier / Fink / Schlake 1996, 264) shows the probability of event A (e.g. reduced mobility) in case event B occurs (e.g. a rise in the oil price). In addition, a joint probability can also be calculated (that is, the probability that both event A and event B will occur (rising oil price and concurrently reduced mobility). These interlinked probabilities can be worked out mathematically with the aid of linear optimization based on the event probabilities of future events and their consistency values.

24 The table is to be read as follows: event B has an initial probability of 0.4 (40%). If event A occurs, the probability of B rises to 0.50. Event C has an initial probability of 0.75. If event A occurs, the probability of C rises to 0.85, etc.

Further refinement and fine-tuned differentiation of the techniques of cross-impact analysis (CIA) have been going on intensively since the 1960s. As a result, the technique of correlative CIA outlined above has been joined by a causal type of CIA (cf. Götze 2006, 146 ff) which in turn offers both a static and a dynamic variant (cf. Gausemeier / Fink / Schlake 1996, 264).

For an **example** of causal CIA, used for example during scenario construction and taking "the automobile industry" as a topic area, see Götze (2006, 155 ff.). This technique is well-suited for use when plausible probabilities are to be included and the mutual influence of probabilities for different factors is to be treated. CIA almost always requires a software program.

The **advantages** of CIA are that it is highly formalized and thus essentially traceable – at least in the hands of professional users – and transparent (cf. Mietzner / Reger 2004, 54). Many experts regard the method favorably and consider it to be above all a good starting point for scenario construction and a way of bringing together experts from different disciplines who can then deal in full with the different influencing factors and their interrelationships while also keeping possible alternative developments in view (cf. Mietzner / Reger 2004, 54).

However, other authors consider this technique to be dispensable in the context of scenario processes (cf. Gausemeier / Fink / Schlake 1996, 264), since it contains a number of **disadvantages**. For example, it is formalized to such a high degree that the usefulness and reliability of its contents are often neglected (cf. Mietzner / Reger 2004, 54). In addition, its premise of values as dichotomous "either-or options" often fails to do justice adequately to the realistic, ongoing expansion of a "funnel into the future" which is then likely in contrast to bear the stamp of multidimensional spectra. Classical CIA works exclusively with data pairs. This is an oversimplification, since numerous different developments often influence one and the same event concurrently, as reflected e.g. in system dynamics models (cf. section 2.5.1). Moreover, the identification of probabilities usually takes place very subjectively and is to some extent more or less the same as "reading coffee grounds". Due to the method's formalized character, however, this aspect is often lost sight of or even swept under the rug. The method must therefore be regarded as very non-transparent for non-experts.

The preceding text has presented instruments for the identification and analysis of key factors; in the following, the procedures employed in sys-

tematic-formalized scenario techniques for the **generation of scenarios** (Phase 4) will be described.

The availability of a relatively large number of "raw scenarios" follows on the heels of the analysis of key factors. The task is then to generate meaningful scenarios which lend themselves to interpretation on the basis of these "columns of numbers". The selection which is related to this is in most cases already prepared via the different forms of consistency checks.

Various representatives of the systematic-formalized scenario technique also advocate a strongly formalized procedure for the selection of scenarios; they advance three criteria, which can be calculated on the basis of consistency analysis, as an aid to this: consistency, stability, and variability, (cf. Mißler-Behr 1993 and 2006). The choice often falls on the scenario assumed to be "most probable" or on one of the two extremes of "worst-case" and "best-case" scenario.

Other techniques also advanced for the selection and generation of scenarios and represented, for example, by Gausemeier / Fink / Schlake (1996, 272 ff.), are "Projection-Biplot" and "Projection Bundle Mapping"; according to their proponents, they create an overview of scenarios in the future environment via factor analysis and/or the establishment of multidimensional scales.

In actual practice, however, even with systematic-formalized scenario techniques, it is often the case that a substantively interpretative selection of scenarios takes place on the basis of consistent key factor characteristics.

These scenarios are then usually put into the form of a text. In quality, these textual formulations range from brief descriptions of individual key factors to textual sketches and outlines which may contain merely the premises and implications involved in the scenario or may go all the way to a "standard form" of description, that is, a full account of the future situation and the paths leading to it (cf. Steinmüller 2002b, 8). This means not only that at least the main future characteristics of the key factors are detailed but also that the causal relationships between these characteristics are clarified (cf. Gausemeier / Fink / Schlake 1996, 312).

However, all systematic-formalized scenario techniques are alike in that they contain subjective and intuitive aspects, e.g. both in their definition of the main characteristics of key factors and in the selection of scenarios

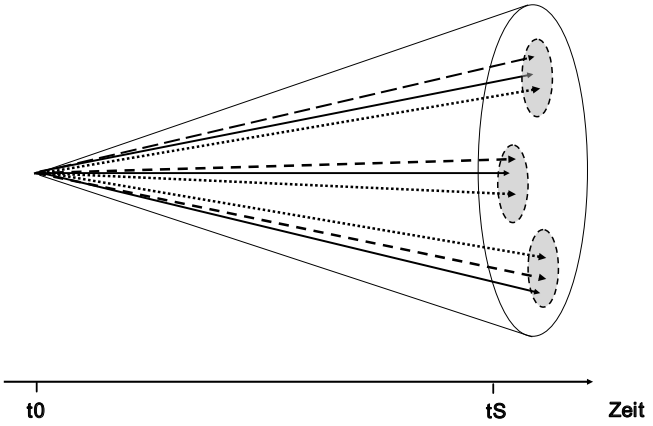
which in actual practice have a greater impact than may at first appear to be the case upon reading their theoretical description. Their ideal-type counterpart, i.e. the creative-narrative type of scenario technique, puts precisely this intuitive dimension of scenario processes explicitly in the foreground.

2.4.3 Creative-narrative scenario techniques

This group of scenario techniques is characterized less by formalization than by the explicit implementation of creative techniques, intuition, and implicit knowledge. In addition, there is often a strong focus in this group of scenario techniques on the scenario process itself as a communication process and/or as a participatory approach. These techniques are used in part for the development of desirable, i.e. normative scenarios and partly also within the context of explorative techniques.

It is important to note in advance that these intuitive-creative, narrative techniques are guided by the same basic principles as the formalized techniques.

Figure 7: Widening of the "funnel into the future" by means of creative-narrative scenario techniques (shown here in simplified form)



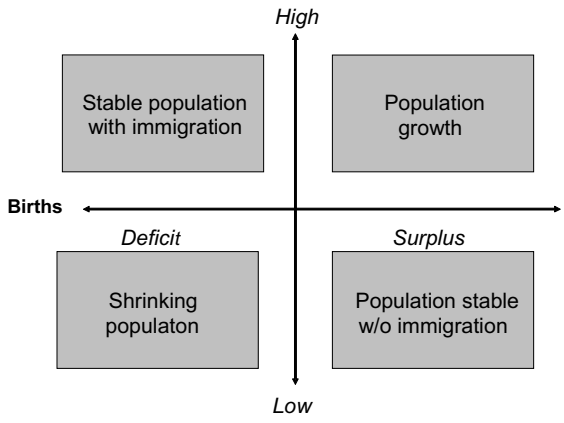
Source: IZT

It is therefore not by chance that a description in graphical form of the widening of the "funnel into the future" due to these techniques is identical in appearance with the systematic-formalized techniques (cf. Fig. 6 and Fig. 7). The effect of the more or less formalized and more or less creative-intuitive observation of alternative possible future major characteristics of key factors is to widen the span of a "funnel into the future" while subsequently leading to a concentration of individual scenarios.

The techniques used in this group are formalized in very different ways. In the most intuitive variant, quasi-literary texts are drafted by a single author or small teams to describe possible futures.

A further and less complex variant of this scenario technique consists in the **complete permutation** of only a few future possibilities. The basic idea (cf. Steinmüller 2002b, 26 ff.) behind this procedure that all possible values of key factors can be combined with all other values of key factors as a means of formulating the basic foundation for individual scenarios. This

Figure 8: Description of a complete permutation, taking population development as an example (in simplified form)



Source: IZT

technique is employed above all in the case of brief, intuitive scenario processes in which for the most part only two key factors are defined in each case with reference to two of their major values, resulting in a "grid" of two times two scenarios. This is practical, since more than two key factors would quickly render the technique impenetrable.

Such scenarios are of course greatly simplified in form and "more like a woodcut" (Steinmüller 2002b, 27); however, they can be quite useful, for example as a means of clarifying basic positions (cf. ibid.).

In the case of the more complex techniques within this group of scenario techniques, on the other hand, a specific design is often drafted for all individual and separately distinguishable phases of the scenario process. For this reason each of these techniques will be presented individually as an overall process in order to avoid "disconnecting" the individual techniques from one another.

As representatives of the whole of complex creative-narrative techniques, "Intuitive Logics", "Morphologic Analysis", and "Normative-Narrative Scenarios" will be described.

Intuitive Logics

This approach was developed by the Stanford Research Institute (SRI), and by Global Business Networks and Shell starting in the 1970s and was first described by Peter Wack (1985) (cf. Mietzner/ Reger 2004, 53). Viewed historically, these are scenario techniques which were developed internally by and for commercial business entities and with a multiplicity of variants (cf. Bradfield et al. 2005, 799).

Characteristic of this type of procedure is a focus on decision-making processes which takes into account not only unpredictability but also every piece of available information about the future in order to recognize inherent structures and develop new ideas (cf. Wilson 1998, 81). The approach is called "intuitive" because it explicitly allows for estimates, "gut feelings" and uncertainty evaluations in addition to "objective" data and their analysis. It is to be noted, however, that in doing so it takes the intuition of "experts" as its reference point, that is, the intuition of those persons who are actively involved and most familiar with the scenario field. (In the beginning, the primary issue in this approach was the management of the respective business firm). This feature, namely the integration of persons who

are actively involved in the scenario process, along with their (implicit) knowledge, is regarded as the decisive point of departure of this approach. The participation and commitment of these actors is important for the success of the technique and constitutes the basis for development on the part of these actors of a kind of "sense of ownership". That is, they come to regard the scenarios as their own and in the end do in fact employ the scenarios in order to guide their decision-making processes (cf. Wilson 1998, 81).

The entire process is decision-oriented. That is, the very definition of the scenario field contains above all the question: "*What decisions must be made and what steps must be discussed? What is therefore the focus of the scenario process?"* (cf. Wilson 1998, 82).

The second step is to identify the key factors: "What are the important aspects which we need to know about, e.g. in order to make decisions?" Once identified, these factors can be arranged according to the PESTE Schema (Political, Economical, Social, Technological and Environmental) (cf. Wilson 1998, 87), e.g. in order to check the extent to which the relevant areas are covered.

After that, the "key factors, or "driving forces" can be evaluated via a coordinate system according to their degree of **unpredictability** and their **degree of impact** (cf. Steinmüller 2002b, 24; Local Government Association 2001, 5):

– High uncertainty/ high impact: pivotal uncertainties
– High uncertainty/ low impact: potential jokers
– Low uncertainty/ high impact: significant trends
– Low uncertainty/ low impact: context shapers

By the end of this identification and evaluation of key factors, the nature of the relationship of the factors to one another should be clear, and an overview of the factors and their interactions should have emerged.

The fourth step is to study the "scenario logic". Here the goal is to construct a manageable number of consistent scenarios. This is the step which requires the most intuition and creativity (cf. Wilson 1998, 89). The basic assumption here is that factors lacking significant unpredictability can come together to form a single profile during the course of the scenario process

whereas factors involving a "considerable amount of unpredictability" (cf. Steinmüller 2002b, 24) should be taken into account in the form of numerous different possible profile curves. During the further course of the scenario process, the focus is above all on critical factors with a high level of unpredictability, that is, on "pivotal uncertainties" (cf. Local Government Association 2001, 5 and Steinmüller 2002b, 24).

