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Wil A. H. Thissen
Warren E. Walker *Editors*

Public Policy Analysis

New Developments

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Preface

This book is about *ex-ante* policy analysis—that is, analysis that aims at supporting policymakers and other actors involved in the difficult tasks they face in policy development. *Ex-ante* policy analysis emerged after World War II, when systems analytic and operations research methods were increasingly applied to a range of strategic policy problems. These 'traditional' policy analysis approaches are characterized by a focus on system modeling and choosing among policy alternatives. However, while successful in many cases, this approach has been increasingly criticized for being technocratic and ignoring the behavioral and political dimensions of most policy processes. In recent decades, increasing awareness of the multi-actor, multiple perspective, and polycentric character of many policy processes have led to the development of a variety of different perspectives on the styles and roles of policy analysis, and to new analytical tools and approaches—for example, argumentative approaches, participative policy analysis, and negotiation support. As a result, the field has become multi-faceted and somewhat fragmented.

While most publications in the field elaborate on one particular approach, this book acknowledges the variety of approaches and provides the first synthesis of the traditional and new approaches to policy analysis. It provides an overview and typology of different types of policy analytic activities, characterizing them according to differences in character and leading values, and linking them to a variety of theoretical notions on policymaking. Thereby, it provides assistance to both end users and analysts in choosing an appropriate approach given a specific policy situation. It broadens the traditional approach and methods to include the analysis of actors and actor networks related to the policy issue at hand. It deepens the state-of-the-art in certain areas, such as problem formulation, designing a policy analytic approach, and dealing with uncertainty. And, while its main focus is on the cognitive dimensions of policy analysis, it also links the policy analysis process to the policymaking process, showing how to identify and involve all relevant stakeholders in the process, and how to create favorable conditions for use of the results of policy analytic efforts by the policy actors.

Intended Audience

This book is intended for use by a broad audience, including educators in faculties dealing with public policy and public administration, policy analysis practitioners, and those who commission and consume policy analysis in government. It will probably be of most use to educators, for whom it will provide instructional material that can be used in a variety of undergraduate and graduate courses as a primary text and as supplementary material. Instructors in fields besides public policy and public administration, such as business administration, engineering, and environmental studies, will also find the text useful, because the approaches we describe can be used in those areas. While some chapters are mainly descriptive in nature, outlining developments and variety in the field, other chapters have a more prescriptive character. As a result, the book should also be useful to practicing analysts. It provides instruction and guidance in structuring complex problem situations, and identifying and applying appropriate methodologies to deal with them, as well as advice for practitioners based on the experiences of the authors in carrying out actual policy studies. For policymakers, the book includes realistic examples and practical guidelines that should help them understand what policy analysis is and how it may be of assistance to them.

The book should find a worldwide audience, since the approaches described and problems addressed have worldwide applicability.

Outline of the Book

The book has as its major objective to describe the state-of-the-art and the latest developments in *ex-ante* policy analysis. It is divided into two parts. Part I, consisting of Chaps. 2–6, explores and structures policy analysis developments (Chaps. 2 and 3) followed by the development and description of approaches to diagnose policy situations (Chap. 4), to design policy analytic efforts (Chap. 5), and to create policy process conditions, such that policy analytic outputs are taken into account (Chap. 6).

Part II focuses on recent developments regarding models and modeling for policy analysis, placing modeling approaches in the context of the variety of conditions and approaches elaborated in Part I. It consists of three chapters, discussing system analytic models for policy analysis (Chap. 7), models of actors and actor networks (Chap. 8), and analytic approaches to identify good policies in the face of uncertainties—and, in particular, deep uncertainties (Chap. 9).

In the Appendix, we provide brief summary explanations and specifications of a small set of conceptual analytic approaches and tools that are particularly useful in the context of the overall approach described throughout the book. The descriptions of the tools provide references to more extensive treatments and explanations of the methods.

Acknowledgments

This book emerged during the last decade as a joint effort of many staff members of the Faculty of Technology, Policy, and Management at the Delft University of Technology. During the last two decades, the faculty has developed and implemented interdisciplinary education programs in Systems Engineering, Policy Analysis and Management (SEPAM), and Engineering and Policy Analysis (EPA), both aiming to produce graduates who can synthesize systems analytical and modeling capabilities with knowledge of behavioral and process aspects of policy development. The associated Multi-Actor Systems (MAS) research program explicitly targets the development of a synthesis of traditional, systems-based approaches to dealing with complex policy and design issues, and behavioral approaches rooted in the social and policy sciences.

Many of the chapters in this book emerged from material developed and class-tested in close cooperation with scholars possessing a range of disciplinary backgrounds, including operations research, systems engineering, and the policy sciences. We thank the many generations of students and many colleagues who, sometimes unknowingly, helped sharpen our views and concepts. In particular, we acknowledge the support and feedback of our present and former colleagues of the Faculty of Technology, Policy, and Management, some of whom are authors or coauthors of chapters in this book. We, finally, appreciate the admirable patience and endurance the contributors to this volume have shown during a process with many revisions and delays.

Delft, September 2012

Wil A. H. Thissen
Warren E. Walker

Contents

Chapter 1
Introduction

Wil A. H. Thissen and Warren E. Walker

1.1 Policy Analysis: A Multi Faceted Field

The world is undergoing rapid changes. The future is uncertain. Policymakers are faced with problem situations that are complex, and with alternative courses of action that can produce far-reaching consequences that are hard to predict. Different groups perceive and value the problem situation and the alternative actions differently. Nevertheless, policymakers have a responsibility to develop and implement policies that have the best chance of contributing to the health, safety, and well being of their constituencies. Given this context, policymaking is not easy. Uncertainties abound. Data are limited. Identifying the key issues is a difficult task. However, without proper analysis and guidance, important policy choices end up being based on hunches and guesses, and policy processes may get stuck for long periods—sometimes with regrettable results.

A number of books have been written in the past that deal with various aspects of policy analysis. However, significant additional experience has been built up over the last decades. New perspectives have emerged regarding the role of government and its inter-relationships with various groups in the process of making and implementing policy. In parallel with these changes in its environment, policy analysis has evolved to include new perspectives on its role and new analytical tools and approaches—for example, argumentative approaches, participative policy analysis, and negotiation support.

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Most books dealing with policy analysis describe the traditional approach, focusing on modeling the system or choosing among policy alternatives (Quade 1989; Miser and Quade 1985, 1988, 1995; Patton and Sawicki 1993; Stokey and Zeckhauser 1978; House 1982; Dunn 1981). Others describe and propagate new approaches, including argumentative and participative ones (Fischer and Forester 1993; Fischer et al. 2007; Geurts and Joldersma 2001). Yet others are more procedural, focusing on the policymaking process and the roles of the various actors involved (Wildavsky 1979; Bobrow and Dryzek 1987; Bardach 2000). These authors emphasize the multi-actor and political nature of most policy processes, and emphasize the potential contributions of analysts as process facilitators or policy entrepreneurs. As a result, policy analysis has become:

> A multi-faceted field in which a variety of different activities and ambitions have found a place. Some policy analysts conduct quantitative or qualitative research while others reconstruct and analyze political discourse or set up citizen fora. Some policy analysts are independent researchers; some are process facilitators, while others act as political advisers. The debate on the discipline—for example, on its foundations, underlying values and methods—is conducted in a fragmented way (Mayer et al. 2004).

This book acknowledges the variety. Instead of elaborating one particular approach or introducing yet another approach, we provide an overarching view, leading to a synthesis of the traditional and new approaches to policy analysis. We explore the variety of views on policy processes, their implications for policy analysis, and their relations to the different approaches to policy analysis. Our premise is that there is no single, let alone 'one best', way of conducting policy analyses. Rather, different circumstances will require different approaches, and creative combinations of methods are possible and needed. We elaborate how multi-actor policy situations can be diagnosed, and how, given a specific situation, a policy analytic approach can be designed using creative combinations of methods that originate in different traditions. Furthermore, we show what policy process characteristics are favorable to the fruitful embedding of policy analytic activities. Finally, we describe the state-of-the-art and lessons for the field of policy analytic modeling, contrasting it with modeling for scientific purposes, and elaborating on approaches to modeling actors and actor networks, and on approaches to dealing with uncertainties.

1.2 Scope and Starting Points for This Book

The variety of authors and approaches has also led to multiple interpretations of basic notions and concepts, including what the overall scope of the field is. While it is not our intention to adopt a normative standpoint on what the most preferable ontology of policy analysis should be, we have attempted to achieve consistency of scope and interpretation in this book. We therefore first explicate our starting points and assumptions to the extent we are aware of them, some of which, inevitably, will be influenced by our own predispositions and biases.

1.2.1 Ex-Ante, As Is, and Ex-Post Policy Analysis

We will use the term policy analysis to indicate activities intended to support actors in their policy *development* efforts. This is also referred to as *'ex-ante'* policy analysis, which emphasizes the explicit orientation toward action and intervention, intended to achieve some future objectives. In the literature, the term 'policy analysis' is also used to refer to studies of *existing* policies (as analysis *of* present-day policies), or to studies evaluating the effects of policies *after* they have been implemented. While the latter kind is sometimes referred to as *'ex-post'* policy analyses, we prefer the term 'policy evaluation' for this kind of activity. Yet other authors (e.g. Parsons 1995; Greenberg 2007) use the term policy analysis to indicate studies of policy (making) processes. These, we prefer to call policy studies contributing to the policy sciences.

Our interpretation of policy analysis as an action- or intervention-oriented activity does not, however, preclude the relevance of studying existing or past policies and/or evaluating them. On the contrary, knowledge about the present situation (including present policy), about the (lack of) effectiveness of past policies, and of policy processes in general is often essential for a good understanding of what might be successful in the future. But, in our perspective, policy analysis first and foremost must be functional as a future-oriented activity rather than focusing on a knowledge objective in itself.

1.2.2 The Purposes of Policy Analysis

Most early publications dealing with policy analysis describe an approach oriented toward public policymakers, and based on the core idea that the results of systematic, science-based analysis will assist policymakers in choosing the best course of action to achieve their goals. The focus, then, is on the substance of policy, and on improving outcomes. Traditional policy analysis provides independent, science-based knowledge to participants in a policy process, who may subsequently enter into negotiations, make value tradeoffs, and make joint or individual decisions. In that perspective, the extent to which the information provided is objective, science-based, and value-free is an important, if not central, quality criterion along with others, such as relevance and timeliness.

Different actors in a policy process may, however, have different views on what a good policy outcome is, and on whether the results of the policy analysis efforts contribute to achieving that outcome (Twaalfhoven 1999). Some of the newer approaches to policy analysis (such as the argumentative and participative ones) acknowledge the multi-actor character of policy problems and processes, and explicitly include purposes related to policy process improvements, such as transparency, democratic character, and efficiency. Generally, the quality of policy processes and policy outcomes comprises multiple attributes: not only efficiency and effectiveness, but also legitimacy, democratic character, fairness, transparency, accountability, and other values come into play, and may even conflict with each other. If the ultimate purpose of policy analysis is to contribute to the quality of both the policy process and its outcomes, analysts will have to find ways to deal with such multi-actor, multiple value situations. The different approaches to policy analysis that have emerged provide different answers to this challenge, or focus on fostering specific values.

In this book, we acknowledge the variety in purposes, and the associated and sometimes conflicting values. A prime challenge to the practicing policy analyst is to strike a balance among scientific norms, fostering or obeying other values, and being effective and efficient. Requirements and constraints will be different for each situation. How to choose an appropriate approach, given the characteristics of a specific situation, is one of the core subjects of this book.

1.2.3 The Clients and the Users of Policy Analysis

As a typical situation, we will assume that an actor, perceiving a need for assistance in a specific situation requiring action, will contact an independent analyst for help. Generally, the analyst will then work for this actor—called the problem owner or client—based on a specific agreement or contract, and the client will be a principal user of the insights provided by the analyst. However, in most cases the insights provided by the policy analyst will be accessible and useful to other—if not all—participants in the policy process. As will be elaborated later (e.g. see Chap. 3), many variations are possible in the client–analyst–user relation. For example,

- analysts may be employed by a government agency instead of being independent and contracted by a problem owner for support on a specific policy issue; generally, in such situations a senior bureaucrat and/or policymaker will act as if (s)he were the client;
- analysts may be contracted by a specific actor or agency, but the insights from the analysis are intended for use by a broader group of actors participating in a policy process; in such cases we designate this broader group as the (intended or targeted) users of the results of the policy analysis;
- analysts may act as so-called ‘policy entrepreneurs’ (cf. Meltsner 1976), who target advancement in a policy arena without having the benefits of a specific client in mind; here also we would designate all the players in the policy arena as users of the policy analytic efforts;
- actors not explicitly belonging to the class of intended users may nevertheless find the results of a policy analysis activity useful, and use it in whichever way they want.

Moreover, there may be a wide variety in the types of clients. Traditionally, most of the policy analysis literature has implicitly or explicitly assumed a public policymaker or policymaking body as the client. However, it is very well possible that non-government parties enlist the services of a policy analyst.

In this book, we will use the term ‘client’ to designate the initiator and/or sponsor of the policy analysis activity, and the term ‘user’ to designate the intended and non-intended users of the results of the policy analysis. Clearly, the class of users includes, but is generally much broader than, the client.

1.2.4 What Policy Analysis Is Not

Given the broad perspective taken, the reader may wonder whether we consider any policy-oriented activity as belonging to the field of policy analysis. The answer is that this is not so. Except for the discussion in Chap. 2 on the historical developments in the field, we focus on elaborating and providing guidance to what we consider ‘good’ policy analysis. In our view, good policy analysis is broad, focused, and directly oriented to supporting decisionmaking with respect to a policy arena. This means we exclude:

- studies with primarily scientific aims, mainly focused on advancing knowledge in a specific field
- studies devoted exclusively to building a system model
- monodisciplinary studies, even if policy oriented
- studies focused on one aspect only, e.g., process management

Additionally, we state our normative principle that, whatever value-related choices are made in a policy analysis, these choices should be made transparent by stating all choices and assumptions explicitly, including the grounds on which they were made, and exploring the implications of alternative but plausible assumptions (van de Riet 2003; Walker 2009).

1.3 Outline of the Book

The book is divided into two parts. Part I, consisting of Chap. 2 through 6, explores and structures policy analysis developments (Chaps. 2 and 3) followed by the development and description of approaches to diagnose policy situations (Chap. 4), to design policy analytic efforts (Chap. 5), and to create policy process conditions, such that policy analytic outputs are taken into account (Chap. 6).

Part II focuses on recent developments regarding models and modeling for policy analysis, placing modeling approaches in the context of the variety of conditions and approaches elaborated in Part I. It consists of three chapters, discussing system analytic models for policy analysis (Chap. 7), models of actors and actor networks (Chap. 8), and analytic approaches to identify good policies in the face of uncertainties—and, in particular, deep uncertainties (Chap. 9).

Chapter 2 starts with a brief account of historical developments in policy analysis. Having its roots in applied operations research, systems analysis, and economics, the field initially focused on supporting decisionmakers by collecting knowledge on the substantive aspects of the decision problem, with the expectation that this would enable decisionmakers to make more rational decisions. However, the systems analytic approach was not always successful, and it was considered as being technocratic, and neglecting the human, political, and institutional sides of policymaking. In reaction, new approaches to policy analysis were advocated, notably participative and argumentative policy analysis. The chapter continues by turning the attention to the variety of theoretical models of the policymaking process, each having different implications for policy analysis. The chapter concludes with an account of the varied implications of the different policy process models for policy analysis.

Chapter 3 presents a conceptual typology of the variety of policy analysis activities, most of which can be related to one or more of the policymaking models presented in Chap. 2. The typology distinguishes six different types of policy analysis activities, each of which is associated with a different purpose. The typology is visualized as a hexagon. It structures the field, and, in doing so, helps to characterize the different approaches more clearly. At the same time, it can be of assistance to an analyst facing the need to design a policy analytic approach. The conceptual model can be viewed as providing a menu with a variety of dishes. Given a specific situation, the analyst may choose one or a combination, depending on the situation characteristics and needs.

After these two theoretical and foundational chapters, the following three chapters provide practical guidance for an analyst who has been asked or wants to support a specific policy situation. These chapters build on the theories and concepts developed in Chaps. 2 and 3.

Chapter 4 outlines an approach to diagnosing policy problem situations. It starts by identifying the requirements for a good diagnosis, and lists the situational aspects to be looked into. The approach proposed emphasizes the need to get a rich picture of the situation, looking at it from different complementary angles: the substantive issues, the actors and the policy network, and the institutional context. The appropriate approach is elaborated for each of these angles. Focusing on the substantive aspects, a stepwise system analytic approach is proposed, building on the use of a range of conceptual modeling tools, including the system diagram, objective hierarchies, and causal diagrams. For the analysis of the actors and the network, a number of complementary approaches are proposed, each focusing on a different aspect of the situation. Institutional analysis, in turn, concentrates on formal and informal rules and habits in the network, including trust. The chapter proceeds with a discussion on the integration of the different findings, and concludes by exploring the implications of diagnostic findings for the design of a policy analytic approach.

Chapter 5 focuses on the design of a policy analytic approach. Planning a policy analysis is conceptualized as planning a sequence of interventions, some of which are cognitive, while others are communicative. An initial set of interventions is planned based on the results of a situation diagnosis, and different examples are given of how this might be done. It is emphasized that situation characteristics may change during the process, as a result of the policy analytic activities and/or external developments. Therefore, situation characteristics need to be continuously monitored in order to adapt the policy analytic approach as circumstances change. The chapter illustrates how the hexagon model can be used to visualize the (changes in the) character of policy analytic support needs.

Chapter 6 complements the preceding chapter by considering policy analytic activities from a policy process perspective. It explores why policy analytic input gets to be used in some situations, but not in others. Subsequently, based on policy process theories, a number of principles are outlined for creating the conditions needed for policy actors to be receptive to policy analytic inputs.

Part II of the book focuses on recent developments regarding analytic methods for policy analysis, in particular models and modeling approaches. A distinction is made between models of the system that is the subject of policy actions, and models of the policy arena in which actors interact about problems and solutions. Finally, particular attention is given to the handling of uncertainties, which are of crucial importance in many contemporary (long-term) policy debates.

Chapter 7 begins by outlining the requirements and uses of models in a policy analytic context, contrasting these with modeling requirements and uses for scientific purposes. In policy analysis models, breadth of scope and flexibility are essential, while depth and detail are crucial in scientific and many engineering design applications. The differences are illustrated with examples, and elaborated for the different phases in the model building and use process. Next, different types of system models are discussed that may be used, depending on the specific characteristics of the (sub) system to be modeled. The chapter concludes with a number of practice-tested general guidelines.

Chapter 8 focuses on actor models and the modeling of policy arenas. First, an overview is given of different approaches for the modeling of actor perceptions. Next, a variety of models is discussed that focus on interrelations and/or interactions among actors, including stakeholder analysis, game theory and conflict analysis models, transactional and exchange models, and gaming approaches. The chapter ends with a discussion of the differences among these methods, providing guidelines regarding which approach to use under what circumstances.

Chapter 9 focuses entirely on new approaches to one of the key challenges in policy analysis: dealing with uncertainty about the future. First, uncertainty is defined, key concepts are introduced, and an overview is given of some of the basic literature. Next, a classification of uncertainties is introduced that assists in the identification and assessment of uncertainties in the context of model-based policy analysis. The chapter continues with a description of innovative analytic approaches to exploring the range of possible future developments. Finally, it is illustrated how the insights gained can be used to develop wise policies in the face of (irreducible) uncertainties, emphasizing the use of adaptive policies.

In the Appendix, we provide brief summary explanations and specifications for a limited set of conceptual analytic approaches and tools we find particularly useful in the context of the overall approach described throughout the book. All of these tools are referred to in the main text. The descriptions of the tools in the Appendix provide further references to more extensive treatments and explanations of the methods.

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Part I
Policy Analysis in a Multi-Actor Context

As indicated in Chap. 1, Part I of this book focuses on the multi-faceted character of policy analysis, with particular emphasis on integrating traditional system analytic concepts and approaches in the multi-actor context that is characteristic for many public policy settings. It explores policy analysis developments and a variety of theories on the policy process and their implications for policy analysis (Chap. 2). It structures the field by identifying six different types of activities and their associated leading values (Chap. 3). It subsequently develops and describes an approach to diagnose policy situations (Chap. 4), followed by a guide to designing policy analytic efforts (Chap. 5). Finally, it describes how to create policy process conditions so that policy analytic outputs are taken into account (Chap. 6).

Chapter 2
A Policy Sciences View on Policy Analysis

Bert Enserink, Joop F. M. Koppenjan and Igor S. Mayer

Let's pretend there's a way of getting through into it, somehow, Kitty. Let's pretend the glass has got all soft like gauze, so that we can get through. Why, it's turning into a sort of mist now, I declare! It'll be easy enough to get through… In another moment Alice was through the glass, and had jumped lightly down into the Looking-glass room. The very first thing she did was to look whether there was a fire in the fireplace, and she was quite pleased to find that there was a real one, blazing away as brightly as the one she had left behind. 'So I shall be as warm here as I was in the old room,' thought Alice: 'warmer, in fact, because there'll be no one here to scold me away from the fire. Oh, what fun it'll be, when they see me through the glass in here, and can't get at me!'

Lewis Carroll (1871), "Through the Looking Glass and What Alice Found There", illustration by John Tenniel.

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2.1 Introduction

The quintessence of abstractions like ‘public policymaking’ and ‘policy analysis’ (PA) readily escape human perception. To give meaning to such notions, we construct and use ‘frames’, which in the policy sciences are often called ‘conceptual models’ or sometimes ‘(policy) paradigms’, ‘lenses’ or ‘belief systems’ (Rein and Schön 1986, 1993, 1994; Kuhn 1970; Allison 1971; Sabatier 1987; Hall 1993). Through conceptual models, we ‘make sense’ of ambiguity and superimpose structure and logic onto chaos; in constant recognition however, that our conceptual models are fairly limited and should be under constant scrutiny and subject to revision. The purpose of this chapter is to examine several such models or frames of policymaking in order to understand the course of policy processes. The main objective is to examine their implications for PA.

In the policy sciences, there are many different ways of looking at public policymaking—for instance in terms of phases, cycles, rounds, or streams. Also, policymaking is sometimes viewed as an arena, a garbage can, a routine, a policy discourse, etc. (for an overview on policymaking and policy models, see for instance: Teisman 2000; Hill 1997; Sabatier 2006; Howlett et al. 2009; Hill 2009). Some influential authors have argued that more than one model should be used to shed light on the same sequence of events (Allison 1971). In the same fashion, we assume that various models of public policymaking can act as ‘lenses’ for looking at PA. By changing lenses, we may get alternative answers to the question of what PA can and cannot do. Like Alice, therefore, we propose to step through the mirror and wonder about the strange reflections that the various models of policymaking have on the requirements for effective PA.

The outline of this chapter is as follows. First (to familiarize the reader), we present PA in a nutshell. We then argue that one’s perception of what PA is, or what it should be, very much depends on one’s view toward public policymaking in general: whether it is ‘neat and rational’ or ‘chaotic and messy’. We refine this simple dichotomy, to position five ‘models’ in the policy sciences that view policymaking as: (1) a rational decisionmaking process; (2) a political game; (3) a discourse; (4) a garbage can; or (5) an institutional process. We examine how these five models give meaning to the notion of ‘PA’ and how they define the function, the ambitions, and the strategies of PA. Although, we may have a personal or scholarly preference for one model over another, we assume that each model can add significant meaning to the understanding of PA.

2.2 Policy Analysis in a Nutshell

2.2.1 The Two Meanings of Policy Analysis

Policy analysis is a rather ambiguous notion. First, it refers to the analysis *of* public policy, i.e., the study of public policy in an academic (e.g. descriptive, interpretative, or explanatory) fashion. By and large, this form of PA aims to achieve a generic understanding of public policymaking by means of social–scientific–political–historic research, as in the example of 'foreign PA' (see, for instance, Hudson 2006). At the same time, we witness daily in the media that scientific analysis of a policy issue—e.g., analysis that can inform or improve the Obama or Bush administration's foreign policy—can have a profound impact on the public debate and policymakers' way of thinking and actions.

This first type of PA can be referred to as 'public policy (case) studies' or simply 'policy research studies'. Good examples are Graham Allison's (1971) threefold analysis of the Cuban missile crises (see also Allison and Halperin 1972) and Flyvbjerg et al.'s (2003) comparative analysis of infrastructure decisionmaking. In rough terms, this is what political and policy scientists do: find and analyze the rationality that underlies and explains public policymaking and reformulate or try to understand it in generic theories and models about policy processes, policy networks, institutions, etc. In many cases, the results of these studies can also be used indirectly to draw up policy recommendations and lessons for the future. But, for many academic policy analysts, day-to-day impact in the policymaking process and having an influence on policymakers is a side effect, and not an intentionally designed activity. In this fashion, science and policymaking are 'loosely connected'.

The second type of PA refers to analysis *for* public policymaking; in other words, to the activities, methodology, and tools that are used to give aid and advice in a context of public policymaking (Dunn 1994; Brewer and DeLeon 1983; Hogwood and Gunn 1984; Miser and Quade 1985; Patton and Sawicki 1986; Quade 1989; House and Shull 1991; Parsons 1996; Mayer 1997; Radin 2002; Mayer et al. 2004; Fischer et al. 2007). This type of PA can best be seen as the 'interventionist' or 'prescriptive' branch that stems from the policy sciences tree. Much like an 'art' or 'craft', it is assumed that significant parts of the PA discipline can be taught to and learned by professionals working in, for, or with the public sector (Wildavsky 1979). This book is primarily concerned with this, the second type of PA—analysis for public policymaking.

2.2.2 Accommodating Science and Action

Wise men advising policymakers can be traced back to Aristotle (384 BC), who educated Alexander the Great, and to Machiavelli (1469–1527), who 'flattered' and 'advised' Lorenzo II di Medici (see, The Prince, 1513, 2003 edition).

Giving science-based or expert advice to policymakers is a main part of what policy analysts do. But underlying contemporary PA is the notion of a distinguishable, professional discipline with emphasis on tools, scientific methods, tricks of the trade, professional ethics, training, and reflection (Dror 1967).

Like all interventionist disciplines, PA needs to bridge the gap between science and action (Latour 1987)—in our case, political action or policymaking. This of course can be done in different ways; roughly by 'accommodating policymaking to science' or, vice versa, by 'accommodating science to policymaking'. The first way is associated with 'scientism', 'technocracy', and 'expertism'. It aims to establish firm scientific, technological, and rational foundations for decisionmaking and policymaking. The experiments with Planning Programming Budgeting Systems (PPBS) in the US (in the mid 1960s) and with COBA in the Netherlands (in the 1970s) are classic examples of this type of accommodation (see Mayer 2007). The second way of accommodation is based upon 'constructivism', 'pragmatism', or even 'relativism'. It significantly loosens the scientific straight jacket of objectivity, validity, and generalizability, etc., in order to gain more useable, temporal, action-oriented knowledge.

2.2.3 Evolution

The historical development of PA in the US, and in countries such as the Netherlands, Canada, Germany, New Zealand, and India, has been told in quite a few publications on public PA (see, for instance, Dunn 1994; deLeon 1988; Walker and Fisher 2001; Radin 2002; Stone and Denham 2004; Mayer 2007; Fischer et al. 2007). We will not repeat what has been recounted elsewhere. It is important to understand, however, that the emergence of PA is part of a much wider rationalization process in public administration that goes back to the work of Max Weber and others on modernization, rationalization, and bureaucracy. This rationalization process found fertile ground in the US after World War II, and culminated in the emergence of what came to be known as the decision sciences: Operations Research (OR), Systems Analysis (SA), and PA.

At the very root of the decision sciences, we find applied mathematics and a variety of engineering sciences. These were used in a rather experimental fashion to support military operational planning during World War II, typically for things like the planning of convoys and bombing raids. This practice caused the emergence of a discipline named OR in the late 1940s and 1950s (see, for instance, Hillier and Lieberman 2005). In general, OR aims to develop optimal solutions for relatively well-structured operational and logistical problems, especially in the area of (military and business) planning and management. OR generally uses methods derived from mathematics—formal modeling, game theory, decision analysis, computer simulation, etc. In due course, OR evolved into a related discipline called SA (Quade and Boucher 1968). While OR mainly looked at the optimization of relatively well-structured operational planning problems, SA took up a broader, socio-technical perspective. In general terms, it looks at the more complex behavior of systems mainly through the analysis of its interacting entities or components. SA was highly influential in the 1960s. It was implemented by Robert McNamara (US Secretary of Defense, 1961–1968) to make military decisionmaking more rational by, for example, promoting institutions like the SA Office and the use of quasi-formal methods for the *ex-ante* evaluation of proposed weapon systems (Adams 1982; Enserink 1993). In retrospect, it can be viewed, in part, as an attempt to depoliticize complex and highly political decisions.

During the 1950s and 1960s, the goal of making public decisionmaking more rational spread throughout the US Federal Government in the form of another branch of the same tree, called public PA (PA)—the use of analytical methods derived from the social sciences to support public policymaking and public policymakers in non-defense policy domains (cf. Brewer and deLeon 1983; Hogwood and Gunn 1984; Dunn 1994; Parsons 1996; Mayer et al. 2004). A flourishing industry of 'think tanks' emerged, with leading corporations such as RAND conducting significant policy and SA studies and constantly innovating methods for PA (Williams and Palmatier 1992; Abelson 2004). Graduate programs teaching PA to students and bureaucrats were established at universities. By the late 1960s and early 1970s, a profession of PA had come into existence (Dror 1967; Radin 2002). PA became somewhat discredited due to the hard-felt failure of Planning, Programming, and Budgeting System (PPBS) introduced into the Federal government in the mid 1960s. During the late 1960s and the 1970s, PA was taken up by the whirlwind of (revolutionary) changes that were challenging vested authorities and values in society, politics, and science (Bachrach and Baratz 1962; Baumgartner and Jones 1993; Cobb and Elder 1983). PA itself became criticized for its strong bias to economic efficiency, value maximization, and 'technocracy', and its perceived neglect of democratic and moral values (deLeon 1988; Ellis 1998; Williams 1998). Gradually, the PA discipline and methodology opened up (Lynn 1999). This contributed to more self-reflection, disciplinary debate, and a greater variety of PA theories, approaches, and methods, such as participatory, critical, narrative, and argumentative PA (Fischer and Forrester 1993; Dryzek 1990; deLeon 1990, 1994; Roe 1994; Mayer 1997; van de Riet 2003).

2.2.4 The Science–Policy Interface

Policy analysis is now an established professional discipline in North America and Europe. But the science–policy interface itself has become the subject of social-scientific research (Caplan 1979; Dunn 1980; Weiss 1977; Weiss and Bucuvalas 1980; Jasanoff 1990; Stone and Denham 2004). The interface between the decision sciences and policymaking is full of tensions, e.g., regarding the (ir)relevance and (ab)use of methods and analysts in the policymaking process. The evolution of PA can be seen as a 'dialectic process—swinging back and forth between the two forms of accommodation, trying to find some form of balance between 'truth' (scientific rationality) and ‘power’ (political rationality). During the last five decades, this dialectical process has produced different disciplinary views on what PA is, or what it should be (see also Mayer et al. 2004).

The evolution of PA, for instance in the US or the Netherlands, has been influenced by an intricate blend of change factors on both the demand side and the supply side (deLeon 1988; Mayer 2007). Changes in the demand side generally relate to changes in the ‘belief systems’ of policymakers. This presents itself to policy analysts as minor or major shifts in knowledge demands, policy priorities, and issues on the political agenda. But such changes may be an indication that more fundamental views on things like democracy, civil rights, the role of science and technology, and the effectiveness of public or stakeholder participation are in flux. Furthermore, societies at large go through altering periods of consensus and dissensus on political issues, such as immigration, flood control, healthcare, financial regulation, and environmental policies. Science and PA play their part in the policy debate and are triggers for change. But not only does a paradigm shift in policymaking influence the kind of policy questions that policy analysts are requested to answer, it also has an effect on the paradigm of PA itself, e.g., in its core beliefs about the science–politics interface, about professional ethics and democracy, and about methodology.

Changes in the supply side of PA generally relate to changes in policy sciences theories, and especially the methods and tools for research and analysis. The interpretation of what PA is and how it should be conducted very much depends on one’s view toward public policymaking in general: whether it is ‘neat and rational’ or ‘chaotic and messy’. Let us explore this simple dichotomy a little further.

2.2.5 ‘Neat and Rational’ Versus ‘Chaotic and Messy’

If policymaking is viewed to be ‘neat and rational’—or at the least, that it should be—we can very much rely on the methods and rational-analytic tools derived from ‘science’ to support policymakers. Advisors to policymakers should use the best available scientific knowledge and analytic methods derived from mathematics, computer sciences, economics, social sciences, in order to provide ‘optimal’ answers to complex societal problems. For an interventionist discipline like PA, it implies that ‘political rationality’ must be accommodated to ‘scientific’ or ‘technical’ rationality. In fact, over the years the discipline of PA has provided us with many rational-analytic tools—the PA toolbox—by which we can reduce uncertainty or optimize solutions to policy problems. Typical examples are cost–benefit analysis (CBA), impact analysis, trend extrapolation, linear programming, discrete event simulation, etc. (Dunn 1994).

But on the other hand, if we assume that policymaking is inherently ‘chaotic and messy’, such approaches and methods have a serious handicap: they are unable to cope with the unpredictable and seemingly irrational behavior displayed by real people and organizations. Or, when they do try to incorporate human behavior, human actors are reduced to factors like variables or agents that can be put into a statistical analysis or computer model.

The thing is that the ‘chaotic and messy’ perspective on governance and public policymaking has recently found common ground. Its models and theories—such as bureaucratic politics, garbage can model, stream model, and network theory—are considered to be more in line with political reality. Policy scientists increasingly have come to realize that government is not a unitary body that seeks to optimize solutions to well-defined problems. Instead government, like society, is fragmented into many loosely coupled agencies, departments, and individuals, which in many cases have their own interests in mind (e.g. departmental budgets or personal careers). The many stakeholders that operate in the public arena often have different and conflicting views on the causes and consequences of societal problems. Facts are often disputed, knowledge is negotiated, and scientists often are stakeholders—‘hired guns’—in the policy arena (Jasanoff 1990). Furthermore, there are many societal actors that are largely unresponsive toward deliberate government interventions—e.g., by regulations, subsidies, or taxes. And these stakeholders deliberately attempt to influence the outcome of the political process to their own advantage, e.g., by lobbying, by going to court, by hiring consultants, by presenting counter evidence, and most of all by making strategic use of their resources (money, authorities, information) upon which government bodies depend for the implementation of their policies. In this perspective, public policymaking takes place in a dynamic arena where policy issues come and go and where stakeholders enter and leave as they will. Thus, there are no ‘optimal’ or ‘best’ solutions; only politically negotiated, acceptable, and feasible solutions. For an interventionist discipline like PA, this implies that ‘technical-scientific rationality’ must accommodate to ‘political rationality’. The analyst’s role changes significantly as she becomes an advisor, stakeholder, or mediator in the policy arena.[1]

2.2.6 Five Models

The dichotomous perspective on policymaking—‘neat’ versus ‘messy’—is, of course, a gross simplification of the richness and variety of theories about policymaking. The messy view for instance, does not say anything about what constitutes and causes the ‘messiness’ and the erratic and volatile nature of policymaking. The dichotomy also does not say much on how to find a balance between ‘science’ and ‘action’. In order to refine our understanding of the relationship between policymaking and PA, we therefore examine five ‘models’ that view policymaking as:

[1] Throughout the book, to make functional use of gender, the policy analyst is referred to as “she”, all other actors as “he”.

1. A rational decisionmaking process.
2. A political game.
3. A discourse.
4. A garbage can.
5. An institutional process.

These five models will act as our lenses to look at PA. For each model, we will look at their core assumptions on policymaking, their normative implications (good or bad policymaking), and their implications for PA.

2.3 Five Models of Policymaking

2.3.1 Policymaking as a Rational Decisionmaking Process

The classic understanding of policymaking is that of decisionmaking by a rational, unitary, actor (see also Allison 1971). At the same time, it is commonly acknowledged that the rational model of policymaking is an 'ideal type' and does not exist in reality. The model has been reconstructed out of several theories and common practices in US defense and military decisionmaking after World War II. In textbooks on public policymaking, the prevalence of the rational model is often exaggerated mainly to serve as a 'straw man'—a focal point of criticism and a rhetorical way of presenting alternative models. The rational policymaking model, however, constitutes an important frame of reference for many public policymakers. It is straightforward, easily applicable, and, most important in the context of this book, has had a marked influence on PA.

2.3.1.1 Assumptions

By and large, the rational model rests upon three pillars:

1. **Policies**: rational, intelligent decisions based on synoptic information.
2. **The policymaking process**: evolves in a few (chrono)logical steps, phases, or cycles.
3. **The institutional context**: closed, unicentric, hierarchical, authoritative.

According to this model, policymaking is (or should be) regarded as an intellectual activity in which a key actor decides upon alternatives in a rational way, using objective knowledge (Simon 1957a, 1977, 1981). Core to the rational model are assumptions about 'comprehensive' or 'synoptic rationality'. Frequently, synoptic rationality is portrayed as following a number of analytic steps, such as (Lindblom 1959; Hogwood and Gunn 1984; Walker 2000):

1. Define and rank governing values.
2. Specify objectives compatible with these values.

3. Identify all relevant options or means of achieving these objectives.
4. Calculate all the consequences of these options and compare them.
5. Choose the option or combination of options that would maximize the values earlier defined as being most important.

The above model of rational decisionmaking has many similarities with the linear or cyclical process model of policymaking.

> 'Policy is assembled in stages, as if on a conveyor belt (agenda formulation, policy formulation, adoption, implementation, and evaluation). So conceived, the policymaking process parallels the cognitive steps of the rational model of decisionmaking' (Stone 1988, cited and discussed in Fischer 1989, p. 944).

In order to organize policymaking as a rational process, activities should be structured according to this set of ordered steps. By adding a step for evaluation and iteration, the process gets a cyclical nature, thus including a feedback mechanism and opportunities to learn. The rational model also assumes that policies are made by a unitary actor (e.g. government) and that they are implemented hierarchically, through command and control in the bureaucracy.

2.3.1.2 Normative Implications

Policy failures or ineffective policymaking are seen to be caused by errors in 'intelligence' and 'order' in the policy process. One or more steps in the linear policy process may have gone wrong: there was insufficient information or understanding, not all alternatives were examined, important steps were skipped, actors were not aligned, etc. Remedies for these failures are, for instance:

1. Produce more/better information. Improve the 'evidence' on which policy decisions are based, e.g., through (independent) analysis and research.
2. Better specify the set of objectives that are being pursued and prioritize among them.
3. Restructure the policy process, according to above mentioned steps, building in checks that have to be met before activities pass onto the next step.
4. Strengthen the position of the key decisionmaker by making more resources available and by reducing the number of actors involved in the process of policymaking.
5. Improve the administration of the process of implementing the policy.

2.3.1.3 Amendments

The many points of criticism to synoptic (comprehensive) rationality are well known. Milder forms of criticism have led to what has been called the 'classical amendments' to the rational model. These are attempts to modify the rational model in such a way that the characteristics of real-world policymaking are acknowledged, while simultaneously articulating or seeking to enhance the rationality of these processes.

1. Simon (1957b) emphasized the ‘bounded rationality’ of decisionmakers due to limited information processing capacity and involvement in various issues at the same time. As a result, decisionmakers will not ‘optimize’, but will ‘satisfy’ their objectives (*satisficing*).
2. Lindblom (1959) argued that policymaking evolves in an incremental fashion, because of ‘risk avoidance’ (among other reasons). Incremental decisionmaking is ‘rational’ because it provides more gradual feedback on the impact of decisions and allows for adaptations and revisions along the way.
3. Etzioni (1967) introduced ‘mixed scanning’ as an attempt to reconcile ‘bounded rationality’ and the ‘rational model’. It argues that the problem environment or solution space is scanned, and a limited number of solutions (alternatives) are explored in a synoptic fashion.
4. Dror (1968) argued that policy problems of a repetitive nature can be dealt with by meta-decisions that establish the routines to deal with these problems. Rational comprehensive policymaking is reserved for unknown, complex problems that cannot be dealt with in a routine-like fashion.

2.3.1.4 Implications for PA

The ‘rational model’ of policymaking has been very influential for the common understanding of PA. Rational policymaking and rational PA are isomorphic (see Chap. 3). They are based upon the same core assumptions about the role of intelligence in policymaking, the linearity of the policy process, and hierarchical, unitary decisionmaking. Below we elaborate the implications of this isomorphism.

- *The mission of PA*. In line with the rational view of policymaking, the mission of PA is to reduce the complexities and uncertainties that public policymakers are faced with.
- *The role of the policy analyst*. The role of PA is to underpin the (scientific) evidence base of public policy. To fulfill this role, the policy analyst intervenes by doing systematic analysis, providing information, and enclosing the scientific insights needed to make informed decisions and to go through the various steps of the policy cycle. Working for or within bureaucracy is not considered problematic, because the institutional setting is not identified as fragmented in values or interests, and analytical activities are assumed to uncover an unambiguous truth, in accordance with the neo-positivistic approach to science that underlies the rational model.
- *The policy analyst’s toolbox*. The toolbox of the policy analyst has been grouped and ordered to support the above described roles, e.g., into methods and

techniques (M&T) for collecting policy relevant information on current problem situations and underlying causes, for monitoring (e.g. surveys, trend extrapolation), for developing and ranking options or alternatives (e.g. Cross Impact Analysis, CIA), for comparing costs and benefits (e.g. Cost-Benefit Analysis, CBA), for *ex-ante* and *ex-post* evaluation (e.g. program evaluation, scenarios of possible futures), etc. And these methods and techniques of the policy analyst—e.g., computer models (see Chap. 7)—can and should be developed, sharpened, and renewed constantly, to reach more validity, fidelity, comprehensiveness, etc (Walker 2000, Rosenhead 1989).
- *The skills of the policy analyst*. The role of the policy analyst in the policy process is viewed as a trained professional, fully skilled, and equipped to operate the methods and techniques of science and analysis and to communicate the results and outcomes. This implies living up to the requirements of what is considered the state of the art of good (scientific) analysis by the professional (scientific) community of policy analysts.

2.3.2 Policymaking as a Political Game

Instead of a rational process, policymaking can be seen as a political game between interdependent stakeholders (see Chap. 6 and 8). In this view, policymaking comes about in a 'polycentric' context, or interorganizational arena, in which the underlying political rationalities of many actors need to be understood and managed.

2.3.2.1 Assumptions

By and large, the 'political game' model rests upon three pillars:

1. **Policies**: political compromises between autonomous, but interdependent stakeholders.
2. **The policymaking process**: a 'power play' or 'bargaining game' between stakeholders.
3. **The institutional context**: a pluri-centric, elitist, interorganizational arena with restricted access.

This perspective on policymaking can be found in the work of Lindblom, who rejected the idea of comprehensive planning by the state on empirical and normative considerations. According to Lindblom, policymaking is rife with partisan interest representation in policy arenas and is a bargaining process among (especially the elites of) different powerful interest groups (Lindblom 1965; Dahl 1994).

Policymaking as a political power game is well represented in the Bureaucratic Politics model, first introduced by Allison (1971) and Allison and Halperin (1972) to understand the course of events that became ‘the Cuban Missile crisis’. According to Allison, ‘where you sit, is where you stand’. Decisionmakers identify strongly with organizational and personal interests, like budgets, competencies, and careers. They ‘push and pull’ to reach decisions that suit their own interests and try to prevent solutions that are unfavorable to them. Outcomes of policy processes are largely a result of the formation of winning coalitions or compromises.

‘Bureaucratic Politics’ originally referred to the internal power game among the politicians and directors that are heading the different governmental agencies, departments, and bureaus. But, with some adjustments, the notion can also be used for interorganizational decisionmaking in non-hierarchical arenas of public, private, and non-governmental actors (Crozier and Friedberg 1980; Scharpf 1978, 1997; Kickert et al. 1997; Jenkins-Smith 1990). These are typical policy situations in which there is no single dominant actor who can enforce or implement policy decisions, but there are multiple interdependent actors. This makes policymaking very much like a strategic game, with player-roles, rounds, stakes, stalemates, opportunism, foul play, and many strategies for cooperation, winning, and blocking opponents (Allison 1971; Teisman 1992). To make it even more complicated, policy problems are sometimes dealt with in different loosely coupled policy arenas at the same time. Different ‘strategic games’ may be linked to each other, because the problems interrelate or because actors play different games at the same time. Such linkages may further complicate the effective solution of a problem, but they can also provide possibilities for agenda coupling, package deals, and tradeoffs (Axelrod 1984; Koppenjan and Klijn 2004).

2.3.2.2 Normative Implications

In order to solve problems, actors need to reach a common understanding on the problem and share resources to solve it. If actors succeed in developing collaborative strategies, they may arrive at integrated solutions that do justice to the various preferences and perceptions involved. Huxham speaks of ‘collaborative advantages’—win-win situations that none of the parties involved could have achieved on its own (Huxham 2000; Dery 1984; Ury and Fischer 1983; Axelrod 1984). However, this is far from easy; strategic games may result in blockages, caused by conflicting strategies of actors not being able or willing to agree, ‘poor’ compromises resulting in lose-lose outcomes, and imposition of one-sided policy measures with high implementation costs and loss of trust.

Recommendations based on the political game perspective recognize that actors do not easily succeed in working together, due to diverging and conflicting preferences and perceptions, and the fact that collaboration is costly and vulnerable for opportunistic behavior. In order to enhance interaction, there is a need for facilitation, brokerage, arbitration, and the creation of supportive arrangements to increase commitment, such as letters of intent, covenants, and platforms for interactions (O’Toole 1988; Gage and Mandell 1990; Kickert et al. 1997; Teisman 2000). Recent ideas on process design and process management build upon these insights (De Bruijn et al. 2002; de Bruijn and Porter 2004).

2.3.2.3 Implications for PA

What are the implications of the political game perspective for PA? Once we accept that policymaking can best be viewed as a political-strategic game, it must be acknowledged that, in reality, policymaking does not live up to the ideal of the rational model. Ideological prejudices and seduction of power may make policy-makers disregard research outcomes and scientific insights, and instead base policies upon their political preferences.

- *The mission of PA*. In this light, the mission of the policy analyst has traditionally been formulated as 'speaking truth to power' (Wildavsky 1979), contributing to the rationalization of policies and policymaking processes. PA should accommodate technical–scientific rationality to political rationality and prevent policy advocacy and report wars.
- *The role of the policy analyst*. The fulfillment of this mission may result in various roles or interventions. First, PA may be aimed at systemic analysis and the use of scientific evidence, thus strengthening the evidence base of the public policies. This role implies that PA systematically 'doubts' proposed problem formulations and solutions, and looks at the problem from a large number of different sources and perspectives (Mason and Mitroff 1981, p. 14). However, the literature is full of accounts of how attempts to speak truth to power result in the non-use of analysis by policymakers. To counteract this, the role of PA may be redefined as user-focused, producing usable knowledge. The analyst should ensure that results are aligned with the knowledge demands of practitioners, and are presented and communicated in an understandable and attractive way (Patton and Sawicki 1986). However PA can be (mis)used for all kinds of strategic purposes: e.g., to postpone a decision, stall a controversial issue, get ammunition for attacking opponents, put issues on the agenda, or break stalemates. Policy analysts sometimes serve as 'hired guns'. Well-organized advocacy groups and lobbyists may use and produce scientific knowledge and various forms of PA to back their own arguments or refute those of others. This sometimes leads to a 'reports war', with piles of contradictory facts and findings (Radin 2002, p. 36). In such a way, PA contributes to uncertainty instead of reducing it. To overcome these strategic uses of PA, other roles may be necessary. Policy analysts may take up the role of process manager by arranging the interface between the political bargaining process and analytical activities. Arranging the involvement of stakeholders in research activities may increase the usefulness and authoritativeness of PA. It may also contribute to the rationality and evidence base of compromises actors in the power game agree upon. De Bruijn and Ten Heuvelhof (2002) speak in this respect of the need to prevent the development of negotiated nonsense, and of the possibility of generating negotiated knowledge. The political game perspective suggests another role for the policy analyst: that of facilitator or mediator of interaction processes—helping stakeholders to develop a joint course of action by answering knowledge questions and organizing processes of joint fact finding and joint image building (see Chap. 3).