The scenario selection is also carried out in dependency upon the goal of the scenario process and the criteria of quality (cf. Wilson 1998, 91). Three elements are recommended here for working out scenarios (cf. Morrison / Wilson 1997):

1. *„**Highly descriptive titles**"*, that is, expressive titles which are easy to remember and convey the essence of the respective scenarios;
2. *„**Compelling story lines**"*, that is, convincing and consistent lines of action which not only describe how the scenario will end in the future but also convey the dynamics of the developments leading up to that point (Morrison / Wilson 1997): *"In simple terms, a scenario should tell a story; that story should be dramatic, compelling, logical, and plausible."*
3. The decisive point for the expansion of the "funnel into the future" is an overview which captures for each scenario the different profiles of the key factors which are taken into account, that is, "*a sort of line-item description that details what might happen to each key trend or factor in each scenario"* (Morrison / Wilson 1997). This material provides the contents with which the scenario's skeleton is "filled out".

This scenario technique explicitly includes the transfer of scenarios in the overall process as a means of then evaluating and selecting concrete strategies. To this end, the scenarios are evaluated with regard to aspects which are relevant for making decisions. This may take the form, for example, of SWOT analysis (i.e. the evaluation of Strengths, Weaknesses, Opportunities and Threats).

One **example** of a scenario project which is especially based on this technique is the study "Scenarios for Chinese Foreign Policy in the Year 2020+" (Gabriel et al. 2008).

The **advantages** of this technique are that very different information about the future can be included and analyzed, and new, creative ideas can be de-

veloped. Since from the very beginning the persons relevant for the decisions, along with their explicit and implicit knowledge, are actively involved in the process, the scenarios allow a high degree of connectivity.

The **disadvantages** of this technique are, however, that such scenarios are often worked out "behind closed doors" by small groups of internal experts, meaning that the quality of the technique stands and falls with the quality of the experts who generate it (cf. Mietzner / Reger 2004, 53). Moreover, the concrete processes take such different shape in each case that it is difficult to formulate a general evaluation (cf. ibid.).

Morphological Analysis

Morphological analysis (MA) is based on the principle of the "morphologic box" of Fritz Zwicky, that is, on a systematic-analytic creativity technique. Morphological analysis was developed, among others, by the French CNAM-LIPSOR[25] and has the following basic principle (Velte et al. 2006, 7):

> *"Morphological analysis aims to explore possible futures in a systematic way by studying all the combinations resulting from the breakdown of a system."*

MA is basically used to study complex networks of interrelationships, above all in the area of non-quantifiable socio-technical problem complexes, "variously called 'wicked problems' and 'social messes'" (cf. Ritchey 2007, 1). It can be used to visualize and analyze highly complex networks of interrelationships as a basis, for example, for risk or stakeholder analyses and thus precisely for the development of scenarios. In view of its principle this is more a "soft" modeling method.

When it is used in the area of scenario techniques, the scenario field already described is broken down into its details via a set of "components" which might develop in different directions (analogously with key factors). The formulations used to describe the various profile curves of these components are "hypotheses" or "configurations".

25 CNAM-LIPSOR = "Laboratoire d'Investigation en Prospective, Stratégie et Organisation" at the "Conservatoire National des Arts et Métiers"

Table 6: The morphologic box

Components (factors):	Hypotheses (profile curves)			
	1	2	3	4
Factor A	A1	A2	A3	A4
Factor B	B1	B2	B3	B4
Factor C	C1	C2	C3	C4
Factor D	D1	D2	D3	D4

Source: IZT according to Ritchey (2007, 3)

All of the components and all of their profile curves are noted in a matrix (cf. Table 6), and all combinations of these hypotheses (or factor profiles) together form the "morphological space" or the morphological field.

In a second phase, the various combinations of profile curves are selected from this morphological field. This can take place in two ways.

First – and this is the **intuitive** manner of proceeding – a value is selected on each horizontal line of the matrix, and the various fields thus selected are connected with each other by drawn lines which are then regarded as an alternative solution (in the example here: the combination of factors A1, B3, C4 and D1) (cf. Table 6). Different lines can be drawn to select different combinations; in each case, these are then taken as a basis for the construction of a scenario.

Secondly, the selection can also be carried out **systematically**; that is, the number of possible combinations can be limited via a reduction technique to only those which represent consistent "bundles" of values. The central reduction steps are based on "exclusions" (i.e. the exclusion of inconsistent pairs of characteristics from consideration) and "preferences" (i.e. combinations of well-suited pairs of characteristics) (cf. Fig. 9). This technique can also be carried out with the support of software.

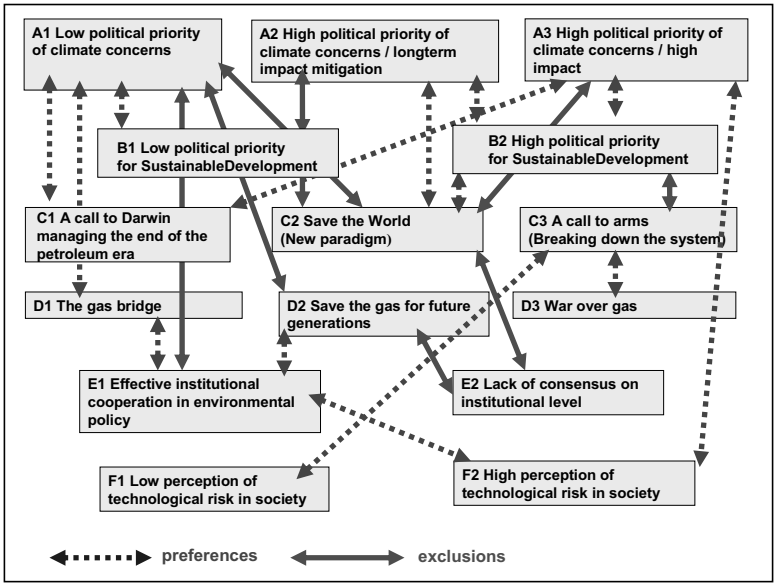
Selection and evaluation of the consistency of combinations of key factors in MA is central to the subsequent scenario development. For that reason it should be carried out in the context of a workshop and as far as possible together with other stakeholders and experts than the ones who have already

worked out the components (i.e. the key factors). This increases the degree of both creativity and intersubjective verifiability.

The result of this selection process is a number of "bundled" key factor characteristics which can then be brought together in condensed form to create scenarios.

This approach also makes it possible to generate system scenarios; this is done by first developing two morphologic fields (cf. Ritchey 2007, 4): an "external world field" containing the respective factors which cannot be directly influenced or controlled, and an "internal" or "strategy" field which can be used to visualize a working space. The two fields just named are then linked with each other in order to test different actions or strategies with re-

Figure 9: Sample description with morphological analysis



Source: Authors' own description, closely in accordance with Velte et al. (2006). The example is from the project: "The EurEnDel Scenarios – Europe's Energy System by 2030". For better legibility only the most central "preferences" and "exclusions" are shown here.

spect to different scenario contexts. However, the overall number of possible combinations then grows very quickly, even though it is possible to react to them with different strategies.

One **example** of the possible applications of this scenario technique is the IZT project "EurEnDel" (cf. Velte et al. 2006 "The EurEnDel Scenarios – Europe's Energy System by 2030").

The **advantage** of MA is that different dimensions of a scenario field (demography, the economic sector, techniques etc.) can be first distinguished from one another and then studied as a whole. This is a creative technique for comprehensive study of a scenario field and its possible future developments and systematic identification of relationships and structures. Simultaneously, definitions, evaluations and decisions can be well documented and visualized, with the result of increased transparency.

Disadvantageous is that this technique can easily lead those who use it to lose themselves in a plethora of "hypotheses". As in more formalized approaches, the problem lies in the fact that only a limited number of components and hypotheses (i.e. key factors and values) can be taken under study. As a result, selectiveness is required in order to keep the technique manageable. In addition, there is a basic risk that central aspects can be lost sight of even during definition of the components. MA-processes also require expert moderation, since otherwise there is danger of creating a morphological field which is merely trivial (cf. Ritchey 2007, 8). It is also the case that the approach is time-consuming. Ritchey (2007, 8), for example, when discussing the systematic variant, speaks of two to 20 full-day workshops. Moreover, the number of participants in the expert groups is limited to a maximum of eight, since uninterrupted joint work is otherwise very difficult.

The number of possible participants is significantly larger in the type of scenario technique described next.

Normative-narrative scenarios

Scenarios designed to motivate those involved in innovation processes and spur them to think creatively of necessity offer attractive and adequately positive conceptual futures (cf. e.g. Siemens 2004, 6 f). Among others, Minx and Böhlke at the Future Research Center of Daimler AG emphasize the effect of desirable futures (2006, 18):

> *"The normative dimension puts the focus of attention on the positioning activities of those concerned in the respective scenario world and forces them to identify needs for change and to take the appropriate steps."*

In addition, such **normative** scenarios combine potentialities whose roots are in the reality of the present, but select these with regard to desired developments – without, however, abandoning the realm of what is in principle possible.

This is reflected in the IZT's cooperation with strategy processes of the Federal Ministry of Education and Research (BMBF) since 2001, in which the methodology of normative-narrative scenarios is being continuously adapted and further developed (cf. Gaßner / Steinmüller 2006).[26] In essence, the focus of this is on (further) concretization of scientific-technical fields of innovation by working with scenarios while providing support in communication processes by means of illustrative conceptual futures. The purpose of the scenario is to make possible and desirable futures concretely conceivable while triggering subjective associations, thus establishing a broader basis for the discussion of goals and options for taking action. In particular, the development of positive visions and desirable perspectives for the future is methodically promoted.

In working these out, great value is placed on the joint character of the process, that is, on mutual encouragement of those who are actively involved and on an interdisciplinary and inter-institutional give-and-take.[27] Among others, Minx and Böhlke speak of systematic, "*multi-disciplinary"* group work as an important prerequisite for "a collectively supported view of the whole"; they also speak of a frequent, "*collective cognitive leap within the group, a leap which is derived from the individual transformation and widening of individual perspectives"* (Minx / Böhlke 2006, 19).

Narrative scenarios take on a quasi-literary shape in the form of brief narratives about fictitious persons or institutions. This manner of depiction is not only appropriate for this communicative type of task work but also compels those involved to achieve a high degree of concreteness, detail,

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26 "Future – The German Research Dialogue" and "Hightech Strategy of the German Federal Government".

27 For more on "social creativity" see: Jungk / Müllert (1995).

and realism. Experience shows that when an issue is thought through in narrative form (so-called "contextualization"), the "germinal visions" which underlie the scenario are automatically put into perspective socially, economically, technologically, culturally etc. and are analyzed for correlations and possible (unexpected) consequences. In the ideal case, this process of narrative creation thus represents a holistic form of plausibility and consistency checking.

The experience of the IZT has been that it is advantageous to divide the process of shaping normative-narrative scenarios into the following seven steps:

– **Scenario workshop**[28] (including the phases of scenario field determination, key factor identification, key factor analysis, and parts of scenario generation). In such a workshop, 12 to 24 experts work together with the persons actively involved and/or the stakeholders and apply different creative methods (e.g. mind map group work and specially structured brainstorming sessions) to single out and develop desirable aspects. This results in the elaboration of generalized traits (i.e. the "scenario premises") of the conceptual future in question and of a basic consensual set of visionary ideas and goals: What is to be or could possibly be achieved by the time of the specified time horizon?). The documentation of the workshop proceedings is then used to gain initial feedback from the workshop team.

– Elaboration of the **scenario exposé**: the germinal visions worked out in the workshop are analyzed and "interpreted" as the case may be against the background of an analysis of key factors. The normative goals and desires for the future, which are to some extent still only implicit, are then evaluated, systematized, and visualized in the form of graphical images (see Fig. 10) for the purpose of participative feedback. Then the main characteristics of the scenario (visionary aspects awaiting closer description, preliminary constellations of persons, basic principles of lines of action) are presented in draft form by the workshop team for a second feedback.

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28 Combinations of (offline) expert surveys, analysis of the literature, and qualitative trend analysis can also be taken into consideration as – somewhat untoward –- substitutes for such workshops.

– Creation of a "**Story-Board**": the lines of action are worked out in greater detail, with integration of the visionary aspects, and the information concerning persons involved in the scenario is concretized.

– **Scenario writing**: such aspects as inner logic, consistency, plausibility, desirability (that is, agreement with the normative workshop results), suspense etc. are taken particularly into account in working out a formulation of the scenario; this is followed by presentation for yet a third round of feedback.

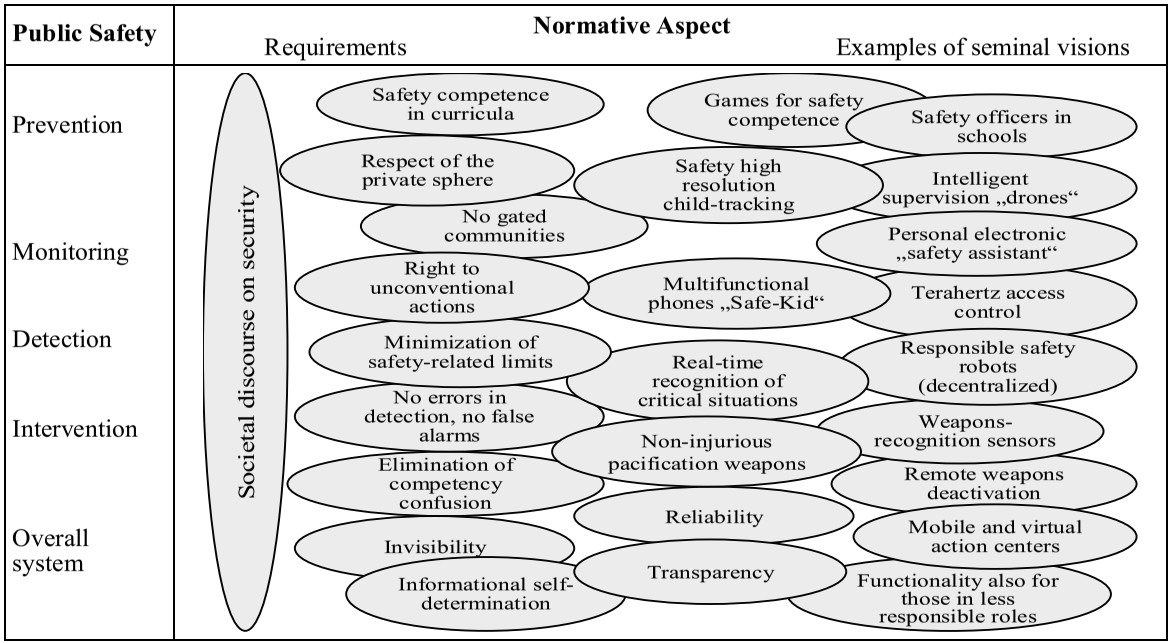
– (As the case may be:) **optimization**: that is, the input from the third round of feedback is used to enrich and/or fine-tune the scenario with further visionary ideas, concrete concepts for application, information concerning the technological context and the underlying political and juridical conditions, social implications etc.

– (**Whenever possible**:) evaluation of the scenarios. Depending on the character of the process as a whole, it may be possible here to follow up with a work step – usually another workshop – in which the current participants or another group of "persons who are involved or affected" evaluate the scenario with regard to its implications and draw concrete conclusions for future possibilities of design and for decision-making processes in the topic area in question. The rough procedure for such an evaluation is: determination of the scenario's reception, subjective evaluation and selection, joint clustering of topics, weighting of the various elements, selection of focus, formation of groups, and development of possible lines of action.

– (As the case may be:) **Publication** and/or application of the results within the context of an ongoing communication strategy.

In contrast to explorative scenarios, which project current key factors into the future, normative scenarios are built up taking concretely conceptualized desires and/or goals as a point of departure. Although it almost never makes sense to build an individual *explorative* scenario, it may be thoroughly expedient – as in the present case – to develop a single normative scenario for a specific topic on the basis of consensual preferences. In principle, of course, it is also possible to work out numerous different normative scenarios parallel to each another on the basis of different, carefully distinguished target dimensions (e.g. one scenario with a focus on "em-

Figure 10: Sample description of the analysis of key factors and normative dimensions in the context of normative-narrative scenarios



Source: IZT

ployment“, another focusing on “gender mainstreaming“, and yet a third addressed to “ecological sustainability“).

The ideal-typical case would be one in which normative narrative scenarios consist of the following elements:

– A brief **introduction**, if appropriate with a list of premises (trend assumptions regarding the context, etc.) and/or a set of “instructions for reading” which may include background on the context in which the scenario was created or is to be applied.

– (The **core**:) a narrative account of the status of future conditions based on courses of action involving only one or a number of different fictitious persons or organizations, and finally

– „**Marginalia**” (marginal notes). These serve to call attention to and emphasize certain aspects or to provide additional background on specific elements as a help to the reader.

One advantage of this approach above all is its participative-communicative orientation; that is, it is not a “closed-shop” procedure. In other words, it actively supports open, transparent discourse through its emphasis on bringing in external experts, persons actively involved, even the “man on the street“, etc. as well as through its usually good general comprehensibility.

A particular advantage lies in the interdisciplinary character of the approach; that is, it permits collaboration among persons with the widest possible variety of origins and qualifications in the development of a scenario and its transfer; moreover, this variety can find be reflected in the text form which is selected (for example, the text may reflect the natural sciences, the history of thought, the economic sector, or simply the perspectives of everyday life). The focus of the whole is on a search for points of agreement; it thus avoids a “trench warfare” among individual disciplines, institutions or ideologies.

Moreover, it is unnecessary to either select or exclude key factors. As a result, clearly distinguished and manifold nuances can be included.

As a result of the fact that many developments need only be indicated in passing, it is possible to draft a conceptual future which is on the whole

very much more "concentrated" and holistic than that produced by systematic-formalized procedures.

Normative-narrative scenarios "*are very useful for deepening our understanding of sociotechnical room for creativity and clarifying the 'bundles' of consequences of corresponding decision alternatives"* (see VDI 1991, 18).

The **disadvantages** of the procedure, on the other hand, are that it is time-consuming and costly due to the required group process (feedback deadlines, moderation, travel costs, venue accommodations, etc.). Particularly in cases where consensual "wish-scenarios" have been constructed, such normative-narrative scenarios invariably trigger in the reader in the rule a plethora of subjective reactions involving both agreement with and rejection of the aspects presented – which is, after all, precisely the desired communication effect. Precisely for this reason, on the other hand, such scenarios are only conditionally suitable for purposes of "illustration" or as a basis for publication of the (end-stage) project results.

By no means should the workshop and/or process participants be "delegates" or "lobbyists" with an "external mandate". They must be motivated and open to all possibilities when thinking about the future and plumbing the depths of their own expectations and requirements regarding the future.

2.4.4 Interim assessment: Scenario techniques in overview

To conclude this segment, the different scenario techniques from the three ideal-typical groups will be compared again here in tabular form (see Table 7 on the next page).[29]

In the concrete process of shaping a scenario process, it is, however, the case that the borderlines between these ideal types often blur (cf. Fig. 11).

29 For the sake of overview it was necessary to show some of the parameters differentiated in this chapter in abbreviated form. Moreover, this description also ignores to some extent differences which can result from the concrete design of individual scenario processes.

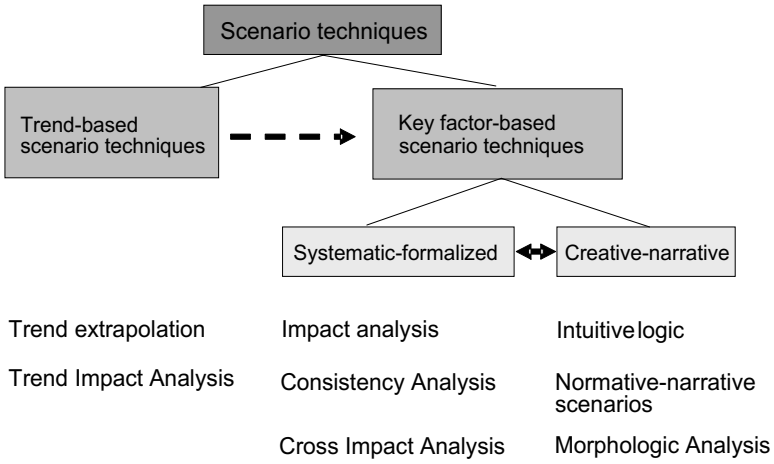
Table 7: Overview of different scenario techniques in the scenario process

Scenario techniques / In the scenario process	Scenarios on the basis of trend extrapolation	Formalized scenario techniques	Morphological analysis	Intuitive logics	Normative-narrative scenarios
Phase 1 "Determination of scenario field"	Demarcation of topics and definition of the scenario's purpose				
Phase 2 "Identification of key factors"	Trend observation and trend analysis (incl. operationalization)	Identification and characterization (e.g. via impact analysis)	Definition of "components" of the "morphological field"	Evaluation and selection of factors according to their unpredictability and degree of impact	Collective collation and ordering of relevant factors
Phase 3 "Analysis of key factors"	Timeseries analysis and statistical trend extra-polation (if appropriate: variation of trends via TIA)	Consistency analysis or cross-impact analysis in order to form consistent bundles of characteristics	Systematic definition of "hypotheses" in the Morphologic Box	Overview of the values of central factors per scenario (line-item description)	Scenario workshop (incl. development and elaboration of germinal visions)
Phase 4 "Scenario generation"	"Most probable" scenario/ BAU scenario	(Statistical) selection of raw scenarios, textualization	Combination of "hypothesis" bundles into consistent scenarios (intuitively or systematically), textualization.	Textualization of scenarios on the basis of expressive titles, convincing lines of action and an overview of salient characteristics (see above)	Normative evaluation and narrative condensation into consistent scenarios (feed-back loops)

Table 7: Overview of different scenario techniques in the scenario process (continued)

Scenario techniques / In the scenario process	Scenarios on the basis of trend extrapolation	Formalized scenario techniques	Morphological analysis	Intuitive logics	Normative-narrative scenarios
Advantages (e.g.)	Verifiable calculations, solid grounds for knowledge of the future in the case of "strong" trends (e.g. demography).	Systematic evaluation of factors, formalized consistency checks & probability calculation of bundles of characte-ristics; transparent for experts.	"Systematic creative technique", with clear visualization & documentation; high level of analysis and synthesis.	Incorporation of implicit and explicit knowledge, integration of decision-makers (extensive follow-up capability), no stringent constraints on the number of factors to be taken into account.	Participation of many actors of many different types: transparent, consensusproducing discourses, no restric - tions on the number of factors to be taken into account, focus on constructive options.
Dis-advantages (e.g.)	Requirement of comprehensive (quanti-tative) data (longterm time series); study of a single possible future (instead of alternative futures); suggestive of too much certainty.	Limited number of factors, not transparent for the layman, intuitive and normative elements are swept under the rug, over-formalization at the cost of substance, resource-intensive.	The number of factors is limited, since the technique otherwise becomes impenetrable; the number of partici-pants is also limited; the process of resource-intensive.	A "closed-shop" technique whose quality and legiti-macy are difficult to assess from the outside.	"Wish-scenarios" tend to be especially selec-tive and provocative: they have only limited appropriateness as an "end product"; they are resource-intensive.