- *The policy analyst's toolbox*. In addition to the toolkit of 'traditional' PA discussed in the rational model, this perspective requires PA to provide methods and tools to analyze the political and multi-actor context, e.g., by conducting forms of stakeholder or strategic analysis for policymakers and clients (see for instance, Bryson 2004). Some of these methods and tools are discussed in Chap. 8 of this book. Another way to gear PA to a polycentric or political context is to make the analytical tools and methods more interactive; i.e., to involve the important stakeholders with different forms of expertise, values, and interests in the analytical process. 'Interactivity' takes off the 'sharp edges' of technocratic rationality. CBA, Goal-Means Analysis (GMA), or Cross Impact Analysis (CIA) can be done by one expert policy analyst for a single decisionmaker. But the policy analyst can also guide several stakeholders through the same process, turning the method into an interactive CBA, GMA, or CIA, so that the outcomes can be used by multiple decisionmakers and other actors (see for instance, Enserink and Monnikhof 2003). Arranging the interface between the processes of interaction and research activities may include involving stakeholders in the various steps of the analytical process: up front, by formulating the research question, the research methods, and the research assumptions used; during the analysis, by discussing intermediate results and formulating additional questions; at the end, by debating the outcomes of the analysis, their meaning and implications for further action (Koppenjan and Klijn 2004).
- *The skills of the policy analyst*. These additional roles have repercussions for the skills policy analysts need to possess. Besides the need for scientific methods and tools, PA comes to rely on the political skills and strategic insights of analysts (Wildavsky 1979). They must develop an awareness of the existence of multiple perceptions and the limitations and subjectivity of analysis, in line with a social constructivist orientation that follows from this policy perspective. Policy analysts must be aware that they operate in a political context and that PA is 'part of the strategic game'. They must capture the use of new analytical tools to analyze the strategic environment. They must develop sensitivity to understand the needs of clients and the interests and positions of stakeholders. For this, they require skills in the area of facilitation, mediation, and negotiation.

2.3.3 Policymaking as Discourse

The approach of policymaking as a political game has been criticized for its one-sided attention to strategic interaction—with great emphasis on power, stakeholder interests, and strategic behavior. Some authors have argued that 'power play' alone is insufficient to explain policymaking and policy change (Fischer and Forrester 1993; Hoppe 1999). The discourse model focuses on the (quality of) arguments that stakeholders use in a policy debate (see for instance, Fischer and Forrester 1993).

2.3.3.1 Assumptions

The discourse model of policymaking rests upon three pillars:

1. **Policies**: consist of constructed and shared meanings in a policy debate.
2. **The policymaking process**: an interactive learning process—an exchange of arguments and meanings.
3. **The institutional context**: a number of advocacy coalitions—policy communities with different belief systems or paradigms.

According to this perspective, policymaking processes are regarded as 'conversations' or 'discourses', in which actors exchange their arguments, aimed at influencing the perceptions of others and, eventually, the course and outcome of the overall debate. In trying to arrive at shared meanings or to impose their own interpretations on others, they will develop a consistent storyline or structured argumentation in order to convince or force others to adapt their perceptions (Hajer 1995). Rein and Schön (1993) refer to this process as 'naming and framing', and to the perception of actors of the reality that surrounds them as 'frames'. Depending on character, values, and professional training, people have fundamentally different views of reality. They frame policy problems differently (Schön and Rein 1994). Usually, they apply a limited set of coherent 'frames' to a policy problem. Drug addiction for instance can be 'framed' as a medical, social, or justice problem. Different frames will lead to different policies. Due to different problem perceptions, some policy issues, like nuclear energy, genetic screening, or climate change, are highly controversial with fierce debate among a few antagonistic frames or 'advocacy coalitions'.

Frames are also referred to as 'belief systems' (Sabatier 1987) or 'policy paradigms' (Hall 1993). The framing theory implies that actors are not inclined to change their frames, since they are part of a broader community in which these frames are nested. According to Sabatier, this is especially true for the policy core of a belief system, the norms and values of such a system being tightly connected to culture, identity, and ideology. Learning between what he calls 'advocacy coalitions'—actors that share the same belief systems—will be restricted to the marginal parts of the system and leave the core unchanged (Sabatier and Jenkins-Smith 1993). As a result, fundamental policy changes will not easily occur. Rein and Schön (1994) seem to be more positive about the perspectives of what they call 'frame reflective dialogues'—policy debates in which actors reflect upon their frames and engage in a mutual learning process.

Hall (1993) connects the concept of policy paradigms to that of policy discourses. A policy discourse is made up of ideas and values that are continuously maintained, reshaped, and discovered in an ongoing discussion among members of a policy community, producing a set of assumptions and discussion rules that fulfill the function of creating meaning and gatekeeping at the same time. It is a storyline that structures the debate, determining which arguments are valid and which are not. It is both a way by which actors try to arrive at shared meanings and a tool for the exercise of power by which actors try to impose their own interpretations of reality on others and exclude or silence countervailing voices (de la Bruhéze 1992; Hajer 1995; Hoppe 1999).

2.3.3.2 Normative Implications

According to the discourse perspective on policymaking, failure occurs when parties, notably policy coalitions, do not succeed in realizing a shared meaning that allows them to adequately address the problems they encounter. This perspective especially draws attention to 'dialogues of the deaf'—enduring impasses about substantive views, in which parties talk past each other using reasonings that are plausible by themselves, but mutually exclusive (Wildavsky and Tenenbaumm 1981; van Eeten 1999, 2001). Asymmetrical argumentation structures within the discourse may prohibit consensus building or participation of actors in the debate on an equal footing. When, in these situations, actors use PA to advocate their own arguments in attempts to convince, PA may result in a war of reports, contributing to information overload and ambiguity instead of reducing it (Koppenjan and Klijn 2004). Remedies that are characteristic for this perspective include the introduction of new agendas, frames, and parties in order to change the nature of the discourse by initiating frame reflection and enhancing cross-coalition learning processes. Not all parties have the same opportunities in this argumentation game. Experts, policymakers, institutionalized interest groups, and media will be most influential. Politicians and citizens are floored and outmaneuvered by information overload and an array of interpretations. Weakly organized interests will not be heard (Hoppe 1999; Mayer et al. 2005). Remedies may also be aimed at helping parties who tend to be outmaneuvered in the argumentation game to develop arguments and storylines that hold in the ongoing policy discourse (van Eeten 1999, 2001).

2.3.3.3 Implications for PA

What are the implications of the discourse perspective for PA? Actors or stakeholders form advocacy coalitions that share certain values, cognitions, and beliefs about policy problems and solutions. The discourse perspective argues that the core belief systems of policymakers or communities are relatively stable and persistent. This explains why it is difficult or almost impossible to convince antagonistic stakeholders merely by new research findings. Different belief systems are likely to produce different research outcomes. They also interpret the results differently. Scientific studies and PA are often used to corroborate or improve one's own belief system and attack the belief systems of others. Over a longer period of time, however, the belief systems (paradigms) can change—not only as a result of external events, but mainly as a result of social or policy-oriented learning. Science and PA may play an important role in triggering learning and policy change.

- *The mission of PA*. Following the logic of the discourse perspective, PA is aimed at overcoming asymmetrical debates among advocacy coalitions and furthering a constructive dialog among them, by enhancing frame reflection and learning across advocacy coalitions with different belief systems.

- *The role of the policy analyst*. In this perspective, the policy analyst is engaged in discourse analysis, proposing argumentation strategies to overcome deadlocks in debates and acting as facilitator and mediator among different advocacy coalitions and belief systems.
- *The policy analyst's toolbox*. Policy analysts in this perspective analyze discourses, argumentation structures, and the belief systems that underlie them. They adapt and design storylines, create new tools of communication, and build new agendas to overcome asymmetrical debates and dialogs among the deaf. Policy analysts may facilitate interventions aimed at reframing perceptions, initiating cross-frame reflection, and learning across advocacy coalitions. They give feedback on the experiences and outcomes of existing policies. They pinpoint anomalies in belief systems that cannot be understood.
- *The skills of the policy analyst*. In order to perform these tasks and to master these methods, the policy analyst must be able to conduct discourse analysis, and develop sensitivity for understanding the various arguments and languages spoken and the perceptions and beliefs that underlie them. She has to be creative, coming up with ways to overcome deadlocks and capture skills for mediating and initiating cross frame learning among policy advocacy coalitions with diverging or conflicting belief systems.

2.3.4 Policymaking as a 'Garbage Can'

The garbage can model adds to the political game and discourse perspectives the idea that policymaking does not evolve in a stable environment. Due to the fragmented nature of the context in which policies come about, multi-actor problem solving is governed by disruptions, unexpected events, and coincidences to a far greater extent than in the previous perspectives.

2.3.4.1 Assumptions

The garbage can perspective rests upon three pillars:

1. **Policies**: coupling of problems, solutions, politics/participants at the right moment (window of opportunity).
2. **The policymaking process**: 'erratic' and 'volatile'—it progresses by 'fits and starts'.
3. **The institutional setting**: fragmented, with many actors and *ad-hoc* networks with little stability—an 'organized anarchy'.

Cohen et al. (1972) conceptualized the erratic character of decisionmaking in a metaphorical 'garbage can' model. A decision situation is like a garbage can into which participants deposit all sorts of problems and solutions. The outcome of the decisionmaking process depends on the content of one garbage can at one moment, the availability of other garbage cans, and the speed at which the garbage can is emptied. The garbage can model was originally developed and used to understand decisionmaking in professional organizations, such as universities and hospitals. But the model applies generally to 'organized anarchies'—complex situations in which there is no clear hierarchy of goals and values, routine procedures are absent, and participation in the decisionmaking process is not regulated. The main idea is that the important activities in policymaking, such as problem formulation, design of a solution, participation, and decisionmaking, seem to develop independently of each other. Cohen et al. (1972) refer to separate streams of problems, solutions, participants, and decision moments. The garbage can model turns the rational decisionmaking model upside down. There is no rational, linear process from problem analysis to policy. Beside problems looking for solutions, solutions can look for problems, participants can look for problems and/or solutions, and opportunities can look for participants.

With some modifications, Kingdon (1995) applied the garbage can model to public decisionmaking. He identified three streams: problems, policies, and political events. By replacing the participants from the garbage can model with political events, Kingdon incorporates political factors into his model. Political events for instance are a change in government or political climate that causes certain problems and solutions to gain and others to lose in political favor. Participants are not viewed as a separate 'stream'; participants operate within and between the streams. Problems and solutions cannot be seen independently from participants; the participants articulate them. An important new element in the model is the metaphor of a 'policy window'. A policy window occurs when there is an opportunity to couple (i.e. bring together) the three streams (see Fig. 2.1). At those moments, decisions can be taken and policies come about. Without a policy window, no policies will be decided upon, no matter how urgent the problem is. A policy window is temporal. It may open or close, due to developments in one of the streams. There may have been changes in government, certain actors may have left the arena, the salience of problems may have changed, or new technologies may have become available. Policy windows may appear or disappear coincidentally. Sometimes they are created by so-called policy entrepreneurs. These are actors looking for solutions to problems, or for problems that match a solution. Or they are looking for political support for a problem–solution combination.

The streams model may appear to make little sense at first sight, but closer examination will reveal numerous recognizable points. For instance, the criticism expressed about the policymaking process for a new Dutch rail freight line called the Betuwe line boils down to the Central government having put forward a solution—i.e., a ready-to-go design of a freight transport rail line between Rotterdam and the German border—instead of starting out with a problem it wanted to solve. This was not a unique, parochial peculiarity: starting policymaking with solutions instead of problems is a widely used practice in public administration.

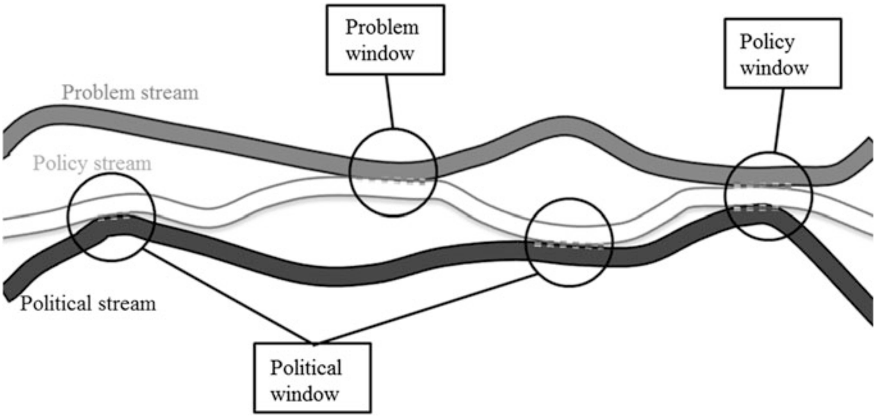

Fig. 2.1 Kingdon's 'streams' model (*Source* Pauli 2001)

The garbage can and streams models presented above have been modified and elaborated by different authors. In one of these elaborations, the 'rounds model', policymaking resembles a boxing contest. It takes place in rounds, not progressive steps, from problem to solution. In each round the players, the agenda, and the result can be different. The winner becomes known at the end. Complex decisionmaking processes are characterized by a zigzag course, fits and starts, and iterations. The activities of formulating the problem, designing the solution, and mustering support occur simultaneously and are interconnected in various ways (e.g. Teisman 1992).

2.3.4.2 Normative Implications

Policy failure and success in the garbage can perspective depends on the extent to which the streams of problems, solutions, and political events are coupled, such that favorite combinations can be made and effective policies can come about. Explanations of success and failure emphasize the role of irrationality, dynamics, and coincidence, but also of entrepreneurship and political skills. The model suggests that possibilities to get a grip on the erratic nature of multi-actor problem solving are essentially restricted. Still, it provides us with a number of recommendations: actors can try to anticipate policy windows; they can use strategies to influence the content of policy streams or to create or maintain couplings. Entrepreneurship therefore should be encouraged. Creating a negotiated environment and careful management of political interfaces may reduce the risks of unexpected contextual disruptions. However, these efforts do not guarantee the occurrence or maintenance of couplings—at all times, strategies and attempts to manage policymaking may be disturbed by unexpected developments.

2.3.4.3 Implications for PA

What are the implications of the garbage can model for PA? The garbage can perspective shows that policymaking is erratic and volatile. It explains why, in many cases, nice ideas and good solutions never take off. And why ‘not-so-good ideas’ sometimes get funded. It explains why excellent research reports can disappear in a deep drawer. And why other studies or reports are able to attract unexpected levels of attention, e.g., in the media or in the political arena. For many rational policy analysts, such phenomena are incomprehensible and even frustrating. Policy analysts can play their part, create and seize opportunities, but can not control or rationalize the policymaking process.

- *The mission of PA.* In these circumstances, the challenges for PA may be to contribute to the development of good problem formulations, solutions, and lists of selection criteria in the various streams, to enhance the occurrence of policy windows, and to help realize good matches of problems, solutions, and political preferences (and prevent bad couplings) once policy windows occur.
- *The role of the policy analyst.* Like other participants, policy analysts can decide to go with the flow. Their analyses can help to develop problem formulations, solutions, and clarifications of criteria in the various streams, in order to have the gun loaded when an opportunity comes along (Kingdon 1995). In addition, they can take a more proactive role and signal problems, solutions, or political events, and act as advocates for them. But most importantly, policy analysts can act as entrepreneurs or as strategic advisors for entrepreneurs. In this role they engage in brokerage activities, trying to accomplish couplings.
- *The policy analyst’s toolbox.* In this perspective, traditional PA methods are needed to support the activities in the various streams. These methods, however, need to be complemented with tools supporting the scanning of developments in the streams. In addition, policy analysts that engage in entrepreneurial activities will need to operate at the interfaces of social networks and scan the boundaries of organizations and institutions. This also implies that results of analysis and research reports should be communicated in the right way and at the right moment. As timing is everything, the effectiveness of large-scale, long-term PA studies may be questioned. The impact of quantitative modeling in the policy process is often limited due to development lead times. By the time the results of the model or project are available, the client may have other burning questions, the urgency of the matter may have disappeared, or the client himself may have been replaced.
- *The skills of the policy analyst.* A combination of analytical tools and political skills should make policy analysts professionally suitable to signal and couple problems, solutions, participants, and political events. For this, they must rely on a wide social and professional network, a good feeling for the political climate and timing, and a good understanding of the functioning of the media and the ability to anticipate this.

2.3.5 Policymaking as an Institutional Process

The institutional scenery of the 'garbage can' model is highly fragmented and disordered, with many actors and *ad-hoc* coalitions. The question may be raised whether things like formal and informal rules, norms, and cultures are more important determinants in policymaking than the garbage can and streams model seem to suggest. New institutionalism, which includes parts of policy network theory, argues that the role of institutional factors in policymaking has been neglected and that it is time to rediscover the role of institutions (March and Olsen 1984, 1989).

2.3.5.1 Assumptions

The (neo-)institutional perspective on public policy rests upon three pillars:

1. **Policies**: 'reproductions' of earlier solutions, shaped and constrained by norms, cultures, rules, etc.
2. **The policymaking process**: repeated interactions based upon institutional norms, cognitions, cultures, routines, etc.
3. **The institutional context**: sets of formal and informal rules with varying levels of stability at the organizational, network, system, and culture level, nested within each other.

'Classic' or 'old' institutionalism has a long history in economics, sociology, and political science. In rough terms, it aims to understand (the emergence) of formal organizations in a comparative fashion, like the various judicial, welfare, or educational systems, political parties, international or transnational organizations, or the organization of governmental departments and agencies.

In the 1980s, the importance of institutions was rediscovered. However, the neo- or new institutionalism defined institutions in a much broader sense than 'old' institutionalism. It primarily focuses on informal institutions, such as rules, norms, cognitive perceptions, routines, and culture, and is particularly interested in the way such factors constrain or shape behavior (March and Olsen 1984, 1989). New institutionalism has found its way into economics, sociology, political science, and policy sciences (Powell and DiMaggio 1991; Williamson 1996).

New institutionalism can be related to ideas on routine decisionmaking and organizational theories as far as they see organizational routines (standard operating procedures) as important determinants of behavior (Allison 1971; Morgan 1986; Scott 1995). But organizational routines are only one specimen of the set of institutions that simultaneously influence behavior. Williamson distinguishes four layers of institutions: 1. organizations; 2. interorganizational arrangements; 3. formal institutions, like laws and regulations; and 4. informal institutions, like culture. Due to processes of coevolution, these institutions have a certain extent of coherence and are nested within each other (Williamson 1996; Goodin 1996).

Through repeated interactions, interdependent actors develop cultures, rules, shared perceptions, standard operating procedures, a common language, and trust. These stabilize the interactions among actors into patterns that make it easier for them to deal with new policy problems. Institutions reduce the transaction costs and the risk of opportunistic behavior by providing routines, stability, and predictability (Williamson 1979; Olson 1965; Ostrom 1990; Giddens 1984).

In the policy sciences, patterns of repeated interactions among autonomous but interdependent actors are called policy networks (Rhodes 1986; Kickert et al. 1997). The policy network literature builds upon concepts of policy communities, subgovernments, iron triangles, and neo-corporatism (Adams 1982; Rourke 1984; Jordan 1990; de la Bruhéze 1992; Blom-Hansen 1997). According to Rhodes (1988, p. 78), policy networks are "characterized by stability of relationships, continuity of a highly restrictive membership, vertical interdependencies based on shared service delivery, responsibility and insulation from other networks and invariably from the general public (including parliament)".

Like institutions in general, policy networks may be considered a form of social capital, facilitating interactions among these interdependent actors by reducing transaction costs and risks of opportunistic behavior. Policy networks, like all institutions, develop a somewhat closed and exclusive nature. This may lead to excluding salient problems, neglecting the interests of under-represented or non-represented actors, and producing unwanted outcomes (Marin and Mayntz 1991; Marsh and Rhodes 1992; Monnikhof 2006). In the literature on agenda building, these phenomena are known as 'mobilization of bias' and non-decisionmaking (Schatschneider 1960; Bachrach and Baratz 1962). Networks may become closed and non-transparent settings, not open to democratic accountability mechanisms, resisting change, and prohibiting innovation (Klijn and Koppenjan 2006). Policies designed and decided upon in this setting are based on a narrow sectoral view, thus limiting the possibilities for more integral or holistic approaches to problems.

On the other hand, Heclo (1978) considers policy networks to be far from closed or stable. They have vague boundaries, an *ad-hoc* character, and participants move in and out constantly (Heclo 1978; see also Kenis and Schneider 1991). Apparently, networks may vary in the extent to which they are institutionalized. Heclo refers to 'issue networks', which have a low level of institutionalization and in fact are equal to the arenas of the political game approach and the garbage can-like processes of Kingdon (see above).

2.3.5.2 Normative Implications

Success or failure according to the neo-institutional approach is caused by a lack of shared institutional arrangements, due to either a lack of institutionalization or incompatibility of institutions. As a result, interactions may be hindered by high interaction costs, misunderstandings, and uncontrolled conflict. Also, closed institutional settings may exclude relevant interests and stakeholders, prohibiting integral and interdisciplinary solutions. Recommendations aimed at concrete policy processes include enhancing reflection on the institutions that (implicitly) guide behavior, making explicit *ad-hoc* agreements on the set of rules that will guide future behavior, and laying these rules down in e.g., covenants, etc. Attempts to break through the mobilization of bias may require empowerment of stakeholders, building or supporting new advocacy coalitions, but also regulation aimed at safeguarding interests and institutional change. With regard to attempts at creating or changing institutions, the new institutional approach is reserved, acknowledging the ungovernability of institutional design processes and the risks of destroying the social capital accumulated in existing institutions based on long-term interaction and learning processes. On the other hand, in practice, institutions are created and restructured all the time, which makes it important to understand and formulate principles of good institutional design. Although some of these principles are identified and addressed in studies on institutional design, in general the theory on this subject is not very well developed and urgently needs further elaboration (Goodin 1996; Ostrom 1990; Klijn and Koppenjan 2006).

2.3.5.3 Implications for PA

One of the interesting implications of the (neo-)institutional perspective is that 'PA' itself is (part of) an institutionalization process. Institutionalization of PA takes place inside bureaucracy, but also through think tanks, science and advisory committees, consultancy and applied research organizations, and advocacy groups. Neo-institutionalism makes us aware that different PA communities constitute rules, norms, cognitions, and cultures that facilitate repeated interactions at the interface of science and politics. PA builds upon relatively stable and closed policy networks in which many issues, views, and values have been institutionalized. This creates efficiency and trust. This makes it easy for PA to become authoritative. But not all values and interests have been institutionalized with the same force. Institutionalization in networks easily turns into monopolization of knowledge and exclusion of less powerful parties from decisionmaking. Deinstitutionalization also happens, for instance, by outsourcing PA, resulting in the proliferation of a splintered consultancy market. This in turn may lead to a loss of in-house expertise on the side of policymaking organizations, enhancing trends toward policy advocacy, and weakening the existence and functioning of PA communities and their capability to safeguard quality and professionalism.

- *The mission of PA*. In addition to enhancing the evidence base of policies pursued in networks, the institutional perspective underpins the need for PA to support the development of integral, cross-sectoral, and interdisciplinary approaches to problem solving, to help overcome the problems of under-representation and exclusion, to bypass routines in order to arrive at fitting and innovative solutions, and to prevent or break through knowledge monopolies or mitigate the impacts of outsourcing and splintering of the PA.
- *The role of the policy analyst*. Policy analysts will, in addition to delivering traditional PA, focus on clarifying the role of institutions and their positive and

negative impacts in policymaking. Their role may be extended to (supporting) mediation activities to realize coordination among various policy sectors and disciplines, enhancing capacity building for deprived stakeholders, or taking up the role of solicitor for unrepresented interests. Lastly, policy analysts require a self-critical role, evaluating their entanglement with vested interests or the impacts of the way they operate in a fragmented, competitive consultancy market.

- *The policy analyst's toolbox*. To fulfill these roles, the traditional toolbox should be extended with research tools such as network and institutional analysis, stakeholder analysis, and agenda building research. Going beyond organizational routines requires methods that stimulate out-of-the-box thinking. Intersectoral and interdisciplinary methodologies are needed to support the pursuit of integral solutions. Furthermore, methods are needed to support capacity building activities.
- *The skills of the policy analyst.* The toolbox needs to be complemented with policy analysts possessing skills to engage in institutional analysis and design and to bridge the routines of various sectors and disciplines. Policy analysts, in the institutional perspective, require an awareness of how various stakeholders and interests are affected by policies. They should be able to understand and communicate with these stakeholders. Ultimately, policy analysts are needed that can self-critically reflect on the position of their own community within the wider institutional landscape, on the way this affects the conditions to realize the mission of PA, and on how these conditions, if necessary, can be accommodated.

2.4 Conclusion and Discussion

The objective of this chapter was twofold: (1) to familiarize the reader with the notion of PA, and (2) to examine the implications of five different policymaking models for PA. We have argued that policymaking and PA are isomorphic—mirror images of each other. We are aware that the scope of the chapter has been rather wide; nevertheless, even more questions about policymaking and PA can be raised. For reasons of space, we have left out many theories and notions as well as case illustrations. Some of these omissions will be filled in by later chapters. In particular, Chap. 3 relates the five policymaking models to six styles of PA.

Table 2.1 summarizes the five models and their implications for PA. What is the overall image that it conveys? The main conclusion is that, in a pluralistic and open society that increasingly relies upon complex networks, our understanding of PA cannot be one-dimensional, linear, or based upon routines and simple recipes. PA constantly faces boundary tensions and dilemmas, where conflicting demands on the PA methods, the policy analyst, the outcomes, and the process need to be balanced. Therefore, PA should be multifaceted, varied, and pluralistic. Only in that way will the discipline of PA be able to cope with the wide variety of knowledge demands that need to be accommodated in policymaking in a complex, network society.

Table 2.1 Policy models and their implications for PA

Policy model	Policies	Policy process	Institutional context	Implications for policy analysis
1. Rational decisionmaking	Rational, intelligent decisions based upon synoptic information.	Evolves in a few (chrono)logical steps or phases.	Closed, unicentric, hierarchical, authoritative.	Producing knowledge to support decisions in policy phases.
2. Political game	Political compromises among autonomous, interdependent stakeholders.	Power play or bargaining game among stakeholders	Pluricentric, interorganizational arena with restricted access.	Speaking truth to power; producing usable and authoritative knowledge; rationalizing the policy process and enhancing evidence based compromises.
3. Discourse	Constructed and shared meanings in a policy debate.	An interactive learning process; an exchange of arguments and meanings.	Number of advocacy coalitions and policy communities with different belief systems or paradigms.	Overcoming asymmetrical debates, furthering frame reflection, and learning across policy coalitions.
4. Garbage can	Coupling of problems, solutions, politics/participants at the right moment (window of opportunity)	'Erratic' and 'volatile'; it progresses by 'fits and starts'.	Fragmented with many actors and *ad-hoc* networks with little stability.	Supporting policymaking activities within streams and entrepreneurial actions to realize policy windows; enhancing the realization of good problem–solution combinations.
5. Institutional process	'Reproductions' of earlier solutions, shaped and constrained by norms, cultures, rules, etc.	Repeated interactions based upon institutional norms, cognitions, cultures, routines, etc.	Networks with varying levels of stability, nested in a larger institutional environment.	Conducting institutional analysis to overcome dysfunctional routines and institutional barriers to integral problem solving; supporting capacity building for under represented stakeholders; reviewing and improving institutional embedding of policy analysis.

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Chapter 3
Perspectives on Policy Analysis: A Framework for Understanding and Design

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3.1 Introduction

As made clear by the discussion in Chap. 2, policy analysis is a multifaceted field in which a variety of different activities and ambitions have found a place. Some policy analysts conduct quantitative or qualitative research, while others reconstruct and analyze political discourse or set up citizen fora. Some policy analysts are independent researchers, some are process facilitators, while others act as political advisers (Dror 1967; Jenkins-Smith 1982; Durning and Osuna 1994). The debate on the discipline—for example on its foundations, underlying values, and methods—is conducted in a fragmented way (Dunn 1994; Brewer and DeLeon 1983; Hogwood and Gunn 1984; Bobrow and Dryzek 1987; Wildavsky 1987; DeLeon 1988; MacRae and Whittington 1997; Hawkesworth 1988; House and Shull 1991; Weimer and Vining 1992; Fischer and Forester 1993; White 1994; Radin 1997; Mayer 1997; Hoppe 1998; Shulock 1999; Lynn 1999).

The variety and multifaceted nature of policy analysis makes it clear that there is no single, let alone 'best', way of conducting policy analyses. The discipline consists of many different schools, approaches, roles, and methods. The observed diversity of policy analysis gives rise to numerous questions. If we are unable to construct cohesion and unity behind this great diversity, we cannot speak of a discipline.

In Chap. 2, we reasoned from the outside in: the implications of different policymaking models for policy analysis. In this chapter, we will reason from the

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inside out: from policy analysis activities and styles, to their implications for policymaking. What relationship exists between the different schools and activities in policy analysis? Do they exclude each other or are there—in practice—numerous hybrids and combinations? What conceptual framework do we have at our disposal if we need to demarcate the discipline, design new methods and approaches, or evaluate projects? Can we enrich the methodological toolbox by adding new methods? What is the relationship between policy analysis methods and new insights from the policy sciences, such as interactive policy development and process management (Edelenbos 1999; de Bruijn et al. 2002)? These are important questions that we obviously cannot answer in full and all at once, but for which we hope to provide a framework.

The great diversity of views, schools, and methods easily causes confusion and gives rise to the need for insight into the discipline for insiders and outsiders alike (Radin 1997; Lynn 1999). Various attempts have been made to untangle and explain policy analysis as a methodical discipline. Some well-known examples of models in which activities and methods are systematically related can be found in Dunn (1994), Brewer and DeLeon (1983), Hogwood and Gunn (1984), Bobrow and Dryzek (1987), Miser and Quade (1985), Patton and Sawicki (1986), Weimer and Vining (1992), and Mayer (1997).

It is precisely because of the varied developments in policy analysis and the diffuse image that they create of the field that this chapter seeks to make the field transparent and to structure it with the help of a framework or conceptual model. Structuring will not take place by choosing a specific author, perspective, or school, but rather by displaying the variety of views of policy analysis. It is not our intention to adopt a normative standpoint on what the most preferable form or style of policy analysis should be. This chapter provides a framework for positioning the different perspectives and for highlighting the implications of choosing a perspective when designing or evaluating a policy analysis project. A somewhat broader view of policy analysis will be taken in this chapter compared to the other chapters of the book. All activities related to policy research and advice are taken into account, in order for the conceptual model to cover everything that may be considered to be part of policy analysis in the literature.

The conceptual model presented here has three functions. First, structuring the field into activities and styles provides a greater insight into and overview of the diversity of policy analysis. The model is a means to demarcate and understand the field as a whole. Second, when designing a particular policy analysis project, the analysts will select methods and tools they consider to be appropriate. The model can support choosing existing methods and designing new methods. Third, we believe that the quality of a policy analysis project can be judged from different perspectives. The model helps to formulate the values pertaining to a perspective, values from which criteria for the evaluation of a policy analysis project can be derived. In the following sections, we will develop the conceptual model step by step. The activities and styles are portrayed in an archetypical way, i.e., the way they are presented in the literature by proponents of the style.

3.2 Policy Analysis Activities

Our strategy in developing the conceptual model has been to first address the question: "What general activities do policy analysts perform when it comes to supporting policy and policy processes?" We distinguish a number of major clusters of activities. These clusters of activities have been identified using both authoritative literature on policy analysis as well as by studying exemplary and contrasting cases of actual policy analyses in the fields of water management, transport, environment, genetic and medical technology, science and technology policy, and spatial planning and construction (Mayer et al. 2004). The six major clusters of activities are:

1. Research and analyze
2. Design and recommend
3. Clarify values and arguments
4. Advise strategically
5. Democratize
6. Mediate

In real-life cases and projects, a policy analyst will combine one or more of the six activities, albeit not all at the same time. As more activities are combined, a policy analysis project will become richer and more comprehensive, but also more complex.

The hexagon in Fig. 3.1 is a diagrammatic representation of these six activities. The theoretical foundation will be discussed later in this chapter, when we show the policy analysis styles and criteria on which the clustering of activities has been based. In this section, we focus on the six activities and illustrate these with the help of examples based on actual policy analyses. At the end of this section, we look at the relations among the various activities in more detail.

1. *Research and analyze*

Has the number of cases of driving under the influence of alcohol increased compared to previous years? Has privatization of public utilities and services led to lower prices for consumers? Is our climate really changing? And if so, how is it likely to affect coastal regions?

Questions like these, which are highly relevant to policy, are about facts, causes, and effects, and therefore call for scientific research. In some respects and manifestations, policy analysis is indeed a form of applied research (cf. Dunn 1994) that uses research methods and techniques that are scientific or derived from science, such as surveys, interviews, statistical analysis, but also simulation and extrapolation. This cluster of activities matches with a perspective on policy analysis as knowledge generation. Knowledge institutions, such as statistical agencies, semi-scientific research institutions, and research agencies, gather and analyze, on request and at their own initiative, knowledge and information for policy purposes. It is possible that the political agenda influences their research

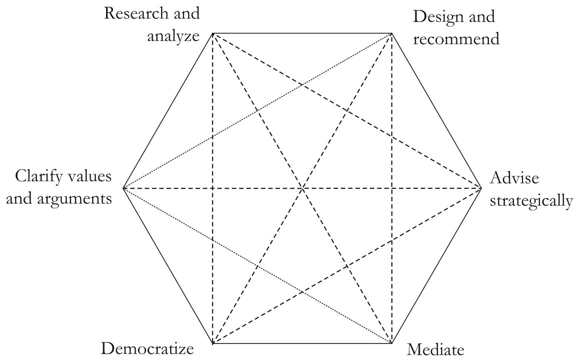

Fig. 3.1 Activities in policy analysis

priorities, but the results of their autonomous research activities may also influence the political agenda. Translation of the results of their research into a policy design or recommendation is not a primary part of their task or mission. It is up to the political system to identify consequences and draw conclusions from the best available knowledge. Box 3.1 contains an example of a policy analysis project in which the research and analyze cluster was of particular importance.

Box 3.1: Research and Analyze—The IMAGE 1.0 Model

The IMAGE project (integrated model to assess the greenhouse effect) is an example of research and analysis in the field of climate change. The example dates back to the situation prevailing in the mid-1980s, when climate change was not yet a major political issue in the Netherlands. After developing a successful prototype, the Dutch National Institute for Public Health and the Environment (RIVM) started developing the IMAGE 1.0 model in 1986 (Rotmans 1990). IMAGE 1.0 used simplified models of the carbon cycle and of atmospheric processes to calculate future atmospheric greenhouse gas concentrations and the accompanying changes in temperature and sea level for a number of different scenarios of future emissions of greenhouse gases. IMAGE 1.0 was the first model in which an attempt was made to integrate the climate system all the way from emissions to effects. The output of IMAGE 1.0 attracted public and political attention because the model's results were incorporated in the first Dutch national environmental outlook in 1988. The results in themselves were not new, but the integrated picture of impacts of different emission scenarios helped to put the climate issue high on the political agenda (van Daalen et al. 2002).

2. *Design and recommend*

What can government do to improve the accessibility of large cities? What measures can municipalities take to improve local safety? How can the container storage capacity in harbor areas best be increased—by improving utilization of existing capacity or by creating more capacity?

These policy questions are mainly design and solution oriented. When sufficient data and information have been gathered in earlier research, a policy analysis will focus on translating the available knowledge into new policy, either by making recommendations or by making a complete policy design. Recommendations will typically be the result of comparing the effects of different policy alternatives and weighing the options based on various criteria. Policy analysts in this way are supportive to the policy process by translating available knowledge into new policy either by advising or by making (partial) policy designs in terms of 'actions-means-ends'. A complete policy design typically involves generating and comparing the estimated outcomes of a set of alternative strategies, each of which may consist of several policy options aimed at achieving particular objectives or sub-goals (Walker 1988; Walker 2000). Box 3.2 contains an example of a project in which the prime consideration was the assessment of alternative strategies.

Box 3.2: Design and Recommend—the FORWARD Study

The following project in the field of freight transport is an example in which a policy analysis was aimed at design and recommendation. At the end of the 1980s, the Dutch Government was faced with the goals of sustainability as well as economic growth in the transport sector, and decided that action needed to be taken. The proposed policy was published in a policy document in 1990. This document, however, did not include many policy statements on freight transport, and various parties argued that there could be more attractive alternatives to a number of the policy options that had been suggested (Twaalfhoven 1999). As a result, a broad study was commissioned. This analysis of Freight Options for Road, Water And Rail for the Dutch (FORWARD) was carried out by RAND Europe. It examined the benefits and costs of a broad range of policy options for mitigating the negative effects of the expected growth in road transport while retaining the economic benefits (Hillestad et al. 1996). The study involved the development of a comprehensive policy analysis model and the identification of some 200 policy options that might be combined into various strategies for improving freight transport. The model enabled the design and assessment of individual policy options and combinations of options (strategies) for several economic scenarios extending to the year 2015.

3. *Clarify values and arguments*

Why, or more accurately about what, is there a clash of opinions between supporters and opponents of river dike enforcement or the expansion of a national airport? What values and arguments come to the fore as regards approving or rejecting developments in the field of modern genetic technology, as in the case of prenatal diagnosis and cloning?

There will always be implicit normative and ethical questions and opinions behind public policy. Prolonged conflicts and social issues that turn into stalemates often come about through fundamental normative and argumentative differences (van Eeten 2001; Fischer and Forester 1993). Abortion, euthanasia, and drilling for natural gas in protected areas are examples of such issues. Policy analysis may not only make instrumental recommendations for policymaking; it may also analyze the values and argumentation systems that underpin the social and political debate. Moreover, policy analysis seeks to improve the quality of the debate by identifying the one-sided or limited nature of arguments or showing where blind spots exist in the debate (Fischer and Forester 1993; Hoppe 1998). Box 3.3 contains an example of the clarification of the arguments of different stakeholders.

Box 3.3: Clarify Values and Arguments—Civil Aviation Infrastructure

An example of a project in which argumentation analysis was used, is a policy analysis commissioned in 1997 by the Future of Dutch Civil Aviation Infrastructure project (TNLI). Representatives of the Ministry of Housing, Spatial Planning and Environment, the Ministry of Transport, Public Works and Water Management, and the Ministry of Economic Affairs joined forces in a project group to prepare policy on this subject. The aim of the policy analysis was to put forward recommendations for the design of, and agenda-setting for, a broadly based public debate. A discourse analysis formed part of this policy analysis (van Eeten 2001).

The debate on the future of Amsterdam Airport Schiphol regularly boils down to a dichotomy: either for or against expansion. However, this dichotomy contrasts with the wealth of ideas that come to the surface in the real debate. In the analysis, the Q- methodology was used to reconstruct and understand the underlying lines of argumentation. A study conducted among 38 representatives of the actors involved revealed the existence of five important views or policy arguments that fell outside the confines of the simple for-or-against setting. An example is "search for sustainable solutions for a growing demand for mobility". By ignoring these views of the problem, options and arguments that could lift the debate out of the growth/no-growth dichotomy are left unutilized. The recommendations that resulted from this discourse analysis were used in the design of the public debate, in which discussion platforms were set up based on the five policy arguments.

4. *Advise strategically*

What should a government minister do to bring about acceptance of road pricing plans? What strategy can a government minister adopt to allocate radio frequencies?

These questions illustrate that policy analysis will often be a strategic, client-oriented activity. The substantive or procedural advice will be made dependent on the analysis of the field of forces that exist, i.e., the environment in which the client and his problem are located. The policy analyst will advise the client on the most effective strategy for achieving certain goals given a certain political constellation, i.e., the nature of the environment in which the client operates, the likely countersteps of opponents, and so on. Box 3.4 contains an example of a policy analysis project that emphasized the 'advise strategically' cluster of activities.

Box 3.4: Advise Strategically—Waste Discharge Policy

A policy analysis in which strategic advice was given to the Dutch Ministry of Transport, Public Works and Water Management addressed the problem of discharges into the sea of waste substances by the titanium dioxide industry (Rijkswaterstaat 1983). Titanium dioxide is produced for the paint industry. Its production releases waste substances that were still being discharged into the North Sea at the time the study was conducted in the 1980s. Some companies had exemptions for the discharge of environmentally harmful waste substances. As the expiry date of the exemptions approached, the Dutch government had to determine its position on the future strategy for discharges. Circumstances the government had to consider included the possible reactions of producers—they could have decided to continue the discharges elsewhere—and developments in the sector, such as European Union regulations. The Directorate-General's policy analysts used a decision-event tree to analyze how producers might respond to decisions concerning the final dates for discharges. The analysts made allowance for uncertainties regarding the availability of alternative production technologies, and the time of development of European legislation in this field. The Dutch government adopted their strategic advice.

5. *Democratize*

How can citizens receive more and better information about how to have their say in decisions regarding important social issues like genetic technology or a new metro line? How can citizens make an informed choice when it comes to a tricky and difficult question like the reconstruction of a railway station area?

In the 'democratize' cluster of activities, policy analysis does not have a value-free orientation, but a normative and ethical objective: it should further equal access to, and influence on, the policy process for all stakeholders (DeLeon 1994, 1988; Lerner and Lasswell 1951). In many policymaking situations, experts and elites are more likely to be involved and carry greater weight than ordinary citizens and laymen (Fischer 1990). Policy analysis can try to correct this inequality by calling attention to views and opinions typically overlooked in policymaking and decisionmaking (Fischer 2000). Box 3.5 gives an example taken from the field of technology assessment (Mayer 1997).

Box 3.5: Democratize—Genetic Modification

An example of a democratization project is the first Dutch consensus conference that was organized in 1993 by the Dutch parliamentary technology assessment organization to address the issue of the genetic manipulation of animals. In this public debate, citizens discussed the subject with all kinds of experts, such as researchers, representatives of environmental groups, industry, and ministries. The panel consisting of sixteen laymen was selected from people who responded to a newspaper advertisement, and the organizers prepared the panel for the debate over two weekends of meetings. The preparations resulted, among other things, in a list of questions for the experts. The actual debate took place during a weekend in which ideas, problems, risks, and choices were discussed. At the end of the second day, the participants wrote a final declaration that was published and also presented to Parliament. Today, the participation of laymen plays a more prominent role in technology assessment. The consensus conference format, originally a Danish method for public participation, has been adopted in many countries (Mayer 1997; Joss and Belluci 2002).

6. *Mediate*

How can industry and government agree on the moderation of their dispute about the possible harm caused by zinc emissions to the environment and health? How can they deal with conflicting findings of scientific research on this matter? What is a good process for exploring the future of a municipality with all stakeholders, such as citizens, businesses, etc.?

These questions show that resolving policy issues may require mediation. Policy analysts can play a role in enhancing the knowledge actors have about their own position, about the actors' room for maneuvering, and in looking for possible compromises and win-win options. In addition, they can be involved in designing the rules and procedures for negotiating in a policymaking or decisionmaking process, and in managing the interaction and progress of that process.

The mediation cluster comprises different types of activities, with a focus on analyzing contextual factors (e.g. dependency analysis, transaction analysis), and designing, and possibly also facilitating, meetings in which different stakeholders and decisionmakers consult and negotiate. Box 3.6 contains an example of a policy analysis that emphasizes mediation activities.

Box 3.6: Mediate—Recreation and Tourism Development in the Utrechtse Heuvelrug National Park

An example of mediation can be seen in the support of a policy develop ment process for the recreation and tourism sector in the municipality of Rhenen (Timmermans 2004). In response to the designation of a new national park in the Netherlands, the municipality of Rhenen, which is located at the southern end of the park, commissioned a project to reformulate its recreation and tourism policy plan. Although an integrative approach to planning was seen as desirable in developing the plan, in practice a sectoral approach was taken and participation of stakeholders in development of the area was limited to roundtable meetings. The limited progress that was achieved motivated the design and execution of an intervention workshop. The objective was not to decide on the future development of the area or to repeat ongoing discussions, but to analyze and present interdependencies among actors and to indicate potential for cooperation. The transactional approach (Timmermans 2004) was applied in this intervention. The actors were first identified in a three-round Delphi. During the workshop a limited number of issues were first derived in a facilitated discussion. Actors then modeled their own perception of dependencies on other actors using an interactive visual modeling tool. In addition, each actor assessed his interests in and control over the issues. This was followed by a discussion using a comparison among the individual assessments and calculations across all assessments.

3.2.1 Relationships Among the Activity Clusters

Depending on the specific policy analysis design (see Chap. 5), one or more of the activity clusters may become dominant, while other activities may play a subordinate role in certain (phases of) projects, or be irrelevant. In Fig. 3.1, we have arranged them in such a way that activities we consider to be most akin are shown alongside each other. For example, ‘design and recommend’ activities are a logical extension of ‘research and analyze’ activities, and ‘clarify values and arguments’ activities can feed into ‘democratization’ and ‘mediation’ activities.

The further away activities are from each other, the greater the field of tension for uniting the activities will be. A scientific research activity can easily conflict with the pragmatic and involving nature of mediation among actors. But if we identify opposing activities as fields of tension, we certainly do not mean that these activities are incompatible. The tension will have to be resolved in the specific policy analysis design. It will be necessary to make an ‘arrangement’ whereby—for example—the analysis of arguments and underlying values can support the mediation and dialog among conflicting standpoints; or whereby the design of the analyst is produced through open and equal dialog with citizens, laymen, and stakeholders. It is precisely the bridging of these tensions that generates innovation in projects and methods.

Combinations of two adjacent clusters of activities can be traced to specific *styles* of policy analysis. We will look at this matter of styles of policy analysis in the next section.

3.3 Policy Analysis Styles

It is the objective of the hexagon model to clarify and understand the discipline of policy analysis. Numerous schools of thought, paradigms, and models can be found in the policy analysis literature (Bobrow and Dryzek 1987; DeLeon 1988; Hawkesworth 1988; House and Shull 1991; Mayer 1997). In this section, we will refer to *styles* of policy analysis rather than to a paradigm, model, or school.

3.3.1 Six Styles of Policy Analysis

Based on the schools discussed in the literature and on the conceptual framework in Fig. 3.1, we have identified six policy analysis styles. Each style is associated with the side of the hexagon linking two adjacent vertices. The styles are:

1. Rational style
2. Argumentative style
3. Client advice style
4. Participatory style
5. Process style
6. Interactive style

Figure 3.2 shows how these six styles relate to the six activities shown in Fig. 3.1. In what follows, we briefly discuss the styles in an archetypical manner, presenting the arguments that are used by proponents of each of the styles.

1. *Rational style*

The rational style of policy analysis is shaped to a large degree by assumptions about knowledge and reality, and by a relatively large distance between the object and subject of study. It is assumed that the world is to a large extent empirically knowable and often measurable. Knowledge used for policy must be capable of withstanding scientific scrutiny. The role of knowledge in policy is a positive one, i.e., a greater insight into causes, effects, nature, and scale produces better policy (Weiss and Bucuvalas 1980). Policy should come about—preferably—in neat phases, from preparation to execution, with support through research in each phase (see Chap. 2).

An example of this policy analysis approach is the systems analysis method developed by the RAND Corporation (Quade 1989; Miser and Quade 1985; Walker 2000). The advice on policy regarding the Eastern Scheldt storm surge

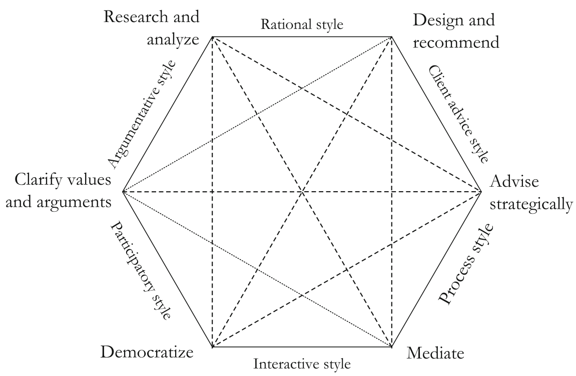

Fig. 3.2 Policy analysis styles

barrier in the Netherlands was obtained using this method (Goeller et al. 1977). This style is discussed in many general textbooks on methods of policy analysis (Patton and Sawicki 1986; MacRae and Whittington 1997; House and Shull 1991).

2. *Argumentative style*

This style assumes that policy is made, defended, and criticized through the vehicle of language. The basic assumption of the argumentative style is that, when analyzing policy, it is important to devote attention to aspects related to the language game that takes place around a policy problem or issue. Attention will shift to the debate and the place in the debate of arguments, rhetoric, symbolism, and stories (Fischer and Forester 1993; Fischer 1995; van Eeten 2001). Arguments aim to have an effect on the public. Therefore, policy analysis will make policy easier to understand by illustrating the argumentations and the quality thereof schematically and making a judgment based on criteria such as justification, logic, and richness (Dunn 1982, 1994). It is not sufficient to identify values and arguments, but the argumentation also has to be valid. The argumentative style assumes that it can make the structure and progress of the discourse transparent and can also bring about improvements by, for example, identifying caveats in the debate.

3. *Client advice style*

The client advice style is based on the assumption that policymaking occurs in a complex and rather chaotic arena. There are numerous players, each having different interests and strategies (de Bruijn and ten Heuvelhof 2000; de Bruijn et al. 2002). Therefore, it is wise to gain insight into the various objectives, means, and interests of the actors involved. For that reason, the analysis of this complex environment is important and can be undertaken analytically and systematically by such means as stakeholder analyses, although intuition and soft information definitely play a role. Besides knowledge and insights gained through research, policy analysis is largely a question of politico-strategic insight and skills, including client–analyst communication. In addition to being a skill—methodical and explicit—policy analysis is also an art, in which tacit knowledge plays an important role (Wildavsky 1987).

4. *Participatory style*

Participatory policy analysis is based on the fact that traditionally, for a variety of reasons, some stakeholders are not included in the policymaking process, which can lead to values and arguments being overlooked and difficulties in policy implementation. Researchers, economic elites, institutionalized non-governmental organizations, and politicians often dominate policy discussions about major social issues (Jasanoff 1990). Researchers, stakeholders, and policymakers may even change roles and positions within one and the same system. Certain subjects, and also certain groups of actors, are often excluded from the social debate. This is referred to as the technocratic criticism of policy analysis (Fischer 1990). Participatory policy analysis assumes that citizens can have a voice and be interested enough to deliberate on substantive and politically difficult questions (Dryzek 1990; Fishkin 1991; Durning 1993; DeLeon 1994; Mayer 1997; Fischer 2000). It assumes that there may be several different sets of values and perspectives on a policy issue, and that the analysis should include these different points of view. The policy analyst can take on a facilitating role in such deliberations by promoting equality and openness in the entire project—giving ordinary citizens and laymen a role alongside others in the policymaking process (Mayer 1997)—and/or by ensuring that all relevant arguments are included in the debate.

5. *Process style*

Just as in a game of chess, the parties that participate in a policymaking process will exhibit strategic behavior in the pursuit of their own objectives and achievement of the best possible positions, even if such action runs counter to the public interest formulated in policy (de Bruijn et al. 2002). It is perfectly understandable that, in controversial and complex issues, opponents will underpin their case with conflicting research reports. Impartial experts do not exist, and a solution introduced through a new report or study can actually aggravate the problem. In fact, in this style, knowledge is (not much more than) negotiated knowledge. It is better to negotiate and reach agreements about the use of the results of a study or jointly contract for the research (de Bruijn et al. 2002).

The process style of policy analysis is based on the assumption that substantive aspects of a policy problem are in fact equal, or perhaps even subordinate, to the procedural aspects of the problem. The analyst or process manager creates a 'loose coupling' of the procedural aspects and substantive aspects of a problem. Procedural aspects are understood to be the organization of decisionmaking or the way in which parties jointly arrive at solutions to a problem. To that end, agreements can be reached through 'mediation and negotiation'. The analyst will focus on issues related to the process, such as stakeholder objectives, resources, power and strategies, rather than on substantive issues of the situation. If the procedural sides of a policymaking or decisionmaking process have been thought through properly, it will greatly increase the likelihood of substantive problems being resolved. Substantive problems can be made part of a process design, for example, by placing the different substantive aspects on the agenda.

6. *Interactive style*

The interactive style of policy analysis assumes that individuals—experts, analysts, clients, stakeholders, as well as target groups—who are involved in making a decision about a policy problem, may have differing views of the 'same' problem. An insight relevant to policy can be obtained by bringing about a confrontation and interaction of different views. The interactive style has a strong socio-constructive foundation. Different views of reality ("perspectives") can be valid simultaneously. Through continuous interaction and interpretation—the 'hermeneutic circle'—it is possible to gain an 'insight' (Guba and Lincoln 1989).

In the interactive style of policy analysis, target groups and stakeholders are usually invited to structure problems and devise solutions in structured working meetings at which policy analysis techniques may be used (Mason and Mitroff 1981). Through these multiple interactions, the views and insights of the analyst, the client, and the participants are enriched (Edelenbos 1999). The selection of views is obviously crucial. Political considerations (the power to obstruct) and enrichment arguments (what do citizens really think?) may be interwoven. The interaction that is organized among the stakeholders is aimed at an effective exchange of views and is more action oriented (focused on the decision) than in the participatory style. If policy analysis concerns the redevelopment of a city square, for example, stakeholders such as local residents and business people can be consulted by means of workshops about the problems they experience with the present arrangement of the square and their wishes with regard to the new plans. The interactive style assumes that a process like this is informative for decision-makers and planners, is more likely to lead to acceptance and fulfillment of the plans, and can bring about all kinds of positive effects among the participants (learning about each other and about policy processes) (Edelenbos 1999). Community Operational Research (Midgley and Ochoa-Arias 2004) is an example of the interactive style of policy analysis.

3.3.2 *Definition of Archetypal Styles*

Figure 3.2 shows the policy analysis styles placed in an 'archetypal' way in between the different activities. Every style balances two important activities. The balance does not necessarily need to give equal weight to both activities. Participatory policy analysis balances 'democratization' and 'clarification of values and arguments'. The emphasis may be more on one activity than on the other: citizens can be directly involved in discussions about genetic technology, or the analyst may be mainly interested in the value systems, arguments, and opinions of citizens about the technology and may want to systematize them for the purpose of policy advice.

The argumentative style balances 'research and analyze' and 'clarification of values and arguments'. Some argumentative policy analysts attempt to improve the quality of policy by testing the policy design as thoroughly as possible, or by building on the consistency, validity, etc., of the underlying arguments (Dunn 1994). This is based on the principle that ‘claims must be backed up by facts’ (‘backings’). The ‘formal logic’ is dominant in this setting. Others reconstruct arguments, not in relation to scientific quality, but according to their variety and richness. This allows greater scope for normative systems, religion, and intuitive arguments (Fischer 1995).

In a similar way, the rational style balances ‘research and analyze’ and ‘design and recommend’; the interactive style balances ‘democratize’ and ‘mediate’; the client advice style balances ‘design and recommend’ and ‘advise strategically’; and the process style balances ‘advise strategically’ and ‘mediate’.

The styles of policy analysis may thus have different manifestations and emphases. A focus on a certain activity may result in a style leaning more toward one activity than another.

3.3.3 Relating the Styles to Policymaking Models

As implied above, policy analysis styles are influenced and co-defined along multiple dimensions, such as assumptions about science (epistemology), democracy, learning, and change, which are subject to continual change (see Chap. 2). The various frames or models of policymaking described in Chap. 2 can be mapped onto the policy analysis styles as shown in Fig. 3.3. The mapping is meant to be indicative, rather than a precise one-to-one mapping.

1a. The rational style of policy analysis can be related to the rational view of policymaking in which policymaking is regarded as an intellectual activity in which policies are chosen in a rational way using objective knowledge.
1b. Classical amendments to the rational model move away from a purely rational view of decisionmaking, for example by considering satisficing rather than optimizing, and by taking a more pragmatic view that leans more toward the ‘design and recommend’ type of activity in both the rational and client advice styles.
2. If policymaking is regarded as a political game in which policies are based on political preferences, policy analysis can be related to the strategic end of the client advice style in which knowledge obtained through research is combined with politico-strategic insight and bureaucratic politics.
3. In the garbage can model, policymaking is seen as erratic and volatile. As both substantive and procedural aspects are considered to be relevant, this view of policymaking can be related to the process style of policy analysis. Since problems, solutions, participants, and political events have to be coupled in this view of policymaking, it is more oriented toward interactions among stakeholders than is the case in the client advice style.
4. In the (neo-)institutional view of policymaking, institutions stabilize the interactions among actors into patterns that make it easier for them to deal with new

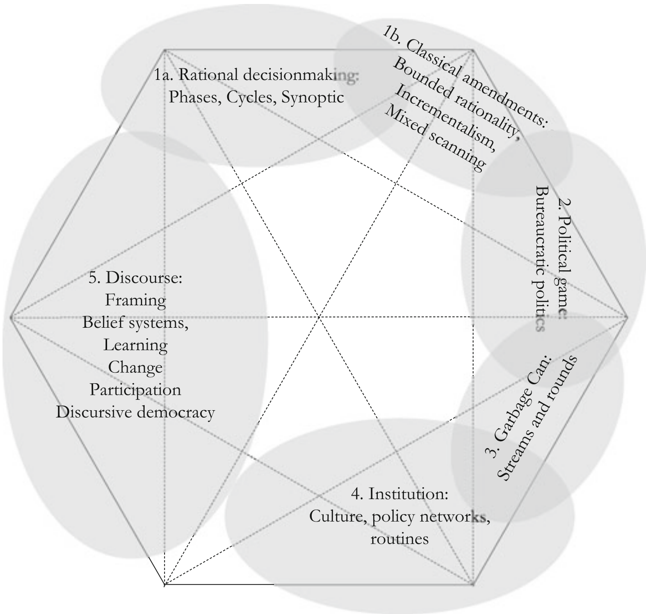

Fig. 3.3 Policy analysis styles related to models of policymaking

policy problems. This requires shared institutional arrangements and institutional settings in which all relevant stakeholders and interests are included. The interactive style of policy analysis can support this view of policymaking, since it emphasizes the confrontation and interaction of disparate views.

5. The discourse model of policymaking focuses on the (quality of) arguments that stakeholders use in a policy debate. This view can relate to both the argumentative style of policy analysis and the participatory style of policy analysis. These policy analysis styles differ with respect to the balance of scientific rigor and representation in the debate, but the point of departure for both is the view on policymaking as a discourse.

3.3.4 Other Ways of Combining Activities

In Sect. 3.3.2, we differentiated among the policy analysis styles by arguing that each one balances two adjacent activities. It is also possible to combine activities that are not adjacent to one another. In other words, a policy analytic arrangement can be made whereby two or more activities that are opposite, rather than adjacent, to each other in the hexagon of Fig. 3.1 are combined. This kind of combination or arrangement, symbolized by the dashed diagonals in the hexagon, is achievable in two ways: the activities can be carried out sequentially or separately, either in various parts of one policy analysis project or in different complementary or competing projects (i.e. a form of methodological triangulation of activities). As part of a policy analysis project focusing on climate change, for example, research can be conducted first by experts using climate models (activity: 'research and analyze') and subsequently the perceptions and arguments of ordinary citizens and laymen regarding climate change can be mapped out (activity: 'clarify arguments').

The various activities can be integrated into a single project. As part of a project focusing on climate change, for example, climate models can be used to get various groups of stakeholders, experts, politicians, and so on, to jointly generate and test policy proposals, while obtaining feedback from representative citizen panels. Such a project design would integrate several policy analysis activities—in particular, research, design, democratize, and mediate.

3.4 Policy Analysis Evaluation Criteria and Policy Analyst Roles

3.4.1 Criteria for Evaluating Policy Analysis Activities

In addition to demarcating and understanding the field of policy analysis and designing a policy analysis project, the hexagon model has a third function: evaluation of policy analysis projects and methods (Twaalfhoven 1999; Thissen and Twaalfhoven 2001). The various activities are based on underlying values and orientations. The values determine the way a policy analyst or others will view the quality of the policy analysis study, and hence they determine the criteria that will be applied to examine the study. The criteria can be made explicit by addressing the following questions for the styles and then translating these to the related activities:

1. Rational style: what is good knowledge?
2. Argumentative style: what is good for the debate?
3. Client advice style: what is good for the client/problem owner?
4. Participatory style: what is good for society?
5. Process style: what is good for the process?
6. Interactive style: what is good for mutual understanding?

Depending on the activities that are carried out, the criteria related to answering these questions will be different. For example, with regard to 'mutual understanding', more emphasis will be placed on transparency in a 'democratize' activity, whereas, in a 'mediate' activity, commitment will be more important.

Figure 3.4 shows that the activities in the top half of the hexagon are primarily object-oriented activities: a system, a policy design, an argumentative analysis. The activities at the bottom are subject-oriented activities. They focus primarily on

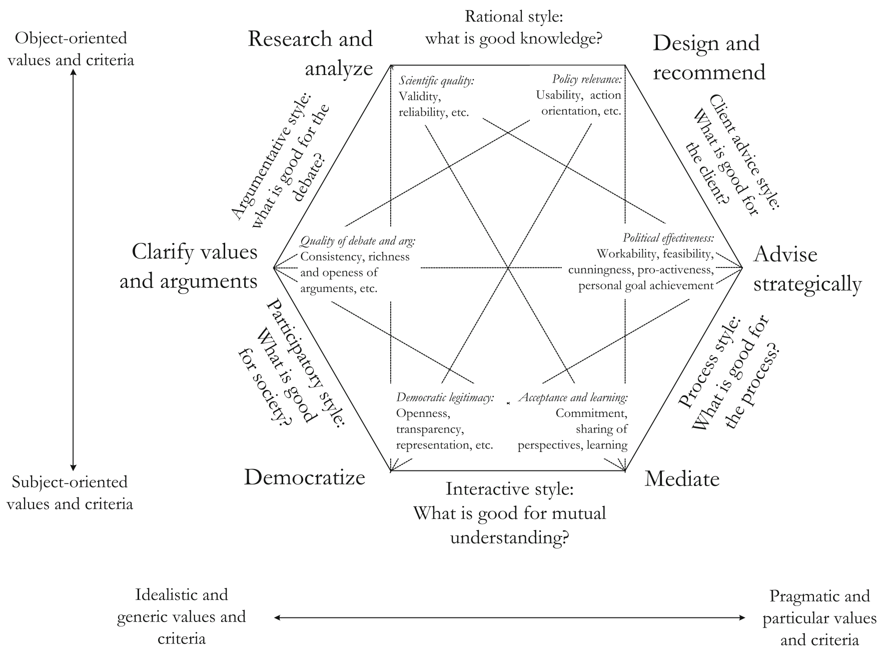

Fig. 3.4 Evaluation criteria for policy analysis activities

the interactions among citizens, stakeholders, the analyst, and the client. Whereas the top half activities are usually captured in a product—e.g., a report, a design, a computer model—the effects of the bottom half activities are usually captured in the quality of the process itself: increased support base, sharing of perspectives, citizenship, learning. The distinction 'object–subject' translates into the types of evaluation criteria to be applied. Object-oriented policy analysts will judge the quality of a policy analysis by its scientific rigor or the substantive insights it has yielded. Subject-oriented policy analysts will base their judgment on the contribution of the orchestrated interaction among the participants to the decisionmaking process. The pivot point between object and subject oriented activities lies with 'clarify values and arguments' and 'advise strategically'. These can be object-oriented, subject-oriented, or both.

Figure 3.4 also shows that the activities on the left-hand side are judged by generic scientific and socially desirable criteria, such as validity, reliability, consistency, fairness, equality, and openness. The activities on the right-hand side of the hexagon are judged by more pragmatic criteria, such as workability, usability, opportunity, feasibility, and acceptability.

These criteria for evaluating the quality of a policy analysis project or method are summarized in Box 3.7 and appear in the corners of the hexagon in Fig. 3.4. Note that these are illustrations of possible criteria. They are not meant to be a definitive, comprehensive list.

Box 3.7: Quality Criteria for the Activities

Research and analyze
The policy analysis will be judged by substantive (scientific) quality criteria, such as validity and reliability, the use and integration of state-of-the-art knowledge, the quality of data gathering, and the formal argumentation and validation of conclusions.
Design and recommend
The policy analysis will be judged by instrumental criteria of policy relevance, such as usability and accessibility for policymakers, action orientation and utilization, presentation and communication of advice, weighing up of alternatives, clear choices, etc.
Clarify values and arguments
The policy analysis will be judged by the quality of the argumentation and the debate. Some argumentation criteria are formal logic (consistency) and informal logic (rhetoric and sophism). Some quality of debate criteria are richness, layering, and openness of arguments.
Advise strategically
The policy analysis will be judged by pragmatic and political effectiveness criteria, such as the 'implementability' of the advice, political cleverness and proactive thinking, insight (for the client) into the complex environments (political and strategic dynamics, forces and powers), and the targeting and achievement of goals.
Democratize
The policy analysis will be judged by democratic legitimacy criteria, such as the openness and transparency of the policymaking process, representation and equality of participants and interests, absence of manipulation, etc.
Mediate
The policy analysis will be judged by external acceptance and learning criteria, such as the agreement that mutually independent actors reach on the process and/or content, support for and commitment to the negotiating process and the resulting solutions, and the amount of learning about other problem perceptions and solutions.

3.4.2 The Role of the Policy Analyst

While the hexagon model is based on activities, styles, and quality criteria, it can also be used to generate and organize positive and negative images, and even descriptive metaphors for the policy analyst (Dror 1967; Jenkins-Smith 1982; Durning and Osuna 1994). Some policy analysts allow themselves to be guided mainly by their wish to conduct objective scientific research; these are the *objective technicians*. In contrast, others are mainly focused on their interactions

Table 3.1 Positive and negative images of the policy analyst

Activity	Positive role image	Negative role image
Research and analyze	Independent scientist; objective researcher.	A-moral researcher; technocrat.
Design and recommend	Independent expert; impartial adviser.	Desk expert; 'back seat driver'.
Clarify values and arguments	Logician or ethicist; narrator.	Linguistic purist; 'journalist'.
Advise strategically	Involved client adviser; client counselor; policy entrepreneur	'Hired gun'
Democratize	Democratic (issue) advocate.	Missionary; utopian.
Mediate	Facilitator; mediator; process manager.	Manipulator; 'relativist'.

with the client; these are the *client advisers* or *counselors*. Some advocate a clear standpoint, such as a more stringent environmental policy; these are the *issue activists*. How the role of a policy analyst is perceived depends on one's own values and position in a policy process. A skilful strategic advisor, for example, may be highly appreciated by her client, but portrayed as a hired gun by her client's opponents. In Table 3.1, positive and negative images of the role of the policy analyst are depicted for each activity.

3.5 Perspectives on the Field of Policy Analysis

Figure 3.5 presents the complete conceptual model in which policy analysis activities are related to the underlying styles, the quality criteria, and the policy analyst's roles. The figure enables us to demarcate all manifestations and varieties of policy analysis, and also to develop new approaches and methods. Methods developed mainly within one style of policy analysis can be combined with insights from another style and adapted to new activities. Below, we briefly recapitulate the three functions of the conceptual model—demarcate, design, and evaluate.

3.5.1 Demarcation of Policy Analysis

Policy analysis is characterized by both ambitions and ambivalences. Some approaches complement each other, while others are somewhat in conflict, so it is very difficult to define and describe what policy analysis is. The added value of the hexagon model is that it makes it clear why policy analysis is ambivalent and

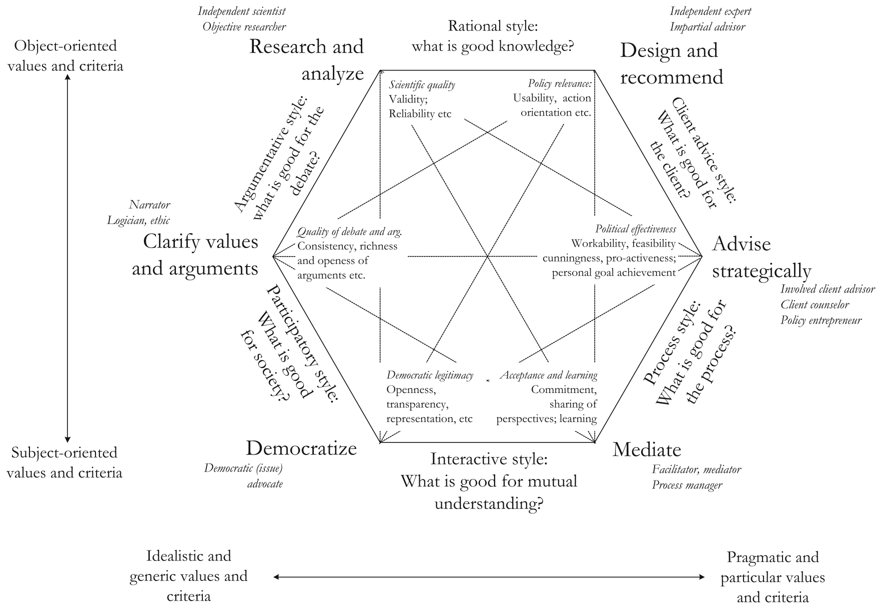

Fig. 3.5 Overview of the complete hexagon model of policy analysis

elusive—because the proponents and opponents reason from different points of departure about what they are doing, and why they are doing it, and because of the limitations, or conversely the richness, of the discipline. It is not our intention in this chapter (or in the book) to specify a preferred form of policy analysis, even if we were to have one. Depending on one's own position, one may accept the wide picture of policy analysis as depicted in the entirety of the model. But it is likely that many will argue that certain styles or activities are not (proper) policy analysis (e.g. Lawlor 1996; Walker 2009). For those critics, the hexagon may turn into a straight line, a triangle, or a square. The problem of course is that there will be no disciplinary consensus on what activities and styles to cut from the hexagon and on what grounds. For every policy analytic style there are both proponents and critics. Given the actual and desirable development of the various definitions of policy analysis, we are of the opinion that the discipline can better be defined too widely than too narrowly. The integrated conceptual model depicted in Fig. 3.5 offers full scope without losing the unity of policy analysis and causing the disintegration of the field. The model offers the possibility to examine policy analyses already performed and to relate these to each other. The model seeks to provide a foothold, or a framework, for demarcating the wide field of work, regardless of the name under which the work had been categorized.

3.5.2 Design of a Policy Analysis

The hexagon model provides an overview of the wealth of possibilities of policy analysis studies and the interrelationships among them, and can be of help in reflecting consciously and creatively on the design of a policy analysis. As a rule, policy analysis projects require a customized design. It is possible, however, to fall back on standard methods of policy analysis, although the choice and combination of methods will depend on the problem under examination. The model definitely does not seek to prescribe instrumentally how a policy analysis should be designed. The opposite is the case, because we advocate creativity and innovation in designing approaches, actions, and methods. Innovative combinations of researching, designing, recommending, mediating, argumentation, and democratization can be made.

For example, a rational style of policy analysis may be combined with a process style. This would 'interweave' analytical or scientific study in mediation processes among parties (de Bruijn et al. 2002). As a second example, the Institute for Water Resources (an organization within the US Army Corps of Engineers) recently developed a policy analytical approach for solving water resources management problems that it calls 'Shared Vision Planning (SVP)' (Cardwell et al. 2009). SVP is a collaborative approach that combines traditional 'research and analyze' and 'design and recommend' with structured public participation and collaborative computer modeling. Beall et al. (2011) explicitly relate SVP to the six policy analysis activities of the hexagon model.

We consider the design of a policy analysis to include the development of new methods of policy analysis so as to allow a good integration of subactivities. In point of fact, the history of policy analysis is characterized by the repeated application of creative and intelligent combinations of methods; methods that originated in one domain are commonly translated into applications for other domains. The, by now, classical Delphi method and scenario method came about as methods for studying the future, but are currently used for strategic advice, mediation, and even democratization in policy Delphis, interactive scenario methods, and scenario workshops (Mayer 1997). Cross-impact techniques and stakeholder analysis techniques, which came about as methods for advising clients, now have interactive applications and are used for mediation. Consensus conferences, which came about as a method for study and mediation among top experts in medical scientific controversies, have been transformed into methods for democratizing and for public participation (Mayer 1997; Fischer 2000; Joss and Belluci 2002). Also, methods that were developed within specific disciplines can be combined in a multidisciplinary approach to addressing practically any policy problem.

Because of the importance of designing a policy analysis, and the small amount of literature devoted to the subject, we devote two entire chapters to it (Chap. 5 and Chap. 6).

3.5.3 Evaluation of a Policy Analysis

Each policy analysis activity is based (implicitly) on criteria concerning the quality and purposes of the activity. Therefore, policy analysis projects can be judged from a variety of perspectives. This may lead to different opinions about success or failure, quality or shortcomings (Twaalfhoven 1999; Goeller 1988). A substantively thorough and valid study might be unusable for a client. A brilliant and workable compromise that breaks a stalemate may be based on negotiated nonsense or may violate or manipulate the interests of legitimate participants. Conflicts like these are inherent in almost every evaluation of large policy analysis projects. In the design and evaluation, the policy analyst attempts to cope as well as possible with these tensions and dilemmas, by making choices and/or by finding new routes.

3.6 Conclusion

This chapter has presented a conceptual model for policy analysis called the hexagon model, which is based on six archetypal policy analysis activities. This subdivision makes it possible to relate various policy analysis styles found in the literature to each other and to analyze the characteristics of and differences among the styles. Additionally, the activities provide pointers for evaluating policy analyses. By explicitly identifying the activities being carried out in the policy analysis, it is possible to identify success criteria for the work. The hexagon model seeks to map out transparently the enormous variety of different types of policy analyses and to allow them to be viewed in relation to each other. The model can also be used to design policy analysis studies. By making explicit which activities are relevant in a particular policy analysis, a conscious choice can be made for a certain policy analysis style and the policy analysis methods can be selected in a well-founded way for the contribution made by the method or technique to the activities to be carried out.

While the hexagon model provides pointers for reflection, design, and evaluation, it is not intended to be a rigid, prescriptive model. Rather, the intention is for the policy analyst to be consciously working on the goal of the analysis in relation to the policymaking process, and to produce her own policy analysis design and evaluation.

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Chapter 4
Diagnosing Policy Problem Situations

Wil A. H. Thissen

4.1 Introduction

As argued in Chap. 2, policy processes are multi-faceted and may display a wide variety of characteristics. Consequently, policy analysis in a multi-actor context needs to be contingent, multi-faceted, and pluriform. The concluding section of Chap. 2 articulated a wide array of requirements for good policy analysis. Chapter 3 outlined a conceptualization of the variety of different activities and associated purposes policy analysts may engage in. Which of these are most appropriate and which less so depends on the characteristics of the situation and on the ambitions of the client and of the analyst. Both chapters set the scene for the question: Given a specific policy situation, what requirements and type(s) of policy analytic activities are essential for achieving the purposes of client and analyst? In other words, how can an analyst make a reasoned design of her interventions? This will be the subject of Chap. 5.

In order to be able to make such a reasoned design, an assessment of key attributes of the situation is needed. In this chapter, we first address the question of what kind of insight into the situation is important as a basis to make a reasoned design. Next, we outline a set of approaches that can assist in acquiring the needed insights. Finally, we discuss the implications of the insights for the choice of follow-on activities.

Initial reconnaissance activities an analyst undertakes are often called 'problem formulation' or 'problem framing' efforts. As these terms suggest that the objective is to reach a single or best definition of the policy problem (which fits the rational model of policymaking described in Chap. 2, but less so the other models),

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we prefer the more neutral term 'diagnosis'—a term that nicely parallels medical practice, where the diagnosis precedes the choice of deliberate treatment.[1] The term also covers the exploration of the context in which a problem situation occurs, in addition to formulation of a problem in a more narrow sense.

4.2 What Constitutes a Good Situation Diagnosis?

Analyzing or structuring messy policy problem situations has been recognized for a long time as one of the most critical policy analytic activities, determining to a large extent in what direction further analytic activity will develop. Solving 'the wrong problem' is one of the most serious errors one can make (Miser and Quade 1985; Dunn 1994). In fact, Russell Ackoff (1974) once said: "We fail more often because we solve the wrong problem than because we get the wrong solution to the right problem." Despite the recognized crucial role of this initial policy analytic activity, relatively little attention has been given so far to developing and testing systematic approaches to problem diagnosis. Most authors who have written on the subject (e.g., Wildavsky 1979; Miser and Quade 1985; Dunn 1994; Sage and Armstrong 2000) stress the need for a multiplicity of approaches and for iteration, emphasize the inherent subjectivity of many of the choices to be made, and point to a variety of pitfalls in the process.

Our starting point is that problem diagnosis should provide an adequate basis for client and analyst to first decide on whether or not the situation is worth further (policy analytic) efforts. Therefore, it is important to assess the severity and urgency of the situation: is there a real problem? Is there a serious dilemma? Is there a need for short-term action? But equally important is to explore the extent to which opportunities for improvement or amelioration exist or can be created. If no such opportunities seem to exist, the best choice may be to simply leave the situation as is and spend efforts on more promising issues. Second, problem diagnosis should provide the insights needed to determine the nature and extent of the intervention activities to be undertaken: what purposes/values are important, for whom, and what types of associated activities are called for?

The various theoretical perspectives on policymaking and policy analysis discussed in Chap. 2 provide a basis for the situation characteristics that should be examined in such a diagnosis. Since each of the models discussed takes another perspective, and thereby points to other aspects and issues of potential importance, we will briefly revisit all of them here.

The *rational model* emphasizes the use of (scientific) knowledge in order to support efficiency and value maximization. Its focus is on the substance of the

[1] Sometimes there is no clear diagnosis in medical practice, but only a suspicion about the illness to be cured, and either no treatment or a tentative treatment is chosen, to explore its effects and perhaps adapt treatment after some time. Analogous situations occur in policy processes as well.

policy issue at hand. A diagnosis effort should identify the key knowledge elements of importance, and assess what kinds of knowledge are missing and could contribute to improved policymaking. Key knowledge elements include the problem definition (what is the problem about, and how bad is it?), an idea of what causes the problem, the policy objectives, the range of available policy options, insight into the impacts of policy options on the objectives, and possible other factors affecting the possibility to solve the problem in future. An initial diagnosis should identify these key elements, and the extent to which undisputed scientific knowledge about them is available, or could be acquired by additional analysis.

The *political game model* sees policymaking as complex political interactions among interdependent stakeholders pursuing their own interests in a policy arena. It acknowledges pluralism: the notion that perspectives on values, substantive problems, and solutions may vary widely. It emphasizes power, stakeholder interests, and strategic behavior. This model points to a variety of characteristics that are relevant in an initial diagnostic effort:

- Who are the key players in the policy arena?
- What are their perspectives, values, etc.? To what extent are these different?
- To what extent are knowledge and values contested?
- What is the extent and nature of value conflicts (compatible or antagonistic, incommensurable)?
- To what extent are actors interdependent? What is their relative position of power?
- To what extent is strategic behavior dominant? Is there any trust among the parties?
- Are there any possibilities for (opportunistic) deals among the parties?

The *discourse model* aims to understand the dynamics of policymaking in terms of policy-oriented or social learning occurring as a result of persuasive discourses/debates among actors or coalitions. It focuses on belief systems and advocacy coalitions. For the diagnostic phase, this means:

- What are the belief systems of the actors in the debate?
- How different are they?
- Can (advocacy) coalitions be identified?
- What are the constraints/opportunities for arranging a constructive dialog among the different individuals and/or coalitions?

The *garbage can model* highlights the chaotic character of many policy processes, and the independent ways in which problems, solutions, and policy agendas evolve. For a diagnostic effort, the following questions come up:

- To what extent is the process indeed chaotic? Are there no routine procedures or regulations about participation in the decision processes?
- What problems, solutions, actors are present in the policy arena? Do any linkages appear to be possible and worth pursuing?
- How volatile is the situation?

Table 4.1 Aspects and questions to be addressed in problem diagnosis

Substantive aspects	Perception of problem: objectives, causes for not achieving them, seriousness of the situation, policy options, external influences, insight into the relevant mechanisms affecting the problem Assessment of knowledge availability: to what extent are critical insights missing? Assessment of most relevant uncertainties
Actors and network characteristics	Who are the relevant actors, what is the boundary of the policy arena? What are their perceptions, belief systems, interests? How different are these? To what extent are knowledge and values contested? Actor interdependencies and power relations Resolution power in the network The type of conflict: is it about interests, divisible resources, or about more fundamental values? Who is to benefit, who is to lose from what solution options?
Institutional characteristics	Existence and strictness of formal rules Level of (dis)agreement about decision procedures Differences in informal rules, routines, values? Tensions as a result of these? Degree of fellowship and trust versus strategic behavior and fight Openness versus closedness of the network Variability/volatility of the situation

The *institutional model* emphasizes the existence and importance of institutional rules, norms, procedures, cognitions, and routines as drivers of policy processes. Diagnostic efforts need to explore the existence of such institutional elements, since they may provide constraints, as well as opportunities, for analysis. In particular, it is relevant to identify:

- The composition of the policy networks: who are the key participants, who is out (but affected)?
- Existing cultures, rules, standard operating procedures, common language, trust relations in the policy network
- How stable are the networks and rules? Are they closed, i.e., not open to change, or more open? Are there opportunities to change along this line of thinking?
- Are there tensions because of the presence of multiple, antagonistic institutions with different rules, norms, and routines?

Not surprisingly, there is some overlap among the aspects considered relevant from the perspective of the different models of policymaking. For practical purposes, we have grouped the different aspects to be explored under three classes:

- the substantive aspects of the situation;
- the actors involved, their views, needs, means, and interdependencies, with particular reference to the specific issue(s) at hand,

- the institutional and network context characteristics (these provide the general conditions for the decisionmaking process and generally exist beyond the specific issue).

Table 4.1 gives an overview of the way in which we have classified the more specific topics.

We will return to the way in which insights into these characteristics can guide the choice of follow-on activities at the end of this chapter.

4.3 Approaches to Diagnostic Efforts: How to Look, and to Decide Where to Look Further

As argued above, diagnostic efforts need to address a broad spectrum of issues covering substantive, actor and network, and institutional aspects in a coherent manner. In the process, choices also need to be made regarding what is most important, and what less so. How these choices are made may significantly affect the results.

Referring to the hexagon model of Chap. 3, different values will often be leading in this process: are they scientific values? democratic or stakeholder ones? or the values dictated by the client? When scientific and technical validity and consistency are the leading values, what is important and what not is determined based on technical data, analyses, and scientific knowledge (Lawrence 2007).

Alternatively, one may start "from the premise that subjective, value-based judgments about what is important should result from interactions among interested and affected parties" (cf Lawrence 2007, p. 736), or that "a problem is a social and political construct" (Hisschemöller and Hoppe 1995). Then, the problem diagnosis process itself should be an open, interactive process in which participating actors may choose to amend or even change the subject.

Similarly, where the diagnosis starts may significantly affect the outcome. The initial starting point may be a focus on substance, or a focus on the actors and processes in the policy arena. Let us consider the example of capacity problems at a not entirely hypothetical airport (see Box 4.1). If the initial analysis concentrates on substance, political, and institutional issues (such as competition for power or control between stakeholders, government departments, local, regional and national authorities, cultural differences, and past events affecting the relations between actors) will come to light only later, if at all. If, on the other hand, the initial attention goes to the political arena, political or institutional problems (such as the lack of trust between key actors involved) will come to the front, and the substantive aspects of the issue may be driven to the background or suppressed altogether, since solutions for the trust problem may be found in entirely different fields.

While ideally, in a balanced approach, all the different aspects are considered and synthesized, craft issues and personal judgment are important in attempts to achieve this ideal—if possible at all.

Box 4.1: Airport problem perspectives

Airline traffic at 'FlyAway' airport has been growing significantly over the past decades, to such an extent that airport and air traffic control capacity regularly falls short of demand, causing delays and disruption of travel, and increasing pressure to not accommodate new connections, despite demands by carriers to expand. A main carrier, bringing a lot of business, threatens to move its hub business to competing airports abroad. In response, airport authorities wish to expand capacity, e.g. by building new runways. They see the problem as one of a mismatch between demand and supply, and their preferred solution is to increase supply to match future demand. However, some local residents see problems of congestion, noise, and air pollution, and fear expansion will lead to even more nuisance. They advocate either restrictions on air traffic, or the 'export' of growth to other locations. Local authorities and other residents, however, cherish the airport, as it provides a main source of income and employment, so they maintain friendly relations with airport management. Environmental lobbyists see the rapid increase of air traffic as a threat to nature, in particular causing significant depletion of fossil fuel resources and climate change because of CO_2 emissions. They, therefore, oppose any increase in air traffic, and certainly decisions accommodating (and, thereby, in their view, stimulating) such increase. Regional authorities, while emphasizing the economic benefits of the airport to the region, also see the situation as an opportunity to regain some of the ground they had been losing to the national and local authorities, airport expansion being an exemplary issue requiring a lot of coordination at the regional level. The national authorities, on the one hand, emphasize the importance of the airport and an appropriate transport infrastructure for the economy (ministries of economic affairs and transport), and on the other, after a number of incidents, are concerned about safety and long-term sustainability (ministries of internal affairs and environment).

In our further elaboration of a problem diagnosis approach, we will assume that a policy analyst mostly gets involved at the initiative of a client, i.e., an actor who feels a need for support. In the description of our approach, we first take the problem owner's initial problem perception as a starting point. Next, in line with the main argument of this book, we focus on the cognitive dimensions and show how an approach starting with a focus on the substantive aspects of an issue can be extended and integrated with an analysis of actors and institutions.

4.4 Substantive Diagnosis Using a Systems Analytic Approach

4.4.1 Conceptual Framework

In our systems analytic elaboration of problem diagnosis, we will use the following working definition of a *problem*: A problem is a perceived difference between what an actor (the problem owner) considers desirable (a goal), and the present or expected future reality. Essentially, a problem is a (perceived) gap between a situation and a normative principle or objective. Different actors will perceive different problems. Returning to our example in Box 4.1, airport authorities see the shortage in runway capacity as the problem (their objective being to be able to meet demand), neighborhood residents see the excessive noise as the problem (their objective is a quiet living environment), and air travelers see the problem as the unpredictable delays (their objective is to arrive on time at their destinations).

Actors perceive problems with respect to some part of reality. We will call the relevant part of reality the *system*. What the relevant system is depends on one's problem perception. In the example, the system for the airport authorities is the runway configuration, which provides capacity to meet demand for aircraft takeoff and landing slots; for the environmentalists, who see non-renewable resource depletion and global warming as key problems, the system of relevance extends to the worldwide air transportation system, including its usage.

We will use a simple conceptual input–output model, originally developed in systems and control theory and referred to as a *system diagram* (see also the Appendix), to guide and structure efforts at identifying and selecting key elements of a client-centered problem formulation. The system diagram pictures a system as the part of reality that is affected by certain inputs called factors, and that produces specific outcomes of interest (see Fig. 4.1). We distinguish two types of inputs: factors[2] influencing the system that are not controllable by the problem owner, and factors that can be influenced deliberately by the problem owner. The former we call *external factors*. The latter we call *policies*. For the airport authorities, a largely uncontrollable external factor would be the demand for air transportation; a controllable or policy variable would be the number of runways (or the number of take-offs and landings allowed per hour on a specific runway). *Outcomes of interest* are those system outcomes in which the problem owner (and other stakeholders) is interested. The objectives of the problem owner (and the other stakeholders) determine what the outcomes of interest are. For the airport authority in the example, this will be the degree to which runway capacity matches demand (costs of expansion, of course, will also matter). We discuss the identification of outcomes of interest in Sect. 4.4.4. Specification of inputs and outputs defines the

[2] A *factor* is an attribute of an entity (a thing, a person, a process) for which a value can be established on a scale via direct or indirect measurement.

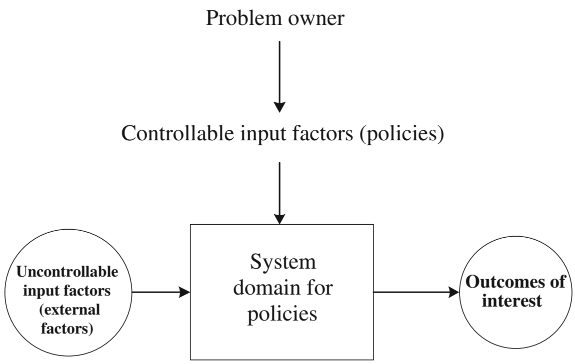

Fig. 4.1 Single-actor system diagram [3]

system boundaries. In addition to inputs and outputs, system delineation includes specification of a relevant temporal and—where relevant—spatial scope. For our example, the relevant time frame extends from the present to about 30 years in the future. That choice reflects the fact that decisionmaking, planning, and realization of a runway takes anywhere between 5 and 15 years, and that the economic lifetime of the investment extends over another 15 years or so. The spatial scope of the system would be regional, as the major impacts of shortage and possible expansion will affect a region, from the direct vicinity to 50 or 100 km from the airport.

4.4.2 Steps and Iteration

Generally, problem diagnosis is an iterative process in which new findings are confronted with earlier ones, fed back to the problem owner (and possibly others), and then reconsidered, etc.—i.e., there is a lot of feedback and iteration. For reasons of simplicity, we present an approach to problem diagnosis as a series of sequential steps. The sequence of the presentation of the steps takes key dependencies among steps and the choices made in them into account. We discuss steps the result of which may have a major impact on subsequent ones first. In some of

[3] Different systems traditions have developed different conventions regarding where to put the different types of influences in the visualization. In control systems engineering, the controls are put entering from the left side; while in the field of information systems, the controls are generally put on top, entering from above [like in the Structured Analysis and Design Technique (Marca and McGowan 1988)]. We will use the latter convention.

the steps, specific (conceptual) modeling techniques are used. The Appendix provides concise descriptions of the key features of some of these techniques.

We will describe the following steps in a substantive problem diagnosis:

1. Initial problem sensing and scoping
2. Analysis of objectives and specification of criteria
3. Causal analysis
4. Identification of possible solution directions
5. Exploring uncertainties about the future
6. Synthesis and iteration

In each of these steps, the system diagram is used as a basic framework, according to which problem specification elements are identified and structured. The findings of each step will generally lead to adaptation/changes in the previous formulation, and hence in the specification of the system diagram. We will continue to illustrate the approach with reference to the airport expansion situation introduced in Box 4.1 of Sect. 4.3.

4.4.3 Initial Problem Sensing and Scoping

The starting point for exploration is a situation in which someone—henceforth called the problem owner—perceives a problem and enlists the help of a policy analyst. While initial talks with the problem owner will provide key elements, we suggest adding exploration of written material as a basis to identify the following elements of the problem owner's situation:

- The problem owner's perception of the problem, i.e., the gap he perceives between (expected) reality and desired reality
- The problem scope according to the problem owner, including possible constraints he sees (such as limitations in time, available funds, etc.)
- The perceived causes of the problem situation
- Perceived key elements of importance to the problem situation
- Other actors who may be important with respect to the problem, possible solutions, or the implementation of solutions
- Future developments and trends that may affect the problem situation or the performance of solutions
- Possible solution directions the problem owner sees, and possible limitations to his maneuvering space

Let us illustrate this for the management of 'FlyAway Airport' as problem owner. For them, the central gap is the shortage of runway capacity. Given trends of continuously increasing demands, they expect that this situation will only worsen in the future, threatening the position of the airport as a major hub. Their perceived solution is to expand the airport by building another runway, and correspondingly intended actions concentrate on acquiring the land from private

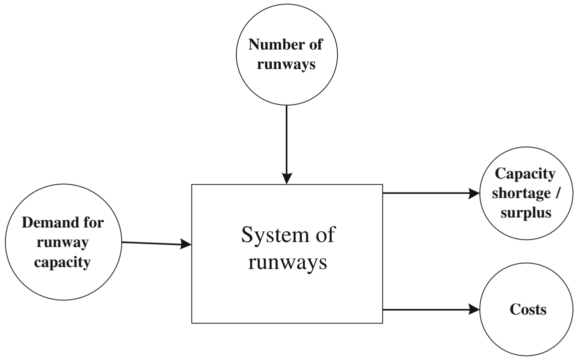

Fig. 4.2 Initial system diagram for problem owner 'airport management'

owners and obtaining the necessary permits from the public authorities—the other key actors that play a part in this venture. Costs of the investment, of course, are also important. The above simple system diagram represents this initial perception (Fig. 4.2):

In the initial version of this case, the system is confined to the configuration and number of runways; the only two outcomes of interest (or performance criteria) are (1) the extent to which capacity shortage persists; (2) the costs of the configuration. The controllable input under consideration is the number of runways; the most important external uncontrollable input is the demand for runway capacity. The dilemma is to find the appropriate trade-off between investment costs and runway capacity expansion.

4.4.4 Analysis of Objectives and Specification of Criteria

Policy analysts can make a major contribution by being critical about the initial framing of the problem: Is the initial formulation appropriate? Does it not preclude the search for options that may, in the end, be more attractive than those pointed at by the initial formulation? Well-known is the tendency of problem owners to adopt a problem formulation that is too narrow, focusing all attention on one specific solution direction. This tendency is also referred to as 'jumping to solutions'. Sometimes, a client even poses the problem in terms of finding ways to implement an already chosen solution. For example, in 1993, the Netherlands Ministry of Transport asked RAND Europe to help find appropriate ways to shift part of the freight transportation in the country from road to other transport modes, in particular rail and water (In fact, the project was initially called the "Diversion of Freight from Roads" project.). However, in critical discussions it appeared that the true underlying objective of the Ministry was to reduce the negative impacts of freight transport. It was decided, subsequently, to focus on the negative impacts of freight transport (congestion, emissions, safety, noise) as the key performance indicators. The study that followed (Hillestad et al. 1996) showed that other options (such as smarter logistics, larger trucks, cleaner engines) were more cost-effective at achieving the objective than shifting trucks from road to rail or ship.

Something similar may be the case in our airport example. Airport management is focusing on meeting the demand for runway capacity, as illustrated by the outcome indicator ‘capacity surplus/shortage’ in Fig. 4.2, and considering to build a new runway. Will this really solve the underlying problem? What is the underlying problem, anyway? A helpful approach for the analyst is to ask the ‘why?’ question: Why is runway capacity a problem? Why would things be better if supply and demand would match? The answer would probably be that without capacity expansion the airport would not be able to satisfy its potential clients, and that providing good service to clients is a leading principle in business. Next, the ‘why?’ question can be asked again. The answer may be that, because of reduced service, some clients (e.g. major carriers) may shift their activities to other airports, and the airport in question will lose business. Apparently, the underlying problem is a fear of missing future business, given a desire or norm to expand business if possible. Next, the ‘why?’ question could be asked once more, and this time the answer could be that expanding airport business is important, since it brings all sorts of benefits (employment, attraction of other business) to the region, in addition to bringing profits to the airport itself. This way, the more fundamental, underlying objectives or values are uncovered systematically. A *means-ends diagram* (see Keeney 1992 and the Appendix) provides a graphical representation of the relationship between the fundamental or strategic objective (also called ‘goal’) and the more operational (means) of achieving it. The diagram is a conceptual model or graph whose top element is an intended or desired situation [formulated as ‘(to) achieve something’], and the arrows represent the relation ‘will contribute to’. Relations represent intentions, and are based on (perceived) causal relations between lower-level means and the higher-level (fundamental) objective. The Appendix provides a more detailed explanation of the means-ends diagram, and how to construct one. For the airport example, consider Fig. 4.3.

Going upwards from what the airport authorities consider as their objective (‘Meet demand for runway capacity’), the next level is found each time by following the solid arrows. The more we go upwards in the scheme, the closer we get to the fundamental objective. For the airport management, the fundamental objective could be ‘Maintain a healthy airport business’. Such a fundamental objective is also called an actor’s *interest*. An actor’s interest is generally situation independent, i.e., it remains unchanged whether the current issue is runway capacity, safety, connections to public transport, or whatever.