Figure 11: Transitions between "ideal-typical" scenario techniques



Source: IZT

For one thing, (quantitative) trends may also flow and merge into key factor-based methods, whether the latter are systematic-formalized or creative-narrative in nature; secondly, sys-tematic-formalized scenario techniques also contain creative-narrative elements. Vice versa, creative-narrative techniques may also run their course in a more systematized fashion, as was shown in the example of morphological analysis (depending, of course, on the variant which is selected).

In order to round out the description of individual scenario techniques, the following excursus will present a few typical scenario transfer techniques.

2.4.5 Excursus: Techniques of scenario transfer

Once scenarios have been created, a plethora of applications and further uses become possible. These "transfer options" are compatible with many different specific scenario techniques; however, they should be kept in mind even during the course of the concrete scenario process in order to prepare optimally for them.

At this point, event analyses should be presented via "wild cards" and "backcasting" as being particularly scenario-typical approaches. The reason is that many of the other possible transfer steps are not typical of scenario method techniques alone but are also belong to the canon of general methods which are prevalent among research and advisory services, especially in the area of scientifically based futurology and future-building.

Possible transfer steps are, for example:

- Interpretation and evaluation of scenarios according to probabilities (How probable is which development?)
- Trend analysis (research in greater depth on individual developments for the purpose of empirical grounding and validating subordinate aspects of the scenarios)
- Interpretation and evaluation of scenarios according to their desirability and/or positive and negative aspects (Do we want this or that?)
- Problem event analysis (What could happen if unexpected events enter the picture?)
- Impact analysis (What opportunities and risks are bound up with the situation described in the scenario?)
- Actor analysis (What meaning do these possible developments have for the individual persons who are actively involved and for the constellations of such actors?)
- Sectoral analysis (What meaning do the scenarios have for different areas of business activity?)
- Development of options for taking action / derivation of strategies (What can we do?)
- Evaluation of current strategies against the background of scenarios
- Roadmaps or backcasting (What do we want to achieve and with what steps?)
- Implementation of scenarios for the purpose of internal and external communication

Wild Cards

Since scenarios are expected to draw up consistent, plausible conceptual futures, they must often forego thinking about very improbable individual events. However, it is also possible to deal with this "conservative" tendency either during or following the generation of a scenario by subsequently working through "scenarios" of individual disruptive events in order to focus better on uncertainties (cf. Gausemeier / Fink / Schlake 1996, 330 f.). This can be done with the help of "wild cards". Such wild cards (cf. Steinmüller / Steinmüller 2003, 17 ff. and Burmeister /Neef / Beyers 2004, 147 ff.) are:

– Discontinuous events, i.e. serious individual events,

– less probable events whose probability is difficult to estimate,

– but which have, when they enter the picture, a deep and far-reaching impact,

– are perceived as surprising, and

– alter the manner in which we think about the future – and about the past; that is, they change our "thought patterns", along with the interpretive templates with which we construct the world around us.

Nearly "classical" examples of –now historic – wild cards are the fall of the Berlin Wall in 1989 and the concerted attack on the World Trade Center on September 11, 2001.

Following upon the construction of scenarios, wild cards can be used to anticipate developments which were initially left out of consideration in the scenario process and to analyze their consequences for the scenarios (cf. Steinmüller / Steinmüller 2003, 54 ff.). In that case they are often employed as a means of testing the "robustness" of scenarios, since any scenario which completely "falls apart" as a result of any freely selected wild card can be regarded as relatively unstable and non-robust. It is therefore advisable first to study a broader array of wild cards rather than only a few. Secondly, to be sure, the primary "negative" wild cards which endanger the scenario should be brought into play as a means of testing the robustness of scenarios. But it is also a good idea to go through the possible consequences of "positive" wild cards in order to study unexpected consequences as well. And thirdly, a study should be made not only of wild cards which stem from

the central topic area of the scenario but also of those which affect its underlying conditions.

Support for the **identification** of relevant disruptive events can be provided, for example, in the form of brainstorming sessions, surveys of experts, finding historical analogies, or even via an evaluation of science-fiction. This is, however, invariably difficult, and it is best to call upon the help of external competence as a means of reducing "professional blindness" (cf. Steinmüller / Steinmüller 2003, 27 ff.).[30]

Backcasting

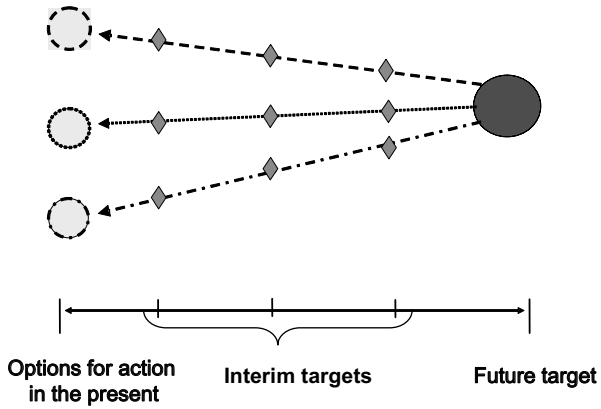
Although backcasting can represent a scenario transfer technique, it is sometimes also viewed in itself as an independent type and/or intrinsic element of the scenario technique (cf. e.g. Greeuw et al. 2000, 8).

One way of describing backcasting is to call it a "backward scenario process". Most of the approaches described in the present study up to now start from the present and develop so-called "forecasting" scenarios (cf. Greeuw et al. 2000, 8). Backcasting, on the other hand, begins from a (desirable) future situation as its target and develops various options for taking action in order to reach that target (cf. Alroth / Höjer 2007, 723). The target situation itself can, for example, be construed as a (consensual) wish-scenario via a scenario process. The central question in doing so is: "*What possibilities do we have for reaching our target?"* and/or *"What must be done now and later in order to reach (social) targets*?" (Grunwald 2002, 225). Thus the paths for realization of the goal which are developed in this way, are retrospective in character, i.e. they work backwards from the already agreed-on target situation. The process is one of unfolding, as it were, the entire panoply of possible contemporary options for taking action with a view to the attainment of goals in the future.

When it is visualized in graphic form, a type of "inverted" scenario funnel (cf. Fig. 12) emerges in which "*realization of the goal is broken down into*

30 Steinmüller / Steinmüller (2003, 59 ff.) present an entire catalogue of potential wild cards, arranged according to different social areas as well as, for example, according to probability and intensity of action.

Figure 12: Backcasting



Source: IZT

a multiplicity of individual steps and intermediate targets which in turn determine the time frames within which specific tasks are to be carried out" (cf. Renn / Zwick 1997, 141).

Some authors emphasize that backcasting techniques are particularly well-suited for helping to attain long-term global targets which extend over a long period of time, particularly when conventional political solutions have shown themselves to be ineffective in achieving this (cf. Renn / Zwick 1997, 139 ff.). For example, this technique can be implemented for strategically planning how to meet sustainability targets, cf. e.g. Holmerg / Robert (2000).

In conclusion: scenario transfer does not function automatically, particularly when it is important to develop concrete options for taking action; depending on the goal, it must rather be correspondingly planned, prepared, and moderated (cf. Minx / Böhlke 2006, 21). Often separate workshops are required for this.

Table 8: The phases of backcasting

Phase 1	Starts by **defining a target situation** in the future, e.g. “Wish-Scenario 2020“.
Phase 2	**Alternative paths to the target** are broken down by looking back from the future to the present (”Retrospection“).
Phase 3	Individual **steps** are defined: ”where must we be in 1, 2, 3, years in order to reach our goal in 2020"? (cf. also ”Roadmapping” in Section 2.5.3).
Phase 4	The end product: different **options for action**, worked out in detail; these can then serve as a basis for discussion or as a basis for decisions concerning a concrete strategy. In conclusion: scenario transfer does not function automatically, particularly when it is important to develop concrete options for taking action; depending on the goal, it must rather be correspondingly planned, prepared, and moderated (cf. Minx / Böhlke 2006, 21). Often separate workshops are required for this.

2.5 Method combinations

Practical futurology involves combining scenarios in a plethora of ways and integrating them with other methods. Precisely such method “mixes” often constitute very fruitful approaches (cf. e.g. Wilms 2006b; Steinmüller 1997). In the following, three method combinations will be presented as examples: the combination of scenarios with modeling methods (2.5.1), with Delphi surveys (2.5.2), and with roadmapping techniques (2.5.3).

2.5.1 Scenarios and modeling methods and/or simulations

Modeling methods are chiefly employed for the systematic analysis of complex causal relationships. When thus used, they simulate – usually with the aid of one or more computers – the reactions and interactions of different variables. This gives them the ability to identify even unexplicitized causal relationships and consequences. In futurology, simulation models are used to create images of non-linear dynamics and often as well to quantify variables and their consequences.

Although a wealth of modeling techniques exists, three main types above all are employed in the context of futurology:

– System dynamics models
– The agent-based modeling method
– Special qualitative models

These model types have very different capabilities. System dynamics models are usually brought into play as a means of quantifying variables (cf. e.g. Forrester 1970; Meadows 1972; Größler 2006, 93 ff.). The agent-based modeling method simulates the behavior of individual actors during the course of their interaction (cf. e.g. Berger et al. 2007). Qualitative models, such as the "Syndrome Approach" of the Scientific Advisory Committee on Global Environmental Change (cf. e.g. WBGU 1996), still represent a relatively young area of research. However, they appear particularly suitable for creating appropriate images of elements of unpredictability which are inherent to the future. Recent developments in this area are aiming more and more at a hybridization of qualitative and quantitative models and at their integration in the widest sense (i.e. integration of stakeholders, of dimensions (for example the dimensions of sustained development), of individually created modules, etc.).

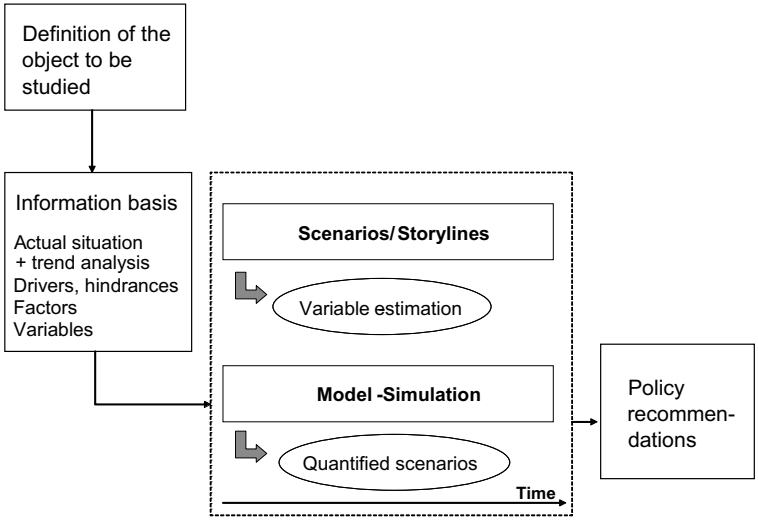
Models can be combined with scenarios in a multitude of ways. For a long time, scenarios in modeling processes were primarily regarded as the result of models whose activities were fully free to run without chronological restraints into the future, as in the Club of Rome study "Limits to Growth" (1972). However, the multiplicity of possible parameter values of such scenarios, and the difficulty in communicating these, have gradually led to an opening up of modeling methods, so that these methods increasingly deal with scenarios as "bundles" of consistent drafts of the future. As a result, both quantitative and qualitative scenarios today are often translated out of different contexts of origin into models and thus quantified where this is appropriate (cf. e.g. Barré 2004). Moreover, the results of such modeling activities are often "translated" into scenario texts. Other approaches often weave numerous different stages from narrative scenarios (often referred to in this case as "story-lines") into models and back again into narrative scenarios, thus refining both the scenarios and the models and giving them validity (cf. e.g. IPCC 2007). This approach is also referred to as the "Story-and-Simulation" approach (SAS) (cf. e.g. Alcamo 2001).