A means-ends diagram used in this way helps in identifying and communicating the underlying objectives, and thereby in making a conscious choice regarding the scope of the problem to be taken as the starting point for further analysis. Taking a more fundamental objective as the starting point implies taking a broader spectrum of possible solution directions into account. This may open up possibilities for better solutions. (For example, in the freight transport case, changing the starting point from “getting the trucks off the roads” to “reducing the negative impacts of freight transport” opened up many solution directions in addition to ways to accomplish

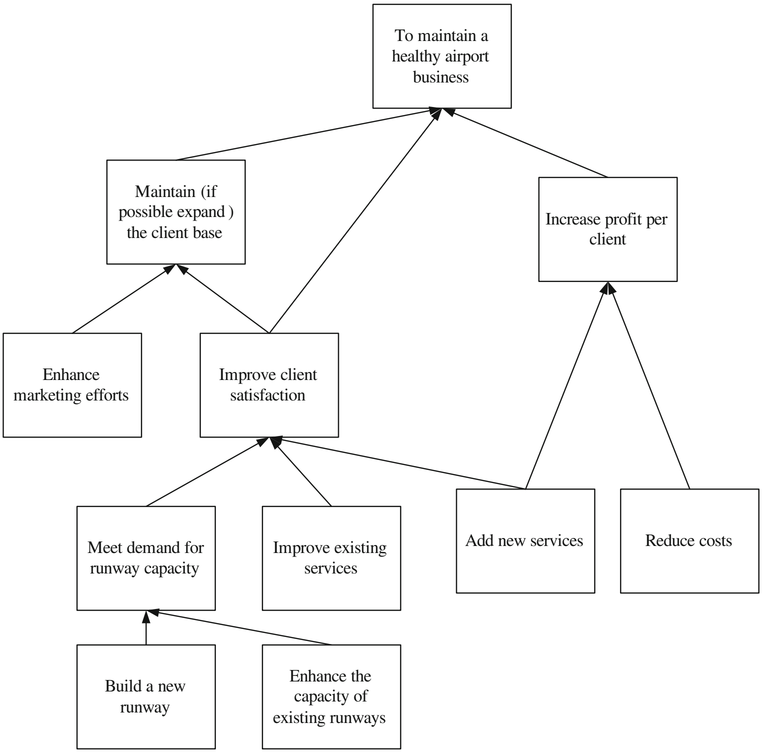

Fig. 4.3 Means-ends diagram for airport case

modal shifts). The drawback of choosing a more fundamental objective, however, is that analyses and debates may become more complex, less transparent, and unattractive if one wants to decide quickly. While there is no standard solution to this dilemma, in general we suggest the more fundamental approach, since it concentrates on what really matters instead of on only a single solution direction. Moreover, it may open more opportunities for compromises in discussions or negotiations with other interested parties, while a narrow focus on a specific solution may lead to continued deadlock. The bottom line is that the analyst should make the dilemma explicit and discuss it openly with the problem owner.

In the airport example, framing the problem as a mismatch between supply and demand for runway capacity limits attention to two solution directions, i.e., building a new runway and expanding the capacity of existing runways. This may easily lead to ignoring other ways that, perhaps in a more effective way, could lead to realization of the more fundamental objective of maintaining a healthy airport business. Therefore, it may be wiser to re-frame the problem as a threat to the long-term health of the airport business, rather than as a mismatch between demand and supply of runway capacity.

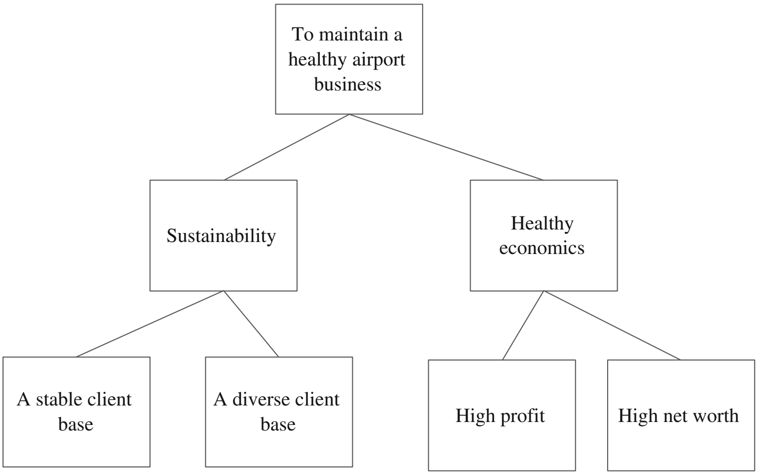

Fig. 4.4 Objectives tree for airport case

Figure 4.3 illustrates a number of ways in which the fundamental objective could be achieved. Such options may be identified by reasoning backwards from the top objective, by asking ‘How could this be achieved?; by what means? The figure illustrates that building a new runway is indeed just one of many means that can contribute to maintaining a healthy airport business.

The choice of a more fundamental objective as the starting point for problem formulation directly and significantly affects the attributes used to indicate the level of achievement of the objectives. If, as in Fig. 4.2, shortage of runway capacity is seen as the key problem (and making supply meet demand the corresponding objective), then the degree of shortage is a prime outcome of interest. However, if we choose, instead, to focus on the objective of maintaining a healthy airport business, entirely different indicators are needed. Generally, the objectives or criteria should be defined such that they can be ‘measured’—that is, that the degree of attainment can be expressed on some scale, preferably an ordinal or ratio-scale. Therefore, we need to be more precise as to what the rather fuzzy objective ‘maintaining a healthy airport business’ means, and how its achievement can be measured. This can be done by identifying the essential attributes that define the health of an airport business—for example, the turnover, the level of profit, the vulnerability of the business, and the stability of the client base.

Construction of an *objectives tree*, or *objectives hierarchy* (Keeney 1992) is a helpful way of systematically developing a set of evaluation criteria or *outcome indicators*. Essentially, the objectives tree develops the relevant attributes of the chosen fundamental objective to such a level that measurable indicators can be identified. Figure 4.4 shows an example for the airport case, assuming the fundamental objective is to maintain a healthy airport business. The hierarchy, in its first level, identifies two key attributes of the fundamental objective: the health of the operational economics, and the sustainability or durability of that situation. At the next level, these are further specified into more specific indicators. Note that in Fig. 4.4, the sustainability of the airport business is not specified in terms of, e.g., years, but in terms of so-called *proxies*: indicators that do not directly measure the attribute, but relate to it and are more easily assessed than the direct attribute. As the objectives tree defines what is considered desirable, it directly specifies the measurable outcomes of interest (which we call outcome indicators) in the system diagram. For more guidelines on how to build an objectives tree and use it to identify a good set of outcome indicators, see Keeney and Gregory (2005) and the Appendix.

4.4.5 Causal Analysis

After (re)specification of the outcomes of interest and measurable indicators, we proceed by exploring the factors that have an impact on these outcomes. We can do this by working back from each of the outcomes that we have identified, this time asking the question: 'What factors influence the value of this outcome?' or 'What factors will cause the value of this outcome to change?' Some of these factors will be similar to the elements identified in the means-ends diagram, as the means are, in essence, intentional changes in factors that affect the outcomes of interest. The important difference between this 'causal (relation) diagram' and the means-ends diagram is that (a) a causal diagram indicates causal influences, not intentions or desired directions of change, and (b) factors that cannot be deliberately changed or controlled but that can have an important influence on the outcomes are included. For example, the shortage of runway capacity is affected by demand for capacity, which depends on international growth rates of air travel, but also on developments in air transport technology (e.g. allowing shorter intervals between landings), and on developments at competing airports. The causal diagram is based on insights into the system's workings, rooted as much as possible in generally accepted theory. It may also be relevant to explicate causal mechanisms as perceived subjectively by an actor, particularly when it is important to make his perception explicit and debatable.

A causal diagram fulfills several different functions. It serves to specify the knowledge available regarding linkages between relevant inputs and the resulting outcomes of interest. In this way, it is a first step in developing a conceptual model of the system which can be used in a later phase to build a computer system model. It also serves as an aid to communication with the client and other relevant actors about perceptions concerning what the system is, what causes the problem, etc. Thus, there is a tradeoff between comprehensiveness and transparency and the clarity of such diagrams. We suggest a relatively high level of aggregation in a first exploration phase, identifying only the major factors and their key interactions, instead of specifying the many factors and interrelationships among them at a detailed level.

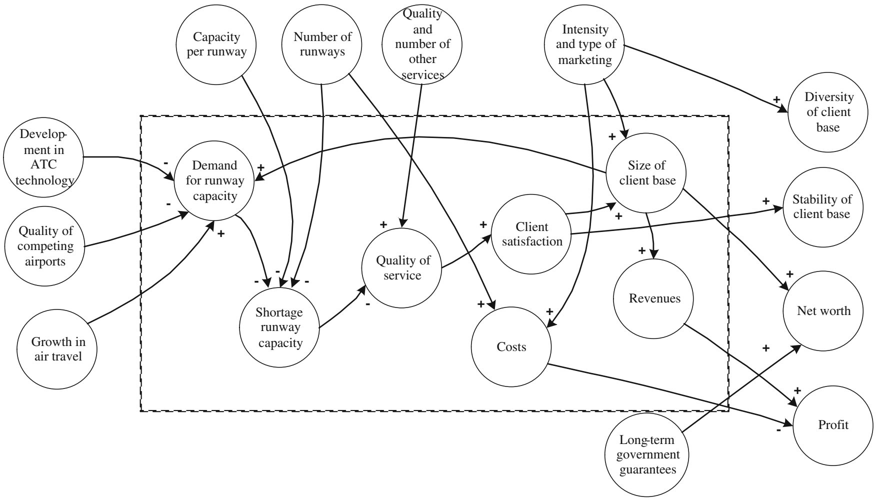

Fig. 4.5 Illustrative causal (influence) diagram for airport case

Figure 4.5 shows a simplified causal diagram for the airport example. It shows the key outcomes of interest as identified in Fig. 4.4 at the right-hand side. It also illustrates the influences on these outcomes of a number of factors. External and policy factors are also shown. We emphasize that the figure is an illustration only. It is far from complete. We also see that the diagram contains a feedback loop: shortage of runway capacity affects satisfaction, and thereby the client base; in turn, if the client base diminishes, this will negatively affect demand for capacity, more or less reducing the shortage in a 'natural' way. This is a sign that the system of concern contains internal dynamics that will need to be taken into account in the analysis.

4.4.6 Identification of Possible Solution Directions

Ideas for actions contributing to problem resolution may be defined at different levels of specificity and combined in different ways. For example, the construction of an additional runway, the submission of a request for permission to build the runway, and the start of negotiations with landowners about purchase of the land are all actions one may think of. Clearly, these actions are related: both permission and ownership of the land are required before one can actually build the runway; but, only the actually building of the runway will change the system (and, hence, change the outcomes of interest from the system). We need some clear terminology for specifying solutions to policy problems. Following Walker (2000), we use the following classification and terminology:

- a *policy option* is an individual measure that directly affects the system of interest.
- a *strategy* is a combination of policy options aimed at realizing a specific objective; for example a variety of options may exist that can help reduce costs; a smart combination of these we would call a cost reduction strategy.
- a *policy* is a combination of strategies, which might be designed to help achieve multiple objectives. A policy may also include a specification of the necessary measures for implementation.

In our example, constructing an additional runway would be a policy option, a capacity expansion strategy would be a combination of runway expansion, smarter landing and take-off logistics increasing the capacity per runway, and perhaps other policy options, and a policy for the airport might include a noise reduction strategy, a strategy aimed at increasing commercial revenues, and perhaps implementation measures, such as obtaining permits and buying land, obtaining investment funds, etc.

We suggest that the exploration of solution options in the problem diagnosis phase should primarily concentrate on the identification of categories of policy options; too detailed an elaboration of specific options at this stage would lead to a waste of resources and distract from exploring the broadness and variety of the solution space.

There are various complementary approaches to developing ideas about possible policy options, for example:

- using a causal diagram, and scanning all factors for possibilities to actively change their behavior;
- using a means-ends diagram (this overlaps partially with using a causal diagram);
- diagnostic thinking: what are the causes of the problem, what could be done about them?
- using creativity enhancing methods (see Michalko 2001), such as brainstorming, brainwriting, and the like;
- using checklists—for example, look for policy options in each of the following categories: technical, financial, managerial, regulatory, and informational (Walker 1988);
- interactive processes involving stakeholders and/or experts, e.g. workshops, IT enhanced group work, and the like.

Depending on the method(s) used, one may quickly be overwhelmed with large numbers of ideas and detailed policy options. We suggest, in this stage, to look for possibilities for aggregation, grouping similar options together. What matters in the problem diagnosis phase is to get a broad view of the spectrum and type of possible ways to influence the system, rather than a detailed one.

An important next step is to explore the possible side effects of the identified policy options. For example, expansion of the airport's capacity may lead to increased noise hindrance, and the airport may be forced to compensate affected residents for this, leading to increased costs. Costs of implementation, in general, are a side effect of most policy options. Knowledge about relevant side effects should be included in the causal diagram, and if other objectives than those already identified are affected, these and their associated criteria should be added.

Building on the (partial) causal diagram of Fig. 4.5, factors that can be changed through policies under control of the airport management include the capacity per runway, the number of runways, the quality (and number) of other services, and marketing efforts.

4.4.7 Exploring Uncertainties about the Future

The preceding sections have largely concentrated on analyzing the present or soon to be expected situation, based on 'business as usual' assumptions with respect to the factors determining the outcomes of interest. Some of these factors, however, may change dramatically in the future, and a problem exploration effort is not complete without explicitly addressing possible future changes of relevance.

We suggest creative thinking about possible future developments and constructing a variety of possible future system changes and contexts to become aware of the scope of uncertainties about the future. One approach is to follow the well-known steps of scenario building and use (e.g., van der Heijden 1996). Chap. 9 provides a more extensive discussion on scenarios, and how to deal with the many different varieties of uncertainty in carrying out a policy analysis.

The traditional scenario building steps are:

1. Start from the most recent (i.e., adapted based on the results of the preceding efforts) system and causal diagram, establish an appropriate future time horizon, and identify the external factors that could significantly affect the outcomes of interest.
2. Identify the more general driving forces or mega trends driving change in the external factors.
3. Roughly assess each of these with respect to (a) degree of uncertainty in development over the relevant time horizon, and (b) significance of the impact of these uncertainties on the outcomes of interest. Then select those that display significant uncertainty and would have significant impacts.
4. Consider combinations of plausible (not probable) developments in each of the selected uncertain external forces (there may be many possible combinations depending on the number of forces selected in Step 3), and screen these for feasibility (check for internal inconsistencies). Select three or four combinations that span a broad variation in futures.
5. Develop a scenario description for each of these combinations.
6. Confront the present problem formulation with each of the scenarios and assess what the impact of the scenario situation on the problem situation would be. Does the problem worsen, or perhaps ameliorate, or even disappear in some

possible futures? Which are the uncertain factors having the largest impacts? Will new factors possibly come in?

The insights and awareness thus obtained may enrich the problem analysis in two ways. First, a better impression of the stability of and possible autonomous developments in the problem situation is obtained, underscoring or qualifying the need for action. Second, factors and mechanisms that may have important effects on the system and its outcomes of interest in the future that were not identified yet should be added to the analytical framework. In turn, these findings may trigger the need to think of even other solution directions than those considered thus far. More generally, how scenarios can be used for policy development that explicitly takes uncertainty into account will be explained in Chap. 9.

For the airport example, a future time horizon of 25–30 years is reasonable in view of the (technical and economic) lifetimes of the investments considered. Significant and unpredictable changes may occur over this period in various factors. For example, demand for air transport may go up significantly, or stabilize, or even go down as the result of political crises, terrorism, costs of fuel, etc. The dominant structure of air transport may change from the current hub-and-spoke system to a system of direct connections (which would mainly negatively affect airports now benefiting from a hub function for a major airline). Major competition from a nearby airport may develop. Important clients of the airport (such as the hub airline) may go bankrupt or be taken over by another airline that decides to use a different airport as a hub. National policy and public opinion may change dramatically—e.g., toward isolationism or environmentalism. Flight technology may change and improve safety, noise, and/or emissions, and much larger planes may come into operation, reducing the number of take-offs and landings per passenger, but requiring more sturdy construction of landing strips and adaptation of other terminal features. An example of the elaboration of these and other scenario examples for a case of airport strategic planning in the Netherlands may be found in (RAND Europe 1997).

In contrast to the perspective from which the analysis for the airport example started (expected continued growth in air transport demand), the exploration of plausible futures can identify possible developments in which the runway capacity shortage problem may disappear—for example, in the event of a decline in the demand for air transport, or when a major carrier leaves for another airport or goes bankrupt. Of course, this would perhaps be an even bigger threat to the health of the airport's business than a situation of continued growth in demand that cannot be met! Awareness of this possibility underscores the need to explore policy options that would be beneficial under such situations, such as investing in additional services, added-value activities, etc. Similarly, the possibility of much larger airplanes would trigger reconsideration of runway (re)construction options as part of the solution space.

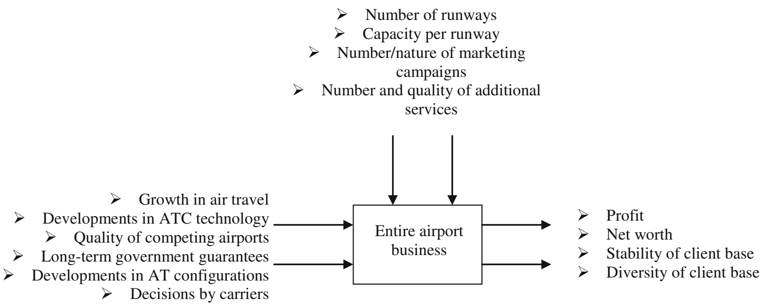

Fig. 4.6 System diagram after redefinition of the problem, cf. Fig. 4.5

4.4.8 Synthesis and Iteration

The system diagram keeps playing a role throughout the problem diagnosis process as a vehicle for synthesis and maintaining consistency. Choices with respect to the core of the problem formulation, including the elaboration of indicators for the objectives chosen, identification of causal factors, and possible solution directions, all help specify key elements of the diagram: the inputs, outcomes of interest, and key factors inside the system.

Figure 4.6 illustrates an expanded system diagram for the airport example, based on choices discussed above. To keep things simple, the figure shows only the inputs and outcomes of interest. Note the significant differences from the diagram shown in Fig. 4.2. As a consequence of the choice for a more fundamental approach, the system's boundaries are much wider, including the total of the airport business instead of just the runway system. Accordingly, the outcomes of interest are now defined at the more fundamental level, a wider range of policy options is included, and, through the causal analysis, a number of uncontrollable but very important external factors have been identified. Yet, this still is a representation based on the single-actor view of the airport management. In the next section, we discuss how to proceed to consider multi-actor complexity.

4.5 Exploring the Policy Arena

In the preceding sections, we have adopted the perspective of a single problem owner, and concentrated on the substantive aspects of the problem situation. We have focused on the part of reality of concern to the problem owner's problem perception, which we called the 'system domain for policies'. In a single-actor situation, the problem owner may decide by himself. However, decisionmaking about public policies generally takes place among multiple actors, who may influence the system and each other. We conceptualize the (multi-actor) process of deliberation, negotiation, and policy choice to occur in a *policy arena* outside the

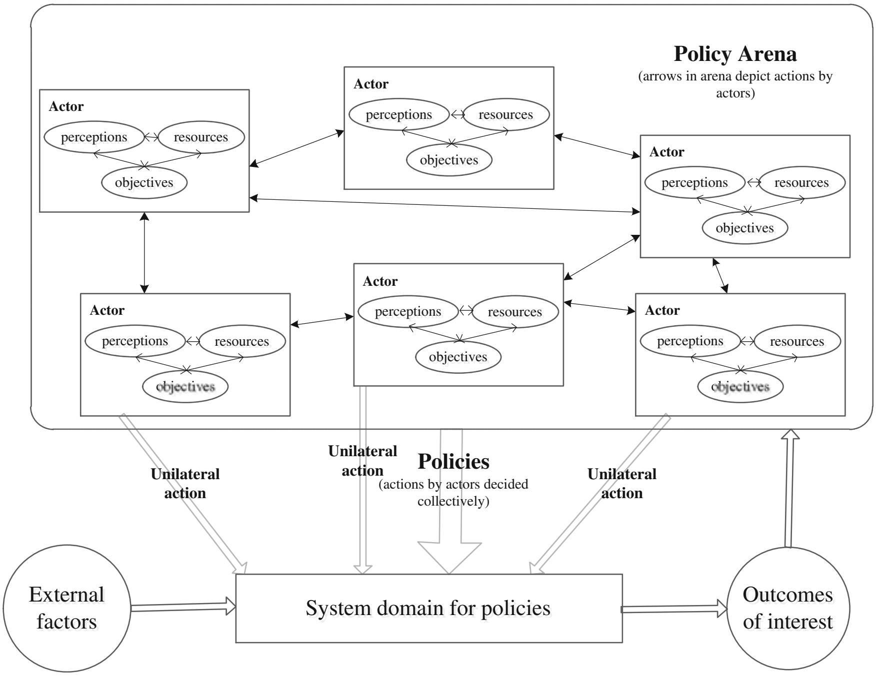

Fig. 4.7 System diagram with multi-actor policy arena added (after Hermans 2005; see also Fig. 8.1)

system domain for policies, and, in this section, we take a complementary view to the one taken in Sect. 4.4, considering the policy arena as the central object of analysis. That is, we focus on the relevant actors, their interrelationships, the more general institutional context, and the characteristics of the decision situation from a multi-actor perspective. This expanded view leads to an expansion of the simple diagram of Fig. 4.1 to one that adds a (multi-actor) policy arena (see Fig. 4.7).

Note that in Fig. 4.7, actor perceptions, objectives, and resources are depicted as key attributes of each of the actors. Furthermore, a distinction is made between policies decided by actors collectively and unilateral actions by individual actors affecting the system of interest. The introduction to Part II of this book, and in particular Chap. 8, provide more information on the policy arena.

4.5.1 Actor Analysis

In this section, we first discuss how to identify the relevant actors. We then indicate what basic information about those actors to collect. We conclude by pointing out some analytic methods that can be used to explore some of the relevant features of the situation. These methods will be discussed in more detail in Chap. 8.

4.5.1.1 Identification of Relevant Actors

Who the relevant actors are depends on the definition of the substantive problem. Alternatively, by selecting a specific set of actors, we implicitly choose the (set of) problem(s) relevant to those actors. For example, selecting the problem formulation of environmental actors in the airport case as a starting point would have led us to issues like non-renewable resource depletion, global climate change, and the like—and these subjects are debated in a different policy arena than issues of expansion of a specific airport. As outlined before, we assume that a client/problem owner initiates the policy analysis process, and we start from his or her problem perception. We note that actors can be related in different ways to a problem situation:

- Actors *affected by* the problem situation or by (some of) the solutions considered. (In the remainder of the book, we call these actors *stakeholders*, since they have a stake in the outcome of the policymaking process.)
- Actors *having an influence on* the problem situation and its development, including those formally involved in decisionmaking in the field, e.g. public authorities. (In the remainder of the book, we call these actors *policy actors*.)
- Actors *needed for implementation* of (some of the) solutions, e.g. for obtaining permits, or because they may oppose or even block certain solutions.

Note that some of the actors may have different roles at the same time, for example, stakeholders may also have the possibility to actively influence the situation, and/or possess means needed to implement certain solutions.

There are several complementary methods for identifying the relevant actors (see, e.g., Mitroff 1983; Bryson 2004; Enserink et al. 2010). First, an initial substantive analysis as outlined in the preceding sections offers several starting points. Which actors can influence the key factors that determine the outcomes of interest? Which actors have an interest in (maintaining or resolving) the problem situation at hand? Which actors may be affected by solutions under consideration? Which actors control resources needed to implement certain solutions (capital, land) or could block implementation (e.g., by refusing building permits)? Discussions with the problem owner and study of written material can help in drawing up an initial list.

Second, analyzing the formal structure of decisionmaking in the policy arena will help to identify key actors, their formal relations, and the procedures in which various actors could take part and affect decisionmaking. This is mostly seen as part of the institutional analysis (see also Sect. 4.5.2).

Third, the so-called ‘snowball’ or ‘reputation’ method can be useful. An initial list of actors is drawn up with the problem owner; next, the actors on this list are interviewed and asked to identify other actors who, in their perspective, are relevant, etc.

Fourth, individuals or organizations who see themselves as stakeholders may nominate themselves (for example, they may respond to a public call for inputs). This is called the ‘self-application method’ of stakeholder identification.

Application of these methods may result in an extensive list of potential actors. For practical reasons, the number of different actors selected for a first, deeper analysis can be reduced by aggregation of actors sharing similar perceptions and interests into a single composite actor, and by concentration on actors on which the problem owner is dependent (i.e., actors who possess means necessary to realize the problem owner's goals).

Note that the framing of the airport problem as discussed in Sect. 4.4.3 significantly affects the selection of actors. If the problem is framed as overcoming the burdens of realizing an additional runway, actors such as major airlines stay out of the picture; they come into play, however, if the problem is to maintain a healthy airport business. For the airport case, assuming the substantive problem framing as elaborated in Sect. 4.4, a variety of relevant actors can be identified:

- National, regional, and local authorities, since they may change zoning laws, control the necessary permits, and may contribute in other ways (e.g. by adapting the highway structure around the airport); they also have overarching interests with respect to both the living environment and economic progress.
- Major airlines using the airport, since their decisions may strongly affect demand for airport facilities and, hence, affect the health of the airport business.
- Air travelers who, depending on developments, may decide to favor other airports.
- Air traffic control, which may coordinate with the airport toward a more efficient use of existing capacity.
- Local residents, who may be affected by noise, odors, and other nuisances, and may block or slow down procedures.
- Landowners in the area where a new runway would be built.
- Environmental lobby groups who oppose expansion, stress reduction of air traffic, noise, etc., and may block or slow decisionmaking procedures.
- Businesses that benefit from expanding airport activities.
- Workers who depend on the airport for their income.

4.5.1.2 Actor Needs, Perceptions, and Positions

The literature on actor analysis shows a wide variety of partly overlapping approaches regarding what information to collect about the relevant actors (cf. Hermans 2005, Chap. 2; Hermans and Thissen 2009). For the sake of simplicity, we distinguish three different angles to actor analysis:

1. Identification of individual actor needs, problem perceptions, and positions. This information helps to:
   - enrich the problem formulation;
   - identify the degree to which problem perceptions are different;
   - identify potential conflicts and their nature;
   - identify the degree to which perceptions on relevant causalities differ.

2. Actor interdependencies. Insight into interdependencies helps to identify the practical relevance of taking other actors' needs into account; it may also point to possible deals or trade-offs that could be made among the actors.
3. Differences and commonalities among the actors, based on insights obtained under 1.

We suggest to start with the completion of a relatively simple table specifying the key characteristics per actor as the preliminary target product of an actor analysis. In the table, the following elements should be included for each actor:

- The problem perception, formulated as a perceived gap between reality and the actor's objectives;
- The objective(s) with regard to the problem situation;
- The actor's more fundamental interests;
- The causes the actor sees for the problem situation;
- Potential resources of interest under the control of the actor;
- The actor's position with respect to the situation; i.e., his intention to act or not act, and the way in which he would act.

We emphasize the relevance of identifying the actor's more fundamental interests, since a focus on interests rather than objectives may yield more opportunities for compromise or arrangements satisfying multiple interests than does a focus on specific objectives. For example, a focus on the initial objectives of the airport authorities and the environmentalists would lead to two diametrically opposed positions: the airport management's initial objective is to build a new runway; the environmental lobbyists' objective is to block further expansion of the airport. Concentration on both parties' interests (a healthy business for the airport and improving environmental conditions for the environmentalists) may offer more opportunities for compromise. For example, one may search for possibilities for a healthy airport business that is environmentally friendly, or for possibilities for compensation of environmental damage by re-building nature elsewhere (van Eeten 2001).

Several different approaches can be used to search for the information needed. Analysis of publicly available documents (reports, position statements, mission statements, etc.) may provide a good starting point. Interviews will help to verify and deepen initial impressions. Increasing the number of interviews and questioning the actors about each other's positions may help improve the reliability of information.

In addition to bilateral interactions with individual actors, a variety of participative group methods have been proposed in recent years. These include structured workshops, ICT-supported group meetings, policy exercises, focus groups, quick scans, and the like (see, e.g., Mayer 1997). While many of these approaches extend beyond initial problem situation diagnosis, they can nevertheless be particularly helpful in this initial phase.

A point to keep in mind is that actor perceptions and positions may change over time, and that actors may behave strategically—for example, they may have

Table 4.2 Actor analysis table for airport example

Actor	Problem perception	Objective(s)	Interest(s)	Causes of problem	Resources	Position
Environmentalists	Growing air traffic depletes resources and pollutes the environment	Prevent further expansion of airport; reduce air travel	Nature conservation/ restoration	Growth in air travel	Lobbying power; publicity campaigns, blocking/slowing down procedures	Will try anything to block new runway
Local residents	Aggravation of noise nuisance and safety concerns	Reduce nuisance; increase safety	An undisturbed, safe living environment	Growth in number of flights	Lobbying power, publicity, block/slow down procedures	Will use all opportunities to protest
Airlines	Unwanted delays	Prevent delays, fly 'on schedule'; cheap and reliable airport facilities	Healthy business: good market share, profits	Capacity shortage and slowness of airport to adapt to demands	Power to move business away to other airports	Waiting to see what will happen
Public authorities (national, regional, local)	Continued prosperity is at risk if the airport business cannot expand; however, also concern about safety, environment	Safeguard economic benefits while not allowing environmental and safety problems to worsen	A prosperous, safe, and environmentally clean jurisdiction	Lack of capacity at airport; environmental unfriendliness of air travel	Power to develop policies and grant permits; holds part of airport stock; money to build infrastructure to accommodate growth	Looking for an acceptable compromise
Local businesses	Attractiveness of region and long-term growth perspectives are threatened	Expansion of airport	A healthy business in an economically attractive region (accessibility, communications, presence of other businesses)	Lack of airport capacity; growing protests damage business image of region	Lobbying power; ability to move business to other region/country	Will lobby actively for expansion
Landowners (farmers)	Loss of land threatens continuity of business	Keep farming as usual or obtain maximum compensation	A healthy, stable farming business	Expansion plans of airport	Power to refuse selling the land; will slow down procedures	Refuse to sell; obtain maximum price if forced to sell

hidden agendas, may give 'desirable answers', and withhold some of their real motives.

Table 4.2 presents an example of how an actor analysis table for the airport case could be filled in. Note that the example is illustrative only, and incomplete—actors such as the air travelers and air traffic controllers and probably others may have to be added.

4.5.1.3 Analysis of Interdependencies of Actors

It is of interest to explore how the problem owner is dependent on other actors for realizing his objectives. We distinguish three different types of dependencies:

- Actors may control resources needed to achieve the problem owner's objectives (for example, owners of land required, or financial institutions able to provide investment capital).
- Actors may have formal power over necessary conditions (for example, local, regional, and national authorities make noise regulations, can set standards of safety, and have the power to grant or withhold various legally required permits needed for airport expansion).
- Actors may have more informal powers to block decisions or frustrate the process (for example, environmental lobby groups can appeal permits several times, and public authorities may be sensitive to their arguments).

To be of practical use, an analysis of dependencies should focus on major dependencies and resources only; an exhaustive list could easily extend over numerous actors and pages, and lead to confusion rather than clarity. A relatively simple way to start the dependency analysis is to start from the relevant resources and powers of the actors identified thus far. Next, the question is asked how crucial this resource is to the problem owner's needs. Actors who control or possess resources that are unique and crucial to the problem owner are called *critical actors*, since their cooperation is essential to reaching the problem owner's goals. If different actors can provide the same crucial resource, these actors are not considered critical. For example, different banks could provide investment capital, and an investor needing such capital is not critically dependent on any individual bank.

The result of the analysis of interdependencies can be condensed into a table listing the resources per actor, the relevance of these resources, the degree to which the actor could be replaced by another actor, and concluding with whether the actor is considered critical or not. Table 4.3 illustrates the possible results of a quick dependency scan for the airport expansion case.

Table 4.3 illustrates, among other things, that the airport authorities are crucially dependent on decisions by the public authorities: national, regional, and local. Regarding their broader ambitions, actors such as the airlines using the airport as a main hub are also critical.

Table 4.3 Actor dependency scan for airport example, viewed from the perspective of the problem owner

Actor	Important resources under control of the actor	Degree to which actor/resources may be substituted	Dependency on actor	Critical actor?
Environmentalists	Power to formally oppose and hence delay procedures, generate negative publicity	Not so much a resource but a potential resistance	Moderate to low	Not critical, but moderation of resistance welcome
Local residents	Lobby/voting power with authorities Power to formally oppose expansion, permits leading to noise hindrance, perceived lack of safety	Not so much a resource but a potential resistance	Moderate	Partly
Airlines	Choice of airport to use	Airline companies may be substituted by others	Moderate, depending on size/share in business	A carrier using a large fraction of capacity (e.g. 30 % or more) could be critical
National government	Major shareholder: board member Permit granting authority for noise, safety, and supervising regional and local authorities Authority to expand connecting infrastructure	Hardly Not Not	Large	Yes
Regional/local authorities	Regional development and land use planning authority Power to support local and regional facilities	Not Hardly	Large	Yes
Local businesses	Power to lobby with authorities Capital to invest in quality of services improvement	Resident entrepreneurs may be replaced by others	Moderate to low	Not critical, but support is welcome
Land owners (farmers)	Power to delay expansion by refusing to sell the land	Somewhat, but may be overruled by government in the end	Moderate to low	Not critical, but moderation of resistance welcome

While the table lists direct dependencies of the problem owner only, the identification of indirect dependencies among the actors can provide additional insights into the policy network structure, and could even lead to the identification of possibilities for three- or four-way exchanges among the actors. A more extensive, 'transactional analysis' (Coleman 1990; Timmermans 2004) can help detect such mutual and indirect dependencies. Section 8.5.3 provides a more extensive description of the approach. Here it suffices to note that such an analysis can be of help in diagnosing whether a specific set of actors possesses enough 'resolution power' to make significant progress toward satisfying the actors' needs. If not, this may be an indication that other actors who control needed resources need to be included in the policy arena. This kind of analysis can also be helpful in identifying the potential of so-called 'package deals', where action on different issues can be traded off to the eventual benefit of all the actors concerned.

For the airport authority example, Table 4.3 does not show a direct dependency on environmental groups or local residents. However, because public authorities are, to a certain extent, sensitive to arguments put forward by environmental groups and local residents (who complain about safety, noise, pollution), the airport authorities indirectly also depend on these groups. The airport also needs land owned by the local farmers for its expansion; this dependency, however, seems to be less critical. If public authorities back up the expansion plan, they have the power to expropriate the land, so this is not a direct concern for the airport.

4.5.1.4 Discourse Analysis

A richer analysis of perceptions and beliefs of actors than the one illustrated in Table 4.3 can reveal interesting insights into the structure of the policy arena: To what extent are the actor perceptions and beliefs essentially different? To what extent are views on problems, their causes, their solutions, and the knowledge claims underlying them, contested or accepted by the actors? Can a few different sets of relevant actors be identified that share the same or similar beliefs?

Again, various methods (most of which can be grouped as 'discourse analysis' methods) exist and can be employed to explore these questions. For example, (semi-)structured interviews with stakeholders (see Hermans 2005) are a good (but time consuming) approach for getting a richer view on actors' argumentation structures, and the findings can then be structured in formal ways (e.g. Toulmin 1958), some of which are supported by computer software (Eden 1989; Bots et al. 2000). Another approach is Q-methodology (McKeown and Thomas 1988). In this approach, respondents are asked to express their degree of (dis)agreement with a number of statements regarding the issue at hand. The answers are analyzed, resulting in identification of a limited set of essentially different views shared by groups of respondents. The resulting insights help to assess more thoroughly what the key differences are between the different perceptions, what the underlying reasons for disagreement are (conflicting interests or more fundamental value differences), and to what extent possibilities exist for fruitful discussions across the different perceptions/coalitions. Section 8.3.1 provides a more extensive discussion of discourse analysis approaches.

Regarding airport expansion, van Eeten (2001) performed such a Q-methodology analysis for the case of Amsterdam Airport Schiphol, and found widely different views relative to the problem situation, ranging from “Expansion of civil aviation infrastructure as a necessity in the face of international economic competition” to “Societal integration of a growing airport” (emphasizing the need to reduce local safety, congestion, pollution, etc.), and “Search for sustainable solutions to a growing demand for mobility”. The reader is referred to the original article for a more extensive discussion.

4.5.2 Institutional and Decision Situation Analysis

As a complement to actor analysis, institutional and decision situation analysis focuses on the formal and informal context within which a policy issue comes up and may be resolved. This includes the nature of relations between actors, such as the culture and dynamics in the network, dominant habits of actor interaction, characteristics of the network (e.g., communication patterns), and potential changes in actor positions and relations. Typically, these characteristics are less dependent on the specific topic of concern, if at all. The institutional context characteristics to a certain extent determine the formal and informal rules of the playing field. Among the many aspects of institutions, the following paragraphs describe the aspects that are of particular interest to a policy analyst exploring a problem situation presented to her.

Actors interact in formal and informal ways. The formal interaction structures can be identified by studying legislation (specifying procedures for decision-making) and related documents (e.g., private arrangements between actors, such as banks or the government providing capital in turn for a certain degree of control). Formal interaction structures may be depicted using an organization chart or a similar type of diagram. Also, in certain cases there may be formal rules or requirements regarding the decision process, such as the necessity to prepare an environmental impact assessment of the options. This, of course, should be taken into account when planning further action.

Informal interaction structures are not as easy to identify, but they can be highly relevant. Insight into ways in which the actors perceive each other and deal with each other informally may be obtained by holding interviews with key players, observation of and participation in debates, and study of newspaper articles on the specific sector. Exploring the history of the problem and ways in which it was (or was not) dealt with in the past may also provide interesting clues: What were the dominant perceptions, what actors were supporting them, has there been a change in argumentations or in coalitions, or not, and why?

A quick, qualitative impression may be obtained by concentrating on different types of relationships that may exist among actors—cooperation, competition, and conflict:

- Typically, long-term natural coalitions among groups of cooperating actors will exist. For example, environmentalists and local residents complaining about noise, pollution, safety, etc., share certain interests and will generally cooperate. They share a common problem frame, and have developed informal ways of exchanging information and helping each other (Sabatier and Jenkins-Smith 1993; Sabatier 1988; Weible and Sabatier 2006)
- Competition exists if actors compete for the same resources, clients, etc. The existence of competition may help explain actor positions and behavior. For the airport example, the airport clearly competes with the local landowners for use of the space. And the airport itself competes with other airports for airline and traveler business.
- Situations of conflict among actors can be the result of conflicting interests. But conflicts may have different natures and origins (Rommetvedt 2006). The conflict may be about different preferences, in which case it is relevant to explore whether the preferences are compatible (i.e., satisfying one preference does not exclude the other) or not. It is also relevant to explore whether the conflict is about divisible goods (so that compromises are possible), and whether the decision situation can be characterized as 'zero-sum', or whether win–win solutions appear to be possible. Finally, conflicts may not be about direct or pragmatic interests, but may find their origins in differences in deep normative principles. Furthermore, cultural differences may cause conflicts, or developments in the past may have led to disturbed relations and created an atmosphere of distrust among some of the actors. Situations of conflict and lack of trust can seriously frustrate attempts to build cooperation. For example, there is often a history of distrust between business interests on the one hand and environmental groups on the other.

More generally, cultural aspects relate to how authority is experienced, how conflicts are resolved (or not), and, how people interact with each other and the values associated with their interactions. A well-known typology of cultural dimensions was developed by Hofstede (1984) and Hofstede et al. (2010). Since our focus is on supporting problem resolution in complex multi-actor settings, dominant habits and values related to conflict resolution and negotiation are of particular relevance to choosing an appropriate approach. These may be present in society as a whole, but can also be specific for the issue at hand. At a minimum, we suggest exploring the following:

- Whether the problem situation is one for which standard approaches and rules have been developed. For example, legislation, procedures, and (technical) requirements for decisions on small-scale building permits and unemployment benefits are clear and well established in most developed countries, while processes and requirements are much less clear (and thus themselves subject to

dispute) for large-scale infrastructure expansion and privacy protection in the age of the Internet.
- What the dominant way of conflict resolution is. Is it, as in U.S. culture, based on a courtroom-like adversarial fight in which the winner takes all, or is a consensus and compromising model dominant (like the 'polder model' in the Netherlands')? Is there a strong hierarchy, such that decisions made by those high in the hierarchy are more respected and more likely to be implemented?
- The extent to which key actors relevant to issue resolution trust each other.
- The extent to which strategic behavior is dominant.

The characteristics of actor networks generally change over time. Individual actor perceptions change; dependencies and other relations among actors change. An analyst should be aware of potential changes and the mechanisms behind them. Some factors causing changes are foreseeable. For example, elections may affect the composition and viewpoints of the local, regional, and/or national government. Some changes are part of existing policy and can be anticipated. Other changes are less predictable. Mergers and takeovers may suddenly change the institutional setting. Because of events outside the direct problem scope, relations among actors may change from friendly to hostile.

We do not know of a standard recipe to assess the dynamics of an actor network. Good starters will be to look into recent history, identify changes to be expected, and explore mechanisms that may affect the dependencies among actors. As explained in Chap. 5, it is also strongly recommended to monitor situation developments as time proceeds, so as to detect possible changes in key characteristics, and adapt the chosen approach in subsequent steps as necessary.

4.6 Synthesizing the Results of the Systems Analysis and the Actor and Institutional Analysis

Unless the analysis has revealed that the problem owner may solve his problem independently, without taking into account other actors' interests (in which case the systems analysis as described in Sect. 4.4 can guide further efforts), a synthesis of the findings of the initial (mono-actor) systems analysis and the multi-actor analysis is needed. The results of the actor analysis, in particular, will generally lead to a need for adaptation and enrichment of the initial substantive, systems analysis. First, it is advisable to extend the initial systems analysis and the associated system diagram by including the critical actors' needs as additional outcomes of interest (see, e.g., Gregory and Keeney 1994). Second, the instruments that these other actors control can be added to the set of policy instruments affecting the system. As a result, the boundaries of the system of interest will be broadened. The resulting system diagram provides the conceptual basis for an analysis of the impacts of a broader variety of policy options on a broader set of outcomes of interest. Third, other actors may contribute additional views on key

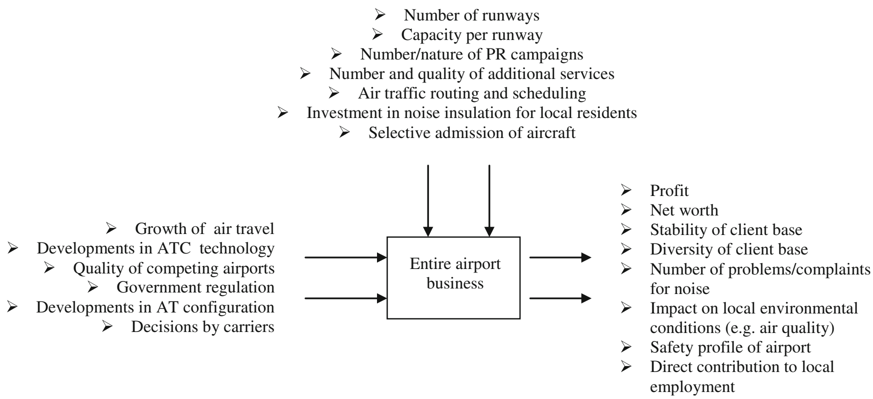

Fig. 4.8 Illustration of possible expansion of system diagram inputs and outputs after actor and institutional analysis

elements and relationships, thus enriching the systems analysis—and, in particular, the system model to be used in the analysis (see Chap. 7).

Continuing with the example of the airport expansion, in a further analysis, the objectives of public authorities, environmental groups, and local residents should be taken into account. Adding these to the analytic framework is a first step. As a result, criteria with respect to local pollution, noise, safety, and the impacts of the airport on the regional economy will need to be added to the outcomes of interest. Next, the causal analysis needs to be extended, in order to include factors affecting these additional criteria, and exploration of additional solution directions and external factors should result in a broadening of the scope of policy instruments to be considered and external influences to be monitored. 'New' instruments may include adaptation of flight paths and schedules, compensation of local residents for extra costs for noise insulation, more selective admission of aircraft and/or carriers, creating extra services at the airport in order to create extra jobs and added value, etc. Figure 4.8 illustrates a system diagram, adapted from Fig. 4.6, to illustrate the possible consequences for the analytic framework (a new causal diagram has not been elaborated).

More generally, after extending the systems analysis based on the results of the actor analysis, a consistency and completion check is needed at this point. When new factors have been added, has due consideration been given to identification of (controllable or non-controllable) influences on those factors, and have these been added to the systems analytic problem description? And have the added influences been scanned for actors controlling them, and had these actors already been taken into account? If new actors having an influence on the system are added, are these added actors important to the problem owner and should their objectives also be taken into account in the further analysis? When new solution directions were identified, has it been investigated sufficiently whether these would have side effects relevant for the problem owner and/or other actors? We suggest a 'final' revision of the analytic framework at this stage in an attempt to include all elements deemed sufficiently relevant, and to achieve as much consistency as possible between the actor analysis findings and the systems analytic representation of the problem situation. Note that each adaptation may affect earlier findings, e.g. regarding actor interdependencies, and other important aspects of the problem situation. Tools such as Dynamic Actor Network Analysis (Bots et al. 2000) have been developed to assist analysts in this process.

We have in the foregoing assumed that knowledge about causal factors and mechanisms was readily available and undisputed. This, however, is hardly ever the case. When this has not been done before, the balance should be made up as part of the synthesis. What parts or elements of the causal model are based on undisputed knowledge and accepted by all? What parts are based on shared perceptions for which solid scientific evidence is lacking? What parts are merely assumptions or best guesses of the analyst? Where do opinions and beliefs regarding key causal mechanisms diverge among actors, and to what extent? To what extent do actors share perceptions on actor interdependencies and positions? What key differences exist in this respect?

Detailed insight into the availability of undisputed knowledge and into differences in perceptions requires a significant effort and interaction with all relevant actors, and time and/or funds may not always be available (Hermans 2005). It is, however, of great importance to the choice of follow-up activities to establish, at a minimum, a broad-brush assessment of the extent of (dis)agreement among relevant actors, and on what topics differences of opinion are most dominant. As problem exploration should provide a basis for deciding whether the situation is worth further efforts, also the feasibility of effective solution options within the scope of the present formulation should be assessed, albeit globally at this stage. To what extent are the solution options identified promising? Can they be implemented without the help of other actors? If not, is there a perspective on cooperation of these other actors? Do fundamental, perhaps long-lasting, conflicts exist, and are there any perspectives for compromises or other ideas for ways to break the deadlock? Are opportunities for compensation available when the situation has a zero-sum character (i.e., some actors may benefit, but others will lose)? In short, is sufficient solution potential present in the problem situation as analyzed and framed to warrant further efforts?

As the primary output from this stage of the analysis, we suggest that the findings be summarized in the form of an 'issue paper' (Quade 1989, pp. 73–78; van der Lei et al. 2011). The issue paper serves as a basic communication document with the problem owner and others as needed, and contains the key results of the problem exploration effort, both in systems analytic and actor analytic terms, as well as a suggestion for further steps in light of these findings.

4.7 Implications for Further Action

Issue papers also generally contain recommendations or proposals for follow-on activities, such as what types of activities to engage in, what questions further research should answer, what actors to approach/involve in further activities, in short: what policy (analytic) approach to choose given the situation.

The combination of the system analysis and the actor analysis provides a rich picture of the context for action by the problem owner. Based on that picture, an initial assessment may be made in order to determine how to proceed. In the literature, several authors (Douglas and Wildavsky 1982; Hisschemöller and Hoppe 1995) have proposed a typology of problem situations based on two distinguishing factors: the level of (dis)agreement on knowledge or facts, and the level of (dis)agreement on values. When agreement on both is dominant (this situation is also referred to as 'well structured'), a policy development approach based on independent expertise is suggested—supported by policy analytic efforts corresponding to the upper parts of the hexagon typology developed in Chap. 3: "Research and Analyze", and "Design and Recommend". When there is general agreement on values, but not on knowledge, a 'negotiation' approach is suggested, an 'accommodation' approach when fundamental value conflicts are dominant, and a 'learning' approach in unstructured situations involving both knowledge and value disagreements (cf. Hisschemöller and Hoppe 1995). De Bruijn and Porter (2004) add the perceived urgency and the perceived importance as distinguishing characteristics, suggesting 'no action' in situations when both are low.

Acknowledging the relevance of these typologies of problem situations, we note that yet other characteristics than those mentioned in the preceding paragraph need to be taken into account, such as the degree of trust, the dominant decisionmaking culture, and the type of issue or conflict at stake. Based on the findings of the problem diagnosis as described above, and linking to the six different policy analytic activity types distinguished in Chap. 3, we suggest the following implications for policy analytic support.

Clearly, when the problem situation is not perceived as serious or urgent, the dominant advice would be to do nothing (we do not explore strategic reasons policy actors may have to act in such situations, e.g. to divert attention from other concerns).

If it appears that the problem owner's means are sufficient to solve his problem, i.e., little if any dependency on other actors exists, and there is no need to take other actor's interests into account, the systems analysis as described in Sect. 4.4 can guide further efforts, and these could be targeted at resolving any knowledge gaps about the effectiveness and efficiency of alternative strategies. This situation resembles the 'well structured' or 'tamed' type of policy problem mentioned above. Referring to the hexagon model, the dominant types of activities would be 'research and analyze', and/or 'design and recommend'. Situations like this, however, will be very rare in the field of public policy analysis where, typically, different actors and stakes need to be taken into account.

If deep normative conflicts are dominant, as is often the case on social issues such as legislation on abortion, or acceptance of the death penalty, it is questionable whether any further policy analytic efforts of the type discussed here could be of assistance. Rather, it should be explored either whether some compromise situation can be developed with which actors are prepared 'to live' (the 'accommodation strategy'), or, in situations dominated by adversarial decisionmaking habits, whether agreement can be reached about the *procedures* for resolution of such conflicts, e.g. voting, court procedures, or other ways outside the spectrum of policy analysis.

If the nature of the conflict is such that perspectives on win–win solutions (or, to the least, win—no-lose solutions) exist, and/or divisible goods are at stake, an approach focusing on supporting a negotiation process would be worth exploring.

The characteristics of the policy arena and of the conflict situation provide further indications about the kind of approach that could be fruitful in situations of significant dependency. If there is a sufficient basis of trust among the key actors that need to be involved, and if the client prefers to work toward a solution in a consensual way, the development of a shared and joint problem framing and action plan is indicated. However, when strategic behavior is dominant, and/or there is a history of conflict and distrust, and/or the dominant culture of conflict resolution is adversarial, it may be wise to advise the problem owner to explore a more strategic approach and propose further analysis supporting such an approach ('advise strategically'). Further indications may be found in Chap. 5 (in particular Sect. 5.2), and Chap. 6.

In practice, the situation will generally not be clear-cut, and different characteristics may be present, calling for an appropriate mix of activity types, where the emphasis may even shift during the process. Because of the often unpredictable dynamics of policy situations, substantive problem perceptions, actors involved, and institutional characteristics may all change, even during the policy analysis process, calling for continuous monitoring and adaptation of the policy analytic approach chosen. This will be further elaborated upon in Sect. 5.7.

4.8 Discussion

In the preceding sections, we have outlined a systematic, stepwise (but iterative) analytic approach to problem diagnosis. The methodology rests on the combination of two cornerstones: systems analysis and actor analysis. We started from the perspective of a single actor as problem owner, emphasized substantive analysis first, and subsequently used the results as a stepping stone for exploration of various characteristics of the multi-actor policy arena. We then suggested a synthesis that enriches, and mostly broadens, the initial systems analysis.

This approach does not necessarily lead to a single, unique problem description. Lack of commonly accepted knowledge and differences in perceptions of actors may give rise to a range of variation in the conclusions of the analysis. Unless undisputed scientific knowledge can resolve such differences, we recommend allowing such variety on the one hand to acknowledge existing uncertainties in the analysis, and on the other, to prevent losing the support of some of the actors. Chapter 9 discusses analytic approaches to deal with such uncertainties.

Beyond the variation in outcomes resulting from the approach outlined above, the question remains whether other approaches would lead to totally different findings. What if the actor analysis would come first instead of the systems analysis? What would, for example, be the impact of taking another actor as the starting point?

As indicated in Sect. 4.3, our initial focus on substance may lead to a lack of attention to purely political issues (such as dealing with favors from the past, or fights for power), which may dominate relations and the attitudes of actors toward each other. These will come to the forefront more prominently if the agenda of a political actor is taken as a starting point (and the actor does not hide his true agenda from the analyst!). However, such an approach would be more suited as a basis for political advice instead of policy analysis. Starting from the substance, our approach will eventually allow the inclusion of political motives—without putting these central.

A different scope and emphasis of the problem framing effort, however, may result if the analysis starts from the perspective of a different actor. In situations with relatively weak dependencies, starting with a different actor in fact means solving a different problem. In a situation with strong interdependencies, however, actors need to take other actors' interests and objectives into account, and the multi-actor problem framing will include the concerns of the interdependent actors, regardless of the choice of initial problem owner. For example, the scope of outcomes of interest, external factors, and actors in the final analysis of our airport example would not have been very different had we chosen to start with one of the public authorities instead of airport management as the initial problem owner. Of course, the solution options under their control would have been different. Had we, however, taken the environmentalist's point of view as the starting point, the scope might have been quite different and may have included the whole of the environmental impacts of air transport, and all of the mechanisms affecting these.

Following the systems analytic path, we have suggested to frame a problem situation as a search for solution directions that will effectively achieve some or all of the objectives. Leading values behind this approach are instrumental rationality, effectiveness, and efficiency. We have added multi-actor concerns and focused on interdependencies in a search for feasible and implementable solutions. In our description, we have focused on the cognitive dimension of diagnosing policy problem situations, and only incidentally mentioned deliberative approaches in which problem exploration is the subject of debate and negotiation between participating actors. While such process-centered approaches are not at the core of this book, Chap. 6 briefly explores this field and presents a number of guidelines for process design. Here, we suffice to say that the type of cognitive analytical analyses presented above may be crucial in structuring and facilitating such multi-actor processes.

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Chapter 5
Designing the Policy Analysis Process

Pieter W. G. Bots

5.1 Introduction

The literature on policy analysis contains few references to design. In fact, the word "design" is notably missing in the index of prominent textbooks on policy analysis (Dunn 1994; Miser and Quade 1985, 1988; MacRae and Whittington 1997; Nagel 1988; Roe 1994; Wildavsky 1987). Bardach (2000, p. 17) and Patton and Sawicki (1986, p. 177) use the term to refer to the design of alternative strategies or solutions as an important phase or activity in a policy analysis. Although the title of their book *Policy Analysis by Design* suggests otherwise, Bobrow and Dryzek (1987, pp. 18–21) speak only of "policy design", which is not the same as the design of a policy *analysis*, because a policy and a policy analysis are two different artifacts. Apparently, although policy analyses are acknowledged to contain design activities, a policy analysis as a whole is not conceived of as something that can be designed.

For most authors, policy analysis is an approach—a way of working—and *a* policy analysis is the process that results from applying this approach to a policy problem. Some authors show how this process can be structured in phases and represented schematically by process diagrams, such as the one in Fig. 5.1. Such diagrams relate to the design of a policy analysis (as a process) like architecture relates to the design of a building: they provide generic structures and principles, but no specifics. On a more operational level, textbooks on policy analysis describe many methods, tools, and empirical cases that can be useful in a policy analysis, but these methods and tools do not address "design"; they are for a policy analyst what construction techniques and material characteristics are for an architect: one should be knowledgeable about them to make a feasible design, but they do not determine the design.

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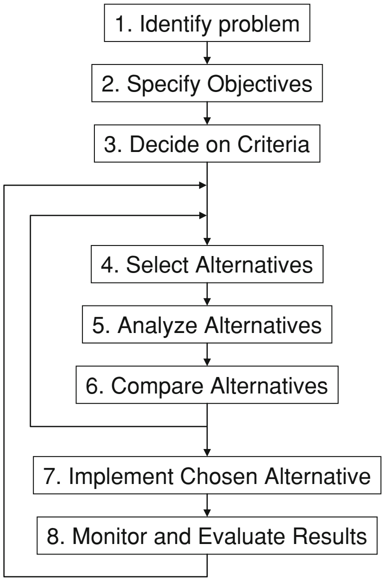

Fig. 5.1 A process diagram for a public policy analysis (Walker and Fisher 1994)

The aim of this chapter is to develop a design-oriented way of thinking about policy analysis that can bridge the gap between the conceptual and the practical, between the six axes of the hexagon model proposed in Chap. 3 (see also Mayer et al. 2004) and the methods discussed in Chaps. 7 and 8, and the Appendix. The chapter is based on the proposition that a policy analysis is designed in a process of means-ends analysis. Provocative as it may seem, it contends that the end objective of any policy analysis is to change people's minds.[1] The analyst diagnoses the client's problem as described in Chap. 4, assesses this in terms of "whose minds need to be changed?", and then plans a set of policy analysis activities (the means) that will—insofar as possible—achieve these "changes of mind" (the ends).

Section 5.2 clarifies this idea and how it relates to the hexagon model. Section 5.3 clarifies the notion of "design" and how it applies to policy analysis. The case example presented in Sect. 5.4 then shows that the actual "building blocks" or "functional components" of a policy analysis are planned communicative interactions. This suggests that designing a policy analysis is a matter of "putting the right parts together in the right way". This idea of designing and assembling communicative interactions is elaborated in Sect. 5.5, where further analysis of the

[1] Terms like "enlighten" or "facilitate learning" sound less manipulative, but do less justice to what a policy analyst aims to do: make people see the world in a new way. All definitions of policy analysis would seem to entail this purpose: when "speaking truth to power" (Wildavsky 1987), the analyst tries to convey actionable insights to decisionmakers; when "making sense together" (Hoppe 1999), the analyst tries to lead different stakeholders to a shared understanding of the issue.

case example shows that a "grand design" approach fails for policy analysis because the insights produced by earlier interactions must be taken into account while designing later interactions. Section 5.6 shows how this dependency can be handled by taking an "adaptive design" approach. The second case example presented in Sect. 5.7 illustrates that the analyst has to make numerous design tradeoffs, and that the hexagon model provides guidance for doing this in a systematic way.

Implicit in the "adaptive design" approach is the notion that a policy analysis *develops* as the analyst designs and then realizes communicative interactions one at a time, adapting to changes in the context and in her[2] client's needs. Unlike technical artifacts such as bridges and airplanes, a policy analysis is not designed first and then realized. The scope of what the analyst can design is limited to that of a single communicative interaction, and even this type of artifact is difficult to design because of the unpredictability of the "human factor". The final conclusion of this chapter may therefore seem a bit bleak: policy analysis is often thought of as an art or a craft, because it is so difficult to design a policy analysis. What makes this chapter worth reading is that one becomes a better policy analyst by understanding *why* this is so difficult, and how to do it better.

5.2 Policy Analysis: Changing People's Minds

Chapter 3 of this book showed how the diversity in styles of policy analysis can be understood in terms of six dimensions, each corresponding to a specific class of activities and a specific set of values. These policy analysis activities all aim to make people change their minds about something or someone:

Clarify values & arguments—This class of activities aims to elicit the fundamental values ("why does this stakeholder prefer… to…?") and arguments ("by what logic does… imply/follow from…?") that underlie the perceptions and positions of different stakeholders. It includes activities such as analyzing the political debate in the media, identifying and interviewing stakeholder representatives, organizing focus groups, etc. In the simplest case, the analyst seeks answers to these questions to enlighten herself while diagnosing the client's problem. In other cases, the analyst also seeks to make the client see the key elements of the policy debate, or to make all stakeholders involved aware that they perceive an issue in different ways.

Research and analyze—This class of activities aims to obtain knowledge of the past and present states of the system ("what is the situation?"), how the system responds to changes ("what happens if…?"), the underlying causal relations ("what mechanism explains…?"), and possible future states ("what are the chances that… (a change, an action) will occur?"). Knowledge creation by

[2] To make functional use of gender, the policy analyst is referred to as "she", all other actors as "he".

definition entails a change of the mind of the scientists, as they gain new insights from their activities (literature review, empirical data collection and analysis, controlled experiments, model simulations, etc.). The analyst's mind changes as she interacts with scientists: she reads their publications; she interviews experts on the appropriateness of theories and models; she integrates knowledge obtained from different sources, and finds ways for dealing with inconsistencies; she commissions studies to obtain additional data or better models. Meanwhile, the analyst may already disseminate the knowledge obtained in order to change the mind of the client and of other stakeholders.[3]

Design and recommend—The analyst performs or commissions this type of activity to discover existing possibilities and invent new possibilities for action ("how can we… ?"), to predict the consequences of actions ("what happens if we… ?"), and to compare and judge alternative courses of action in the light of the client's interest ("is… to be preferred over…?"). To this end, the analyst typically forms a design team and leads this through a process of comparative analysis, reasoning by analogy, and creative synthesis, to produce alternative policy options. Similar to research and analysis activities, this changes the minds of those involved in the activities. The analyst then confronts the client and other stakeholders with the policy options while clarifying their consequences. This may change these actors' minds: they may come to see a broader range of feasible solutions, or to realize that only a few options are promising, but they may also come to raise their expectations, or to change their preferences, and thus change the policy design problem. While working toward recommendation of a policy option, the analyst typically alternates between creative design (variety) and critical appraisal (selection).[4]

Provide strategic advice—With this class of activities, the analyst seeks to clarify the political aspects of the policy issue to the client to enable him to better protect his interests and achieve his goals in the policymaking process. Strategic action is based on anticipation by one stakeholder of how other stakeholders will respond to certain actions (Schelling 1960; Walsh and Fahey 1986; Mu et al. 2010). The analyst will, therefore, perform (or commission) research and analysis activities to answer questions like "how do others perceive… (the system, what is desirable, how one can act, how others can act, the social relations between stakeholders)?", "how do others reason?", and then, combining the answers, "how

[3] Building on the "seven standards of knowledge utilization" defined by Knott & Wildavsky (1980), Landry et al. (2003) empirically measured the extent of "change of mind" as a result of university research (here referred to as "the work") on a 6-point scale: 1-Reception (the actor received the work), 2-Cognition (the actor read and understood the work), 3-Discussion (the actor participated in meetings for discussion and popularization of the work), 4-Reference (the actor cited the work in his own professional reports), 5-Effort/Adoption (the actor promoted the use of the work in decisionmaking), and 6-Influence (the work influenced decisions in the actor's administrative unit).

[4] For more details on policy design processes, see for example Brobow and Dryzek (1987), Schneider and Ingram (1988), Walker (1988), Smith and Browne (1993), Sidney (2007).

will they respond to… ?", "how are my client's stakes affected if they… ?", and "who have such influence that they can change the perception of others?". She may then use the insights obtained to design and recommend strategic action (Pan and Kosicki 2001). By providing strategic advice, the analyst aims at changing only the minds of the client and his "inner circle" of trusted individuals, since sharing the insights obtained with other stakeholders might change their minds in ways that would invalidate the analysis (Young 2005).

Mediate—This class of activities aims to mitigate or even resolve a conflict among two or more stakeholders. The analyst typically assumes the role of "neutral third party". She seeks first to understand the conflict (What issues are at stake? How do the actors involved perceive these issues? How do they perceive each other? What events have led to conflict?), and based on the insights obtained via this conflict analysis, she develops an appropriate conflict resolution strategy. When the conflict is substantive rather than emotional, the analyst will seek to widen the problem scope and find an acceptable "package deal". When stakeholders have hostile feelings toward each other, the analyst may try to "rationalize" the conflict, shifting the focus from the emotional back to the substantive. Different strategies require different types of mediation. When hostility precludes face-to-face negotiation, the analyst may attempt deal-making via "shuttle diplomacy", trust building by "orchestrating a dialogue", or settling via "arbitrage" (Lewicki et al. 1992; McGreary et al. 2001; Deutsch et al. 2006). In all cases, mediation requires that the actors who are in conflict change their minds: cognitively about the situation, and/or emotionally about other actors.

Democratize—With this class of activities, the analyst seeks to sensitize policymakers not only to the views of experts and political elites, but also to the views and opinions of ordinary citizens and laymen that tend to be overlooked in policy decisionmaking. To this end, she will try to identify all individuals and groups who may take an interest in the policy issue (who will be involved in, or be affected by, the changes that are expected, or the actions that are being planned), she will investigate how these people can be represented in the policymaking process, and will seek to create "platforms" or "forums" that will facilitate and legitimate expression and discussion of opinions (Habermas 1984; Dryzek 1990; Webler 1995). Meanwhile, the analyst also seeks to sensitize the actors involved to the complexity of multi-stakeholder policymaking, for example by presenting alternative views on the policy issue, highlighting the multicausality in the system, and the interdependencies among the actors (Rotmans et al. 2001; Healy 2005; Bekebrede 2010).

In sum, all policy analysis activities are based on the assumption that actors behave deliberately, and that to bring about change requires changing the beliefs and attitudes of actors. It appears that all six classes of policy analysis activities rely on communicative interaction to achieve this: scientists debating on data, models, and theories, designers presenting their plans to administrators, a strategy group discussing different scenarios, attorneys contesting a ruling, citizens voicing their opinions to politicians, a project sponsor reading a progress report.

The contribution of the analyst then lies in designing, arranging, and directing an often intricate set of communicative interactions—brief or extended, face-to-face or mediated, bilateral, one-to-many, or many-to-many—that eventually produce desirable outcomes for her client. The key to designing a successful policy analysis is to diagnose a policy context, to determine whose minds need to change in the interest of the client, and to design communicative interactions that will produce these changes.[5]

5.3 Designing a Policy Analysis = Structuring Flows of Communication

The word "design" is a noun as well as a verb. When we say "*a* design", we often refer to a picture of some kind: the sketch of a garment, the layout of a garden, the technical drawing of a machine. A design is a representation of something that does not yet exist, and, more specifically, a thing that when it becomes real will serve some purpose. In other words, the noun "design" denotes a representation of an artifact that provides sufficient guidance for the realization of this artifact within a given context.

The verb "to design" denotes a purposeful intellectual activity that produces a design-as-noun. Design-as-verb is purposeful in the sense that the artifact is to perform a certain function: the designer has in mind a set of goals that are to be attained when the artifact is realized in a given context. To express this function, a design-as-noun describes the structure of the artifact, the context in which it is placed, the changes it will cause there, and the goals these changes are to serve.

The idea that the realization of an artifact causes changes in the environment in which it is realized can be clarified by viewing an artifact as something static (a "structure") that guides something dynamic (a "flow"). Structure and flow are two essential aspects of any artifact: the structure is the aspect that is immediately linked to its realization (think of a bridge, a power plant, a microprocessor); the flow is the aspect that is immediately linked to its function (a flow of traffic, of electricity, of data).[6] The flow occurs when the structure is realized in its

[5] As Susskind et al. (2001, p. 98) put it, "Policy analysis is composed of both intelligence and social interaction. If analysis were purely intellectual, analysts would take center stage. Likewise, if policy analysis were totally interactive, there would be no need for analysts."

[6] Ropohl (1999, p. 63) links structure immediately to function, but it is wiser to keep flow and function as separate concepts, because some of the flows that occur once the artifact has been realized in its context may not contribute to the attainment of the goals the designer had in mind (e.g., a blowout while drilling for oil, or the flight of capital after a tax reform).

environment. When designing, the designer imagines alternative flows that can achieve the goals,[7] but designs typically emphasize structure, because that is the aspect of the artifact that needs to be realized to produce the flow (Bots 2007).

It is essential for design-as-verb that a representation of the intended form and function of the artifact—the design-as-noun—is produced and can be assessed *prior to* the realization of this artifact. A design-as-noun allows an *ex ante* assessment of the changes the artifact will cause in the real world, and it allows the designer (and also the client and the other actors involved in realizing the design) to judge the merits of alternative designs. Without the separation in time—by a period of rational deliberation—of design-as-verb and realization, the artifact would not be designed, but developed.

When applying this conceptual model of design to policy analysis, it takes some effort to distinguish its structure and flow aspects. As most authors consider *a* policy analysis to be the process that results from applying the policy analysis approach to a policy problem, it helps to think of this process as a flow, and then to look for the structure that guides it. When viewed this way, a policy analysis is a flow of policy analysis activities: discussions with the client, interviews with stakeholders, desk research, model construction, presentations to the client, etc. It is this flow of activities that produces the desired results, such as, for example, enlightening the client about the consequences of alternative policies. The structure that guides this flow consists of the configuration of actors brought together at different moments in time, and the agenda that organizes the communicative interactions among them. One could say that a policy analyst designs and realizes a "belief processor", a kind of intellectual device that, by virtue of its configuration (people and the way they are briefed and "programmed" by the analyst), performs a series of activities that affect the belief systems of the people involved.

5.4 An Illustrative Example

The following case example illustrates that a policy analysis can be seen as a set of planned communicative interactions. For the sake of brevity, the case examples in this chapter are presented in a rather rigorous summary format. They have been selected not only because they constitute good exemplars for the concepts in this chapter and the author has first-hand knowledge of them, but also because the policy analysis processes and context are well documented in journal articles.

Case 1—Priority Setting in National Health Care

Source: A detailed account of this policy analysis can be found in (Bots and Hulshof 2000).

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[7] Some artifacts (think of dams, insulation, customs regulations) are designed to prevent a flow from occurring, but this also fits the general idea of "something static that guides something dynamic".

Client: The client who sponsored the analysis was the Department of General and International Health Policy of the Dutch Ministry of Public Health.

Policy issue: Defining high-priority (focal) areas within the public health sector for the 1995–1998 Dutch national health policy, which would constitute the reference for, among others, allocation of financial resources. The consequences of this policy would be felt especially by hospitals, research institutes, the pharmaceutical industry, and special interest groups such as patient organizations.

Diagnosis: The client needed an authoritative rationale for the identification, prioritization, and eventual selection of these focal areas. As these focal areas would be part of a bill to be ratified by the Dutch Parliament (VWS 1995), the analysis should have the approval of key actors in the public health policy arena.

Function of the analysis: It should generate focal areas at an appropriate level of abstraction (easily recognizable, but not specific projects or organizations in search for funding), and recommend a priority ranking based on public health criteria that could be measured objectively. In terms of the hexagon model presented in Chap. 3, this strongly emphasized *research and analyze* and *design and recommend* activities.

Form of the analysis: The policy analysis would follow the multi-criteria decision analysis (MCDA) approach, see e.g., Lootsma (1999) and Ehrgott et al. (2010). It would build on the best available information for health policy preparation: the *Public Health Status and Forecasts* (PHSF), an authoritative 800-page report on the health situation, morbidity, and mortality in the Netherlands (Ruwaard 1994), and the *Financial Overview of the Care Sector* (FOCS), which provided detailed data on the volume and cost of health care (FOCS 1993). To further increase its authoritativeness, stakeholder representatives would be involved in the crucial decision phases. The global design comprised eight steps:

Step 1. *Cluster diseases to be taken into account.* Adopting the medical classification used in the PHSF, the diseases accounting for more than 2 % of all deaths and/or 2 % of health care or 1 % of all hospital releases were selected and aggregated into 37 clusters based on similarity of the clinical picture and cause of the disease.

Step 2. *Determine criteria for screening disease clusters.* This screening (Walker 1988) should identify the set of most policy-relevant disease clusters. In line with the PHSF, three criteria were operationalized: projections to 2010 of prevalence (the absolute number of people having the disease at a given moment), projections to 2010 of potential years of life lost (an indicator for mortality, weighing death at young age heavier than death at old age), and cost of delivered health care specified for treatment of each disease cluster.

Step 3. *Collect data on screening criteria.* To facilitate comparison, the PHSF data and FOCS data were mapped onto a discrete 10-point interval using different linear and nonlinear progression factor scales. The results were discussed with policymakers at the Ministry of Public Health, who eventually opted for these logarithmic scales: $\log_2(n/3000)$ for prevalence, $\log_2(n/750)$ for years of life lost, and $\log_2(n/1.5 \text{ million})$ for cost of care.

Step 4. *Select most policy-relevant disease clusters*. The discussion with policymakers revealed that they considered prevalence, potential loss of life, and cost of delivered care to be of equal importance. The 37 disease clusters were therefore ranked on the sum of their scores on these criteria. The sum score showed a clear drop after the 14th cluster. Sensitivity analysis using different weights showed that this ranking was very robust: the top 14 disease clusters remained the same, with few rank reversals.

Step 5. *Determine policy goals and focal areas.* The policy goals were operationalized as prolongation of the healthy life expectancy, improvement of the quality of life for diseased and handicapped, and reduction of premature death. The lack of independence between reduction of premature death and healthy life expectancy (and to a lesser extent also the quality of life during illness) was accepted. The focal areas for resource allocation were defined as "cure" (including treatment aimed at reducing the harmful effect of an incurable disease, such as insulin injections for a patient with diabetes), "care" (nursing the incurably ill, handicapped, and elderly), and "prevention" (e.g. health education, and including screening programs) for each of the top 14 disease clusters identified in Step 4.

Step 6. *Impact assessment.* A group of 12 public health experts was invited to a computer-supported consensus-building session. They were asked to estimate (on a 5-point scale) for each focal area how strongly resource allocation to this area would contribute to the attainment of each of the three policy goals. A score of 0 indicated infeasibility (e.g., cure for dementia, or prevention for mental handicaps); 1 indicated very little contribution; and 4 indicated a strong positive effect. Participants were asked to enter a question mark if they felt incompetent to judge about an impact. The computer software aggregated the individual scores and displayed the resulting impact matrix on a public screen, while highlighting cells with significant differences among individual scores. These were discussed, resulting in a final score for each cell.

The final selection of focal areas was made in two steps during a half-day computer-supported consensus-building session with stakeholder representatives.

Step 7. *Determine relative importance of policy goals*. The participants were asked individually to express their weighing of the three goals by distributing 100 points over the three policy goals. The resulting scores were aggregated, displayed, and discussed.

Step 8. *Assess effectiveness of allocating resources to focal areas.* Combining the impact matrix from Step 6 with the weights obtained in Step 7, an overall score was computed for each of the 42 focal areas as the sum of (effect score $\times$ goal weight) for the three goals. The focal areas were sorted in order of decreasing total score, displayed on a public screen, and discussed. The outcomes for alternative goal weights suggested by participants were projected side-by-side, revealing the robustness of a large subset of the focal areas. The group agreed to include the list of all $14 \times 3 = 42$ focal areas with their impact scores on the three criteria, ranked on the basis of the aggregated weights, as an appendix to the health policy bill (VWS 1995).

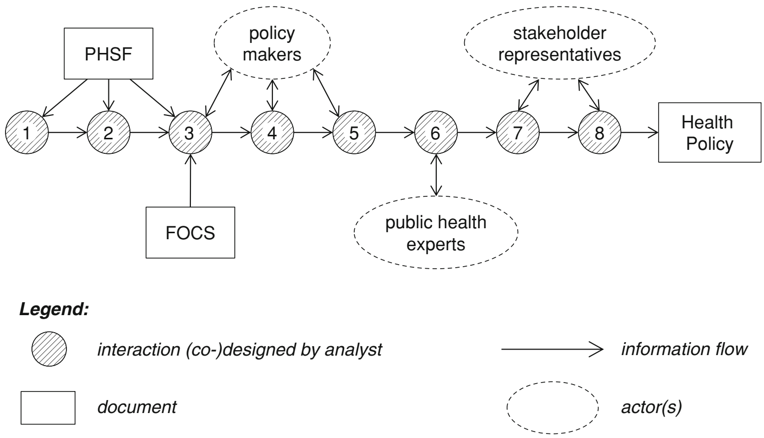


Fig. 5.2 Overall design of the policy analysis in the first case example

This case example brings to the fore several important points concerning the design of a policy analysis. First, each step was designed specifically for the given context. Although the overall design was based on the generic “architecture” that characterizes MCDA approaches, and may be depicted in a process diagram like the one in Fig. 5.1, the actual design decisions are reflected in the division into eight specific steps, the specific activities, data sources, and people involved in each step, and the intended information flow from one step to the next. Figure 5.2 shows the steps, the data sources, and the people (other than the analysis team) involved in each of the eight steps, and the information flows.

The key design decisions reflected in Fig. 5.2 are: to use the PHSF and FOCS as data sources, to consult policymakers at the Ministry to obtain criteria for screening, to invite a panel of domain experts (rather than policymakers or stakeholder representatives) for the consensus-building exercise concerning the impacts of policy options, and to let stakeholder representatives decide on the eventual prioritization. Decisions that are not shown, but were likewise important and deliberately made, concern the selection of individual people to involve, the ways in which information was presented, and the selection, sequence, and timing of the activities during the group sessions.

The case example also illustrates the general idea that when an artifact is designed to function in a context, its structure must be firmly embedded in this context, or it will fail to produce the desired flow. If, when building a bridge, a solid foundation is lacking, it should be laid, or the intended function of the bridge (transporting traffic) is likely to fail. The policy analysis in our example used two authoritative previous analyses (of the *research and analyze* type) as its foundation: the PHSF and the FOCS. Without the widely accepted indicators for the impact of diseases on public health (incidence, prevalence, mortality, quality of life during illness) and cost of care, or without authoritative data on these indicators, the analysis would have failed, or its scope (in time, effort, and people involved) would have had to be extended to lay this foundation first.[8]

The most important point illustrated by the case example is that each of the eight steps in the policy analysis is a communicative interaction. Each step brings together (either face-to-face or mediated via, for example, written documents) a group of people so that they may influence each other with their ideas. Each step is a functional component of the overall policy analysis, designed so that it may change the minds of specific people—that is, either alter or strengthen their beliefs about one or more specific topics. In the first steps, the analysis team (not trained in medicine or epidemiology) learned how to cluster diseases by studying the PHSF. The subsequent discussions about the definition and operationalization of criteria to select the most policy-relevant disease clusters brought new insights for both the client and the analysis team. During the expert meeting, initial disagreement among participants on the effectiveness of cure, care, or prevention was in most cases resolved through argumentation; only rarely did the panel "agree to disagree". Although the participants in the final consensus-building session will probably not have changed their minds about the relative importance of the criteria, they were enlightened by the eventual ranking of options, and reassured by its robustness to changes in weights for criteria. The analysis thus succeeded in providing a sound basis for priority setting in the Dutch national health care.

In sum, designing a policy analysis means designing communicative interactions. Note that, in terms of the hexagon model of Chap. 3, the analysis in the case example combined different types of policy analysis activities. Its primary function was to *design and recommend*: the creative ideas to cluster similar diseases and to define high level policy options as (disease cluster, measure type) pairs can be seen as the "design" part, while the list of top priority policy options compiled at the end of the analysis constitutes the "recommend" part. In addition, the analysis comprised some *mediate* activities (building consensus on the ranking of clusters, and agreeing to proceed with only 14 clusters), and a *research and analyze* activity (assessing the relative effectiveness of prevention, cure, and care for each cluster).

5.5 Policy Analysis = Designing a Series of Communicative Interactions

When designing a communicative interaction as part of a policy analysis, the analyst must find out whose beliefs have to be changed, about what they should change, and the extent to which they should change. She must then choose the appropriate form. A communicative interaction may range from a 20 min

[8] It is instructive to read the second case reported by Bots and Hulshof (2000). This policy analysis, commissioned by the same client, and based on a very similar design, was much less successful, mainly because the definition of the criteria, and the collection of impact assessment information had to be based on less authoritative sources.

consultation with an expert to a six month model-based scientific inquiry, from a 2 h meeting with stakeholders (or a focus group) to a series of five full-day citizens' jury meetings, and from e-mailing a one-page policy brief to a small targeted audience to publishing an 800-page written report. An experienced policy analyst has hundreds of templates for communicative interactions in mind, and is capable of combining them into new ones. Given a client and a situation, she will design the policy analysis by (iteratively) addressing the following questions:

1. Whose minds need to be changed? This will determine the targeted actors.
2. What kind of change-of-mind is desired? This will determine the orientation of the policy analysis within the hexagon model of Chap. 3.
3. What type(s) of communicative interaction can achieve this change-of-mind? This provides the designer with an initial set of alternative design options.
4. Is the present state of the policymaking process such that the preconditions for these communicative interactions to be effective are met? This effectiveness assessment may rule out certain options.
5. Are the client's resources such that the remaining communicative interactions can be implemented? This feasibility assessment may rule out certain options as well.
6. What side effects can be expected when a communicative interaction is implemented? Here, the analyst should consider how the remaining options may affect the state of the policymaking process along all six dimensions of the hexagon.
7. *Closure*: Which of the remaining options is to be preferred? Having established their effectiveness and feasibility, the analyst now assesses the relative efficiency, robustness, and flexibility of the remaining options, and makes the tradeoffs among them transparent.

To answer these questions, the analyst will perform a problem diagnosis of the type described in Chap. 4 (in particular, in Sects. 4.5–4.7).

Provided that the option-screening questions 4–6 above do not rule out all conceivable types of communicative interaction, the analyst then proceeds to detailed design. As proposed in Sect. 5.3, a communicative interaction should be thought of as a configuration of minds that, given a specific set of inputs, will generate a set of outputs.[9] The interaction itself is intrinsically dynamic (a flow), so the analyst designs the configuration and the set of inputs (the structure). The latter may include a format specifying what the outputs should look like (e.g., an impact table, a prioritized list of options, or a map of some kind[10]), but it may also be that the desired outputs are intangible (e.g., trust among the participants). Likewise, the inputs may include an interaction procedure (the computer-supported group sessions in Case 1 followed a rigorous agenda), but the design may also leave this

[9] The design of communicative interactions has become a research field in itself under the name "collaboration engineering" (Briggs et al. 2003; Kolfschoten et al. 2006).

[10] See Carton (2007) for an extensive study on the role of maps in policy analysis.

unspecified (in an expert meeting, for example, the participants are free to figure this out for themselves). When deciding for communicative interaction, and especially when choosing for forms of interactive analysis, the rules of the game for process management as presented in Chap. 6 should be considered as guiding principles for the detailed design.

If, after considering questions 4–6, the set of remaining options is small, or their effectiveness too uncertain, this calls for a reconsideration of questions 1 and 2. The results of the first scan by the analyst may cause the client to change his mind. If that happens, a reiteration over questions 3–7 is called for. If the targeted actor group and desired change-of-mind remain the same, then a staged approach is needed; that is, the analyst will have to investigate whether and in what way the preconditions that are presently not met may be attained. If, for example, knowledge about the soil and groundwater tables in some geographic area is lacking, this may preclude the design of hydrological measures to improve conditions for specific land uses. A lack of financial resources may preclude research activities to obtain new knowledge. High levels of conflict among stakeholders may induce strategic behavior that precludes elicitation and clarification of policy objectives (see Case 2 in Sect. 5.7 for more details on these examples). In the face of such obstacles, the analyst goes essentially through a problem solving and planning process to find a sequence of interactions that eventually leads to attainment of the client's objectives.

A key observation in the health policy case example (but representative for most policy analyses) is that the communicative interactions were designed not at the beginning of the process, but in meetings of the analysis team that took place in-between the eight steps. Although the overall process—the standard MCDA stages of defining decision options and criteria, assessing the impact of options on criteria, prioritizing criteria, and ranking options—was foreseen and approved by the client, the most important design decisions (e.g., to adopt the medical classification used in the PHSF, and the 2 and 1 % thresholds in Step 1, to consult only Ministry employees in Steps 3, 4 and 5, and to have a face-to-face expert meeting to build consensus on impacts in Step 6) were made during such in-between meetings.

Some of these in-between meetings were planned just as carefully as the eight communicative interactions in Fig. 5.2. The designs for the expert panel session (Step 6), and the stakeholder representatives session (Steps 7 and 8), were actually pretested in a meeting during which the analysis team and the client and some of her staff first executed the design by "playing" the roles of the participants, then reflected on the process to see whether the computer support was adequate and the agenda was time-wise feasible, and then tweaked the design accordingly. This shows that a policy analyst will often find herself designing communicative interactions for the analysis team (and often the client as well) to discuss, and then decide on, design choices concerning subsequent communicative interactions. Figure 5.3 visualizes this by also showing the "design interactions"—that is, the communicative interactions that produced the design for the communicative interactions already shown in Fig. 5.2.

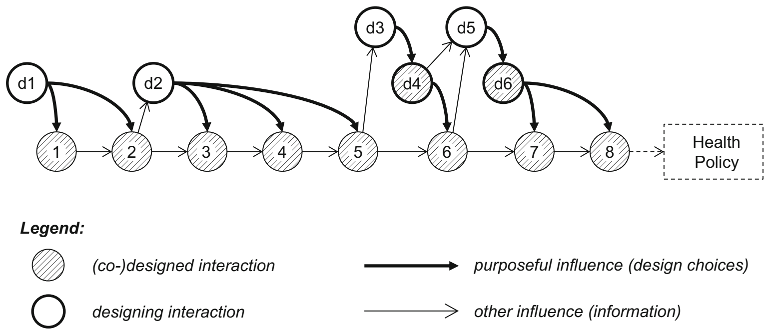


Fig. 5.3 Communicative interactions for designing communicative interactions

As in Fig. 5.2, time proceeds from left to right, and circles denote communicative interactions, such as face-to-face meetings, in which individual actors and/or individual delegates of organized actors exchange opinions. Bold-rimmed circles denote designing interactions, while the gray circles denote communicative interactions that are co-designed by the policy analyst. Figure 5.3 shows that the analysis team first decided (interaction d1) on the specific methodology for steps 1 and 2, and used the results of these steps while designing (interaction d2) the subsequent interactions: compile data from the PHSF and discuss the results with policymakers at the Ministry (interaction 3), perform the screening of disease clusters (interaction 4), and define the focal areas for resource allocation (interaction 5). Having established which disease clusters were to be considered in the subsequent steps, the analysis team composed the panel of experts and developed the procedure and supporting software that would efficiently produce an authoritative impact matrix (interaction d3). Procedure and support tools were first tested and fine-tuned in a simulated expert panel (interaction d4), and then implemented for real (interaction 6). A similar "design-test-implement" approach (interactions d5 and d6) was taken for the session with stakeholder representatives (interactions 7 and 8).

Design interactions are typically initiated and led by the policy analyst, but involve other members of the analysis team and/or external people—hence the term "*co*-designed interaction" for the gray circles. The co-designed interactions are the functional artifacts that first are *planned* in terms of who will participate, what these individuals will communicate about, and what type of "changes of minds" should be brought about, and then are *realized* by inviting people, setting the agenda, mobilizing and using the necessary/available resources, and consolidating results, insofar as this is useful for future communicative interactions and the eventual overall performance of the policy analysis. Note that when design interactions themselves are designed (e.g., interactions d4 and d6), they are depicted as bold-rimmed gray circles.

Instead of information flows, the arrows that connect the circles now symbolize a type of causal influence: A → B means that the process and outcome of communicative interaction A are co-determinants of the process and outcome of communicative interaction B. A bold arrow denotes that the "flow" of communicative interaction A is *intended* to co-produce the "structure" of communicative interaction B. Thus, from all design interactions in Fig. 5.3 there departs at least one bold arrow to a (co−)designed interaction. The thin arrows denote other causal influences (typically flows of information) from one interaction on another—influences that affect only the flow of the indicated interaction, or possibly even the structure, but then without the analyst's intention to do so.

5.6 Policy Analysis = Adaptive Design

An analyst-as-designer cannot impose a structure like the ones in Fig. 5.1 or 5.2 on the entire policymaking process, but—as depicted in Fig. 5.3—she can influence this process by structuring certain parts of it. The set of designed communicative interactions is what is then commonly referred to as "the policy analysis". Separating between structure and flow helps to make clear what a policy analyst *can* design. The dynamics that are inherent in the policymaking process in which a policy analysis is embedded make it practically impossible to design a policy analysis as a whole and then realize it as planned. As realization activities proceed, the "time and space horizons for design" (Simon 1981, p. 178) move, and may reveal new means and ends that call for a change in the design. If the policy analysis does not change, it may become irrelevant (resulting in a report that is ignored). In practice, this often happens (with fixed contracts, with hard-wired terms of reference, work packages, deliverables, etc.).

One way to deal with this moving design horizon is to see a policy analysis as a process of "adaptive design". Keen (1980) coined this phrase to characterize the development process for a decision support system (DSS)—a computer-based artifact that assists decisionmakers in dealing with an ill-structured problem. In Keen's "adaptive design" model, DSS development is characterized by three dynamic interaction loops among the DSS, its builder, and its user (the decisionmaker). As a policy analysis is in many respects similar to a DSS, these three elements and the loops connecting them can be translated in a straightforward manner, resulting in the diagram in Fig. 5.4.

The arrow pairs denote three interaction loops that together constitute the adaptive design process:

1. In the *client* + *other stakeholders* ↔ *designer* loop, the client and other stakeholders communicate needs and policy objectives, while the policy analyst provides method and structure for a proper "meta-discourse" about the policy issue. In this "meta-discourse",[11] the policy context is diagnosed and the purpose(s) of the policy analysis are (re)defined.

[11] We use the term "meta-discourse" to distinguish this communicative interaction between designer and client + other stakeholders from the policy discourse (Fischer and Forester 1993; DeLeon 1998; Torgerson 2003) to which the policy analysis will contribute.

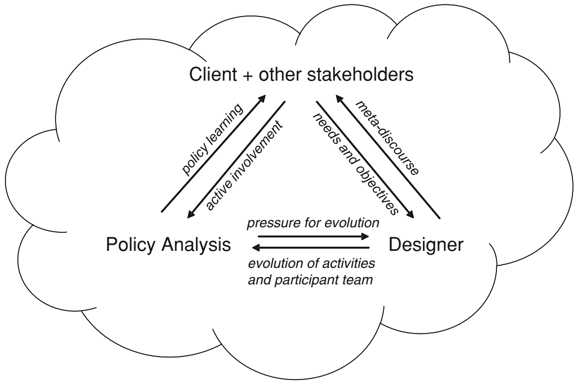


Fig. 5.4 Adaptive design of a policy analysis (after Keen 1980)

2. In the *designer* ↔ *policy analysis* loop, the policy analyst designs the policy analysis activities (communicative interactions) in terms of what, how, and (especially) among whom, and then sees to their implementation. This produces an immediate feedback to the policy analyst that informs her about the effectiveness of the interactions. The analyst reflects on this feedback in terms of "what went as planned, what not, and why?" and this may lead her to reconsider certain design choices. Note that this loop may be fast enough (relative to the duration of an interaction) to allow adaptation by "improvisation in the field".
3. In the *client* + *other stakeholders* ↔ *policy analysis* loop, as part of the policymaking process, the client and other stakeholders participate actively in the policy analysis, contributing to its implementation, impact, and eventual effectiveness. Meanwhile, these actors also gain (new) insights about the policy context, (un)satisfactory situations, possible courses of action, etc. This intended (and sometimes unintended) "changing of people's minds" is a form of "policy learning" (May 1992).

Although Keen's model of adaptive design seems very appropriate for describing the design process of a policy analysis, it does not provide guidance for the design activities themselves. To get a grip on practical design of a policy analysis, the scope of the artifact has to be reduced to a scale where the "time and space horizons" are such that what is designed *can* be realized as planned.

Viewing communicative interactions as *the* building blocks for a policy analysis facilitates "adaptive design", as it renders all communication among analyst, client, stakeholders, and the general public subject to design. The diagram in Fig. 5.3 visualizes this. The policy analysis process thus unfolds as a series of "assess-design-intervene" patterns: the analyst evaluates the state of the policymaking process/context, designs one or more communicative interactions, and sees to their implementation. Together with other (i.e., unplanned) interactions in the context of the policy analysis, this leads to a new state, etc. This form of adaptive design fits well with the process view discussed in Chap. 6 of this book.

5.7 Policy Analysis = Making Design Trade offs

In the public health policy example, the context of the policy analysis was relatively stable: the idea—championed by the Minister of Public Health herself—of setting priorities in the health care sector on the basis of state-of-the-art epidemiological and financial information was not contested by the field. The mediation function of the analysis was secondary, and relatively easy to incorporate in the design. The following case example illustrates that designing a policy analysis becomes much more challenging when the analysis has to perform multiple functions because of a long history of conflict among stakeholders whose perceptions of the policy issue diverge, while authoritative knowledge of the system is lacking.

Case 2—Developing a Local Water Management Plan

Source: A detailed account of this policy analysis can be found in (Bots et al. 2011).

Client: The analysis was sponsored by a local water authority (water board) in the province of Drenthe in the Northeast of the Netherlands.

Policy issue: Defining a so-called "desired groundwater and surface water regime" (*Gewenst Grond- en Oppervlaktewater Regime*, or GGOR for short) for the Bargerveen, a nature area with Natura 2000 status (shaded area in Fig. 5.5). This GGOR would be an essential component of the Natura 2000 management plan, which the Provincial Government was to deliver before 2010. The main nature development objective, set by the Dutch Ministry of Agriculture and Nature Management, was to increase the area covered by a type of living high peat—unique in Europe—which is currently declining. This would require the groundwater level to be raised, which was expected to negatively impact the predominantly agricultural land use in the surrounding area. The GGOR should strike a balance between these competing water interests.

The shaded polygon indicates the Natura 2000 area, the outlined polygon the location of the hydrological buffer zone that was central to the eventual local water management plan.

Diagnosis: The client needed a water management plan that would in particular meet the needs of the farmers having land south of the Bargerveen, and the needs of the agency responsible for the Natura 2000 area, *Staatsbosbeheer* (SBB). These parties shared a long history of conflict, and they distrusted the water board, since a previous, long-debated compromise was unexpectedly vetoed at the last moment by the largest municipality in the area. What further complicated the situation was that the validity of available hydrological models of the area was contested.

Function of the analysis: It should revive the policy discourse among all interested parties, notably the farmers and SBB, but also the local residents, enterprises, and authorities (Ministry, province, municipalities, water board), and produce a GGOR that would be acceptable for all. In terms of the hexagon model

Fig. 5.5 Map of the Netherlands (*left*) showing the location of the Bargerveen (*right*)

in Chap. 3, this strongly emphasized *democratize*, *mediate*, and *design and recommend* activities.

Form of the analysis: The policy analysis would be based on the general GGOR procedure that had been agreed upon by the Union of Dutch Water boards and the national authorities responsible for rural development. This procedure first establishes reference water regimes: the *actual* regime that is currently in practice (AGOR), and for each land use function in the area (agriculture, housing, industry, nature,…) a theoretical *optimal* water regime (OGOR) based on best available knowledge. Next, alternative water regimes are defined and assessed in an iterative process until a regime is found that realizes a certain percentage (typically >70 %) of the optimal performance. If this criterion cannot be satisfied for the present land use functions using the available means for operational water management, changing land use and/or taking more radical hydrological measures may be considered. The GGOR procedure presupposes the use of hydrological models for *ex-ante* assessment of such measures, but does not prescribe particular forms of stakeholder involvement.

Being quite general, the GGOR procedure provided only a global "architecture" for the policy analysis. Since there were no clear steps, the actual process is described here as a sequence of five phases, each comprising numerous communicative interactions. The process is represented in three diagrams using the same "circles and arrows" notation as in Fig. 5.3, but now also showing relevant

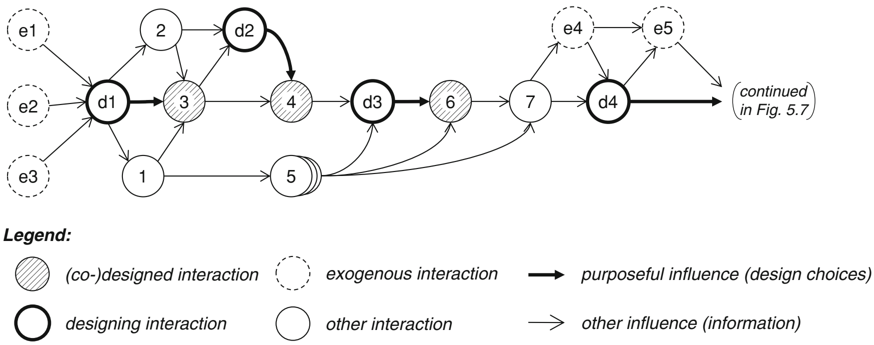


Fig. 5.6 Communicative interactions in the inception and preparation phases

communicative interactions that did not involve the policy analysis team. These interactions are represented as circles with a dashed rim. Although most are indeed external events that influenced the policy analysis, the policy analyst did co-design some of them (e.g., by preparing a presentation for interaction e4 in Fig. 5.6, and by advising strategically on interactions e8 and e9 in Fig. 5.7, and especially on interaction e12 in Fig. 5.8). The communicative interactions will be referred to in the text using the number codes in the circles. As in Fig. 5.3, the letter *d* is used to indicate design interactions. In addition, the letter *e* is used to indicate interactions that were exogenous to the policy analysis.

Phase 1. *Inception* (March–June 2006). The three communicative interactions that eventually led to the commissioning of the policy analysis were the official designation of the Bargerveen as a Natura 2000 area (e1), the formal agreement to use the GGOR procedure for establishing local water management plans (e2), and the decision by the European Commission to fund the Aqua Stress project (AQS) under the 6th Framework Programme (e3). In an informal meeting in March 2006 (d1), two staff members of the water board responsible for the Bargerveen, and a researcher involved in the AQS found that it was a good idea to jointly implement the GGOR procedure. They planned to meet again in June, bringing together the people that could form a joint working team (JWT) that would carry out the GGOR. Both the water board staff members and the researcher sought support (including financial resources) for the project (interactions 1 and 2). At the meeting in June (interaction 3), the water board commissioned the JWT to perform the policy analysis. A water board staff member would formally lead the project and be responsible for resource allocation. The actual GGOR process would be led by a hired consultant, who was highly experienced in managing participatory planning processes. Three AQS researchers would contribute expertise in modeling, decision support, design, and facilitation of group interactions; a fourth would observe and evaluate the process as part of her PhD research project. Additional hydrological and specific modeling skills were obtained by hiring a hydrologist from a large consulting firm.