For the sake of an example, a typical procedure for the **quantification of scenarios** in a system-dynamics model will be outlined in the following (cf.

Fig. 13), and a few conclusions will be drawn from practical experience with this design. The example presented here concerned an assessment of the future impact of information and communication technologies on the environment (cf. Erdmann et al. 2004).[31]

In this project, three scenarios were created with the year 2020 as a chronological horizon: "Technocracy", "Government First", and "Stakeholder Democracy". Scenarios like this are based on the one hand on the same information as that used for the model and on the other hand on interviews conducted with experts concerning the identification of key factors. In order to quantify the scenarios, which have been put into the form of texts, it is necessary to translate the "story lines" of the scenarios into numeric values for the sake of variables which can be processed by the model. A vali-

Figure 13: Example: Quantification of scenarios in the modeling process



Source: IZT, based on Erdmann et al. 2004 (in simplified form)

31 This took place within the context of the IZT project "The future impact of ICT on environmental sustainability".

dation workshop was conducted respectively with outside experts both for construction of the raw scenario and for the purpose of using the scenario in the modeling process.

A number of **success factors** crystallized out of this practical experience with the quantification of scenarios in the modeling process:

– The modeling process on the one hand and the creation of scenarios on the other both tend to take place according to different areas of core competence in different scientific communities. This should be taken into consideration in designing the project.

– The quantification of scenarios in the model imposes special requirements regarding the consistency of the scenarios. They must obey the same inner logic as the model itself; otherwise it will be impossible to interpret the results. For this reason, however, the scenarios are checked in actual practice on the basis of some 10–25 key variables with the aid of consistency analysis.

– The added value of modeling – as also becomes apparent when it is compared with other future research methods – lies firstly in its possible production of quantitative results. Moreover, it is also well suited, when a quantification of scenarios is aimed at, to provide ranges of individual possible developments instead of fixed values. Secondly, a systematic and transparent procedure is indispensable to the modeling process; this has the added advantage that it can also result in fruitful discursive processes. Unfortunately, however, the necessary condition of comprehensive and verifiable documentation required for this is often not realized in actual practice.

In summary, the following may be stated: the scenario modeling method is particularly suitable when a quantification of variables is at issue. For example, such a "translation" of qualitative scenarios can be meaningful when the aim is to investigate the degree to which a specific action takes effect. However, caution is advisable with regard to the inherent suggestion of high precision due to the production and uncritical application of numbers. The fact that knowledge of the future is of its nature uncertain therefore makes the use of other, qualitative modeling techniques also advisable. The minimum requirement is that the most critical steps in the quantification of scenarios should be carried out with maximum possible transparency and

with validation by experts. This is true above all for the estimation of values representing variables.

2.5.2 Scenarios and Delphi surveys

Speaking very generally, the term "**Delphi**" is used to designate a systematic survey of experts over the course of numerous different rounds (cf. Martino 1983 and Benarie 1988). Delphi is an empirical technique which is used above all when that which is known contains uncertainties. In the classical Delphi method, a panel of experts is asked by mail to respond anonymously to statements; this means, for example, that they are to estimate how certain developments could turn out in the future. The results of this initial round of inquiry are collected by a Delphi-team, which evaluates and processes them and sends them back again to the panel of experts with the request that they again take a stand on the issues. This time, however, they must give explicit reasons for any of their assessments which deviate notably from the main tendency of the panel as a whole. In this way, the degree of consensus and/or dissent within the panel, and thus the degree of uncertainty of the knowledge at issue, can be determined over the course of a number of different rounds of questions and answers.

Today further methodological developments are available for the Delphi Survey technique; for example, it is possible to dispense with the anonymity of the experts and to plan a "Group-Delphi" in the form of a presence workshop over a number of days (cf. Webler et al. 1991).

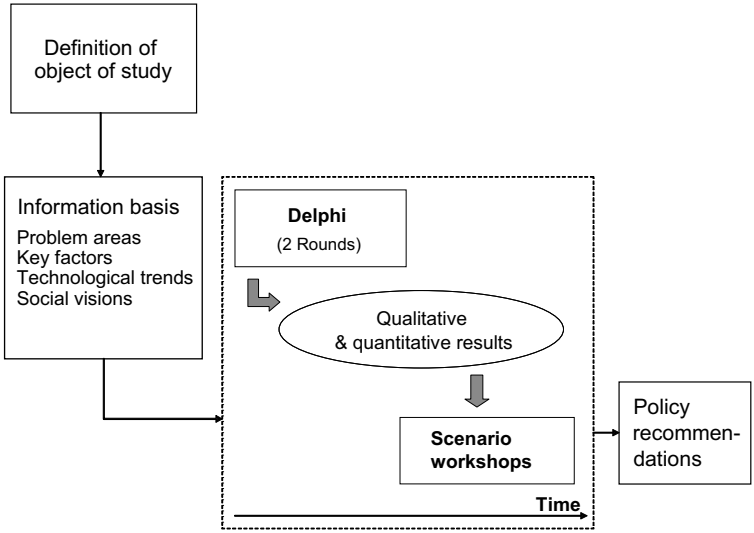
Delphis and scenarios can also be combined with each other in various ways. On the one hand, for example, scenarios may be integrated in the form of inputs which help to establish better focus, or as interim visualizations within Delphi surveys (cf. e.g. AC/UNU The Millennium Project, 2020 Global Energy Delphi Round 2)[32]. On the other hand, the results of a Delphi survey may also be integrated into construction of the scenario.

As an example, a typical procedure for **combining scenarios with Delphi** will be presented (see Fig. 14). In this example, a broad-based Delphi study

32 See: http://www.millennium-project.org/millennium/energy2020.html for further details.

was carried out regarding the technological and social perspectives of Europe's "energy future" (cf. Wehnert et al. 2007).[33] The Delphi results regarding technological and social-normative aspects were integrated as key factors into the scenario building process in the form of different profiles (cf. Velte et al. 2006). Then, using morphological analysis, three scenarios were drawn up with the year 2030 as a chronological horizon: "Change of Paradigm", "Fossil Fuel Wars", and "Muddling Through Across the Gas Bridge". This methodological combination made possible a solidly-based discussion of future forms of energy technology within the context of targeted social and political goals.

Figure 14: Example: Input of Delphi-results in a scenario process



Source: IZT, highly simplified on the basis of Velte et al. (2006)

33 This refers to the IZT project "Technology and Social visions for Europe's Energy Future" (Eur-EnDel). See: www.eurendel.net for further details.

Practical experience with scenario building on the basis of Delphi results has resulted in the crystallization of several **success factors**:

– In creating the scenario, the project team which was previously responsible for the Delphi survey was altered in part by the addition of new partners and the replacement of some by others. This addition of outside views proved to be very helpful as a means of keeping the process from "getting stuck in the mud" of "tried-and-true" perspectives.

– It is also to be recommended that different teams be assigned to work out scenario components for each individual topic area; this prevents them from consciously – or unconsciously – making a priori suggestions for specific constellations. Moreover, the evaluation of combinations of key factors as being consistent or inconsistent is central to the development of the scenario and should be carried out in the context of a workshop and as far as possible together with other stakeholders and experts than the ones who have worked out the key factors.

The added value of this type of methodological combination, in comparison to the classical Delphi method, consists in the link between key factors and their interactions in place of a relatively isolated observation of different aspects. In comparison to the scenario technique, the added value consists in the solid and validated basis of knowledge which in turn lends credibility to the identification and analysis of key factors. It would also be possible and meaningful to use Delphi to draw up reliable descriptions of spectra of the values of key factors.

Transporting Delphi results into scenarios means that individual aspects can be thought through to their logical conclusions and visualized in graphical form. At the same time, however, this also means that complexity is reduced and that in most cases not all of the Delphi results can be completely translated into scenario form. This is also true of the results obtained through the broad-based character of the Delphi panel and the multistage Delphi survey process: the objectivity and quality of these results cannot be completely transferred one-to-one to the scenarios. Rather, some results invariably become blended out due to the necessary selection process.

In addition, Delphi surveys involve a great deal of effort, due especially to their time requirements and the involvement of a large number of experts.

For that reason it appears to make more sense to enhance Delphi studies via scenario techniques than to base a scenario study on an independent Delphi survey. In that context it may be appropriate and more to the point to employ other forms of surveys of experts.

2.5.3 Scenarios and roadmapping

In the present context, a **roadmap** provides a broad-based, orientational framework for future strategic developments. The major characteristics of roadmaps are their systematic compilation of central challenges and options for taking action, along with their graphical presentation of targets for development and milestones along a chronological axis. In the process, various forms of graphical visualization may be brought to bear.

The literature on the subject distinguishes four main types of roadmaps (cf. Da Costa et al. 2003):

– Roadmaps for business enterprises

– Roadmaps for professional branches

– FuE-roadmaps

– Problem-oriented roadmaps

Depending on the respective type, roadmaps are created in collaboration with a vast assortment of actors. Their strong element of practicality in application requires careful selection and involvement of the stakeholders. For that reason too, process-orientation is a major success factor during the creation of roadmaps for their subsequent implementation.

Conventional roadmaps usually convey a one-dimensional picture of the future. In recent times, however, this instrument has been further developed in the direction of being able to integrate alternative futures as well (cf. IZT / ZVEI 2007; Lizaso / Reger 2004). As also in the scenario technique in the narrower sense, the widening out of a "funnel into the future" can take place from the present into the future. But backcasting from the future back into the present can also be a part of this approach.

In the following, an example of a typical procedure for **combining scenarios with roadmapping techniques** will be elucidated (cf. Fig. 15). The

project used for this example concerned the creation of a roadmap for the automation industry in five areas of application (cf. IZT / ZVEI 2007).[34]

Starting from the actual state of affairs, and with a focus on trends, potentials and needs, explorative conceptual futures with an explicitly normative aspect were developed using intuitive techniques and then formulated in the sense of a concrete target („This is our goal."). Examples would be: "The Digital Factory in 2020", "Foodstuff Quality and Safety in 2030", "Megacities in 2030". Then, with today as a point of departure, roadmaps were developed for reaching these goals in view of the relevant trends.

The kinship with scenario methods, as well as the possibility of building combinations, emerges as particularly significant in this backcasting approach to the roadmapping process. That is, the development of a roadmap leading to the conceptual future makes it immediately possible to work out a scenario text, or what might be termed a "story line" Viewed by itself, forecasting represents a further possible future which can be interpreted as a scenario with the question "What would happen if we were to act without a roadmap and without a conceptual future?".

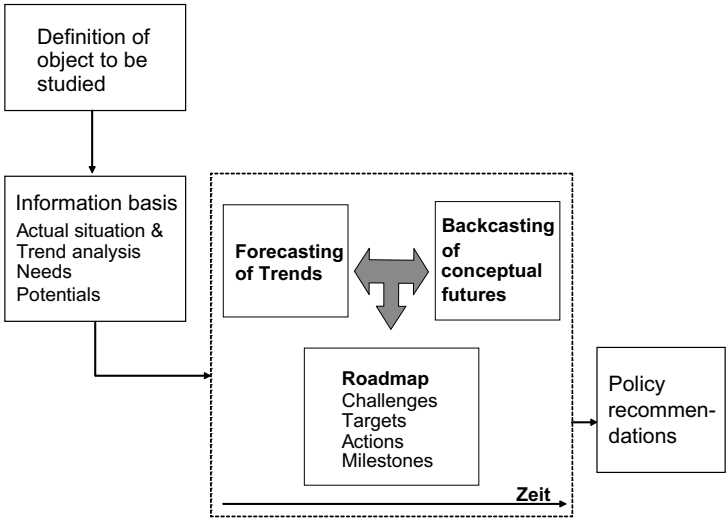
The following **success factors** have crystallized out of practical application of the backcasting approach to the roadmapping process:

– Roadmapping often involves a need for as many attractive and original conceptual futures as possible. For the sake of transparency and plausibility in an appropriate spread of possible futures, care should be taken to derive not only probable trends from conceptual futures but also to make room for less probable and in particular explicitly normative conceptual futures.

– The development of conceptual futures and their discussion is no simple task; rather, it is one which often cannot be carried out by the very persons in whose interest the roadmap is created. For that reason, the involvement of an independent institution for future research is to be recommended as a means of ensuring creativity, credibility, a mastery of high complexity, and a high level of quality.

34 The IZT project in question was "Automation 2015+". See Behrendt et al. (2007) and http://www.zvei.org/index.php?id=298 for further information.

Figure 15: Example of backcasting from conceptual futures in the roadmapping process



Source: Diagram of the IZT, based on IZT / ZVEI 2007 (in simplified form)

– The interpretation of conceptual futures in order to create a roadmap by means of backcasting should involve the most important stakeholders, since the background value concepts, goals, prerequisites and actions to be taken make an open discussion imperative. Roadmaps cannot be deductively derived from conceptual futures but must rather be developed discursively. This means that the conceptual futures must serve above all a communicative and stimulative function.

Roadmapping processes are particularly appropriate for opening up a broad-based orientational framework for future strategic developments. The central prerequisite in this case is the identification and involvement of the most important stakeholders. Such a process of opening up numerous different plausible and original conceptual futures is a highly demanding undertaking which requires competence in the methods used and an adequate supply of experiential knowledge (cf. IZT/ ZVEI 2007).

3. Dimensions of selection for the application scenario methods in the development policy field

A fundamental problem crops up in the application of scenario methods, as is also the case in general with other types of future research methodology; it is that up to now no systematic and detailed compilations of criteria for the purpose of concrete selection of a method have been available (cf. e.g. Tegart / Johnston 2004, 35 ff.; Mietzner / Reger 2004, 60).

That is, there are no easy-to-apply, overview-oriented typologies which might make it possible to assign an appropriate, concrete scenario technique to generally specified goals and functions. Each individual scenario process is in the rule so specific that an individual decision must be made from case to case concerning which concrete methods and techniques are most appropriate.

In order to apply appropriate scenario methods in the field of development policy (DP), it is therefore necessary to clarify a number of questions and alternatives for decision in each case specifically in advance for each project:

– It is always the case that selection of a specific, concrete scenario technique can make sense only if carried out in each case specifically within a concrete research or project context.

– For that reason it is also important to adapt the type of scenario process to the organizational structure and culture of the respective future research institutions and/or participating authorities and official bodies (cf. Burmeister / Neef / Beyers 2004, 74 ff.).

– In so doing, it is of central importance to realistically adjust the procedural steps which are taken to existing resources and underlying conditions while simultaneously making them as uncomplicated and robust as possible (cf. Burmeister / Neef / Beyers 2004, 48).

– When selecting a concrete methodological approach, it is also of decisive importance to precisely identify the respective application-related

35 Otherwise there is a danger of narrowing the focus a priori due to “preferred methods” or standard manners of proceeding.

targets which are to be met with this methodology. This is always important when the aim is not to employ methods for their own sake but rather to ensure that the methods are functionally oriented toward a specific goal.

The following paragraphs will systematically present a number of dimensions of selection which should be studied one after the other in order to prepare solidly-based selection of an appropriate scenario method. This sequential procedure appears advisable as a means of making the selection of scenario techniques as target-oriented and objective as possible.[29] In the process, the individual dimensions of selection will be outlined using the example of development policy as a scenario field in order to illustrate the multiplicity of thematic possibilities and the peculiarities of possible "development policy futures". To begin with, fundamental questions on the implementation of scenario methods in DP will first be addressed (3.1) Then brief questions will be scrutinized concerning the underlying conditions of a scenario process in the topic area of DP (3.2), followed by presentation in succession of a number of specific dimensions of selection for the selection and shaping of a concrete scenario technique (3.3).

3.1 Basic questions on the application of scenario methods in DP

In order to select a specific scenario technique and develop a concept for a scenario process in the area of "development policies", basic methodological questions must first be answered:

Are scenarios the most appropriate method?

Here it is necessary to begin by clarifying whether scenarios represent the best method at all or whether a different approach might be more advisable.

Methodologically, scenarios always represent an appropriate selection for studying the future of development policies whenever **alternative possible futures** in Development Policies are to be traced. Minx / Böhlke put it as follows (2006, 16 f.):

> *"[A scenario technique is advisable whenever] the core issue [is] to describe possible developments during the course of a structured communication processes which aims to increase our understanding of the driving forces and the consequences to be derived*

from them for different questions and/or problem issues. The method is of particular value in cases where quantitative methods of prognosis are of no avail. Above all, it is advisable to use this method when it is necessary to analyze complex topics and their realistically possible paths of development into the relatively distant future."

On the other hand, the limitations of scenarios presented above (Section 2.2.4) should also be taken under study in answering this question. Viewed in that light, scenarios – as the only method to be employed – do NOT appear appropriate. This is the case, for example, if:

– Basic, pure trend analysis and one-dimensional trend extrapolation are likely to be more suitable when the intention is to produce prognoses which are as "hard-and-fast" as possible concerning how the future of DP will turn out and/or how a single future development of DP should be regarded when it is viewed by and large as being beyond doubt. In our view, this is the case especially when only individual factors are to be taken under study.

– Delphi surveys, for example, are more appropriate when the object is merely to gather contemporary knowledge about the future of DP and to evaluate its degree of unpredictability.

– It may be more appropriate to apply modeling techniques when the object is to investigate a few well-researched and quantified factors, provided that knowledge about them and their interactions is relatively certain.

Evaluation of scenarios or generation of scenarios?

Once it has been definitively established that scenarios will be worked with, the question must be asked whether it is advisable to evaluate already existing scenarios or whether the generation of new scenarios is required.

In appearance, the field of development policy is highly complex; on the one hand it must take into account the most varied dimensions of global developments (economic, ecological, cultural etc.) while being tightly intermeshed on the other with further segments of the political arena. For that reason, it appears advisable when investigating the future of development policy to turn to "external" expertise as well rather than wanting to "keep everything in the family".

An evaluation of existing scenarios, with a focus on the respective implications for DP, is, at least as a point of departure, with certainty advisable. For example, it is easy to imagine that scenarios with a prominent element of expertise in the natural sciences, such as climate scenarios or energy scenarios, could be studied for the possible future effects of development policies within the context of scenario evaluations. Again, it could be thoroughly expedient first to evaluate geopolitical scenarios, scenarios involving European foreign policy, or, for example, scenarios concerning the future of the UN with a view to their possible impact on international and/or European DP. Also conceivable for an evaluation with regard to DP would be, for example, scenarios of Intergovernmental Panel on Climate Change (IPCC) and United Nations Environment Programme (UNEP) or the Millennium Project of the AC/UNU.

It would appear advisable to generate new scenarios above all when possible futures of the scenario field "development policy" are to be presented in the form of consistent images. This might be the case firstly, for example, when the desire is not merely to keep the impact of environmental features on DP in focus but rather to keep DP itself in the center of attention. And secondly it might also be the case when not only an analysis of individual trends, developments and influences is needed but rather a synthesis of these elements as a means of studying future possible constellations of development policies as a whole.

After these basic questions have been clarified, the envisioned scenario process can be concretely drafted.

3.2 Defining the underlying conditions

"Who wants scenarios, for what and for whom?"

If appropriate, it must be clarified who is the initiator, that is, the person commissioning and/or interested in the respective scenario project and precisely to what end the scenarios are to be employed or to be of assistance. In many cases, it is often necessary to go beyond the context of the project's creation and to determine more exactly what will be the subsequent context of the project's use and/or what "target group" is aimed at for the scenario – for example, will the project team alone, the "interested public" or even the "public as a whole" react to the scenarios?

Assuming, for example, that the DIE initiates the scenarios, a multitude of constellations nevertheless remains conceivable, e.g.:

– The DIE requires scenarios for its research on and about development policy.
– The DIE requires scenarios for its political consultation services, e.g. to the Federal Ministry for Economic Co-operation and Development (BMZ).
– The DIE requires scenarios for (methodological) services in its advisory capacity on development practice in the sense of: "Scenario work can be carried out in the field in the following way."

The reason why it is of decisive importance to clarify these questions is that the goals and functions to be met and fulfilled by a scenario process depend to a major extent on the interests of the initiators and/or persons who commission it and, if pertinent, the expectations of the body financing it and the persons who are involved.

Clarification of resources

A further dimension which, although not unique for the field of DP, should generally not be neglected in selecting a concrete scenario technique, is the adaptation of the scenario process to available resources. This affects in particular the knowledge which is available for use in advance, the time budget, the personnel resources, and the financial configuration. Projects which are too ambitious or not realistically tailored to the disposable resources and which must be prematurely abandoned or retrenched are completely unfavorable for the project's success and its eventual impact.

For this reason the concrete project planning should also decide whether external "scenario service providers" and/or external moderators are to provide support for the scenario process (cf. Shell International 2003, 28).

3.3 Selection of a concrete scenario technique in DP

Selection of a concrete scenario technique in DP requires that a number of questions be answered regarding above all the precise definition of the target and the pattern of the object under study and the scenario field. Regarding the individual dimensions, this is where pointers are given concerning possible decision-making processes and manners of proceeding.

What concrete targets are to be met through the implementation of the scenario technique?

In order to achieve a precise "fit" for the respective methodological approach, it is important to define in detail the goals which are to be reached via scenario methodology. The four central functions for which the scenario technique can be employed were already mentioned earlier in an overview of scenario methods (cf. Section 2.2.3):

- **The explorative and/or knowledge function:**

Explorative scenarios appear advisable when knowledge about the *possible* futures of DP is required. These "What-would-it-be-like-if" scenarios are suitable for processing the following kind of questions (sketched here roughly and merely for the sake of example):

– How might international DP change if security policies become the dominant topic of foreign policy and international cooperation?

– What is the significance for the role of international DP if China and India, the "Asian drivers of global change", continue to gain in political influence on the international level?