Phase 2. *Preparation* (June–November 2006). As agreed during the June meeting (interaction 3), the process manager and AQS researchers first designed

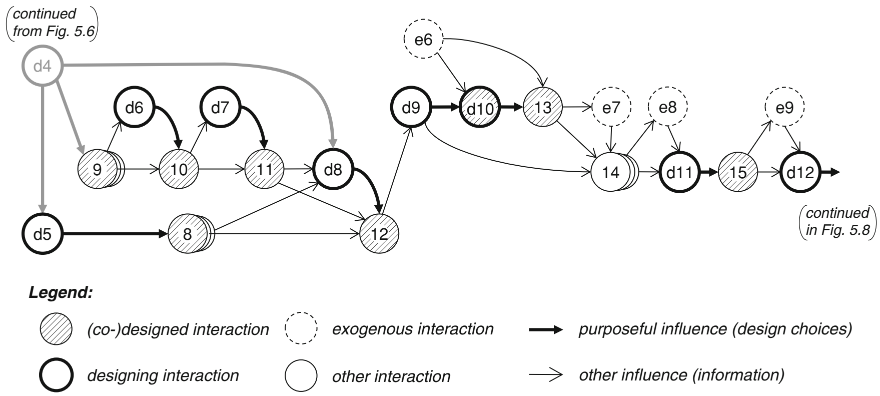


Fig. 5.7 Communicative interactions in problem analysis and model selection

(interaction d2) and then performed (interaction 4) a stakeholder analysis. Meanwhile, land use data were collected (multiple interactions 5). In the following JWT meeting (design interaction d3), the "plan of approach" for defining the GGOR for the Bargerveen was discussed. In outline, this plan followed the GGOR procedure. Since the real challenge was to revive the policy discourse among all interested parties and eventually produce a GGOR that would be acceptable for all, most of the JWT meeting focused on the question how to achieve stakeholder involvement in the process, and commitment to its outcome. The JWT decided to organize stakeholder participation by creating a "sounding board group" comprising representatives of all stakeholder groups (see appendix 1 of Bots et al. 2011 for details on its composition), and carefully planned the first meeting of this group (interaction 6, see also Table 5.1). This meeting was successful: the stakeholders concurred on the proposed approach, their role in it, and made several useful suggestions for the plan of approach. In the following weeks, the process manager updated the plan using all available information (interaction 7), and the project leader then presented it in the next regular meeting of the Executive Council of the water board (interaction e4). This led to some minor revisions of the plan (interaction d4), which was later formally approved in the next meeting of the General Council of the water board (interaction e5). This formal approval made the plan a solid foundation for many design choices later in the process. This influence is denoted by the arrow departing from e5; it is left implicit in Figs. 5.7 and 5.8 to avoid cluttering these diagrams

Phase 3. *Problem analysis* (October 2006–April 2007). To establish the optimal water regime (OGOR) for nature, the process manager assembled a "high peat expertise team" composed of ecologists and biologists suggested by SBB (interaction d5). As these experts had different views, several meetings (interactions 8) were needed before this team was able to specify the particular conditions needed for high peat to develop. As stated in the plan of approach, the process manager and the hydrologist held a series of meetings with small groups of farmers (multiple interactions 9) to discuss the OGOR for their land. The JWT then prepared (interaction d6) a plenary meeting to discuss this OGOR using maps showing water levels and required hydrological measures. This discussion (interaction 10) led to some further refinements (interaction d7) and a second plenary meeting (interaction 11) in which the OGOR for agriculture was approved. Having established the two OGORs, the JWT met again to plan the second meeting of the sounding board group (interaction d8). As stated in the plan of approach, this meeting should focus on measures that would permit a water management regime with acceptable performance (typically 70 % of the OGOR performance). Unfortunately, the optimal regimes for nature and agriculture differed widely: the OGOR for nature entailed an expected highest groundwater level (in winter and spring) for the agricultural area that was several meters above the OGOR for agriculture. This suggested that the water board had only two options: to do nothing and accept a degradation of the peat vegetation, or to create a hydrological buffer zone around the Bargerveen at the expense of agricultural activities. The JWT therefore designed the second meeting of the sounding board group (interaction 12) with the aim (a) to share this insight with the participants, and (b) to clarify that the decision to radically change the water regime so that the high peat in the Bargerveen could flourish would go beyond the jurisdiction of the water board. The process manager would then propose to leave this decision to the province and the Ministry, since they have the capacity to either change the nature objectives, or authorize a change in land use and finance a buffer zone. The second sounding board meeting achieved only aim (a), as the key stakeholders strongly objected against handing over the GGOR decision to a higher political level. The farmers feared that decisions would be taken with insufficient consideration of their stake. SBB doubted the effectiveness of a buffer zone, and wanted more research on the effects of measures. In the subsequent JWT meeting (interaction d9), the team summarized the information needs voiced by the participants, and outlined what additional analysis would be needed.

Phase 4. *Model selection* (April–November 2007). The available computer models were MIPWA (Berendrecht et al. 2007) and Microfem (Hemker et al. 2004). The modelers suggested using MIPWA to explore the effects of measures. This model was especially designed to support GGOR processes in the northern part of the Netherlands, and its development (interaction e6) was co-financed by the water board. The Microfem model, tailored for the Bargerveen area but for a different type of calculations, was considered inadequate. Knowing that the Executive Board of the water board would disapprove a costly model exercise, the AQS modeler arranged a test with MIPWA (interactions d10 and 13), hoping to produce quick results. However, the modelers soon identified serious shortcomings of the model, and enhancement would take at least 1 year. The Executive Board thereupon decided (interaction e7) not to fund additional analysis (including further activities by the process manager!) unless the province would commit to supporting and financing a hydrological buffer zone if such a measure would prove to be effective. In the following months (May–September), the JWT offered strategic advice to the Executive Board (multiple interactions 14) on how to proceed with the GGOR process. In a meeting with the water board principal

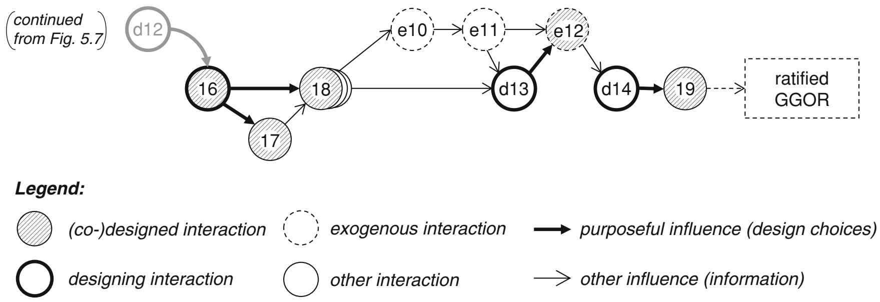


Fig. 5.8 Communicative interactions in assessment of options and policy formulation

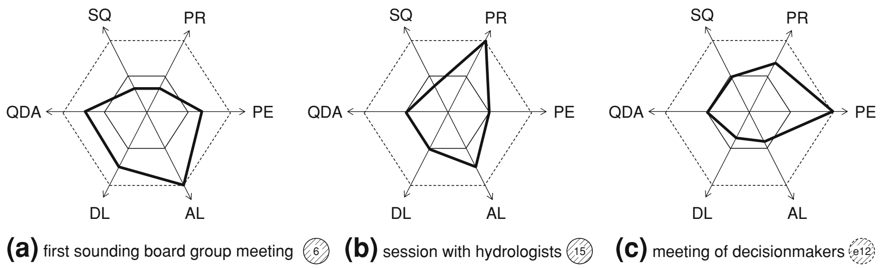
(interaction e8), the responsible executive councillor of the province agreed to base her decision on the best possible prediction with the available models. The process manager forthwith designed (interaction d11) an expert meeting to which all parties could delegate a hydrologist to re-evaluate the Microfem model in a modeling session (interaction 15). The hydrologists concluded that this model could indeed provide an indication of the effectiveness of a buffer zone. When this outcome was presented to the Executive Board of the water board, the board decided to finance additional analysis (interaction e9).

Phase 5. *Assessment of options and policy formulation* (November 2007–April 2008). The JWT quickly proceeded to prepare a third sounding board group meeting (interaction d12). The aim of this meeting (interaction 16) was to discuss the first results obtained with the Microfem model with the stakeholders, and to engage them in the subsequent steps. As agreed in this meeting, the modelers spent some days calculating the effects of a buffer zone of various types and sizes (interaction 17), while the process manager organized bilateral meetings with each of the key stakeholders to discuss the intermediate model results (multiple interactions 18). During these meetings, the modelers explained the structure and parameters of the model, as well as the scenarios evaluated. They presented the model outputs visually with maps that showed the predicted groundwater level related to the two OGORs. Meanwhile, the process manager stressed the limitations of the model and urged the participants to make clear what in their opinion could be decided on the basis of the Microfem model. These sessions were effective. The farmers proposed additional scenarios to evaluate the effects of the OGOR for agriculture on the Bargerveen, while the discussions also revealed their interest in drainage possibilities for wet parcels. SBB initially opposed using the crude Microfem model, but after a critical review of the model and the scenarios evaluated, they proposed some changes, and eventually agreed that the model was adequate for determining the order of magnitude of the effects of a buffer zone. It turned out that, to be reasonably effective, a buffer zone at the south side of the Bargerveen should be at least 500 m wide. This information sufficed for the province to give the green light for developing a GGOR featuring such a buffer zone (interaction e10). When the director of SBB likewise stated that he would support a GGOR with such a buffer zone (interaction e11), the process manager advised the water board principal (interaction d13) to invite the executive councillor of the province and a high official of the Ministry to a meeting "behind closed doors" to make a policy decision. In this meeting (interaction e12), the principal—briefed with the latest analysis results, including review of national and regional budgets earmarked for agricultural land reforms and nature development—managed to obtain commitment of both the province and the Ministry to finding the financial resources that would be needed to implement a hydrological buffer zone. This hurdle taken, the JWT could plan (interaction d14) a final sounding board group meeting (interaction 19) in April 2008 to agree on a GGOR in principle. This final meeting marked the end of the policy analysis.

The GGOR—in principle, because the funding was not firm yet—comprised a 500 m wide buffer zone along two-thirds of the south border of the Bargerveen (see Fig. 5.5), plus measures to compensate the other stakes. In October 2008, the water board, the Ministry of Agriculture and Nature Management, the province of Drenthe, and SBB signed a formal agreement on the GGOR-in-principle (still pending the funding) for the Bargerveen and its surrounding. The definitive GGOR (with a total budget of €20 million) was ratified by the General Board of the water board in May 2009, and formally approved by the provincial council in September 2009.

This account of the Bargerveen policy analysis in five phases illustrates that policy analysis is a process of adaptive design. The gray circles in Figs. 5.6–5.8 show which parts of the policy analysis were designed (as artifacts), while the bold-rimmed circles show the design activities. Compared to our health policy case example in Fig. 5.3, our second case example features many more white circles (i.e., communicative interactions that were not designed). This reflects two characteristics of the Bargerveen case: (a) more "improvisation" by the analyst herself (that is, the analyst relying on her ability to find appropriate structures for interactions in an *ad hoc* manner), and (b) stronger influences of political decisionmaking in the context of the policy analysis. The unplanned communicative interactions in which the analyst herself is not involved (the circles labeled e_i) show how the policy analysis is embedded in a policymaking process. The Bargerveen case shows that these "exogenous" interactions can strongly affect the design of the analysis, but also that the analyst can influence these interactions to some extent.

Adaptive design requires that the policy analyst monitors the policymaking process to assess what communicative interactions are most appropriate in view of the client's needs at different moments in time. The six dimensions of the hexagon model can be helpful in thinking about specific purposes and their relative importance, given the state of the policymaking process. The history of conflict between farmers and SBB led the analyst to consult with these key stakeholders in separate sessions to avoid that the discussion on policy objectives and options would be blurred by the friction. Once properly elicited, the two perspectives could then be used as reference points in subsequent sounding board group meetings. To establish the OGOR for nature, the analyst opted for this design: for want of authoritative scientific literature on the ideal conditions for peat growth, she assembled a team of experts and asked them to establish the "best available knowledge" (*research and analyze*) on this topic in a series of meetings



Legend:

QDA: *quality of debate and arguments* (consistency, richness and openness of arguments, etc.)
SQ: *scientific quality* (validity, reliability, etc.)
PR: *policy relevance* (usability, action orientation, etc.)
PE: *political effectiveness* (workability, feasibility, pro-activeness, personal goal achievement)
AL: *acceptance and learning* (sharing of perspectives, consensus, commitment)
DL: *democratic legitimacy* (openness, transparency, representation)

Fig. 5.9 Desired performance levels (changes in actors' minds) along the six dimensions of the hexagon model of policy analysis (Chap. 3) for three communicative interactions in the Bargerveen policymaking process

(multiple interactions 8 in Fig. 5.7). To establish the OGOR for agriculture, the analyst opted for a different design: she organized a series of "kitchen table talks" with small groups of farmers (multiple interactions 9 in Fig. 5.7) to be able to discuss—on their own "turf"—the specific conditions they required (*clarify values and arguments*). She asked the hydrologist to join these meetings so that possible measures for keeping the land dry could also be discussed (*design and recommend*). These talks provided her with the "building blocks" for drafting the OGOR for agriculture that was subsequently discussed in plenary meetings with the farmers (interactions 10 and 11 in Fig. 5.7).

These examples illustrate that, as was argued in Chap. 3, a policy analysis usually has to be "functional" in more than one dimension, and that specific interactions often need to be "multifunctional" as well. When designing a policy analysis, the purpose for the communicative interactions to be designed can be visualized by using the hexagon model, as in the diagram in Fig. 5.9. The axes correspond to qualitative indicators that can be used to evaluate the performance of each of the policy analysis functions (see the legend and Sect. 3.2 for an elaboration). The inner, solid-line hexagon symbolizes the current "state of mind" of the actors involved. The dashed-line hexagon represents the high end of a qualitative scale, and should be read as the extent to which the "best practice" would be able to change the minds of the actors involved. The center corresponds to the low end of this scale, and should be read as the result of the "worst practice". The thick, irregular polygon connects the points that on this scale indicate the *desired* "level of performance" for the policy analysis on each of the six dimensions of the hexagon model: it indicates the extent to which the communicative interaction that is being designed is supposed to change the client's mind (or, in the general case, the minds of specific actors).

Diagram (a) shows that during the design meeting (communicative interaction d3 in Fig. 5.6) for the first meeting of the "sounding board group" (subsequent interaction 6), the analysis team agreed that this meeting first and foremost should bring together all stakeholders and make them see that the GGOR process would provide a genuine opportunity for resolving the long-standing conflict about groundwater levels. The primary function of this meeting would, therefore, be to mediate among stakeholders. In addition, the meeting should enhance democratic legitimacy (aim: involve representatives of all stakeholder groups), the quality of the debate and arguments (aim: elicit all stakeholder perspectives), and political effectiveness (aim: ensure that all stakeholders commit to the process). The team chose a meeting format that would embody openness and inclusiveness. As the meeting agenda in Table 5.1 shows, the principal of the water board would open with a short formal speech to affirm the intention to find a shared solution. Working in a series of short parallel sessions in small groups (mixing stakeholder groups) would then stimulate social bonding among participants. Letting one reporter summarize what was discussed in his/her group would probably mean that these reporters would have to voice the views of others, which would stimulate appreciation for different perspectives. The facilitator would continuously encourage participants to contribute any potentially relevant pieces of information, including subjective views on the system. Contesting each other's contributions would be prohibited. The risk that this might compromise values of scientific quality and policy relevance was accepted. The shape of the irregular hexagon in Fig. 5.9a reflects these choices.

Diagram (b) in Fig. 5.9 shows that the modeling session with the hydrologists (communicative interaction 15 in Fig. 5.7) was designed with very different priorities in mind. At that stage in the process, the main objective was to establish whether the Microfem model was adequate for assessing whether a hydrological buffer zone would effectively raise the groundwater level in the Bargerveen while keeping the groundwater level in the area south of this buffer zone low enough for agricultural use. The modeling exercise (essentially a *design and recommend* type of activity) should enhance policy relevance (i.e., produce one or more feasible designs) and also acceptance and learning (i.e., convince both the farmers and SBB). The shape of the irregular hexagon in Fig. 5.9b also reflects that the limitations of the hydrological model had to be accepted.

Diagram in Fig. 5.9c shows the desired levels of performance for the meeting of the principals of the waterboard, the province, and the Ministry (communicative interaction e12 in Fig. 5.8). Here, the irregular hexagon shows that this meeting was designed to achieve agreement on a feasible solution. The analysis team prepared factsheets for several alternative water management plans (maps, summary of measures, and cost estimates), and placed the issue of funding as a crucial point on the agenda. In addition, the process manager briefed the water board principal about funds at the provincial and national level that were earmarked for the planned type of land use change. The risk that the format of a meeting "behind closed doors" might be perceived as undemocratic, thereby compromising acceptance of the outcome, was accepted.

Table 5.1 Detailed design of communicative interaction 6—the first formal stakeholder meeting in the Bargerveen process

Time	Topic	Process
8.00	Preparation	Hanging up maps, checking beamer etc.
8.30	Informal start	People arrive/coffee
9.00	Formal start	Welcoming speech by the principal of the water board
9.05	Introductions to the meeting	Short explication of logistics, purpose, and agenda Interactive clarification of expectations in small groups of four: your expectation for this workshop your involvement in the Bargerveen area Each group reports once (but the other persons in the group also get a chance to say their name and affiliation, and can add an expectation if it was forgotten)
9.30	GGOR and Natura 2000	Presentation about GGOR and Natura 2000 (20 min total) Questions of understanding (10 min): no discussion about GGOR/Natura 2000
10.00	Ongoing activities in the Bargerveen area	Presentation of activities that are going on in and around the Bargerveen (in relationship to the GGOR process: 15 min) Questions of understanding (10–15 min) Providing four "raw" maps showing all relevant activities and interests in the area presently known to the project team (5 min for explaining) Working in small groups to complete the maps (20 min)
11.00	Coffee break	
11.20	Reactions to GGOR/Natura 2000 + ongoing activities	Question to all: What are your hopes/fears for yourself/your institution with regard to the GGOR process, Natura 2000, and the ongoing activities? Will they give opportunities for you or your institution? Are you afraid they will bring problems/worries/ uncertainties?
12.00	Activities	Presentation of the planned activities next 15 months (plan of approach: 10 min). Discussion and questions: what is missing, what has already been done, etc.
12.30	Forming "sounding board group"	Discussion about forming a "sounding board group" members and activities are groups missing? responsibilities?! Foundation of the "sounding board group" (if so decided) Checking of dates for next meeting(s)

Each of these specific examples reflects a tradeoff among objectives: give up some scientific rigor to keep key stakeholders on board, accept model limitations to get to acceptable solutions, and accept a low level of participation in the final decisionmaking phase. What the diagrams in Fig. 5.9 do not show are the constraints on time and budget. Nevertheless, the analyst is often bound by such constraints. In both case examples, time pressure was relatively high. To effectively influence the next national health policy bill, the priority setting for focal public health areas had to be done in about 3 months' time. The Bargerveen process, begun in March 2006, was designed to meet the deadline of December 2007 that had been set for all GGORs concerning a Dutch Natura 2000 area. In the Bargerveen case, the policy analysis was at risk to being terminated when the water board refused to allocate additional resources for model development and at some point even suspended the activities of the analyst. In general, a policy analyst will have to work within the budget limits of her client, and she will often have to work against tight deadlines in order to synchronize with the political/administrative calendar. The fact that these constraints tend to change over time provides one more reason for adaptive design.

5.8 Conclusion

The purpose of this chapter was to show that a policy analyst can and should think as a designer. Policy analyses can be designed as artifacts, provided that the distinction between structure and flow is made. A well-designed policy analysis structures the flow of events in a dynamic policymaking process, but its capacity for doing so may be limited, especially when the policy context is unruly. We have argued that to make a meaningful contribution to this process, the design of a policy analysis as a whole needs to be adaptive. As such, the design-as-noun (policy analysis plan) must structure not only the policy analysis activities (interventions) but also the process of adaptation (decision rules for change).

The unruliness of policymaking processes entails that a policy analysis plan can specify in detail only the communicative interactions that will take place in the immediate future. Here, a design rationality focusing on means and ends is appropriate. Such rationality requires that the analyst is capable of assessing the needs of the client and other stakeholders, and of diagnosing the policy context so as to determine the proper "levels of performance" for the next communicative interactions. This diagnosis provides the set of goals by which alternative designs for the next communicative interaction can be judged. To generate different interactions, the analyst needs to have thorough knowledge of the tools of her trade (i.e., the large variety of approaches, methods, and tools that can be deployed in communicative interactions).

Design is a craft, not a science. In addition to a natural inclination toward pragmatic problem solving and a talent for coming up with creative solutions, it requires knowledge and skills that can be obtained in part through education, and in part through professional experience. As Walker and Fisher (1994) point out when they summarize what it takes to be a good policy analyst, it does not suffice to have good domain knowledge (e.g., in the field of natural science, social science, economics);

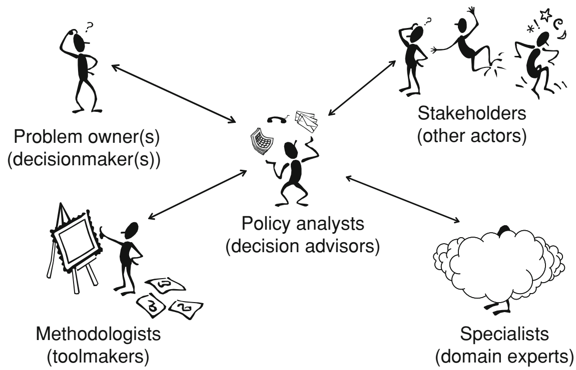


Fig. 5.10 The integrative role of the policy analyst

knowledge of human behavior—of culture—is just as crucial. To this we can add that—fortunately and reassuringly—a policy analyst need not be capable of performing all of the policy analysis activities, as long as she knows how to build, motivate, and direct an analysis team that, in combination, does have this capacity. Figure 5.10 graphically depicts this "spider-in-the-web" role of the policy analyst.

Moreover, a policy analyst should have a sharp "clinical eye", not only for the actors and their relations in the policy context, but also for the individuals and their relations within the analysis team. A policy analysis is first and foremost a series of communicative interactions aimed at changing people's minds, but often enough this requires touching people's hearts.

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Chapter 6
Organizing the Policy Analysis Process

Hans de Bruijn, Ernst F. ten Heuvelhof and Bert Enserink

6.1 Introduction

The outcomes of traditional policy analysis are often discarded, strategically neglected, or (exactly the opposite) strategically used. This illustrates the reality that politicians are not primarily interested in facts and findings, rather they are involved in a political power game in which policy analysis is just one part of the game, or just one element floating by in one of Kingdon's (1995) streams, and is used only in case of a political or policy window. While the traditional view of policy analysis as 'speaking truth to power' may be obsolete, policy analysts have adapted their methods and developed strategies for aligning their working methods to the changing requirements of the dynamic strategic political decisionmaking processes they are trying to support. As illustrated by the hexagon model of Mayer et al. (2004), which was described in Chap. 3, policy analysis activities are no longer restricted to mathematical data crunching in what is indicated there as the 'rational style' of policy analysis; rather modern policy analysts also employ argumentative methods, they mediate, facilitate, involve stakeholders in participative processes, and stimulate social learning (Mayer 1997; Glicken 2000; Pahl-Wostl 2002; Enserink et al. 2010). The integration of content and process, participative policy analysis, and participative modeling have become the core activities of many practitioners working in natural resources, infrastructure management and spatial planning (see, for instance, Geurts and Joldersma 2001; Beierle and Cayford 2002). For example, in the domain of water resources management, there have been claims of a paradigm shift toward a more integrated and participatory management style, which is supported by institutional arrangements, such as Integrated Water Resource Management (Global Research Partnership 2000),

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the European Water Framework Directive (Pahl-Wostl et al. 2007), and Shared Vision Planning (Cardwell et al. 2008). In this domain, though, the focus is mostly on active participation of stakeholder representatives with lower tier government and semi-government organizations.

The pursuit of integration of the political/social and technical elements may be typical for the Netherlands' 'polder model', which puts consultation and compromise in the place of hierarchical administration, since the Dutch decision-making culture is based on the principles of consensus. Outside the Netherlands, more hierarchically organized societies are more typical. But here, too, a turn toward more involvement and sharing of responsibilities can be witnessed. Moreover, even in strictly hierarchical societies, interdependencies exist, and those in power have to cooperate with and involve other parties to reach their goals. Whatever form of administration is present, huge conflicts of interest are common. But they are often dealt with differently in hierarchical societies than in more egalitarian and consensus-oriented societies. Nonetheless, worldwide agreements on issues such as 'good governance' and 'public participation', as for instance laid down in the 'Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters', usually known as the Aarhus Convention (see Rodenhoff 2003), require the initiators of new policies and projects to instigate strategic and environmental impact studies and to allow for the public to have a say. Even China, which is considered to have a very hierarchical government structure, dominated by the state and the party, formally adopted the concept of 'harmonious society' and institutionalized an extensive system of environmental regulations with provisions for public participation, which are currently implemented (Enserink and Koppenjan 2007). These international agreements are a clear expression of the turn toward more participation, and consequently underwrite the need for new participative methods and well-designed and well-managed analytical processes.

This chapter first discusses the need for and character of participation and 'negotiated knowledge' (Salter 1988; de Bruijn et al. 1998; van de Riet 2003; Koppenjan and Klijn 2004) when facing complex or untamed political problems (Douglas and Wildavsky 1983). It then presents a set of 'rules of the game' for organizing these kinds of interactive deliberative processes.

6.2 The Need For and Character of Participation in Policy Analysis and Decisionmaking

Since unilateral decisions using command and control will not work in a network, making a collective decision always results from a process of consultation and negotiation among stakeholders. As discussed in Chap. 2, the many empirical studies into decisionmaking in networks produce a picture of capricious, unpredictable, and, in many cases, seemingly chaotic decisionmaking (Cohen et al. 1972;

Boddy and Gunson 1996; de Bruijn and Ten Heuvelhof 2008). This is because the stakeholders in a network hold different views about the nature and the seriousness of a problem, the aims pursued the authority of the information available, and the need to make a decision. Indeed, they often hold different views about what the problem actually is (van Eeten 2001).

Understanding the role of policy analysis in decisionmaking processes requires insight into the character of the above processes. As many decisionmaking processes involve conflict and are unstructured in character, any decision will create winners and losers, and the parties involved that hold different interests will act strategically. Depending on their degree of engagement, they may be prepared to support or withhold support for the policy or project that is being debated. Consequentally:

- Information is often contested;
- There is no consensus on the character and delineation of the problem;
- The actors involved are often interdependent; no one is in charge or can decide unilaterally what the 'right' problem definition is or what the 'right' information is;
- This world of actors and information is nearly always dynamic; the content of the information changes in the course of time and so does the number of actors involved.

In such a negotiation process, stakeholders use all sorts of strategies (or forms of 'game playing') to exercise maximum influence on the final decision. Examples of strategies that may be used by policy analysts or process managers to enhance progress in such processes are to include as many issues as possible in the process, which increases the number of possible exchanges and couplings (the multi-issue game), to make sure that, for each individual player, 'profit' will exceed 'loss' (the win-win game)), and the strategy of keeping-options-open (i.e., do not fix the problem definition too early, because it might block future decisionmaking) (see Axelrod 1985; de Bruijn and Ten Heuvelhof 2008; Renn et al. 1993).

Two factors are of the utmost importance in characterizing policy problem situations: the certainty about knowledge of the actors and the normative standards (goals, values, principles) that the actors use. As shown in Table 6.1, based on these factors, Douglas and Wildavsky (1983) identified four types of policy problems (see also Hisschemöller and Hoppe 1996):

1. *Tamed problems*: Problems without social conflicts and for which technical solutions are available. These problems are guaranteed to be fully solvable (see also Rittel and Webber 1973).
2. *Untamed ethical/political problems*: Problems with a high certainty of the knowledge available and technical solutions present, but lacking consensus on standards or a normative trade-off of standards is impossible. Many ethical issues come under this category. The debate about pre-embryonic screening, for instance, is not about knowledge, but about values.
3. *Untamed scientific problems*: Problems with a high consensus on ethical standards and/or normative objectives, but little certainty of the knowledge

Table 6.1 Four types of policy problems

	Certainty about knowledge	Little certainty about knowledge
Consensus on normative standards	1. Tamed problems	3. (Un-)tamed technical/scientific problems
Little consensus on normative standards	2. Untamed ethical/ political problems	4. Untamed problems

Source Adapted from Hisschemöller and Hoppe (1996)

available. In order to solve these problems, new knowledge needs to be developed—for instance medicines to cure cancer or HIV infection.

4. *Untamed problems*: Problems with a high uncertainty of the knowledge available and little consensus on ethical standards. There is no *ex-ante* hard scientific information on, for example, the economic and ecological performance of a project. In addition, there is a conflict of values, and different actors will make different trade-offs among, for example, the relative values of economic benefit, ecological sustainability, and safety.

According to Hisschemöller and Hoppe (1996), problem solving strategies seek to mold problems of Types 2, 3, and 4 in a way that makes them fit into Block 1; i.e., untamed problems need to be tamed. This can be achieved by reducing the technological uncertainty and by creating social consensus. This approach will often require redefinition of the problem. For instance, defining HIV/AIDS as an issue of social responsibility and behavior rather than a medical issue opens the door to different types of solutions, such as awareness campaigns aimed at prevention and modification of sexual behavior. Redefinition often allows finding solutions that reconcile the interests of parties who originally opposed each other. Taming Type 4 problems (the real untamed ones) is hard, though. When both knowledge and values are contested, analysis in interaction and consultation with stakeholders (interactive analysis) is the only way forward. As de Bruijn and Porter (2004, p. 268) argue: "especially when the subject is pressing to the stakeholders, knowledge needs to be negotiated and when both values and knowledge are contested the process of involving actors is an important aspect of the analysis itself." When facing an ill-structured problem, discussion on the values is required and, in such situations, policymakers need to engage in a process with stakeholders to jointly find the necessary decisionmaking space. When confronted with a moderately structured problem, extensive consultation of stakeholders and good communication are required (de Bruijn and Porter 2004).

As discussed in Sect. 4.7, several other factors, such as the nature of the conflict, the sense of urgency, the degree of trust among the parties involved, the decisionmaking culture, and the strategy or role chosen by the problem owner need to be taken into account when choosing the kind of interactive approach to follow, making it impossible to provide a simple recipe.

Without going into an extensive discussion, we do point here to the emerging body of literature on (public) participation or participative policy analysis that sheds further light on issues to be considered and problems encountered in designing participatory processes (see, for instance, Bleiker and Bleiker 1993; Gramberger 2001; Pahl-Wostl 2002; Klijn and Koppenjan 2003; Creighton 2005). Generally, participation is considered to contribute to:

- The quality of the analysis, as stakeholder or public knowledge is included and may enrich the analysis;
- The degree of support for the outcomes of the analysis, making them less contested;
- The democratic character of the process (corresponding to 'democratize' in the hexagon model of Chap. 3).

While some authors and guidelines specifically address involvement of the general public, others more generally address participatory approaches, including stakeholder involvement and deliberation. Furthermore, it is pointed out that the distinction between the policy analysis process on the one hand, and the policy or decisionmaking process on the other, tends to get blurred, depending on (a) whether the participation is limited to the preparatory analysis (like in many Environmental Assessment regulations) or to the broader process of building consensus, and (b) the degree of participation chosen. Since Sherry Arnstein published her famous ladder of citizen participation article in 1969, many improved and adapted versions have appeared (e.g. Connor 1988; Tritter and McCallum 2006). Arnstein (1969) distinguished three levels of participation: manipulation, 'tokenism', and citizen power. The bottom rungs are manipulation and therapy, which are considered non-participation, as they are intended to acquiesce the public and get plans accepted or tolerated. Rungs 3, 4, and 5 are informing, consultation, and placation, currently the most common standards for government programs in most countries and considered by Arnstein to be tokenism (citizens are informed and are being heard, but they lack the power to change things). Higher up are the levels of real citizen power with increasing degrees of decisionmaking power: partnership, delegated power and citizen control. At these levels the citizen has a growing ability to bargain and negotiate trade-offs, or even take control. Arnstein's ladder has inspired many others to design their own versions. All have in common that they consider information as the basic requirement for participation, and all have the normative bias that one should move up the ladder to improve democratic decisionmaking.

Two further issues come forward in the literature on participation: the representativeness of those actually contributing to the process, and the connection between a preparatory participative process and the actual decisionmaking process. Who should participate and who actually is participating is a big concern to the organizer of any participatory process, as the outcome of the process should not only contribute to the quality of the plan but also to the legitimacy of the decisionmaking process and the social support for the project. Talking to public participation practitioners in the Netherlands, for instance, reveals a systematic over-representation of retired engineers and the sheer absence of younger people and women with children. To get a good cross-section of society and to check for biases, several stakeholder selection techniques are available, most of them working along the lines and procedures of participatory rural appraisal (Conway et al. 1987; Enserink 2000). More recent methods and techniques for stakeholder identification and actor analysis, for instance by using 'power/interest grids', are described by Bryson (2004), Hermans and Thissen (2009), and Enserink et al. (2010).

The second issue has to do with the management of the expectations of participants in participatory processes and the extent to which their ideas are taken seriously by the decisionmakers, especially by administrators and elected representatives/politicians. It is the basic dilemma reflected in Arnstein's ladder: when does the public get a real say? Mostert (2003); Monnikhof and Edelenbos (2001), Petts (2001), and many others, have addressed this issue and show the discrepancies between promise, expectation, and reality. In addition, Cuppen et al. (2012) argue that disappointment and poor embedding of participatory processes can lead to reduced legitimacy.

In the remainder of this chapter we focus on the design of the participatory process, requirements for the design, and organizational aspects.

6.3 The Need for Process Management

When facing untamed problems, the above discussion suggests that stakeholders should be involved, in one-way or another, in the policy analysis activities. This means that the policy analyst's attention shifts from an exclusive focus on the content of the analysis to the process of involving stakeholders in the policy analysis.

When the focus is on good communication (de Bruijn and Porter 2004), the basic belief still is that the analyst presents the facts, which are accepted by the stakeholders, and the stakeholders make a decision based on them. The stakeholders are consulted, provide information, local knowledge, and opinions, and consequently expect to see their input reflected in the proposed policy or project. This is not a matter of course, however, because there are major differences between the language of science and research and the language of decisionmaking. That is why explicit attention should be given to communicating the findings. The findings should be 'framed' in such a way that they match the stakeholders' frames of reference. See, for example, the comprehensive literature about risk communication (Renn 1998; Morgan et al. 2001).

Essentially, such communication still is a uni-directional activity: the policy analyst tries to explain the findings from the analysis as clearly as possible. However, real interaction is bi-directional and cooperative: it involves stakeholders in designing the analysis and formulating its findings (Burke 1968; Dahinden et al. 1999; Mayer 1997; Renn et al. 1993; Steelman 2001; Kenney 1997; Wondolleck and Yaffee 2000; Yaffe et al. 1996; Giddens 1994). Analysts may make proposals to these stakeholders about the data, system boundaries, and methodologies they will use. Stakeholders can then ask questions about them or put forward proposals for the use of other data. This may be followed by a discussion about the quality of these alternative data. Analysts can check how sensitive the findings are to these alternative data, or analysts and stakeholders can jointly assemble new data. The underlying idea of this strategy is that, in a process of interaction, analysts and stakeholders arrive at common views about the analysis and its findings. In the best case, they will reach complete consensus. Alternatively, there may be consensus about some of the findings and dissensus about other findings. Of course, in the decisionmaking process, the findings about which consensus is reached will be more directive for the decision than those about which there is dissensus.

The findings about which there is agreement are referred to as 'negotiated knowledge' (Salter 1988). This knowledge results from a process of interaction. Participation by the stakeholders guarantees that they will commit themselves to the negotiated knowledge; participation by the analyst guarantees that this knowledge meets professional standards. *Interactive analysis* is partly based on the assumption that once the stakeholders agree with the analyst about the findings from the analysis, these findings will direct the decision. That is why both the analyst and the stakeholders should first invest in consensus about the analysis, followed by the decisionmaking. A major objection may be raised to this assumption because a decisionmaking process has its own dynamic. Stakeholders negotiate with each other, try to gain support for their problem definition and aims, try to conclude package deals, etc. Consequently, each stakeholder will try to gain maximum 'profit' in this process. A stakeholder will, therefore, support negotiated knowledge only if this knowledge contributes to collective decisionmaking that is favorable for this stakeholder. What use is negotiated knowledge to a stakeholder if this knowledge harms its position in the decisionmaking process? There will then be strong incentives for this stakeholder to criticize the negotiated knowledge.

This takes us to an additional strategy, which, in fact, is a complement to interactive analysis. Although interaction serves to reach consensus about the analysis and its findings, these findings also have to facilitate collective decisionmaking (de Bruijn et al. 2002; Collingridge and Reeve 1986). Let us give a number of examples:

- Stakeholders experience a deadlock in the negotiations because they have different problem definitions. Policy analysis may help stakeholders to analyze their own problem definitions. If this causes a number of stakeholders to redefine their own problem analysis, new room for negotiations may be created.
- Stakeholders experience a deadlock in the negotiations because they support different solutions. Policy analysis may help stakeholders, for example by showing them that other solutions are possible that enjoy the support of more stakeholders.
- Stakeholders experience a deadlock, for example because some stakeholders take an ecological view, while others take an economic view. The policy analyst can multidimension this problem—for example, by showing that the problem is an ecological problem, but also a safety problem, a problem of cost-effectiveness, and an employment problem. Multidimensionalism may offer stakeholders new room.

Communication and interactive analysis stand no chance of success, though, if analysis and decisionmaking are planned sequentially, because deadlocks in decisionmaking are difficult to predict. This implies that the analysis and the decisionmaking should run in parallel (they may even be difficult to distinguish in some cases) and that the analysis be designed to be adaptable (see Chap. 5). The analyst and the stakeholders meet in a process of interaction, allowing them to discuss problems in the decisionmaking process.

Interactive analysis implies that stakeholders invest in a process of interaction to reach common views about how to analyze and how to establish the findings from the analysis (de Bruijn et al. 2002). Such a process can be made explicit by agreeing to a number of rules of the game among the stakeholders that state how the interaction should take place. These rules of the game refer to the following issues.

- What experts will conduct the analyses and be involved in the interaction process?
- What will the role of stakeholders be? How will they be involved in the interaction process? For example, how will they be able to ask their questions and offer their criticisms during the research?
- What is the research agenda? How will interim findings be reported? How will the discussion about system boundaries, data, etc., take place?
- If a deadlock arises, how will it be dealt with? How will it be reported? How can deadlocks on issues be prevented?
- How can the process be kept from proceeding too slowly?
- How should progress on the project be reported?
- How should new and unforeseen developments be dealt with?

This complex of rules of the game for such an interaction process is called a *process design*; managing such a process is called *process management* (de Bruijn et al. 2002). A process design is necessary because it structures the interaction among the analysts, among the stakeholders, and between the analysts and stakeholders. Interaction is necessary because there is no single truth in processes with contested information. Moreover, such a design may boost the authority of the negotiated knowledge. If the rules of the game are fair and allow all players—be they analysts or stakeholders—to participate in forming the negotiated knowledge, their commitment to this negotiated knowledge will be stronger, or it will at least be less easy for players to distance themselves from it.

6.4 Rules of the Game

We cannot provide a detailed discussion of the many rules of the game that stakeholders might use. As a matter of fact, the precise set of rules always depends upon the specifics of the situation and the opinions of the stakeholders involved—the right set of rules is the set the stakeholders involved agree upon. Nevertheless, in this section we present some key rules of the game, based upon earlier research and phrased on a certain level of abstraction. As an example, we use a case study (de Bruijn et al. 1998; also see de Bruijn et al. 2002).

Case: *LCA and packages*

The case deals with the "Life Cycle Analysis" of a Dutch waste policy. At some stage, the Netherlands had a shortage of waste processing plants. This led the Minister of the Environment to introduce a packaging policy. He wanted Dutch industry to switch from one-way packages to reusable packages. Reusable milk packs, for example, would reduce the quantity of packaging material needed for the consumption of a unit by a factor of around 40.

Dutch industry fiercely opposed the policy, producing two main arguments: the cost of this changeover to reusable packages would be far too high, and there was no evidence that reusable packages were better for the environment than one-way packages. The reason was that an assessment of the environmental performance of packages required other indicators to be taken into account as well: not just waste, but also the water and energy required, emissions, etc.

After several negotiating rounds, government and industry concluded a partnership agreement. For the time being, the Minister abandoned his plan to introduce reusable packages. Instead, the Minister and various representatives of industry would have life cycle analyses made of the environmental effects of both one-way packages and reusable ones. The research would involve a number of products, including milk, juices, preserved foods, cosmetics, detergents, spirits, condensed milk, and baby food. The Minister and industry also agreed to respect the research findings. If one-way packages were found to perform better environmentally than reusable ones, the Minister would abandon his plan to introduce reusable packages for good. If reusable packages were found to be better, industry would undertake to introduce them. Only one exception to this agreement was possible: further consultations with the Minister would follow, and industry might be released from its obligations should the cost of introducing reusable packages prove to be disproportionately high. Each product would be investigated to see which type of package performed best environmentally.

It will be clear that this problem meets all the characteristics of 'untamed problems' specified in Sect. 6.2. Information is contested, stakeholders are mutually dependent, and situations like these are always dynamic. A process design was made, which was used by analysts and stakeholders to arrive at negotiated knowledge, followed by decisionmaking. Several process designs were made for similar situations. Based upon an evaluation of these process designs-in-action, a number of generic rules of the game for processes were determined.

Rule of the game 1: *Make the stakeholders participate in making the key choices during the analysis.*

Naturally, professional analysts perform the analysis. During this analysis, stakeholders are allowed to influence several important decisions. These are:

- Determining the analysis assignment; also, defining the data and methods and system boundaries that will be used;
- Approving interim reports containing the interim analysis findings, and indicating how the rest of the analysis will be carried out;
- Approving the final report and formulating the conclusions.

In the packaging case, the main stakeholders were the Ministry of Environmental Affairs, several groups of firms (representing the different parts of the packaging chains, e.g. producers of packages, 'fillers', retailers), the environmentalist movement, and the consumer movement. The aim of this involvement was two-fold. First, it allowed the stakeholders to exert maximum influence on the analysis. The idea was that this would increase the chance that they would commit themselves to the result. Second, the stakeholders' involvement forced the analysts to make their analysis as transparent as possible for the stakeholders. This is not self-evident; a particular variable may be of minor importance for the analysts, whereas it is very important for one of the stakeholders. Transparency means that an analyst nevertheless includes the variable in question in the analysis and explicitly indicates its effect on the result.

This transparency is important for committing the stakeholders to the findings from the analysis. During this process, a number of stakeholders attempted to criticize the analysis. Their criticism had little impact, because other parties were able to prove that this criticism had already been dealt with during the process, and that it had no impact on the findings from the analysis.

Rule of the game 2: *Tolerate redundancy in the analysis*.

Consensus in a process like this is not self-evident: stakeholders might disagree about which data or system boundaries should be used. How to deal with conflicting views? The essence is that the conflicting views should be included in the analysis where possible (de Bruijn et al. 1998; Low 2000).

Stakeholders can have additional analysis done in the event of conflicting views. For example, the environmental movement wanted analysis done into the consequences of a changeover to reusable packages for municipal anti-pollution taxes. Although the analysts said it was negligible, the question was nevertheless included in the analysis. The anti-pollution tax consequences were indeed found to be negligible. Widening the analysis would enhance its authority among the environmental movement. It was also attractive to industry, however. The analysis showed that a changeover to reusable packages might increase consumer costs by a maximum of 15 %. Should the environmental movement wish to play down these findings by arguing that anti-pollution taxes would fall (causing the total cost increase to be lower than expected), the defense might be that this aspect had been included in the analysis and that the environmental movement's views were wrong.

Occasionally, parties decide to include each other's exclusive views in the analysis, which leads to competitive analysis. Although this may seem inefficient, in practice it enhances the authority of the findings. If stakeholders' views are irreconcilable (stakeholder A wants to use data set X, stakeholder B wants to use data set Y), they may decide to do an analysis with the help of both data sets. A sensitivity analysis can then be conducted: how sensitive are the findings from the analysis to the different data sets? In the best case, they will influence the findings to only a limited extent. In the worst case, they influence them strongly. If so, this is a fact to be respected and not hidden.

This process gives the analysis a certain redundancy: it has a large number of by-paths and presumed by-paths, rather than taking a linear course. Redundancy improves the quality of the analysis: subsequent criticism of the analysis is difficult, because many of the questions that may be asked were dealt with during the analysis.

Rule of the game 3: *Give the parties a repetitive opportunity to advance their own interests.*

Despite the above arrangements, a deadlock may occur among the players in the process at some stage.

- The stakeholders themselves may disagree about the substance of the analysis; the above options (additional or competitive analysis) are impossible—for example, because they are too expensive, or because there is no time for them.
- There may be disagreement between the analysts and the stakeholders. The analysts may feel, for example, that one of the stakeholders' wishes is infeasible from an analytical point of view.

In such a situation, consensus on the analysis is impossible. If a decision is made, it will always prejudice particular stakeholders, diminishing the chance of achieving negotiated knowledge. It is very important, therefore, to prevent such stalemates where possible or, in other words, to offer the stakeholders the opportunity of advancing their own interests and having an impact on the analysis, as long as possible (de Bruijn et al. 1998; Fisher and Ury 1981; Axelrod 1985; Innes 1996).

This is why the stakeholders should always be asked to formulate the conflict as accurately as possible when there is a stalemate. A peer (i.e., an expert, not being one of the analysts) can then be asked to give a judgment about the matter. The following situations are possible after this peer has given a judgment:

1. In the best case, the players perceive the peer's judgment as binding. It is so convincing that they cannot reasonably avoid it.
2. The peer's judgment may lead to the conflict being reframed. For example, the peer shows that the conflict has more dimensions than the stakeholders had imagined so far. If there are more dimensions, the room for solution will also increase, offering stakeholders a new prospect of agreement.
3. The peer may indicate that the stakeholders' conflict is legitimate. Given the available knowledge, there may be two conflicting views. Although this does not resolve the conflict between stakeholders, it is clear that both views may be legitimate. Occasionally, this may also be attractive to stakeholders; it offers them room in the decisionmaking.
4. The peer may say that one of the stakeholders is right, but the others may refuse to recognize this. Although in this case, too, the deadlock remains, an important rule of the game says the stakeholder who is in the wrong will be obliged to account for its refusal. The stakeholder in question should explain to the other stakeholders, the analysts, and the peer why it takes a view that differs from the peer's. See below about the effects of this duty to give an explanation.

How does this rule of the game work out in the practice of the packaging case? One remarkable finding is that the following mechanism occurred:

- Stakeholders had agreed this procedure beforehand by means of a number of rules of the game;
- Ending up in situation 4 was hardly attractive to them;
- The knowledge that this might happen mitigated their behavior; they made an effort to prevent ending up in situation 4!

Rule of the game 4: *Create repetitive dependencies and a sense of urgency*.

An important aspect of the rules of the game is that, like a timetable, they indicate what decisions the stakeholders should make. There is a final decision (in the example: about the choice of a package), a decision about the findings from the analysis and, prior to this, a series of decisions made during the process (about data, system boundaries, preliminary findings, etc.).

Because the stakeholders know beforehand what decisions have to be made and have made process agreements about them, these repetitive dependencies are specified. The stakeholders know that they will be repetitively dependent on each other during the process, which is an incentive for moderate behavior—a stakeholder showing opportunistic behavior over a sub-decision knows that this may invite a similar attitude on the part of the others over a following sub-decision. Furthermore, the stakeholders negotiating in the process are also interdependent for other issues. Remarkably, these other issues occasionally crop up during the process as well. In the slipstream of the process, many of these other issues are solved in a way that satisfies the stakeholders. For example, the stakeholders in the case study on packages reached agreements about how they would jointly inform the public about environmental issues. This is important, because it boosts the importance of the process and of cooperative behavior in the process.

It is also important, of course, that stakeholders should have a sense of urgency—they have to solve a particular problem, and need each other to do so. The risk of opportunistic behavior will increase if there is no such sense of urgency.

Rule of the game 5: *Make an indirect*, *loose coupling among the findings from the analysis*, *the decisionmaking*, *and the implementation*.

The process on packages had a very clear sequence. First, stakeholders make many decisions regarding the analysis, which result in findings, which can be qualified as negotiated knowledge. Second, stakeholders have to decide which packages, based upon the negotiated knowledge, qualify for reusability. Third, these decisions have to be implemented.