– What will be the consequences for DP if it is not possible to contain the "danger of climate change"? (Schellnhuber et al. 2006; Debiel / Messner / Nuscheler 2006)

- **Establishing and concretizing targets:**

Specially structured **normative** scenarios appear advisable in cases where scenarios are to be employed for establishing and concretizing goals and distinguishing them from one another. What-do-we-want-to-achieve "scenarios" are well-suited for processing the following type of questions (as above, sketched here only in abbreviated form):

– What are the future goals of DP? What goals should DP target over and above the UN's Millennium Development Goals?

– What should be the future mission of DP?

– What should be the guiding ideas and goals of German and European development policies?

– What role should DP play in relation to other political fields which are relevant for foreign policy?

This crystallization and concretization of goals, along with the analysis of target conflicts and dissent, can be rendered possible, for example, via the development and evaluation of "wish-scenarios".

- **Strategic advisory services:**

In most cases both explorative and normative aspects are desirable when scenarios are used for the purpose of rendering strategic advisory services.

On the one hand, highly **explorative** aspects are required in order to ensure the most solid possible basis for the advisory services; this means a solidly-based knowledge of the influencing factors and conditions and their interactions as well as of the action contexts in which strategic alignments and considerations regarding specially structured options for taking action and concrete measures are possible at all.

On the other hand, **normative** aspects too are required, since all strategic advisory services are preceded by a target definition which is demarcated by the questions, "Where do we want to go from here? What are the goals to be reached"? (see above). Then it becomes possible in preparing a development strategy to ask further, "How can we reach these goals"?

Some examples of such strategic questions would be:

– How can DP hold its own in addition to security and economic policies as an important part of international cooperation efforts?

– How can DP contribute to containing climate change?

– How can DP contribute to a strengthening of the guiding ideas of sustainability?

– How can DP promote international integration of the "Asian drivers of global change"?

– How can DP help to bridge the gap between the conflicting resource interests of the "North" and the "South"?

The linking of explorative and normative aspects can be dealt with in various ways in the scenario process.

Normative aspects may of course also be implicitly present, that is, not made explicit. Precisely in the area of development policy, however, an area deeply marked by inherent normative aspects, this appears inadvisable for two reasons: First, an implicit character of normative perspectives can lead to a distortion and/or one-sidedness of the explorative perspective. Secondly, such an implicit character makes it impossible to deal with conflicting goals and with dissent about the goals among different actors in the process. This in turn can endanger the scenario process and undermine the later legitimacy of the scenarios. For these reasons it appears advisable for the future of development policy to be as **explicitly open** and precise as possible about describing and distinguishing the explorative and normative steps within a scenario process.

For example, it might be conceivable to begin by establishing explorative scenarios and only then expanding and evaluating them in a combination of enhancement and scenario transfer regarding their desirable aspects – including these aspects from the viewpoint of the different actors – in order then to take the third step of developing options for action as a means of reaching these goals.

Another possibility would be to focus the scenario process more intensely from the very beginning on the definition of goals by explicitly defining these goals in a first process phase; they could, for example, undergo fine-tuned differentiation in a normative scenario. Then, for example, it would be possible, much as in Backcasting, to develop different action scenarios in light of the developments, trends and interactions to show how the goals individually and as a whole "bundle" could be attained step by step.

This kind of "mixed procedure", that is, one in which two to three explorative scenarios and one explicitly normative scenario, e.g. a "sustainability scenario", are created concurrently or successively as a means of then deriving options for taking action.

- **Communication:**

Scenarios for internal or external communication in DP could, for example, have the following missions:

– Encouraging networking among different actors (from different research communities, e.g. from the fields of research, politics, and actual practice, or from different countries).

– Identifying points of agreement („common ground“) and/or open questions and conflicting views.

– Helping to establish a common point of view or common goals.

– Communicating the project's self-understanding and the role of DP to those outside the project.

– Sensitizing the actors, e.g. the Federal Ministry for Economic Co-operation and Development, for specific topics such as the role of DP regarding climate change.

Scenarios can be used for internal or external communication; in the first case, it is particularly important to mold the character of the process correspondingly; in the second, however, it is particularly the manner of description which is to be carefully adapted.

The joint generation of scenarios is in the forefront of attention when scenarios are intended for use primarily in exchanging ideas and information as a means of establishing networked interrelationships among the different actors.

When scenarios primarily serve the function of communication, that is, when they are to be used above all as "vehicles" for networked interrelationships, for discourse, and/or for the identification of empirical steps, it may suffice to create simpler, roughly outlined scenarios; these can then be jointly prepared by a relatively large number of different actors within a (relatively) short time and subsequently applied for the sake of focus.

Often, however, the function of communication is a (supplementary) function which, if appropriate, lies "at right angles" to the other goals. Depending on the importance of this aspect, care must be taken that the actors – e.g. from different disciplines, cultural backgrounds or the areas of theory and actual practice – are given optimum conditions as far as possible for carrying out their exchanges (a process usually fraught with difficulties). This in turn, for example, makes it imperative to work out a good moderation concept and an adequate chronological time frame, since dynamic group processes are involved.

The following discussion of "target groups" will again take up the topic of how a scenario process could be designed as a communication process re-

garding the futures of development policy, along with the aspects of setting up scenarios for internal and external communication.

What importance do scenarios have within the overall project?

Identification of the goal is closely connected with the task of deciding the position of scenarios within the context of the (research) project. In general, as in every project, the focus of the process as a whole must be clearly specified. Put simply, this means clarifying what role the scenarios have and how they integrate themselves with the course of the process. Should scenarios represent end products of the project? (Normative or explorative scenarios would be conceivable here). Or should scenarios not be goals in themselves but rather a means of communication (= scenarios as a point of departure or a vehicle of communication during a process). Or should scenarios be an instrument for strategic advisory services, that is, with attention given primarily to the evaluation or "further processing" of scenarios, meaning that they should be available soon enough within the process to make it possible to carry out the corresponding transfer steps?

This decision-making process has central impact, for example, on the issue of how many resources must be provided for the actual creation of the scenario.

Demarcation of topics and determination of the scenario field

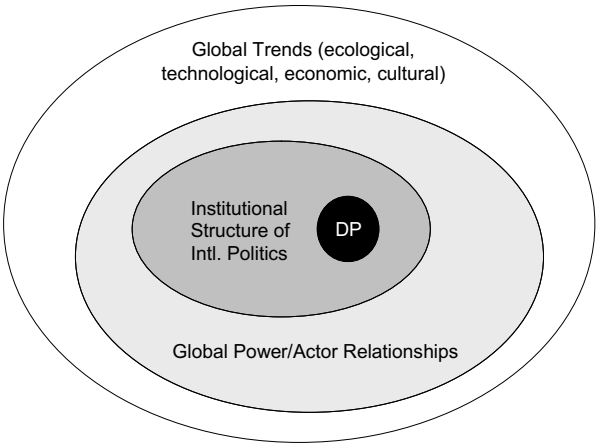
A clear and thorough definition and distinction of the problem issue and object of study is absolutely central to selection of an appropriate, concrete methodological design. This decision-making process is also linked very closely to the later definition of the scenario field, since it includes, among other things, a painstaking definition of 1) the thematic, 2) the geographical, and 3) the chronological scope.

The topic area of "development policy" (DP) may truthfully be designated as a particularly complex policy field. In the first place, a multitude of persons are actively involved in it, including, for example, donor and recipient countries of the most various kinds as well as governmental and non-governmental actors. In the second place, DP affects different levels of governance: the international, regional, national and local. And thirdly, DP includes a whole series of political fields such as the macro-economy, farming, education, and health services.

Were one to attempt to regard this topic area in (invariably) holistic fashion, the various determinants and developments would be relevant on different levels, including, for example, the levels of global trends (economic, ecological, cultural etc.), global constellations of power and actors, the underlying (institutional) conditions of international politics, and – last but not least – DP itself, with its internal dynamics and processes of change. The result is a "multidimensional" scenario field, including contexts which stand in a relationship of interaction with the basic field of DP (cf. Fig. 16).

For this reason, it would appear that decisions which bring a focus to the process, i.e. decisions concerning the dimensions which are to be regarded respectively in greater depth, are urgently to be recommended. Any attempt to investigate the overall system holistically appears feasible only at the cost of very great simplification. The question of how many aspects can be taken into consideration concurrently in the context of a respective scenario process depends very much on how precisely and detailed the individual aspects have been included, and this in turn depends on the amount of prior knowledge to which those involved can or should have recourse. As a result, a basic decision must first be made whether the investigation is to fo-

Figure 16: Diagram of the multidimensional "DP scenario field"



Source: IZT with reference to DIE 2007

cus on specific individual developments and trends or rather on interactions.

A successive, **detailed observation of individual developments** and/or trends, if appropriate, is advisable when above all the object is to absorb and discuss a basis of knowledge. This focus makes it possible to analyze exactly what basis of "certain" knowledge of the future is present. This is turn makes it possible to evaluate "knowledge offers" in order, for example, to integrate and utilize quantitative modeling methods from other disciplines (such as climate models or models of population growth). Such data are rarely trivial in structure and usually require intensive discussion and, if appropriate, "translation" before they can be taken over, for example, as key factors. Trend extrapolation scenarios, for example, appear well-suited for such a goal. However, there is also a danger in the final analysis of describing, for example, "fifty trends" in detail while attaining no overall perspective but rather producing thick, difficult-to-understand "telephone books".

The diametrically opposed manner of proceeding would be above all to study the **interactions** of different levels. This presupposes first that it is already possible to have recourse to a solidly-based ("future") knowledge of individual factors. Secondly, sensible selection is absolutely necessary in order to reduce complexity and make synthesis possible at all.

Many different ways of proceeding are imaginable between these two extremes. In any case, the individual levels and sectors and/or sets of influencing factors must be exhaustively analyzed and then studied jointly; examples might be the factor of climate change from the context of global trends or the level of actors on the international stage.

Thus it would be possible to **select** a sector from the topic area of development policy in relation to a specific scenario field on the basis of a thematic or sectoral viewpoint; this could then be widened to include numerous different levels, as for example concerning the topic of "water". Other possible "filters for observation" are ideas like an in-depth study of institutionally based aspects, or an actor-based perspective.

It remains to be noted that the concrete shape given to the scenario field has a strong influence on many subsequent organizational options. The decisions for inclusion or exclusion which this entails must delimit the scenario field precisely enough that an overall perspective is possible. On the other

hand, every selection also involves a simplification. Moreover, all aspects which are posited as being "constant" (or at least blended out of consideration for the time being) can distort the perspective to a considerable degree (cf. Grunwald 2007, 5).

This leads to the following question: What is the maximum thematic **degree of complexity** with which **scenario techniques** can hope to cope? In general, the following may be said: uncomplicated, trend-based scenario techniques often neglect interactions. All systematic-formalized techniques, on the other hand, are very exhaustive in their definition of individual key factors and also permit detailed observation of individual developments. However, they must restrict themselves, for example, to between 10 and a maximum of 25 key factors. More than that cannot be meaningfully processed. Creative-narrative techniques in contrast have the advantage that their selection of key factors need not be so explicit; this allows them where appropriate to take more aspects, nuances and factors into consideration. However, they often do this in less detail and less systematically.

In distinguishing topics via their definition, different types of **integration** of sub-areas are possible as a means of treating problem-oriented, specific combinations which can then be included either concurrently or, if appropriate, in sensible succession one after the other. On the one hand, it is possible to study different thematic fields jointly or in succession in one and the same process in a process of "horizontal" integration (e.g. climatic change, water and safety, or economic and ecological factors).

On the other hand, it is also possible to study individual topics (e.g. "water" or "migration") in a process of "vertical" integration over different levels of the above-mentioned group of topics in the field of DP, e.g. internal DP, international politics, global power relationships, global environmental trends, and then to arrange these in relation to one another and, if suitable, later to include further levels or aspects. In such "integration steps" it is always important to take interactions into account in all directions; that is, it is important not simply to assume for example that the structure of international politics affects DP, but also to study the effects of DP on these structures.