Research shows, however, that sequences like these may be very threatening from the stakeholders' perspective. Suppose, for example, that the analysis showed that a reusable glass jar for vegetables has a better environmental performance than a one-way glass jar. This might mean that both the Minister and industry, therefore, decide that reusable jars are to be introduced at the expense of one-way jars, and that a company like HAK (the Netherlands' biggest producer of vegetable preserves) has to introduce reusable jars. Such a 'tight coupling' between analysis, decisionmaking, and implementation may create the impression that decisionmaking and implementation are 'self-executing' once the findings from the analysis are known. Such a tight coupling makes the process highly threatening for the stakeholders. This is the most likely reason why they do not want to join the process.

How to solve this problem? An important rule of the game is that a loose coupling is agreed among the findings from the analysis, the decisionmaking, and the implementation. When the stakeholders have created 'negotiated knowledge', they negotiate about the decision they will make. The negotiated knowledge is input for this negotiating process, but other considerations may also play a part. Once a decision has been made, the stakeholders negotiate how they will implement it. The decision is input for this negotiating process, but other considerations may also play a part.

In the decisionmaking, stakeholders may deviate from the findings from the analysis; in the implementation plan, stakeholders may deviate from the joint decision. So the tight coupling is transformed into a loose coupling among these three steps, because a tight coupling would place too heavy a burden on the process. Of course, the flip side is that this rule creates the risk that stakeholders will not commit themselves to decisionmaking and implementation. (The next two rules bear a similar risk).

Rule of the game 6: *Give stakeholders an exit option.*

Another rule of the game is that the process has particular exit rules: rules allowing stakeholders to exit the process while it is in progress. These rules have the following structure.

- On the one hand, a stakeholder is given the opportunity of exiting the process. Few conditions are attached to such an exit. In one of the designed processes, the condition was formulated in very general terms: a stakeholder may exit the process if it is of the opinion that its own interests can be insufficiently served in the process.
- On the other hand, two restrictions are attached to this exit option. The first is that stakeholders can use this option only after some time. The idea is that the process would not have a fair chance if stakeholders could use the exit option too early in the process. In the case study about packages, for example, the stakeholders were offered an exit option after the process had been running for a year.

The second restriction is that, although stakeholders may use the exit option, they have a duty to state their arguments. If they use the exit option, they have to explain their reasons to the other stakeholders. They are then free to exit the process. This creates a rule of the game that allows stakeholders to exit the process, but that is subject to some mild restrictions.

Rule of the game 7: *Give stakeholders the option to postpone commitments to decisions made during the analysis.*

A large number of decisions are taken during the process: about the data, the system boundaries, the conclusions drawn from the interim reports, etc. An important question for the stakeholders concerns the nature of the commitment to these decisions. If stakeholders accept the choice of a data set, are they tied to it? If the data set used is found to lead to particular analysis findings, are the stakeholders committed to them? Such a commitment might be very threatening for stakeholders. After all, they do not know what influence the choice of a data set will have on the findings. Neither do they know the consequences of the summation of the various decisions for the result. This is why there is a rule of the game saying that stakeholders can postpone their commitment to a decision. This means that, on the one hand, they accept a decision (for example, data set x will be chosen), but that they are not committed to it. They may go back on their choice later in the process. This, too, may bring great relief to stakeholders—the process is not a trap, leading to fewer and fewer degrees of freedom.

Another condition is attached to the use of this rule of the game: a stakeholder that first accepts a choice and then distances itself from it should account for it to the partners in the process.

The risk of Rules 5, 6, and 7

The reader will observe that the risk of Rules 5, 6 and 7 is that particular stakeholders will eventually distance themselves from the findings of the process, in which others have invested a great deal. How should this risk be addressed? It has been found that, during these processes, a number of mechanisms operate that greatly reduce this risk. In fact, none of the stakeholders in the case study on packages used the room offered by these three rules of the game.

First, certain relations develop between stakeholders during the process. The stakeholders meet frequently, thus intensifying their mutual relations. The stakeholders also depend on each other for other issues. Remarkably, these other issues also regularly crop up during the process. Relations can be used to solve a large number of issues. The process thus creates significant prospects of gain for the stakeholders. The issues addressed in the slipstream of the process referred to above even enhance these gains.

Second, trust in the process and in each other develops among the stakeholders thanks to the room offered. If there is trust, there is also room for learning processes. Stakeholders learn how to put their own views into perspective and get closer to each other. It should also be remembered here that rule of the game 3 may become effective—what seems a one-dimensional problem, which can only result in deadlocks, may become a multidimensional one thanks to interventions by third parties, thus offering room for decisionmaking. If stakeholders learn, it automatically provides them with new prospects of gain. It was very attractive for industry that the Minister of the Environment should recognize that reusable packages might be worse for the environment than one-way packages. It was attractive for the Minister of the Environment that industry should realize that particular packages could be substantially optimized at low cost.

Third, it is remarkable that the environment's expectations about the process have a major influence. The case study about packages not only concerned Parliament, but also several societal organizations. Because these external relations are very important for the stakeholders in the process, consensus about the analysis yields another form of gain—good relations with these external stakeholders.

In conclusion, the fact that stakeholders are unable to agree about all aspects of the analysis seems an important threat to consensus during the process. Many decisions taken during the process are eventually found to have hardly any effect on the result, however, or to have no effect at all. Occasionally, what looks like a main issue during the process, about which stakeholders are very concerned, proves to be just a detail in the end. The reason is that processes of this kind create a great deal of information. Much of this information has to be aggregated when final decisions are made, causing many sub-decisions to become qualified.

The role of accountability

What happens when a stakeholder uses the room offered by rules 5, 6, and 7? The answer is a simple one: it puts its own gains at risk. By backing out, it harms the relations gained. Relations with stakeholders outside the process may be affected as well. Backing out puts the other stakeholders' prospect of gain at risk. These stakeholders may then decide not to distribute the gains to the stakeholder backing out. This may result in a negative profit and loss account for a stakeholder who wants to use one of the rules of the game.

The accountability attached to each rule of the game makes this stakeholder's position more difficult. A stakeholder who backs out is accountable to its fellow stakeholders. What seems a minor hurdle at the start of a process ('just' accounting for it), becomes a difficult one if the process is good (accounting for it to partners with whom relations were built up and who see their gains threatened).

It should be added that a process might take a different course—a stakeholder is snubbed, is given insufficient opportunities to advance its own interest, or is constantly voted down in the decisionmaking. Such a stakeholder may invoke the three rules of the game more easily. As it was already marginalized during the process, it should not come as a surprise to the other stakeholders if it actually uses the room offered. The stakeholders will be conscious of this mechanism, which may be an incentive for them to ensure that every stakeholder derives sufficient 'gains' from the process.

6.5 Conclusion

The above analysis leads to the following picture. An interactive, process managed approach to analysis and decisionmaking may enhance the authority of the analysis and the decisionmaking. The fact that stakeholders can influence the way the analysis is conducted, plus the fact that this influence is specified beforehand in a process design, are important building blocks for such an approach.

A process is not attractive to stakeholders by definition, however. It may be viewed as a trap by them. This is why rules of the game are needed that offer room to stakeholders. These rules of the game concern the coupling between analysis and decisionmaking, the exit option, as well as the nature of the commitment during the process. It is also important for the process to be effective. It will create a strong disincentive to use the room offered if the process presents prospects of gain and good mutual relations. This presents a picture typical of process management—offer stakeholders room in the process, but make sure that the process is of such a high quality that stakeholders feel less and less need to use this room as the process proceeds.

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Part II
Modeling for Policy Analysis

By definition, policy analysis is an analytic endeavor. And quantitative models are one of the most important tools of the policy analyst. Models can serve a variety of purposes in a policy analysis study, and even for the same purpose there may be many different types of models. Prior to developing a model, the policy analyst must decide what the purpose of the model is and which system or process he or she wants to model. A model can help a policymaker or a group of stakeholders in different ways depending on what is modeled.

The question arises when to use which type of model. Appropriateness is relative to the purpose of the model and the context in which it is applied. Therefore, instead of providing a single answer, in this part of the book we will use the hexagon framework introduced in Chap. 3 and an extension of the traditional framework for policy analysis to support analysts in choosing the appropriate type of model and understanding how to build and use it. The hexagon framework provides six generic purposes to which a modeling exercise may contribute. By understanding the questions that are addressed for each of these purposes, the type of model needed to find answers to those questions becomes clear. The six purposes are the vertices of the hexagon shown in Fig. II.1. As explained in Chap. 3, the top half of the hexagon is primarily 'object-oriented', focusing on systems, policy measures, and system models, whereas the bottom half is 'subject-oriented', focusing on people (decision makers, stakeholders, researchers), and their interactions in a policy process, which require different kinds of models. In Chap. 3, labels were assigned to the arcs joining pairs of adjacent vertices, which are called 'styles' of policy analysis. Figure II.1 shows the six styles identified on the arcs. The following two chapters in this part of the book deal with the variety of models needed to support this diverse set of policy analysis purposes and styles.

Chapter 7 focuses on the 'rational' and 'client advice' styles of policy analysis, which link the 'research and analyze', 'design and recommend', and 'advise strategically' purposes. These styles, which are 'object oriented', are often referred to as 'traditional policy analysis.' Their tools are primarily those of operations research and systems analysis. They are based on three fundamental assumptions:

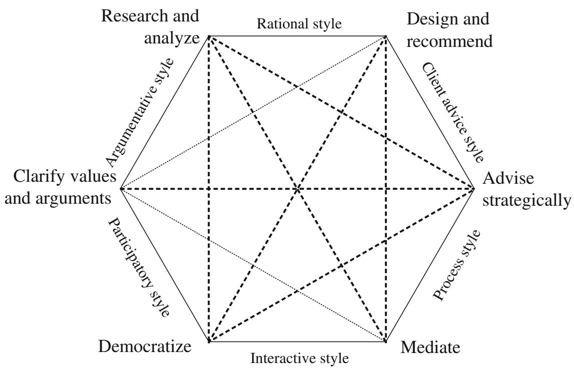

Fig. II.1 The purposes (*vertices*) and styles (*arcs*) of policy analysis.

- The world is to a large extent empirically knowable and often measurable;
- The best available knowledge and methods derived from the social, natural, technical, and economic sciences should be used to provide insights into what might happen if a policy is implemented;
- Knowledge used for policy must be capable of withstanding scientific scrutiny.

Chapter 8 deals primarily with modeling aspects of the remaining four styles of policy analysis. These styles are all based to some extent on the assumption that the substantive aspects of a policy problem are in fact coordinate or perhaps even subordinate to the procedural, subject-oriented, aspects of a policy problem. In these styles, the analyst creates a 'loose coupling' of procedural aspects and substantive aspects of a problem. Procedural aspects are understood to be the organization of decisionmaking or the way in which parties jointly arrive at solutions to a problem.

The traditional framework for the 'rational' and 'client advice' styles of policy analysis is presented in Fig. II.2 (see Walker 2000). In this case, the policy analysis approach is built around an integral system description of a policy domain. At the heart of the system description is a system model (not necessarily a computer model) that represents the domain. The system model clarifies the system by (1) defining its boundaries, and (2) defining its structure—the elements, and the links, flows, and relationships among them.

Two sets of external factors act on the system: external factors outside the control of the policy actors (in the traditional framework, viewed as one or more policymakers), and policy changes. Both sets of factors are developments outside the system that can affect the structure of the system (and, hence, the outcomes of interest to the policy actors and other stakeholders). These developments involve a great deal of uncertainty. The external factors themselves are generally highly uncertain. They include the economic environment, technology developments, and the preferences and behavior of people outside the system. For modeling purposes, the policy changes are not uncertain, but their effects on the structure of the

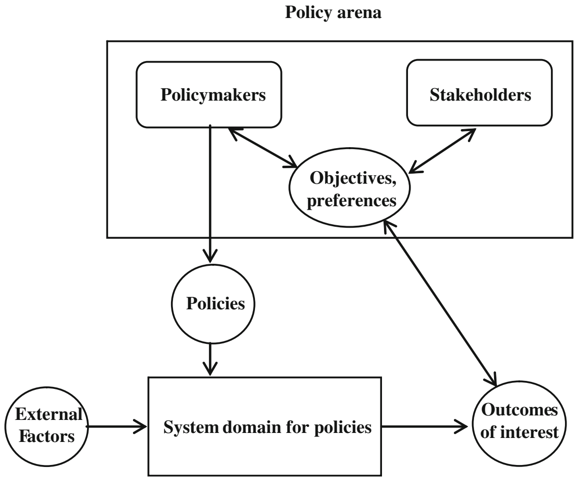

Fig. II.2 Framework for the 'rational' and 'client advice' styles of policy analysis

system are. (We deal with uncertainty and ways to handle it in 'rational' and 'client advice' styles of policy analysis in Chap. 8.)

Policies are the set of forces within the control of the policymakers that affect the structure and performance of the system. Loosely speaking, a policy is a set of actions taken by a problem owner to control the system, to help solve problems within it or caused by it, or to help obtain benefits from it. A goal is a generalized, non-quantitative policy objective (e.g., "reduce air pollution" or "ensure traffic safety"). Policy actions are intended to help meet the goals.

For each policy goal, criteria are used to measure the degree to which policy actions can help to reach the goal. These criteria are directly related to the outcomes produced by the system and determine which outcomes are relevant. Those system outcomes that are related to the policy goals and objectives are called outcomes of interest. Unfortunately, although a policy action may be designed with a single goal in mind, it will seldom have an effect on only one outcome of interest. Policy choices, therefore, depend not only on measuring the outcomes of interest relative to the policy goals and objectives, but also on identifying the preferences of the various stakeholders, and identifying tradeoffs among the outcomes of interest given to these various sets of preferences. The exploration of the effects of alternative policies on the full range of the outcomes of interest under a variety of scenarios, and the examination of tradeoffs among the policies, requires a structured analytical process—the traditional policy analysis process (Walker 2000) that supports the policymaking process.

In the 'rational' and 'client advisory' styles of policy analysis, the object of the analysis is a policy domain. A "system model" is built, which represents the domain and is used to support a decisionmaker, who may have multiple objectives and who has the power to decide whether or not to use certain policy instruments

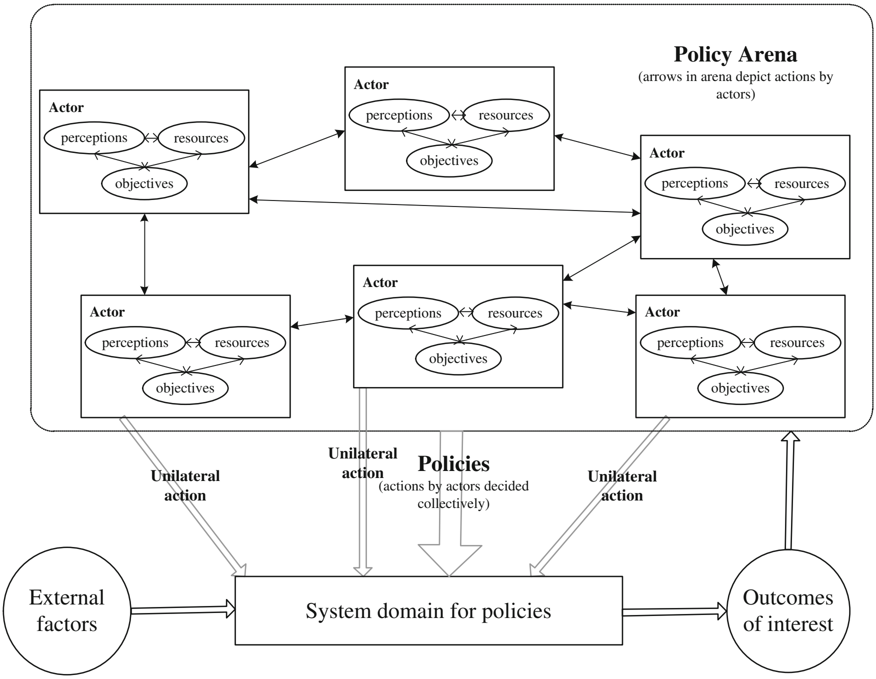

Fig. II.3 Expansion of framework for policy analysis to include multi-actor complexity in the policy arena (adapted from Hermans, 2005)

(e.g. Quade 1989; Walker 2000). The decisionmaker may be a single person at the head of a government organization, or the decisionmaker may be an aggregate construct, consisting of different policy actors. In both cases, the decisionmaker, and his/her preferences and policy instruments are the core of the matter, even though it is assumed that decisionmakers do take into account preferences and ideas from various stakeholders, who might try to influence decisionmaking and policy implementation. This use of system models (basically seen as physical models of a system) and this representation of the role of decisionmakers in policy analysis (basically seen as a single actor) is adequate in many instances, and forms the core of Chap. 7.

But there are three other types of situations in which multiple actors must be considered in greater detail. The three types of situations are summarized below. Each is covered in a separate section of Chap. 8.

First, the policy domain itself can include essential multi-actor components. This is the case if actors form a critical, possibly even dominant, part of the system being analyzed. This will be the case when the system is primarily social or economic in nature—e.g. a healthcare system, education system—or when the main policy instruments to be analyzed are primarily social or economic in nature—economic arrangements, such as markets, prices or tariff structures, or network arrangements, such as covenants between various government and societal actors. The multi-actor character of systems is also increasing in many technical and engineering systems, due to trends of decentralization, liberalization, and privatization in such sectors as water, energy, and telecoms. In all these cases, actors (which are sometimes called agents, and which we will call system actors) are a critical part of the system and, thus, policy analysts should use multi-actor modeling approaches in analyzing those systems. This may result in a mix of physical system models with multi-actor models, or in a system model that is predominantly a multi-actor model (cf. Bots and van Daalen 2007). This situation is treated in Sect. 8.4.

Second, in many policymaking situations, the policymaking context is more complex and chaotic than suggested by the traditional policy analysis framework. Instead of a single actor as decisionmaker, there may be multiple actors that can exert an important influence on the system domain through policies or other instruments. Government, like society, is fragmented into many loosely coupled agencies, departments, and individuals, who have their own interests. Also, the policy domain that is the focus of analysis may overlap with other policy domains, in which other decisionmakers and stakeholders are active and influential. In such cases, it may be inadequate to represent the other actors in the way depicted in Fig. II.2: as ‘stakeholders’ with stakes, goals, and preferences, but no direct decisionmaking power; as ‘external forces’ that represent possible decisions made by important external actors; or as part of an overarching ‘decisionmaker’, lumping them under one label to suggest a homogenous group of decisionmakers. This, more complicated but more realistic, situation has contributed to theories that look at policymaking through policy networks with loosely connected and interdependent actors that interact in the policy process (Hanf and Scharpf 1978).

The main change in Fig. II.3 is the expansion of the box on the top of Fig. II.2 to depict a policy arena that explicitly depicts the multiple actors involved in the policymaking process. Unlike the situation depicted in Fig. II.2, which suggests that policies are decided upon by one or two central actors (‘policymakers’), Fig. II.3 shows that policies are generated within actor networks in which multiple actors are interrelated in a more or less systematic way. The structure of the relationships among the actors in these networks influences the interactions among the actors. For instance, actors with a central position in the network may be able to exert more influence over decisionmaking than actors at the margins of the network. The behavior of actors within networks is further governed by the formal and informal rules that limit and structure the possible range of activities. Thus, policy networks essentially consist of actors, the relations among them, and the rules that govern their behavior (Ostrom et al. 1994; Scharpf 1997).

Specific policy arenas are identified in relation to specific policy problems and issues. These policy arenas provide the platform for actions and interactions among actors in relation to the specific policy problems and issues in the specified system domain for policies. The modeling of these “policy actors” and their interactions is treated in Sect. 8.3.

The third multi-actor situation refers to cases in which decisionmakers seek advice from a policy analyst on how to approach a multi-actor policymaking process, or on how to position themselves in a certain policymaking arena. In such cases, policy analysts are asked to work as process strategists, focusing their analytic efforts mainly on the interaction process among various actors, rather than on the substantive policy problems (de Bruijn et al. 2002; Mayer et al. 2004). This situation has been described in Chap. 6. Modeling approaches that can be used for analytic support in this situation are treated in Sect. 8.5.

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Chapter 7
System Models for Policy Analysis

Warren E. Walker and C. Els van Daalen

7.1 Policy Analysis Models

Although quantitative system models are only one of many tools of a policy analyst, they are an important tool. For the policy analyst, the purpose of building and using models is to estimate things that cannot be observed or measured directly.[1] The prime example is impact assessment—estimating the outcomes of a policy that a decisionmaker may consider adopting. Other uses are diagnosis (estimating what factors have the greatest leverage to change a specified outcome or what is the primary source of a given outcome) and forecasting (estimating how a variable is likely to evolve in the future, usually assuming "present trends"). They also may be used as learning tools (to gain an understanding of how the system works, or may work in the future).

Policy analysis models are fundamentally different from most other types of models that scientists and engineers build. Scientists and engineers usually build models to try to obtain a better understanding of one portion of the real world. The better the match between the model and the real world, the better the model is considered to be. Scientific and engineering models can be validated using empirical data. By contrast, policy models are built to provide information to policymakers who are trying to develop policies intended to solve real world problems, usually for a future situation. They are designed to give policymakers information that can help them develop insights into their problem situation and on

[1] Merriam-Webster's Collegiate Dictionary, 10th edition, 1998, includes the following among its many definitions of model: A description or analogy used to help visualize something (as an atom) that cannot be directly observed.

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which they can base their policy decisions. The models serve as laboratory environments, to test alternative policies and compare their performance without having to actually implement them to see how they would perform.[2]

Many different modeling methodologies are available to the policy analyst. Greenberger et al. (1976) describe modeling methodologies to support policymaking that developed over the course of the twentieth century. An important source of policy models is the field of Economics (e.g., linear and statistical economics), with e.g., input–output analysis, game theory, cost–benefit analysis, and econometric modeling. Another branch of modeling originates more from the mathematical/physics fields (Operations Research, System Dynamics, Agent Based Modeling). With the arrival of faster and cheaper computing power during the 1960s, model development and use became widespread and the models became larger and more complex.

The quality of a policy analysis model is judged not by how accurately it reflects the real world, but by how well it is able to provide information that enables a decisionmaker to make knowledgeable choices among policy options—i.e., how well the model can help construct and defend an argument about the relative pros and cons of alternative policy options. A relatively crude model that can clearly demonstrate that alternative A performs better than alternative B under both favorable and unfavorable assumptions will probably lead to a better decision than a complex model that can perform only a detailed expected value estimation.

Policy analysis models tradeoff rigor for relevance. In many cases they are intended to be used for screening large numbers of alternative policy options, comparing the outcomes of the alternatives, and/or designing strategies (packages of policy options). This means that they should include a wide range of factors (e.g., technical, financial, social), but not a lot of detail about each of the factors. The outcomes are generally intended for comparative analysis (i.e., relative rankings), so approximate results are sufficient. They must provide sufficient information to map out the decision space—the ranges of values of the various input parameters (policy variables and scenario variables) for which each of the various policy options would be preferred. Implementation planning, engineering, and scientific models are needed for examining fewer alternatives according to a smaller number of factors. However, they are used in situations where absolute values are needed (e.g., numbers of vehicles, kilograms of NOx emitted, etc.), which requires more accurate estimation of the results for each factor (and more fully validated models). Therefore, designing a policy analysis model is a balancing act. There is a tradeoff between breadth and depth. Adding too much depth is a pitfall in developing a policy analysis model. Instead of aggregating, approximating, and simplifying, the modeler includes every factor that s/he thinks might have an influence on the results. But to make the model manageable, the boundaries are pulled in (reducing breadth). When the boundaries are too narrow, the model cannot address all the relevant issues. Figure 7.1 illustrates the scope and level of detail of a policy analysis model in relation to that of a scientific or engineering model.

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[2] Of course, engineering design models are built for similar purposes.

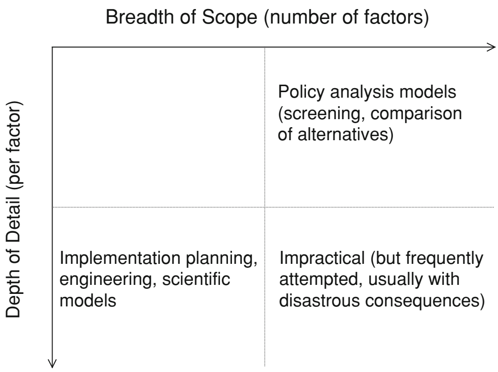

Fig. 7.1 Different types of models have different scopes and levels of detail

A policy analysis model is developed to analyze policies that have not yet been chosen. They have not been (and may never be) implemented, and the impacts cannot be observed directly. Often, though, the theory is suspect, the data have much variation, and even the design of the policy is uncertain. Under such circumstances, it makes no sense to expect to estimate the impacts accurately. Instead, the analyst can use a model to explore the issue (see Chap. 9). A scientific or engineering model will almost always attempt to provide a single estimate of an outcome, perhaps with an error band. A policy model needs to support exploration of possibilities instead of only point predictions.

Once the analyst makes an estimate or draws a conclusion, s/he must persuade the decisionmaker and/or other audiences that it is credible. For this purpose, the model cannot be a "black box"; it must tell a story about how things work in the relevant portion of the world. It must express a set of logical relations, cause-and-effect mechanisms on which to base inferences. The role of a policy analysis model can be shown by looking at the location of the model within the policy analysis framework, which is shown in Fig. 7.2.

A policy analysis system model is a model of the "system domain for policies". A system model is developed to provide the policymaker(s) and other stakeholders with information about the way the system works presently and to explore the possible consequences of implementing different policies under different future circumstances, which is usually impossible to test in a real situation. The role of such a model is schematized in Fig. 7.3. A policy analyst will first investigate a system as it currently operates (the "base case" or the "validation case"). Following this, the system will be investigated in different future conditions ("reference cases" under different scenarios), and for each future condition, many possible policy changes will be explored ("policy cases").

Box 7.1 describes an example of a policy analysis model that has been used to investigate different policy options under different possible future conditions.

A classical example of a policy analysis model is a model that can be used by a policymaker to analyze the consequences of a certain change in a physical system, e.g., adding another runway at an airport. This would have an impact on the number of airplanes that can be accommodated and the noise that is produced, but

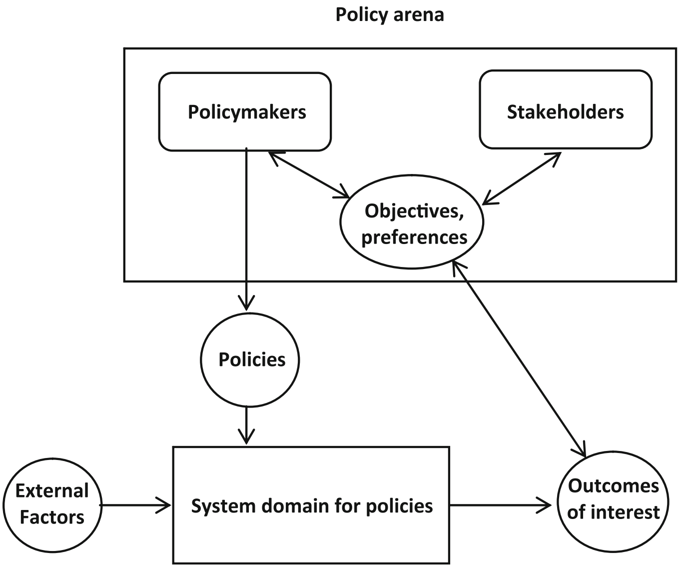

Fig. 7.2 A framework for the rational style of policy analysis

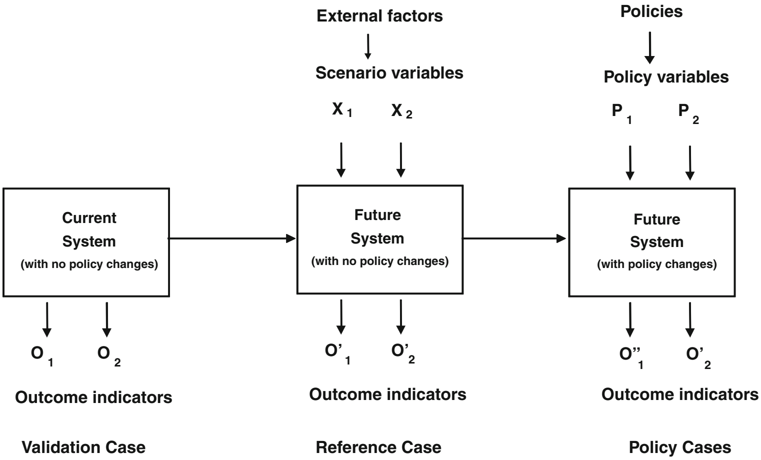

Fig. 7.3 The role of a system model in policy analysis

it will also have socioeconomic consequences a policymaker will be interested in, such as safety, health, and environmental consequences, and costs. The models that can be used for such an analysis will be termed physical system models here, since they consider the policies that impact a physical system. For certain aspects of such a situation, there may specific types of models (e.g., risk and safety) from specific domains; other aspects may require a more general model. A good policy analysis model will allow a decisionmaker to take into account the interests of other stakeholders. The modeler should try to accommodate all relevant outcomes of interest. The outcomes of the models are the criteria that the decisionmaker will use as a basis for decisionmaking, and that the other stakeholders will use to compare the policies being considered. The choice of a preferred policy can be made by weighing the outcomes by their relative importance. In order to select the appropriate method for this type of model, the modeler will have to consider the types of *outcome indictors* that are relevant in the specific situation, and the *characteristics* of the system that is being modeled.

Box 7.1: Example of a policy analysis model for future freight transport in the Netherlands

At the end of the 1980s, the Dutch Government realized that the rapid growth of road freight transport was leading to significant increases in congestion, pollution, and other disbenefits to society. As a result, a broad study was commissioned. This analysis of Freight Options for Road, Water And Rail for the Dutch (FORWARD) was carried out by RAND Europe. It examined the benefits and costs of a broad range of policy options for mitigating the negative effects of the expected growth in road transport while retaining the economic benefits (Hillestad et al. 1996). The study included the development of a comprehensive policy analysis model called PACE-FORWARD, which was used to evaluate the performance of a large number of policy options for several economic scenarios extending to the year 2015. In this model, the major modes of inland freight transportation are represented: road, inland shipping, and rail. The model allows the user to choose a policy option and a scenario. It then estimates a wide range of impacts, including the effects of the policy on vehicle emissions, noise, safety, congestion, and the national economy. Equations and data from a number of sources were used to estimate the various impacts. Although the impact modules come from different sources, the architecture provides a structure within which they function together, using consistent assumptions and a common database. The user chooses the impacts to be displayed and how they are displayed. The results are given as percentage changes from a reference case. Results are displayed graphically and in "scorecards". To run the model for a single policy option takes a few seconds on a PC, so the model provides the user with a way to quickly estimate the performance of many policy options as part of the process of formulating a policy. For further information about PACE-FORWARD, see (Carrillo et al. 1996).

7.1.1 Outline of the Remainder of this Chapter

This chapter discusses both building policy analysis models and how to use them. First, the general life cycle of a model is explained. This life cycle applies to both physical system models and actor models. Following this, we concentrate on physical system models (see Fig. 7.2) in order to identify different types of models and their associated modeling methodologies. The chapter closes with some guidelines for the modeler.

7.2 The Life Cycle of a Model

The general life cycle of a model applies to all types of models. There are a variety of ways of specifying the life cycle of a model (see, for example Robinson (2004) and (Balci and Ormsby 2007)). However, in one way or other, they all include the same basic phases:

Planning: Decide on the model's objectives and what is to be estimated. Planning includes defining the system boundaries and selecting the outcome indicators.
Design: Determine the level of aggregation and general form of the model and specify the details to make it relevant to your particular needs.
Implementation: Represent the model in a way that can be executed by the computer.
Calibration and Validation: Build confidence in the model and identify the questions it will be able to address.
Employment: Make use of the model to further the policy analysis.
Documentation: Explain what the model does, how it does it, and why (and to what extent) its results ought to be trusted.

Each of these phases is discussed in more detail below.

7.2.1 *Planning*

First and foremost, the purpose of models is to help answer the questions you want to ask, and planning can help make this happen. Early in the project, you may not have a clear idea of the specific questions you are going to use the models to help answer. A flexible plan, with due allowance for contingencies, can ensure that you have the time and resources to clarify your ideas. A plan can also keep you from focusing on part of the problem to the exclusion of the remainder. Note that, we speak of models in the plural. It is not necessary, and usually not desirable, to build a single large model that will address all the issues. Instead, think of building a toolkit of many small (but integrated) models (or "sub-models"). Small models have numerous advantages over large models.

A policy analysis model must address the information needs of its users. The first step in designing a policy analysis model should be to assess these needs. Models need to be able to help the policy analyst answer the questions that are asked. This seems obvious, but is harder than it may appear. One problem is that at

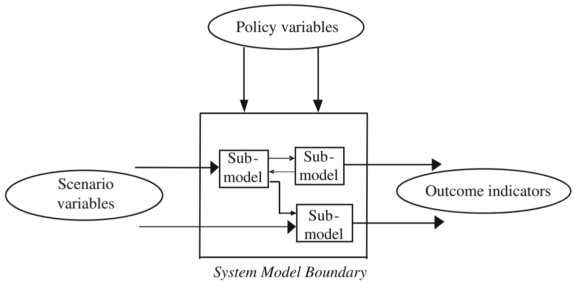

Fig. 7.4 Model diagram with sub-models

the start of model building the policy analyst may not have a clear idea of the specific questions the model will be used to help answer. Take an air quality study, for example. The analyst will clearly need to estimate concentrations of air pollutants from emission rates followed by an estimation of the effects of alternative policies on emissions. So the analyst may set out to build those models. But when the time comes to estimate the outcomes of interest, additional estimations of the financial, social, or health impacts could be needed. This could require building additional models, because the original models were not designed to investigate these aspects.

In order to set the boundaries of the model and to determine exactly what the model should be able to calculate, it is advisable to set up a model diagram. A model diagram is a based on a system diagram (see Chap. 4 and the Appendix). The system diagram is a representation of reality; the model diagram is a representation of the model(s) that will be used to calculate the outcome indicators for the outcomes of interest. In particular, the model (or models) that have to be developed are identified. In addition to system data, the inputs to these models will be policies and exogenous variables.[3] The exogenous variables are variables that the problem owner cannot influence. These may be derived by developing and quantifying scenarios (see Chap. 9). A schematic representation of a model diagram is shown in Fig. 7.4.

Based on the model diagram, the modeler should be able to draw up a set of questions that the model should be able to answer. The questions should include information that is desired to be known about the outcome indicators, which will help in specifying the scope of the model to be built and in selecting the modeling methodology. An example of such a question could be: "What would be the number of takeoffs and landings at a certain airport in the year 2030 for different policies under different external circumstances?".

Table 7.1 indicates questions that should be answered in relation to some of the elements of the outcomes of interest. The final column shows the properties a modeling methodology should possess in order to be of use for estimating the required types of outcomes.

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[3] Note that we label the inputs to a model diagram as *variables* instead of *factors* to emphasize the distinction between a model diagram and a system diagram.

Table 7.1 Relationships between Elements of Outcomes and Model Properties

Elements	Question related to element	Resulting model property
Time	What is the time horizon; i.e., what is the length of the time axis (seconds, months, years)?	Operational or strategic
	Are values of the outcomes needed over the whole period or are only the final values needed?	Dynamic or static
Space	Is the spatial component important?	Spatial or non-spatial
Outcome indicators	What outcomes of interest have to be calculated (e.g., technical, economic/financial, social, environmental)?	Identify submodels needed
	What is the level of detail needed in the outcome of interest?	Micro or macro

The model diagram and the modeling questions will also help the modeler to identify the boundary of the model. It is necessary to decide in advance what will and will not be included in the model. The modeler should be very explicit about the boundary and document it well.

Planning should also consider the elapsed time and person-years of effort it will take to build the models, collect the data, etc. A short study with a small budget implies a "quick and dirty" methodology. During the planning phase the analyst should also explicitly consider the way in which the policymaker and other stakeholders will be involved, since it is essential to involve the relevant stakeholders during the modeling process. Recently, a great deal of emphasis has been placed on what is called "collaborative modeling" or "participatory modeling" (see, for example (EWRI 2011)). These approaches help stakeholders with differing perspectives to integrate their interests into the model, and help to gain their acceptance of the model's results. The model enables them to see "the problem" from their own perspective as well as from others' perspectives. The process of working together on a model keeps the focus on "getting the model right", which reduces the focus on personal conflicts. The experience helps to reconcile the facts and to clarify assumptions, while building trust in the policy analysis process and in the model, and helps the participants to build a shared language and to identify and define areas of agreement and disagreement.

7.2.2 Design

In this phase, the model's structure is specified—the equations and other formalisms that establish the relationship between inputs and outputs. There are many ready-made structures, arising from a variety of disciplines (see Sect. 7.3). You can select one of them and modify it for your own purposes. Or you can formulate your model from scratch.

Formulating a model is a balancing act. Detail can be seductive. Instead of aggregating, approximating, and simplifying, you include all the factors you think might have an influence on the results. But then the model becomes enormous, and to make it manageable you may be forced to pull in the boundary (reduce breadth). If you make the boundary too narrow, your model cannot address all the issues of concern.

Most policy situations are so complex that it is easy to become overwhelmed by the "curse of dimensionality". That is, there are so many possible policy options, so many plausible scenarios, and so many outcomes of interest, that it would be difficult to evaluate the complete range of outcomes for each option and several scenarios. One way to deal both efficiently and effectively with this situation is to use a fast policy analysis model to gain insights into the performance of the policy options. A more detailed model might then be used to obtain more information about the performance of the most promising options. Assessments based on the fast policy analysis model, therefore, would be considered as first order approximations in policy discussions. When a promising policy has been identified using the fast model, it will often be necessary to conduct further detailed planning and research in which full account can be taken of the specific circumstances and characteristics of the problem.

There is no requirement that a policy analysis model need be an aggregate version of a more detailed model that might be used later. In fact, because it is fast, it can contain features that would be impossible to include in a high-resolution model. High-resolution models must be limited in scope, lest they become as unwieldy as to be useless. Also, they are intended to be used for different purposes, so their outputs will be different. For example, a transport policy analysis model might have impact assessment submodels for estimating not only the effects of changes in policies and/or changes in scenarios on transport demand (which is often the focus of high-resolution models), but their effects on the national economy, regional economies, land use, and the environment. The tradeoff between depth and breadth, as discussed in the introduction to this chapter, is extremely relevant here (see Fig. 7.1).

The specific uses of policy analysis models imply that they have specific design requirements. This means that, in most cases, the system models should be designed so that:

- it is easy to represent policy changes in terms of policy variables (variables that the models recognize)
- it is easy to change the policy variables (e.g., they are not hardwired into the models)
- it is easy to represent external conditions in terms of scenario variables and structural changes to the system
- it is easy to change scenarios
- submodels are included for estimating outcome indicators for the outcomes of interest.

These design requirements imply the need for a user-friendly graphical user interface—a "policy cockpit" that allows the user to easily specify and examine the results of different policy choices and policy contexts. A key criterion for judging the usefulness of a policy analysis model is its ability to facilitate the exploration of policy and scenario space (i.e., examine a wide range of policy options for a wide variety of scenarios).

An important part of the design phase is to choose a form for the model or models. Examples of modeling methodologies are System Dynamics and discrete event simulation. Specific modeling methodologies have inherent assumptions about the way a system works. One assumption in System Dynamics, for example, is that the time dimension (and, therefore, the variables in the model) is continuous (i.e., not discrete). The issue of selecting a modeling methodology will be dealt with in more detail in Sect. 7.3.

7.2.3 Implementation

This phase involves developing or acquiring the algorithms for computing the outputs from the inputs and implementing them in computer programs. It also includes the mechanics of feeding the inputs to the programs and collecting the outputs as they are generated.

During the implementation phase, the model is represented in such a way that it can be executed by the computer. If a policy analyst chooses a specific modeling methodology, then there are usually specific software tools that facilitate the representation of these models in the computer. An advantage is that these models can usually be built in a relatively short time. The modeler does need to be aware, however, of the (implicit) assumptions related to the tool and the methodology. A policy analyst can also choose to develop a model using generic software (e.g., a spreadsheet). This means that the model has to be developed from first principles, but there are no implicit assumptions.

Some software tools developed over the last 25 years that have made it much easier to build small models include:

- IThink/STELLA, Powersim, and Vensim, for System Dynamics models
- Arena, Promodel, Automod, and Simul8, for discrete event simulations
- General algebraic modeling system (GAMS), for formulating linear and nonlinear programs
- LISREL, for (statistical) structural equation modeling
- Statistical analysis system (SAS) and SPSS, for statistical analysis
- Analytica and Maple, for models consisting largely of algebraic equations
- Excel, for spreadsheet models
- Access (a relational database tool)
- Matlab (a generic tool for mathematical modeling and visualization)
- Python, a high-level programming language that can be used to integrate (or "glue") existing tools and/or models together.

With the advent of off-the-shelf applications such as these, the architecture of models has changed. Pre-processing (the development of input data) and post-processing (producing data for graphs and tables) used to be programmed as part of the model. Now the model is run and its outputs are dumped into a file. Then the outputs are analyzed using, for example, a standard statistical package. This separation allows more flexibility. Another example is providing scenario (input) data to a System Dynamics model by means of Excel.

Implementation of a model requires quantification of the model's parameters. Determining the parameter values for a policy analysis model is very difficult and time consuming. In a sense, the modeler is not building a representation of the real world, but a representation of observations on the real world. Some of those observations have already been boiled down into a theory (e.g., Newton's laws of motion) that can be incorporated into the representation. Some of them exist as data. But the relationship between theory and the real world, or data and the real world, can be complex.

Data are colored by the circumstances of their collection. Somebody had to decide what to collect, and chose things that seemed important. If the data are collected routinely for administrative purposes, for example, the data elements will be those that the administrator needs, such as employee charges, records showing compliance with regulations, billing records, etc. If a particular data element is costly to collect, chances are it will be collected only occasionally, or a proxy variable (something assumed to be highly correlated with it) will be collected instead. If the people that actually collect and record the data see no benefit for their own jobs, or worse, see a threat (e.g., the manager is checking up on them), the quality of the data is suspect. So, in a sense, there is a model between the real world and the data, which is an additional source of uncertainty in the model's results, even for the base case (see Chap. 9). Experimental data (e.g., clinical trials) will be cleaner. Collecting (and subsequently analyzing) the data is the whole point of the experiment, so attention will be paid to it. But an experiment is controlled. Many factors will be held constant or their range of variation limited. Another way of obtaining data is to use results of more detailed scientific models. The data will then not be based on observations on the real world, but on observations on the output of another model. The resulting model is sometimes called a 'meta-model'.

7.2.4 Calibration and Validation

We want two things from a calibrated and validated model—credibility and the power to predict. But we generally cannot validate our models in this strict sense. *Calibration* establishes the values of otherwise undetermined parameters in the model, using the criterion of a good fit with historical data. There is, however, a great deal of contention about what *validation* is. The most extreme view is that validation should establish that estimates provided by the model are "the same" within specified limits as their real world values would be—a hard thing to do if the model will be used to estimate “things that cannot be directly observed”. If we adopt this view, practically no policy analysis model can be validated. A more modest aim is to establish that the model is well grounded on principles or evidence, or able—when considered as an argument or story—to withstand criticism or objection.

We suggest that validation should be the practical exercise of deciding how the model can be used. Just as a rope may be unable to bear much weight and yet be useful, so a model may be fraught with uncertainty and yet provide important support to an argument. The model may provide a bound—a worst case—that can be used in an *a fortiori* argument. It may provide comparisons you can trust (A exceeds B) without providing good absolute estimates. It may rule out some possibilities. In all these cases, the model can help the analyst construct and defend an argument.

The process of modeling can be viewed as one of narrowing possibilities. One is trying to rule out things that cannot happen. If a great deal about the target system is known, it may be possible to narrow things down to a very small range of uncertainty (i.e., things that cannot happen). If a lot less is known, the remaining uncertainty will be greater. “Validation” is an attempt to describe the remaining uncertainty.

7.2.4.1 Calibration

Calibration can be used to derive parameter values from historical data. This establishes the values of otherwise undetermined parameters in the model, using the criterion of a good fit with historical data. Calibration measures how well the model fits the *historical* data. But it will not say anything about the correctness of the model. That is, even a very good fit will neither guarantee that the correct causal relationships have been identified—the points of leverage for the decisionmaker—nor that it can be used to say anything useful about future outcomes. The same data should not be used for both calibrating the model and validating it, since the results of the validation will then be meaningless.

Many real world observations do not come in the form of tables of numbers, but as qualitative data, such as textual material (interviews, field notes, or published descriptions) or images (photographs or drawings). This information may point toward very important factors that are hard to quantify. For example, morale and training are considered to have a major impact on the outcome of a battle. The question is how these factors can be taken into account in a model. Dupuy (1987) developed his “quantified judgement model (QJM)” as a way to do so, although it has not been widely adopted. Although it is difficult to quantify these kinds of factors, it is often essential into take them into account in a policy analysis model. Lack of data should not lead the modeler to ignore factors s/he thinks are important. These are often “soft” factors that are hard to quantify, but should be included in some way.

Often, there will not be a large set of data points for calibration. Instead the model will have been assembled from lower level bits and pieces, and the value of each calibration parameter will have been obtained from a different source. That is, the model represents a *system*, but the data describe different parts of the system. One can not know whether the data derived from experiments on an isolated part of the system are valid in the larger system context.

We explain and illustrate calibration and validation using the following notional model. This model calculates an outcome Z as a function of a policy P, a scenario S, and some calibration parameters C. The policy, scenario, and calibration parameters are drawn from a policy space, a scenario space, and a calibration space respectively. That is:

$$\begin{aligned} &Z = f(P, S, C) \\ &P \in Pspace \\ &S \in Sspace \\ &C \in Cspace \end{aligned} \tag{7.1}$$

In calibrating the model, it is important to consider the model's behavior throughout the ranges over which the policy and scenario variables are expected to be varied. In Eq. (7.1), we denote those ranges as $Pspace$ and $Sspace$. This requirement is often overlooked when a large set of data points is available and regression is used for calibration. Regression methods fit the model to the data, and give no weight to the behavior of the model where there are no data points. Yet in a policy study the model is often used to extrapolate beyond the range of the data.[4]

There are two classes of extrapolation to consider. First, you may wish to set a variable in the model to a value outside the range it occupies in the data or has occupied in your experience. For example, you might want to examine what would happen if the price of oil tripled, or if the tax on petrol were doubled.

Second, you may wish to consider changes to variables that do not even appear in the model. For example, consider trying to estimate the effect of a new drug on health. A clinical trial is done in which the new drug cures 63 % of the people in the test group, while the standard treatment cures only 27 %. Does this mean we will see a similar improvement in the population at large? Not necessarily. First, the patients in the trial generally won't represent the full range of people in the population at large. Everybody in the trial will be between 25 and 40 years of age, with no allergies and no comorbidities. Studies have shown that subjects in a clinical trial are more likely than the average patient to comply with the drug regimen specified by the physician (compliance rates are so variable that there is no typical rate, but 50 % is as good a guess as any). When the drug is released for general use, physicians at

[4] This can be a point of contention between the policy analyst and the academic researcher. The purpose of an academic study, after all, is to find the truth of the matter. Extrapolation is mere speculation, and is generally frowned upon. The purpose of a policy study is to decide what to do next, and the analyst does not have the luxury of waiting until the truth is known with reasonable certainty. Extrapolation is necessary.

large may not prescribe it for precisely the same conditions as the physicians running the trial. In other words, the carefully controlled conditions of the trial will not be replicated when the drug is released for general use. When we try to predict the effect of the drug on the general population, we must have a way to extrapolate for changes in the factors that were held constant in the trial. Ensuring that the model extrapolates reasonably well requires that the right kinds of features are built into the model during its formulation.

7.2.4.2 Validation

There is a substantial literature dealing with the classical view of validation, especially of simulation models (e.g., Law and Kelton 1991; Kleijnen 1999). In this view, validation should demonstrate that there is some value for C, the calibration parameters, for which the model agrees reasonably well with reality. That is, for some specified bound B:

$$|Truth(P,S) - f(P,S,Cbase)| < B \quad \forall P \in Pspace, S \in Sspace \tag{7.2}$$

Of course, the bound B must be small enough for the purposes of the study in which the model will be used, or the validation can hardly be counted a success. In addition, the policy and scenario spaces, *Pspace* and *Sspace*, must be rich enough to contain the ranges of policies and scenarios of interest in the analysis.