The substantive and thematic complexity of the topic area of DP can and must also be addressed via horizontal and vertical "**integration aspects" on the procedural level**: in the discourses, group processes, and workshops

of a scenario-based approach it is always important to find the "right" interdisciplinary mix of professional experts on the one hand and, on the other, the most appropriate relationship between theoreticians, practicians, decision-makers and those who are affected.

For the purpose of selecting a concrete scenario technique, it is also necessary to decide on the substantive level what types of information are to be included.

This concerns first and foremost the question of whether **quantitative** and/or **quantified** descriptions are possible and necessary. Many questions appear capable of quantification only with difficulty in the field of DP. The aim of studying political structures, social and cultural conditions, institutional aspects and power issues with a view to quantifying is often, it must be said, reductionistic. For that reason it appears advisable regarding many problem areas of DP to design scenario processes which have their roots in qualitative data and information.

Geographical versus thematic scope: the pros and cons

The scenario field of "development policy" can be viewed on fully different geographical levels depending on the concrete topic area in question. Both regional and global perspectives may be advisable in the respective case. Even the local level can be included when scenarios are employed for example in order to define the target(s) or for the development of concrete options for taking action, and this, if appropriate, can even be carried out in participatory fashion on location.

The broader the geographical scope which is selected, the more urgent it is on the other hand to confine the scenario field with regard to other parameters. Put more graphically, this means that when global observation of worldwide systems is desired or exigent, this is attainable only at the cost of considerable streamlining in terms of quantity and/or the degree of detail of the factors under study. On the other hand, it can be questioned to what extent such simplifications are capable of presenting suitable models for the visualization of greater complexity on the global level (cf. Messner /Scholz 2005, 24 f.).

This problem of complexity must be taken into account on the one hand in each case by means of a pragmatic delimitation of the thematic focus. On the other hand, it appears advisable for specific topic areas to integrate the

national and/or regional and global levels "vertically and – if appropriate – iteratively "bottom up" and/or "top down" as well; this not least in order to correct and validate the strong tendencies to simplification which can emerge on the global level by means of regional perspectives.

Implications of the selection of a time horizon

The farther distant the point in time selected for study lies in the future, the smaller will be the extent of available "hard" knowledge of the future and the resulting prognostic possibilities. The room for possible developments becomes ever broader, meaning that the danger becomes ever greater that factors or developments which cannot be adequately evaluated at the present point in time will grow in influence (cf. Alcamo 2001, 12). The farther one looks into the future, for example, the more difficult it becomes exploratively and prognostically to anticipate changes in the system of international politics. Since the unpredictability of possible developments then becomes very great, normative goal-and-wish scenarios are of great practical value, precisely in the case of far distant chronological horizons, as a means of providing orientation regarding the options for shaping these futures and the exigencies for action which result from them. This means asking, for example, how the architecture of the international political system will look in the year 2040 in order to find the required global solutions for problems. It also involves the question: "How can or must DP contribute to turning this vision into reality?"

Higher-level abstraction vs. concrete strategic counseling

It is safe to say that a particular challenge in the field of DP and in working with scenarios is that on the one hand global, complex causal relationships play a major role but are difficult to influence, while simultaneously on the other hand there is usually an urgent need for concrete strategic elements and (sometimes short-term) options for taking action and recommending courses of action.

Deriving concrete policy implications from global scenarios is a generalized challenge, as has also been stated for example by Greeuw et al.; this is also true in the field of global energy and environmental scenarios, which in the year 2000 were still very far from offering concrete assistance in the form of strategic advisory services (cf. Greeuw et al. 2000, 91). In particular, it represents is a very work-intensive, time-consuming, multistage process, to say the least, to pass from explorative global scenarios to the de-

velopment of concrete strategies. Normative scenarios, which in any case are usually built upon participative actor processes, often help to achieve a more transparent manner of proceeding with the aid of corresponding back-casting components.

Target groups and participants

In addition, every scenario process requires a decision whether it should be carried out within an institution, i.e. internally (as is the case exclusively at the DIE) or to what extent outside actors or experts are to be involved (e.g. from other research and consulting institutes and, if appropriate, also from developing or anchor countries, or even experts from the field of actual practice with DP, for example from the BMZ and/or the GTZ).

Parallel to this it is also necessary to clarify whether the scenarios should be specific primarily for internal or also for external use, i.e. to what persons they are to be addressed. Will the scenarios serve the purpose of communication within the research and advisory services community in the field of DP, or should the scenarios be directed toward the political arena as well, e.g. toward the BMZ? These decision-making processes should be taken into account in selecting the participants in the scenario process and also in selecting the form of presentation.

The selection of participants can have a significant impact on **the legitimacy** and **effectiveness** of scenarios (cf. Gaßner / Steinmüller 2006). For one thing, the aim is – via the participants – to inject the best available and up-to-date information into the scenario process. Depending on the respective requirements, this can take the form of both professional scientific knowledge and practical experiential knowledge. In general, both the legitimacy and effectiveness of scenarios can be increased if those to whom the scenario is addressed and/or those who will make use of the scenario are also involved in its creation. In this way the development of a type of "ownership" on the part of the participants becomes possible, and the susceptibility of scenarios for criticism is reduced by the additional fact that the creative and intuitive aspects and/or decision-making processes and selection processes remain transparent and verifiable. To this end, however, the design and character of the concrete scenario process must be adapted to the areas of competence and the motives of the participants.

It is also necessary to decide **how many** persons are to participate in the scenario process: groups of 5 must be differently organized than groups of

50. It must also be decided **when** – i.e. at which point in the scenario process – outside persons are to be involved, if this is appropriate. Theoretically, such participation is conceivable in all five phases. And it must be clarified **how** this participation is to take place, that is, for example, whether it will have an advisory character or will be provided with "decision-making competence". Overall, the distribution of responsibilities in the process must also be clarified (cf. below concerning Shell International 2003, 26 ff.): Will a "scenario director" be named? Who is on the "core team"? What "scenario users" (for example decision-makers) and, if appropriate, what "specialist contributors" might be invited to contribute at various points in the process? The organisational procedures for participation must also be planned. Workshop concepts are quite common here, but online formats might also be conceivable, where appropriate.

However, if those who will later make use of the scenario are not involved in its creation, special care should be taken that the process of creating it and its inner structure are traceable and transparent.

Precisely in the field of Development Policies, it appears important to involve interdisciplinary scientific expertise as well as the expertise of persons with actual experience of DP as targeted as possible in scenario processes. In cases where the scenarios are (also) directed to the political arena, an involvement of this group of persons addressed is also to be consciously planned and/or at least taken under consideration in creating the scenario. This is even more the case in the development of normative scenarios, for example for the concretization of the goals of DP, and to a somewhat lesser degree for explorative processes as well.

We come to preliminary **conclusions**. They can be summarized in the form of the following hypotheses and suggestions regarding the use of scenario methods in investigating the "Futures of Development Policy":

– Exhaustive definition of goals and identification of priorities are required to select the method which fits best.

– A purely quantitative and/or quantifying procedure appears inappropriate.

– An explicit, offensive approach regarding the normativity inherent in the field of DP is called for.

– The complexity of the scenario field of DP is not best tackled with a universal scenario process but rather by dividing it into numerous different parallel or successive approaches.

– When the development of concrete strategies is desired, the scenario process should be pointed at this from the beginning.

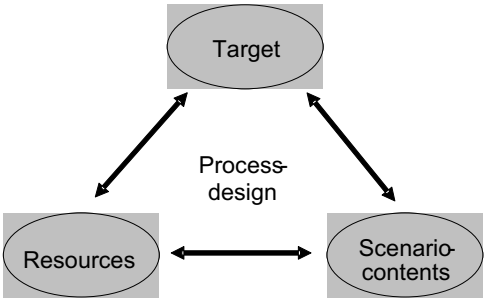
– If possible, those addressed in the development of scenarios about the futures of DP should be brought into the generation process (in order to ensure legitimacy and effectiveness).

4. „Check-List" for the selection of suitable scenario methods for the DIE project "Development Policy: Questions for the Future"

The dimensions of selection just discussed can be treated systematically with a sort of "checklist" aimed at methodologically shaping the DIE project "Development Policy: Questions for the Future".

The design of a scenario process depends above all on parameters in three dimensions: 1) on the goal of the project, 2) on the resources available for this, and 3) on the hoped-for scenario contents (cf. Fig. 17).

Figure 17: Basic organizational dimensions of a scenario project



Source: IZT with reference to van Notten et al. (2003)
(further developed by the author)

The decision-making processes linked with the individual dimensions here are not independent of one another but rather mutually influence one another. For example, specific resources are required to attain specific goals (e.g. resources involving finances, personnel, time, available knowledge, and accessible data). In much the same way, goals and scenario contents and scenario contents and resources are coupled with one another.

For that reason, the following "**checklist**" for the most part does not contain items to be worked through in strict succession; rather, the individual decision-making processes must be fine-tuned to one another. Nevertheless, this list should be able to serve as a good point of departure for the concrete design which is aimed at for the scenario process.

The Goal

1. What is at issue? What is the **overall goal** of the project?
2. Precisely **who** is the initiator, the person commissioning the project and/or the stakeholder in it?
3. Who are the **persons to whom the scenario is addressed**?
4. In the sense of Questions 2 and 3 (if appropriate): must numerous different **sub-projects** be distinguished?
5. Is **scenario work** basically the most suitable methodology?
6. What **position of importance** should scenarios have in the project as a whole, and **at what point** in the project's course should they be situated?
7. What **goals** are to be reached via scenarios, and what, if pertinent, is the appropriate hierarchy of targets?
8. Is the **evaluation** of existing scenarios or the **generation** of new scenarios needed and/or desired?
9. What **results** are expected from the scenario process (e.g. in terms of products and quality)?

Resources

10. How much **time** is available?
11. What **financial** resources are available?
12. What **personnel** resources are available?
13. What **preliminary knowledge** is already present **internally** and can be "called-up" if needed?
14. To what "**outside**" data and expertise can recourse be had?
15. How good is **access** to the stakeholders who are involved?

Scenario Content

16. Precisely what **problem** and/or **topic area** is to be studied?
17. How is the **scenario field** to be defined (e.g. differentiation of perspectives, relationships in the surroundings)?
18. What **geographical** scope is striven for?
19. What **time** horizon is advisable?
20. What **possibilities for combining** the three dimensions of scope (demarcation of topics, geographical scope, and chronological horizon) are in the line with the goals? Could a breakdown into successive or parallel sub-projects be expedient?
21. Is there a tendency to require **detailed analyses** of individual factors, or is the focus more on **interactions**?
22. How are **normative** aspects to be dealt with?
23. Are **quantifications** required? Desired?
24. Are explicit **transfer steps** during the course of the project planned, if appropriate? How is the selected scenario approach to be oriented in this regard in terms of perspectives?

Process

25. Is the scenario project to be carried out "independently" or with **external support** (e.g. conceptualization, moderation)?

26. Who is to **participate** in the scenario process (i.e in terms of quantity, areas of competence, diversity of experts who will be involved, internal/external, actors, stakeholders, persons affected)?

27. When (that is, at what point in the scenario process), **with what intensity** (e.g. only advisory function), and **in what form** (workshops, surveys etc.) is the participation to take place?

28. How will the scenario process be concretely **organized** (membership of the team, division of responsibilities, phases, meetings etc.)?

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