Validation in this strict sense is hardly ever possible, though some models (or theories) in physics come close. Newton's law of universal gravitation plus his three laws of motion constitute the basis for estimating an enormous range of things that are not measured directly. Even this model, however, has a limited range of validity. Extrapolations of Newton's laws of motion to near light speed are very wrong. Moreover, an engineering model based on Newton's laws may be invalid even though the laws themselves are nearly perfect. Friction, for example, may be dealt with by crude approximations. Notwithstanding these approximations, many engineering models have been validated in the classical sense for specific uses.

However, if the classical view of validation is adopted, no policy analysis model could ever be validated. We can validate models only if the situation is observable and measurable, the underlying structure is constant over time, and the phenomenon permits the collection of sufficient data (Hodges and Dewar 1992). It is the requirement to extrapolate beyond the data that makes validation in the classical sense so problematic for policy analysis models. The reason extrapolation makes validation problematic is that the bound B in condition (7.2) becomes large. For most policies and scenarios you can have no confidence that the model matches reality within a usefully small error.[5] A more modest aim is to establish that

[5] This theme is developed in Bankes (1993), Hodges (1991), and Pilkey and Pilkey-Jarvis (2007).

the model is well grounded on principles or evidence, or able—when considered as an argument or story—to withstand criticism or objection.

This does not render models useless for policy analysis. But it does influence the way models can be used. Models have traditionally been used to predict. But when classical validation is impossible, prediction ceases to make much sense. Instead, a model can be used to explore possibilities and investigate hypotheses—in a word, to develop insight. Skeptics often see this as a cop-out; the model can't do the real job, so the analyst has to invent a justification after the fact for having spent so much time and effort constructing the model. A better way of looking at the issue is to note that, although you cannot build a model that can be classically validated without well-nigh-complete information, there is normally a lot of information, knowledge, and data available that can be used to inform decisionmaking. A research methodology called exploratory modeling and analysis (EMA) aims at utilizing the available knowledge and data by specifying multiple models that are consistent with the available information. Instead of building a single model and treating it as a reliable representation of the information, an ensemble of models is created and the implications of these models are explored. A single model run drawn from this set of models is not a prediction. Rather, it provides a computational experiment that reveals how the world would behave if the assumptions any particular model makes about the various uncertainties were correct. By conducting many such computational experiments, one can explore the implications of the various assumptions. EMA aims at offering support for exploring this set of models across the range of plausible parameter values and drawing valid inferences from this exploration (Bankes 1993; Agusdinata 2008). From analyzing the results of this series of experiments, analysts can draw valid inferences that can be used for decisionmaking, without falling into the pitfall of trying to predict that which is unpredictable. (For further discussion of the use of models for exploratory purposes, see Sect. 9.3.4).

Although strict validity cannot be determined, it is necessary to build confidence in whatever model (or models) are being used. This is done by carrying out a variety of tests. As the first step, it is important for credibility that during the development of the model (or models) all information that is available from a variety of sources is taken into account, including observations, general knowledge, theory, and experience/intuition (Van Horn 1971; Law and Kelton 1991), and that people who are knowledgable about (parts of) the system under study and policymakers are involved throughout the modeling process (Law and Kelton 1991).

A model used for policy analysis cannot be a "black box"; it must tell a story about how things work in the relevant portion of the world. It must express a set of logical relationships—cause-and-effect mechanisms—on which to base inferences. If a model is used to extrapolate the historical data (which is often the case in policy analysis), then the data count for less and the form of the model counts for more. This means that a test in which a comparison is made between model and real system output is not sufficient, and a wider variety of tests is required.

Barlas (1996) distinguishes three types of tests for the assessment of System Dynamics models, but these tests can be extended to policy analysis models in general: direct structure tests, structure-oriented behavior tests, and behavior pattern tests. The last type of test relates to comparing model behavior to the behavior of the system that has been modeled, and the first two investigate the internal structure, or form, of the model. During the validation phase, the model structure is studied first and the model behavior is studied only when the structure is considered to be adequate.

In a direct structure test (Barlas 1996), the model is investigated without running it. Direct structure tests include investigating if equations, parameter values, and/or distributions are consistent with theory and/or available data. Additional tests include checking if equations are robust even for extreme input values, and carrying out a formal inspection or walkthrough.

In a structure-oriented behavior test, the model is run and, by investigating outputs, the structure is studied indirectly (Barlas 1996). One such test is an extreme condition test for which extreme values are entered and the behavior of the model as a result of these values is investigated. In a transport emission model, for example, one could test what would happen in a situation in which there are no vehicles on the road and in which there is an extremely large amount of transport. A sensitivity analysis is also a very important structure-oriented behavior test. If the output is sensitive to a part of the model, then that part requires careful modeling (Law and Kelton 1991), as it is important to the behavior of the model. The more coarse tests are carried out before more detailed tests. For example, an extreme condition test would be carried out before a sensitivity analysis.

The third type of test, a behavior pattern test (Barlas 1996), entails determining if the model output adequately represents the relevant system behavior. The model is tested as a whole and requires an existing system similar to the one modeled (e.g., the current version of the system whose future performance is to be estimated), and seeing whether the model adequately reproduces its outcomes. (This is the "base case" shown in Fig. 7.3). When carrying out a quantitative comparison, classical statistical tests cannot be applied directly, because model and system output are often non-stationary (Van Horn 1971; Law and Kelton 1991). Sterman (2000) and Law and Kelton (1991) describe approaches for quantitative comparison of model output and system output. A further test to investigate if the model adequately represents system behavior is a variant of the Turing test in which experts are presented with model output and system output without knowing the origin, to see if they can distinguish which is which. The above tests relate to comparing model and system output. However, rather than focusing on achieving a good fit with historical data, the validation of a policy analysis model should focus on determining if the model can be used for the purpose for which it has been developed, which is usually to investigate the behavior of a future system.

In many cases, the information that exists for building a model is insufficient to specify a single model that accurately describes system behavior. In this circumstance, models can be constructed that are consistent with the available information, but such models are not unique. Rather than specifying a single model and falsely treating it as a reliable image of the target system, the available information is consistent with a set of models, whose implications for potential decisions may be quite diverse. A single model run drawn from this potentially infinite set of plausible models is not a "prediction"; rather, it provides a computational experiment that reveals how the world would behave if the various guesses any particular model makes about the various unresolvable uncertainties were correct. One use of EMA (see Sect. 9.3.4) is to explore the set of plausible models and examine the implications of the resulting computational experiments. Used in this way, EMA can be understood as searching or sampling over the ensemble of models that are plausible given a priori knowledge. (This use of EMA is described more fully by Kwakkel et al. (2010)).

Sometimes model results can be compared to other models that have been developed in the same or similar fields, and there may also be other models that represent part of the system in more detail, where certain variables can be compared. System experts can also be involved in reviewing the model output for the future situation. However, care should be taken with this, since the reason for building a policy analysis is that it is not known what output to expect from the future system (Law and Kelton 1991). It may also be desirable to carry out complementary research to further increase confidence in the model by investigating model results outside the computer context—for example by conducting experiments or carrying out a field-test (Van Horn 1971).

As explained above, policy models are inherently unvalidatable. Hodges (1991) calls these "bad" models. But, he spells out the "six (or so) things you can do with a bad model". The main point here is that any particular model can be used for specific purposes. These purposes should be made clear by the modeler, and use of the model should then be limited to these purposes.

7.2.5 Employment

The findings during the validation phase will limit the ways in which the model should be employed. A policy analysis model will have to be run numerous times, because the reference case and alternative policies will have to be investigated under different external future conditions (i.e., for different scenarios). A model can estimate the absolute values of the indicators, or their values relative to a baseline or reference case. Estimating relative differences from a reference can be more useful and reliable (for analytical purposes, the policy analyst usually cares mainly about how alternatives compare with each other and with the reference case).

Traditional policy analysis assumes that models will be used for prediction (and, sometimes, even for optimization). One standard approach is cost–benefit analysis, for which the analyst calculates all costs and benefits in monetary terms, and selects the policy with the highest excess of benefits over costs. Another approach is cost-effectiveness analysis, where the various effectiveness measures are estimated in their natural units (e.g., number of fatalities, tons of CO_2, etc.). Uncertainty, more than any other circumstance, constrains the proper use of a model. A model with very little uncertainty can be used to accurately estimate the impacts of a policy (prediction), or compare many policies to find the one with the most favorable impacts (optimization). A model with large uncertainties in the relationships or values of the parameters, however, should not be used for either purpose. In this case, even if a model estimates that Policy A has a better outcome than Policy B, one cannot be confident that things will turn out that way in reality.

Traditional policy analysis does recognize the existence of uncertainty, but it assumes one can deal with it within the prediction/optimization paradigm. Two common ways of dealing with uncertainty using predictive models are (1) incorporate uncertainty into a utility function, and (2) find bounds in the outcomes of interest through the use of sensitivity analysis (see Box 7.2).

The traditional method of employing a model runs the model only a small number of times. Exploratory modeling (Bankes 1993) is a method for employing a model that calls for hundreds, even thousands of runs. You may wish to locate really bad regions of the input space—places you want your policy to avoid. You may want to design a robust policy—one that copes reasonably well with a range of possible futures. Or you may want to design an adaptive policy—one that leaves options open. These alternative (non-traditional) ways of using policy analysis models to design policies are described in detail in Chap. 9.

Box 7.2: Example of the use of sensitivity analysis

Caulkins et al. (1997) used sensitivity analysis to generate a figure like Fig. 7.5. The analysts built a model to estimate the reduction in kilograms of drugs consumed per million dollars invested in one of three policies, "More Treatment", "Longer Sentences", and "More Arrests". The figure maps the regions where each of the policies performs best as a function of the values of two key calibration parameters, the cost of making an arrest and the value to a drug dealer of avoiding a year in prison. (The other calibration parameters were all held at their baseline values.)

In the Caulkins study, the analysts made no attempt to develop probability distributions. Instead, they estimated baselines for the scenario *Sbase* (shown by the star). For each policy they ran their model for many scenarios *S* in a neighborhood of *Sbase*. They made the neighborhood large enough so that in their judgment it included all scenarios that were reasonably likely. They observed that the baseline assumptions lie well inside the region where the "More Treatment" policy is the best. They argue that it is unlikely that the true assumptions will be enough different from the baseline to make the "Longer Sentences" policy preferable. They are less sure that "More Treatment" is truly better than "More Arrests." It overstates the conclusions of Caulkins et al. only modestly to say that they regard the "More Treatment" policy as very likely to be the choice that performs best on this impact.

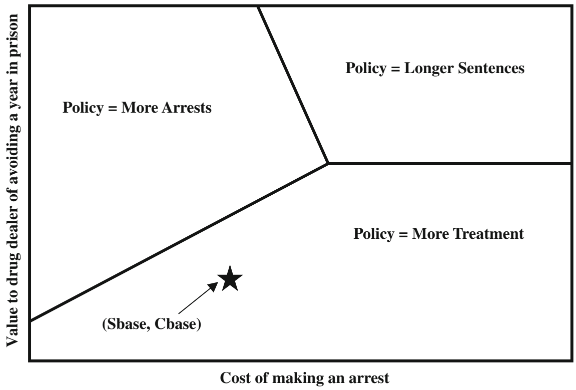

Fig. 7.5 Which program is most cost-effective at reducing drug consumption?

7.2.6 Documentation

There are basically three types of model documentation:

(1). *Executive summary:* This type of documentation motivates the model and describes it in non-technical terms. It is a concise description to help policymakers and other stakeholders understand how the model can be used for policy analysis. It buttresses the model's credibility, and is always necessary.

(2). *Users' manual*: This type of documentation gives complete instructions for collecting data and operating the program. It also presents the mathematical details underlying the model's calculations.

(3). *Program description*: This type of documentation is designed primarily for computer programmers. It includes file specifications, installation instructions, etc. It is useful for maintaining and modifying the model. It should discuss sources of calibration data and the details of whatever formal validation exercises were attempted.

If the model is small and won't be used in any follow-on projects, the last two kinds of documentation are often omitted. Documentation is very costly. But, it is an essential part of any policy study.

7.3 Tools and Templates for Building Physical System Models

Many different mathematical forms of system models have been employed, arising from different disciplines. Interestingly, this list would have looked pretty much the same 25 years ago as it does now. It is very useful to become familiar and comfortable with all of these model forms. On the other hand, one should be wary of using these tools. Each tool tells a story. It can predispose the modeler to see things in a certain way, and obscure alternative ways of looking at things. This reduces the effort when it is the right thing to do, but it can cost additional effort, or lead to wrong conclusions, when it is not. Ackoff (1974) bemoaned the decline of operations research (OR) as follows:

> "By the mid-1960s most OR courses in American universities were given by academics who had never practiced it. They and their students were text-book products engaging in impure research couched in the language, but not the reality, of the real world. As a result, OR came to be identified with the use of mathematical models and algorithms rather than the ability to formulate management problems, solve them, and implement and maintain their solutions in turbulent environments…[P]ractitioners decreasingly took problematic situations as they came, but increasingly sought, selected, and distorted them so favored techniques could be applied to them".

This is old advice—let the problem determine the tools to be used. The trouble with the advice is that these powerful, sophisticated tools exist, and it would be a waste to ignore them. But it is useful to step back from time to time and question the assumptions that are built into the tools and to ask what might be done instead.

7.3.1 Tools from Operations Research(OR)

Operations Research (OR) provides a long list of templates that you can use for your models. Each template is taught with a motivational story or two that suggests the kind of subject matter that it can best represent. A clever practitioner can apply a template to subjects that seem quite remote from those given in the motivational stories, for it is the form and not the substance that counts.

The templates specify which quantities are to be inputs and which are outputs. So they are much more tailored to asking particular kinds of questions than they are to asking questions about particular subject areas. Here is a partial list from a classic OR textbook (Hillier and Lieberman 2005):

- Linear programming—allocates limited resources among competing activities in the best possible (i.e., "optimal") way.
- Nonlinear programming—like linear programming, except the various functions need not be linear. For example, the cost of producing an item may decrease the more items you produce.
- Integer programming—like linear programming, except activities come in discrete packages. You must buy zero units or one unit; you can't buy half a unit.
- Dynamic programming—systematic procedure for determining the optimal combination of decisions when decisions must be made sequentially and early decisions limit later options.
- Decision analysis—like dynamic programming, it addresses sequential decision problems. But it is simpler and less general.
- Game theory—addresses competitive situations in which multiple players make decisions that affect each other's payoffs.

- Queuing theory—addresses situations in which somebody or something waits in line for a service. For example, you may wish to explore the effect of investing in more capacity on the average waiting time.
- Inventory theory—examines situations in which a stock of items is held to cover uncertain future orders. Typically you might determine the reorder policy that minimizes the expected cost of holding inventory when business happens to be slow plus the cost of having to backorder items when business happens to be brisk.
- Discrete event simulation—a very general approach for studying just about any dynamic system. You describe the system in term of individual events involving basic entities, and run the simulation (operate the system for a period of time) to see what happens. Typically you try to make the simulation model a faithful representation of the relevant aspects of the system, and then do experiments on the model as if it were the real system. Some simulation models are entirely automated. Others have a man-in-the-loop, and can be called games (e.g., war games). Modeling decisions is very hard, and the man-in-the-loop can make the decisions instead of the modeler developing an algorithm to do so.

7.3.2 Tools and Models from Other Disciplines

Not everybody comes to policy analysis with an operations research background. Some come from subject matter disciplines, and in many cases those disciplines have their own preferred model forms. They have theories to tell them what factors are important, what categories and definitions are appropriate, what is a cause, and what is an effect.

Physicists and engineers have traditionally built and used models of differential or partial differential equations, such as meteorological models. These are sometimes called simulations, but *continuous* simulations to distinguish them from the discrete event variety (Seinfeld 1986). Such continuous simulations are being increasingly used by policy analysts to model socioeconomic systems, such as urban areas, water basins, etc.

A generic continuous modeling method that may be used for organizational and socioeconomic problems is System Dynamics (Forrester 1961; Sterman 2000). In System Dynamics, a system is considered in terms of its underlying “flows”. For example, flows of people, money, material, orders, and information can be recognized (Roberts 1978). These flows can accumulate in stocks. The stock-flow structure of a system is represented, and simulation of the model generates the behavior of the outcomes of interest over time. The concept of feedback is essential to System Dynamics (Forrester 1961). Feedback loops may have an important influence on system behavior (e.g., positive feedback creating a vicious cycle, or negative feedback that can regulate a system). Feedback can be used in explaining system behavior and in designing policies aimed at influencing system behavior.

Cost analysis and its relatives cost–benefit analysis and cost-effectiveness analysis offer ways to look at costs that are derived partly from economics and partly from accounting. They recommend discounting to compare future costs with present ones, and ways of valuing all sorts of things (e.g., human life and health) in terms of money (Perkins 1994; Gold 1996; Hopkins 1992; Jones-Lee 1976).

Statistics provides a number of model forms. Generally they provide ways to transform data so the undetermined parameters in an estimating relation can be estimated by linear regression. The social sciences rely heavily on these models, as does medical research (Armiger 1995; Morton and Rolph 2000).

Economists study the allocation of scarce resources to alternative uses. Microeconomics (the study of the behavior of individuals—households or firms—when resources are scarce) defines impacts such as consumer surplus (a social welfare impact). Elasticity data let you estimate changes in demand in response to changes in price (Landsburg 2011). Macroeconomics studies the consequences of the behavior of countless individuals for an economy as a whole. Subjects of study include the effects of economic and fiscal policy on inflation, employment, and economic growth (Mankiw 1997).

7.4 Modeling Guidelines

This section discusses a number of important issues that should be addressed by the modeler in the design and development of a model.

7.4.1 Keep the Model Simple and Transparent

One of the most important guidelines for a policy analysis model is that the model must be kept simple and easy to explain. The analyst must keep in mind that s/he is going to have to explain the results and methodology to a policymaker who will generally not be familiar with advanced mathematics. The simpler the model the easier it will be to explain and the better the chance that the policymaker will understand the analysis. As Quade points out: “The most convincing analysis is one that a nontechnician can think through”. (Quade 1989, pp. 362–363). It may seem attractive to use a large model. If the policy analysis study intersects an area with a strong academic tradition, there will often be a standard model. These models tend to be conceptually clean and simple, but often lead to very large and data-hungry models when implemented, and may have long execution times. So there is an incentive to look for simpler formulations that will not lead to such large models. But analysts who do so may face the skepticism (even hostility) of academic experts. The analyst must be prepared to demonstrate that the simple model gets approximately the answers a more complicated model would have gotten, and that the accuracy is sufficient for the analysis being carried out and the problem being addressed.

It is important to limit the number of variables in a model, for as the number of variables increases the model becomes larger, requires more data, and is harder to use. This explosion of variables is called “the curse of dimensionality”. It is vital to contain this explosion. There are different ways to do this, which are discussed in the a few of the following subsections.

7.4.2 Aggregate

A model will often have to categorize something, e.g., income levels, ages, ethnicities, locations. As more categories are created, the model’s hunger for data is increased. Too few categories, however, will limit the questions that can be addressed. Often there will be conventional categories that can be used in the model. If there are too many categories, these can be aggregated. To use the example of population, you can keep track of age in 1-year categories, or 5-year categories, or even monthly categories. Replacing 1-year categories by 5-year categories reduces the number of instances by a factor of five. If categories on three dimensions (e.g., age, income, and zip code) are aggregated by a factor of five each, the number of instances is reduced by a factor of $5 \times 5 \times 5 = 125$.

7.4.3 Limit the Depth of the Model

Work at RAND has examined the advantages and difficulties of deliberately building a hierarchical structure into models (Davis and Bigelow 1998). The analyst arranges the variables in a network, in which there is a node for each variable, and a directed link for each causal influence. That is, if the analyst thinks that a change in variable A will cause a change in variable B, other things being held constant, a link is drawn from A to B. Outcome variables are usually put at the top and the factor variables (i.e., variables representing factors that can influence the outcomes) below. Usually the variables fall naturally into a hierarchy, where each variable occupies a level in the hierarchy equal to the number of links between it and an outcome. This expansion of variables, defining them in terms of lower level variables, is what is meant here by adding depth to the model. Clearly, adding depth to a model increases its size. It makes the model more difficult to use for analysis. Fewer cases can be run, so fewer policies can be tested against fewer scenarios. The size of the model can be limited by truncating the hierarchy, and building the model using variables from a relatively high level rather than going clear down to the bottom.

7.4.4 Estimate Only the Outcomes that are Necessary

Outcome indicators are as likely as any other model elements to proliferate. But a policymaker will rarely be interested in all the detail; instead, the modeler will want to estimate summary measures or specific outcomes. In air quality, a modeler might look at the concentration of a pollutant on the worst day of the year, and at average pollutant emissions. In energy, the modeler could look at peak demand and average demand. In a school system, the modeler could look at dropout rates, truancy rates, literacy, and proportion of students held back a year. In a suite of models for strategic planning at airports that was built at the Delft University of Technology (Walker et al. 2003), outcomes were calculated for the peak hours of the 1st, 5th, 10th, 15th, 20th, and 25th peak days of the year, since peak periods determine the airport's infrastructure requirements. Of course, a model can be built to estimate all of the real world observations, which can then be used to calculate summary statistics. (For example, the airport models could have been run to estimate outcomes for every day of the year). But the model will be smaller (and will run more quickly) if it is built to estimate the summary statistics (e.g., peak day outcomes) directly.

7.4.5 Use Meta-Models

On occasion, the analyst may want to build a policy analysis model for a domain in which there is a large model that has become institutionalized (e.g., econometric, transportation, or climate models), although the model itself may be too extensive to use in the analysis. It is possible to build "meta-models" (also called "repro models" or "fast simple models")—small models that reproduce (approximately) the aspects of a large model's behavior that are relevant for the policy issue at hand. Instead of using the large model directly, the large model (called the target model) is treated as the object to be modeled. The meta-model can then be used either as a freestanding model or as a subroutine within another model. This approach allows the analyst to cite the large model as authority (assuming it is trusted), but reap the advantages of smallness. The meta-model may also be extended beyond the circumstances dealt with in the target model, e.g., by extrapolating to data values not considered in the available outputs from the target model, or by adding or reinterpreting variables.

The process of building a meta-model is no different from building any other model. The only difference is that it is a model of a model, rather than a model of a portion of the real world. One formulates and implements it, then calibrates and validates it. Of course, one should not expect the meta-model to agree exactly with the target model, any more than one expects a perfect match of a model with the real world. Box 7.3 describes one such meta-model.

Box 7.3: The demand response model (DRM) in the SUMMA project

The sustainable mobility, policy measures and assessment (SUMMA) project (SUMMA Consortium 2005) was a policy analysis project carried out by RAND Europe for the European Commission under its Fifth Framework Programme. One of its objectives was to assess transport policy measures for promoting sustainable transport and mobility in Europe. Part of the project's analysis was carried out with the help of a meta-model called the demand response model (DRM). The DRM includes no transport networks. But, it was based on the outputs from the Dutch national model (LMS), the Norwegian national model (NTM-4), The Italian national model (SISD), the Danish National Model, and the Swedish National Model, which are highly detailed models that include network specifications for each of the transport modes.

7.4.6 Beware of Oversimplification

A model should be as small and simple as appropriate, *but no simpler*. The reason the guidelines mentioned above provide ways to control the size of a model is because people tend to build models that are larger and more complex than necessary more than they do the reverse. But beware that there are limits.

Aggregating time steps in a time-stepped discrete event simulation model can produce perhaps the largest aggregation errors of all. It is typical (though not necessary) to assume that rates remain constant during a time step. Vehicles or units move at constant velocities. Supplies arrive at a constant rate. If the size of the time step is doubled, the simulation takes one step for every two it used to take. Instead of taking one step, adjusting the rates, and then taking the second step, the model takes only one large step. It arrives at different states for different step sizes. For the next step, then, the model will start out in different states. The trajectories followed by the model will thus depend on the size of the time step.

7.4.7 Be Aware of Implicit Assumptions in Existing Tools and Templates

While using an existing method or model form can save time, it can also impose biases and preconceptions on the model. Some of the most ubiquitous assumptions are that models are linear (or can easily be transformed into a linear form) and that residual errors are distributed normally (or according to one of the other exponential-based distributions). Statistical modeling deserves a cautionary mention here. Correlation is not causation, and causation—the story behind the model—is what identifies the points of leverage for the decisionmaker.

A number of the assumptions implicit in certain methods and techniques have been discussed in Sect. 7.3. The modeler must watch out for hidden assumptions in some model types, e.g., rationality and market equilibrium in economic models, and the appropriateness of discounting in cost analysis. The modeler must be aware of assumptions and of the perspective on the system that is introduced by using existing methods or model forms.

The effect of type on model size (as measured by, e.g., the amount of data it will require or the amount of code that must be written) is also of importance here. Of course, if the model already exists, along with the appropriate data libraries, the analyst may choose to use it. This is often the position a research or consulting group is trying to get itself into when it invests in building a large model.

7.4.8 Build a Toolkit

Build a toolkit of models rather than a large, comprehensive model. This keeps the analyst at the center of the analysis, since the analyst is the one using the tools. Somebody must be the user of a large, comprehensive model as well, of course, but the large model will automate much more of the analysis process. Decisions about how to design alternatives, or how to weigh one impact against another, will often be implemented as algorithms in the large model.

Conduct the analysis in stages, so as to allow a change of course as necessary. Build the methodology in small pieces—as small models that can be used in stand-alone mode to aid different stages of the analysis.

7.4.9 Cooperate Closely with the Policymaker and Develop a Good Story

The modeler must keep in mind that the model is being developed for the purpose of decision support. This requires the modeler to involve the policymaker and other participants in the decisionmaking process during the whole process of model development, from planning until execution (EWRI 2011). In general, modeling not only involves the model as an end product, the entire modeling process is also a learning process.

In addition, a good story is an important element of the representational core. The policymaker will not accept a model's result "because the computer said so". There must be an intuitively satisfying explanation—though it can be largely qualitative—for why the model results come out the way they do, and why the real world should be expected to act similarly.

7.4.10 Let the Problem Determine the Tools that are Used

Last but not least, the problem situation should determine the methods and tools used for modeling. This is well known advice, and a number of considerations for this were discussed in Sect. 7.3, but it is easier said than done. Analysts have a certain background and may have more experience in using certain methods than others. Although it is easiest to use a familiar method, it is essential to step back to investigate what other possibilities exist and what the advantages and disadvantages of alternative methods might be.

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Chapter 8
Actor Models for Policy Analysis

Leon M. Hermans and Scott W. Cunningham

8.1 Introduction

Systems analysis and systems theory have proven a fruitful basis on which to develop the discipline of policy analysis. However, since the inception of policy analysis in the second half of the twentieth century, the world has changed, new insights have emerged, and thus new challenges have arisen for policy analysts. One of the most prominent changes in this regard is posed by the increasing awareness of the importance of actors, actor networks, and actor systems. This calls not only for different, more actor oriented, styles of policy analysis, but it also calls for models and methods that support the analysis and understanding of multi-actor systems and processes, making them more amenable to the contributions of policy analysts. These models are the subject of this chapter.

If a policy analysis situation features one or more instances of multi-actor complexity described in the introduction to Part II of the book, a specific effort must be made to capture multi-actor complexities adequately in the policy analysis. Actor modeling is likely to offer useful support for such efforts. This chapter presents an overview of various actor modeling approaches and their use in policy analysis. The presentation of these various actor modeling approaches is structured according to the three instances of multi-actor complexity in policy analysis discussed in the introduction, each of which corresponds to a different primary purpose of actor modeling:

1. Actor modeling can be used to support problem framing, providing insight into the policymaking context of policy analysis and its consequences for the scope and focus of the analysis, as outlined in Chap. 4.

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2. Actor modeling can be used to support the analysis of the system domain for policies, when these systems are essentially multi-actor systems.
3. Actor modeling can be used to support process management.

Although we do not pretend to be complete in terms of the actor modeling approaches and their applications in policy analysis, we do believe that, by covering models for the above three purposes, we cover at least an essential part of the actor models for policy analysis. Before starting with our discussion of actor modeling approaches, we introduce the main conceptual building blocks that can be used in constructing actor models.

8.2 Concepts in Actor Models

Before turning to actor modeling approaches for policy analysis, it is useful to take one step back and gain a better understanding of the objects of analysis: the actors involved in public policymaking and their interactions.[1] Many theories address the role of actors in policymaking, and no single theory can be selected *a priori* as being the best or most appropriate.[2] Nevertheless, comparing different theoretical studies from the policy sciences suggests that, at the most abstract level, there is a shared understanding that policies are made in networks of actors governed by formal and informal rules, while each actor has certain perceptions, values, and resources.[3] This means that there are certain key concepts and dimensions in multi-actor policy systems, which are briefly explained below.

[1] An expanded discussion of the concepts in this section can be found in Hermans (2005) and in Hermans and Thissen (2009), which also discusses some of the modeling approaches discussed in this chapter.

[2] See for instance Ostrom et al. (1994), p. 49, the overview book edited by Sabatier (2007), and the related debate on theories of the policy process in the *Journal of European Public Policy* (Dudley et al. 2000).

[3] Although the labels differ, these dimensions are identified by many authors and theories. The advocacy coalitions framework includes policy subsystems, consisting of coalitions of actors who hold different belief systems, consisting of *normative* and *causal beliefs* (cf. values and perceptions), and *resources* (Sabatier 1988). Jobert identifies three dimensions of policymaking: cognitive, instrumental, and normative (Jobert 1989). The actor-centered institutionalism framework recognizes actor constellations in a specific institutional setting, in which interaction takes place among actors, who are characterized by specific *capabilities*, specific *perceptions*, and specific *preferences* (Scharpf 1997). In the Institutional Analysis and Development framework, actors interact in action arenas, based on certain ‘rules-in-use’, while each actor can be understood by variables in relation to its *resources, valuation, knowledge contingencies,* and *information and processes* for selecting a certain course of action (Ostrom 1999).

8.2.1 Conceptual Building Blocks

Public policies are not explained by the intentions of one or two central actors, but are generated within *actor networks* in which multiple actors are interrelated in a more or less systematic way (Kenis and Schneider 1991; Rhodes and Marsh 1992; de Bruijn and ten Heuvelhof 2000). The structure of relations among actors in networks influences the interactions among the actors. For instance, actors with a central position in the network may be able to exert more influence over decisionmaking than actors at the margins of the network. The behavior of actors within networks is further governed by the formal and informal *rules* that limit and structure the possible range of activities (Ostrom et al. 1994; Scharpf 1997). Thus, policy networks essentially consist of actors, the relations among them, and the rules that govern their behavior.

In practice, it may be difficult to define the boundaries of actor networks, as each actor will have relations with many others, thus suggesting a seemingly endless web of actors and relations. Therefore, specific action arenas (Ostrom et al. 1994), policy subsystems (Sabatier 1988), or constellations (Scharpf 1997) are identified, in relation to specific policy problems and issues. We call these *policy arenas* and we call the actors within them *policy actors*. Policy arenas, therefore, provide the platform for actions and interactions among policy actors in relation to specific policy problems and issues.

Looking only at policy arenas has a limited potential to explain policy changes, if not complemented by an analysis at a lower level in terms of properties of the actors (Rhodes and Marsh 1992, p. 196). An *actor* is defined at the most abstract level as an 'action unit' (Bots et al. 2000). In this book, we make a distinction between policy actors and stakeholders. In the system diagram, policy actors are located within the policy arena and *have an influence on* the problem situation and its development. They include those formally involved in decisionmaking in the field (e.g., public authorities). *Stakeholders* are actors *affected by* the problem situation or by (some of) the solutions considered (we call these actors *stakeholders*, since they have a stake in the outcome of the policymaking process). We also make a distinction between policy actors and system actors (see Sect. 8.2.4).

An actor may be a person—for instance, a political decisionmaker—or a group of persons or organizations that is capable of making decisions and acting in a more or less coordinated way (Burns et al. 1985). At the actor level, the behavior of these actors is explained by three important factors: perceptions, values, and resources (e.g., Sabatier 1988; Jobert 1989; Scharpf 1997; Ostrom 1999).

Perceptions refer to the image that actors have of the world around them, both of the other actors and networks, and of the substantive characteristics of a policy problem (Scharpf 1997; Bots et al. 2000). Perceptions here refer only to descriptive theories of how the world operates and of the current state of the world, i.e., causal beliefs and perceptions of world states (Sabatier 1988, p. 131). The normative beliefs on what is good and desirable belong to the sphere of values.

Values provide the directions in which actors would like to move; they help to understand the internal motivations of actors. Related to values, interests describe the issues that matter most to actors. Usually, interests have a certain direction (for instance: increase economic growth, or decrease environmental degradation), thus describing the direction in which actors would like to move. Related concepts such as ‘objectives’, ‘goals’, and ‘targets’ express interests in more specific terms, defining them in terms of ‘desired future situations’. ‘Preferences’ and ‘positions’ translate values into a (relative) preference ordering over specific solutions or policy outcomes. Values and normative beliefs are closely linked to actors’ perceptions or causal beliefs (see also Sabatier 1988, pp. 131–133).

Resources are the practical means or instruments that actors have to realize their objectives. Resources enable actors to influence the world around them, including other actors, relations, and rules in a network. Whereas values and perceptions determine the direction in which actors would like to move policy programs or decisions, their resources will determine their ability to do so (Sabatier 1988, p. 143). As such, resources are closely related to power and influence.

When combined, the three concepts of perceptions, values, and resources may lead to *actions*. Resources can be used to act, but values are used to determine if the resulting actions are indeed useful to an actor, whereas perceptions are used to indicate whether an actor also recognizes this link between the use of resources and achieving value. If an actor takes action, this will be likely to have an *impact*—be it large, small, or even insignificant—on other actors or on the physical environment. Through actions, an actor interacts with the environment; the physical and natural environment, as well as other actors and other actor networks and policy arenas.

The different elements in a multi-actor system are related in many and complex ways. For instance, the possible actions, their impacts, and possible responses (sanctions, rewards, or other) are limited and structured by the rules and relations that exist at the network level. Notably, rules may give actors control over resources, as may their position in a network—actors that are central in the network, or that monopolize communications with another powerful actor, may derive a useful resource from their position in the network. Further, groups of actors can share values, or their values may conflict. The presence or absence of a shared value base is likely to shape the relations among actors, i.e., actors with conflicting values may not communicate as frequently or openly as they would if they had shared values. Conversely, actors who interact and communicate frequently, for instance, because the rules-in-use in a network prescribe regular meetings, may develop a certain overlap in their perceptions and even in their values, whereas actors that have no intensive relation may see their perceptions diverge over time.

8.2.2 Change in Multi-Actor Systems

The final example in the previous section brings us to an important aspect, which is that of change. So far, the discussion of conceptual building blocks may have given rise to the impression that multi-actor systems are fairly static and relatively stable systems. They are not: dynamics are an essential feature of multi-actor systems. Many of the underlying theoretical works, in fact, concern policy *processes*, which are by nature dynamic. However, conceptually, these processes are depicted as 'snapshots' of situations at different moments in time. This is, for instance, clearly visible in the 'rounds model' proposed by (Teisman 2000). A theoretical argument for this discrete 'snapshot' approach is that, on the short term, actor constellations may be relatively stable, but over a longer period of time, important changes can be observed (Sabatier 1988).

One important driver for change in multi-actor systems is indigenous and stems from the actors themselves, and their desire to control and modify their environment in desired directions. For instance, although the network level sets the conditions for actions of the individual actors, the actors that constitute the network can shape and change the network of which they are a part. Through education or propaganda activities, actors can influence the perceptions of other actors, seeking to come perhaps toward more shared perceptions. Also, rules can be a source of power and influence, but this influence can, in turn, be used to change the rules that are used in a network. Even fundamental values of actors may change over time, and certainly preferences and priorities can change.

8.2.3 Relating Actor Modeling Concepts to the Framework for Policy Analysis

The relationships among the concepts introduced above are depicted in Fig. 8.1, which also introduces the link between actor networks and the policy analysis framework. Policymaking takes place in interaction with a system domain, consisting of a physical and a social subsystem, from which policymaking gets input and which will be changed and transformed by the actions of policy actors. For example, infrastructure policies are made in relation to a physical system in which a certain infrastructure is present at a certain time in a certain form. Generally, public opinion influences the interest that actors take in an infrastructure policy, and economic development (an external factor) influences the funds available for the implementation of possible policy alternatives. Similarly, the actions of policy actors may alter the physical environment, for instance when a decision is made to change, remove, expand, or rehabilitate a certain piece of infrastructure.

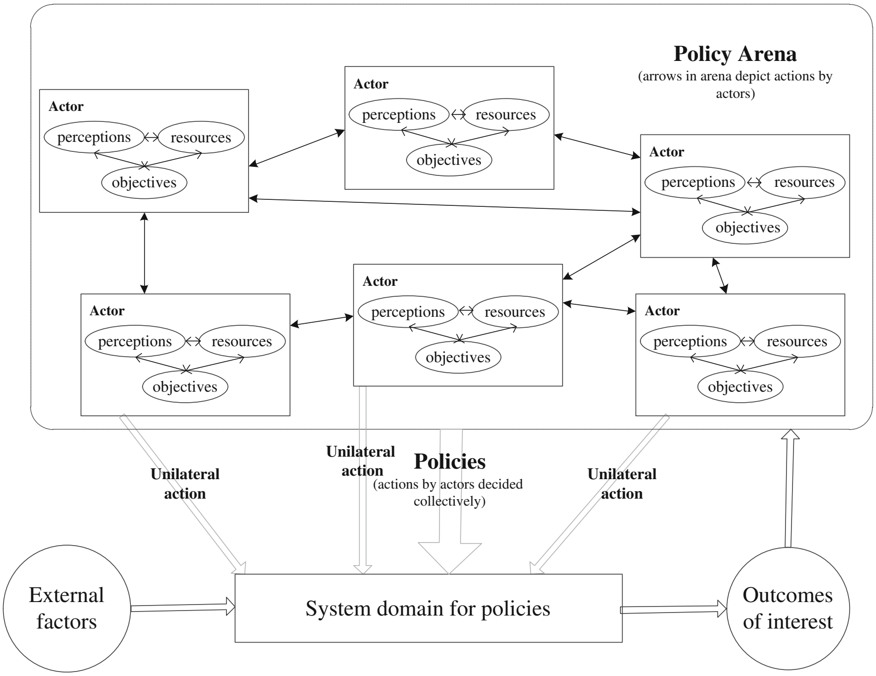

Fig. 8.1 Concepts in actor models (showing multi-actor complexity external to the system domain)

8.2.4 Policy Actors and System Actors

As discussed in Sect. 8.1, multi-actor complexity can be found in the policymaking context, or policy arena, but also in the system domain for policies. Although both can be captured with the concepts introduced above, it is useful to identify the differences among actors in a policy arena—i.e., policymakers and other policy actors—and system actors. Four properties of system actors help to make this distinction. System actors have behaviors which, as individuals, remain largely unnoticed and unremarked upon by other actors (focus). System actors, as individuals, have little ability to enact meaningful policy changes (agency). System actors, as groups, must have a substantial ability to impact the system or they would not be meaningful for inclusion within the system model (significance). System actors can, therefore, significantly change outcomes of interest, without themselves being able to drive systems towards chosen ends. While the system actors will have impact upon outcomes, they are not able to strategically coordinate with one another (coordination). System actors who could strategically coordinate should be identified as members of the policy arena who also have a role in the system (so they are both system actors and policy actors). System actors are also among the stakeholders for a specific policy issue.

Table 8.1 Distinguishing among policy actor, system actor, and system

Factor	Policy actor	System actor	System
Agency	Able to make meaningful policy changes	Unable to make meaningful policy changes	Unable to make meaningful policy changes
Coordination	Able to coordinate strategically	Unable to coordinate strategically	Unable to coordinate strategically
Focus	Actions may be noticed and acted upon by others	Actions are unnoticed and not directly acted upon by others	Natural forces included in the system model must be noticeable and acted upon by others
Intentionality	Forms intentions	Forms intentions	Does not form intentions
Significance in system domain for policies	Not a significant part of the system domain, unless also having a role as a system actor	Able only as a collective to significantly impact system functionality	Significant aspects of nature must be incorporated into the system model

Systems and system actors bear some properties in common. Systems, like system actors, are unable to enact policy change, are unable to strategically coordinate, and must constitute a significant component of the system domain or be better omitted from the system model. Systems, like policy actors, must have focus: system forces must be noticeable and be acted upon by others. Again, without focus, the system component would be better omitted from the system model. While systems, system actors, and policy actors have some properties in common, there is one property that fully distinguishes actors from systems: intentionality. All actors form an intention, even if they cannot usefully enact their intentions upon the system. Table 8.1 shows the factors distinguishing among policy actors, system actors, and systems.

An *external factor* as a topic for actor modeling deserves special attention. This component of the policy analysis framework is currently used for five distinct elements, some of which entail actor modeling. First and primarily, this component of the framework is used for modeling uncertainties affecting the system. Second, this component is used for representing inputs to the system that cross the system boundaries. Third, this component is used to represent emergent forces acting from within the system. Fourth, this component is used to represent the choices of actors, making policy choices on other partially overlapping system domains. Fifth, this component is used to represent the choices of emergent social action within the system.

These last two model elements—policy actors with overlapping domains, and emergent social action—are actor related, and may, therefore, be explicated through the use of actor models. However, these elements represent the intentional choices of actors, not the random action of nature. Modeling them as system forces, not actor forces, may be misleading. Nor is it entirely suitable to model these components of the framework as system actors (discussed below), since they represent substantial uncertainties concerning system operation. The use of *scenario variables* may be the best practice in managing these external or emergent actor forces (see Chap. 9), with the caveat that these are social forces.

8.2.5 Actor Concepts in Other Bodies of Literature

It should be noted that, although the concepts above are derived primarily from the literature on public policymaking, other bodies of the literature confirm their relevance. The systems perspective on decisionmaking, as evidenced in systems engineering, economics (particularly game theory), management science, and operations research, utilizes a similar set of concepts. Operations research analyzes objectives (values) subject to decision variables (resources), leading to specific strategies (resources). Trees are a common mechanism for structuring decision processes, and reveal the use of rules for analysis. Information and belief enter into these analyses as well. Arenas and actors are implicit in these analyses, but are seldom the subject for the analysis itself. Another example is that of game theory (e.g., von Neumann and Morgenstern 1944). Game theory speaks of players (actors), strategies or actions they can take (resources), and payoffs (values), while also the role of information (perceptions) is acknowledged (Harsanyi (1967, 1968a, b)).

Important theoretical works in organization science and sociology identify similar concepts. Social theory as developed by Coleman (1964, 1990) identifies exchanges of control over issues in which actors have an interest as central mechanisms of social interactions. Crozier and Friedberg (1980, p. 19) talk of the 'hands', 'hearts', and 'heads' of actors in organizations, and Mitroff (1983, p. 36) identifies purposes and motivations of a stakeholder, beliefs that a stakeholder has, and the resources a stakeholder commands, in his discussion of stakeholders of organizations.

8.2.6 Using the Actor Concepts to Characterize Actor Modeling Approaches

The conceptual multi-actor framework depicted in Fig. 8.1 helps us to characterize actor models not only regarding their purpose for policy analysis, but also based on their conceptual focus. For instance, an important actor modeling approach is rooted in game theory, and these models, such as the Graph Model for Conflict Resolution (Kilgour and Hipel 2005), typically focus on resources and values of actors to explain their actions and interactions. Social network analysis models

Table 8.2 Actor modeling approaches discussed in Chap. 8

Section/purpose	Modeling approaches discussed
8.3.1 Supporting problem formulation	Discourse analysis: argumentative analysis, narrative analysis, Q-methodology
	Individual actor models: cognitive mapping, strategic options development and analysis, dynamic actor network analysis
8.4.1 Modeling system actors	
Light intentionality, high uncertainty	Stochastic agents, social network models
Heavy intentionality, high uncertainty	Consumer choice models, gravity models, conjoint analysis, hierarchical linear modeling
Low intentionality, low uncertainty	Agent-based models
Heavy intentionality, low uncertainty	Linear complementary problems, general equilibrium models, public choice models, game theory models
8.4.2 Gaining insights into the system being studied	Gaming and simulation
8.5. Supporting process management	Game theory and conflict models: Analysis of options, metagame analysis, hypergame analysis, graph model for conflict resolution, expected utility model, confrontation analysis
	Transactional models and exchange models
	Stakeholder analysis

(Carrington et al. 2005) focus on the structural characteristics of networks, i.e., the structure and patterns of relations among actors. Models for discourse analysis (Dunn 1993) or comparative cognitive mapping (Bots et al. 2000) primarily aim to assess actors' perceptions and values as a basis for understanding actors' behavior.

The conceptual framework also provides us with grounds to claim that models for preference elicitation or multi-criteria decision analysis cover only a very limited part of multi-actor complexity, focusing exclusively on actors' preferences for certain collective actions. The individual actions that form the basis of such collective actions remain part of a 'black-box', as do the values and causal assumptions behind the measured preferences.

Finally, the conceptual framework helps us to define what we mean by the term 'actor model'. An actor model is any model that has as its primary focus for analysis one or more of the conceptual building blocks that were defined in Sect. 8.2.1. What focus and what models are most appropriate will differ with the demands and conditions of a specific situation, as illustrated in the coming sections. An overview of the various actor modeling approaches discussed in the following sections is presented in Table 8.2.

8.3 Actor Modeling to Support Problem Formulation

Policy analysts working in a rational, knowledge oriented, systematic style—seeking to analyze substantive policy problems, to provide recommendations to policymakers based on sound systems analysis, or to clarify the various arguments that play a role in a substantive policy debate—could benefit from actor modeling when they operate in a complex multi-actor environment. This is typically the case when the policymaking process includes multiple policymakers and actors that (can) have a substantial influence on the system domain through their policies or actions.

In such cases, policy analysts could benefit from models and methods that help them to get a better understanding of the actors and mechanisms that drive the processes in the policymaking realm. For instance, actor analysis could help to identify the concerns, objectives, and priorities of different actors, and to mobilize relevant knowledge from a broad actor base (Grimble and Wellard 1997; Bryson 2004). Such knowledge helps to improve an understanding of the system under study, to identify outcomes of interest, to identify a wide range of possible policy alternatives, and to identify the main perspectives from which to analyze the system—disciplinary perspectives as well as actor or interest-group perspectives. Also, actor analysis provides useful insights into the feasibility and implementability of policy instruments and management strategies, based on interests, potential conflicts, and the influence of different actors (Grimble and Wellard 1997; Brugha and Varvasovszky 2000; Bryson 2004). This will help policy analysts to evaluate different policy alternatives, but also to identify new policy strategies, based on a recombination of different instruments that may offer sufficient compensation to make them more acceptable to a larger group of actors. Taken together, such insights may help analysts to 'formulate problems worth solving' (Wildavsky 1992).

8.3.1 Actor Models that Aid an Understanding of Actors' Perceptions and Values

When the main purpose of an actor analysis is to identify the broadest range of objectives and policy alternatives for consideration, or to help understand the various lines of reasoning employed by the main actors in the policymaking realm, actor modeling approaches that focus on actors' perceptions are generally very useful. These models often include the underlying values and norms when delineating these actor perceptions, thus covering in many instances both causal and normative beliefs. Such models are based on the idea that the behavior of actors is driven by their perception of the situation they find themselves in. Analysts may consider these perceptions to be incomplete or incorrect, but in policy problems, these subjective perceptions are the reality with which analysts have to deal (Bots et al. 2000). This is in line with the theoretical perspectives in which perceptions, belief systems, or frames of reference, are considered to be some of the most important factors for explaining policy development (e.g. Sabatier 1988; Fischer and Forester 1993). The perceptions of actors in a policy process can be analyzed at the level of the public discourse, focusing on the perceptions shared by different groups of actors, or at the level of individual actors, by constructing cognitive maps that take the perceptions of individual actors as a starting point for analysis.

Examples of models and methods that are used to analyze the perceptions at the level of the public discourse (i.e., in the policy arena) are argumentative analysis (Toulmin 1958; Mitroff 1983; Dunn 1993), narrative analysis (Roe 1994; van Eeten 2006), and Q-methodology (McKeown and Thomas 1988; van Eeten 2001). The lines of reasoning of actors in policy debates may be modeled in different ways based on the arguments that are used (as in argumentative analysis), the stories that are told (as in narrative analysis), or the statements with which people agree or disagree (as in Q-methodology). Also, discourse analysis can be effectively combined with social network analysis methods to relate the different arguments or narratives to different networks of actors (e.g. Termeer 1993; Klijn et al. 2000).

Discourse analysis models are typically used to clarify the perceptions of groups of actors about the relation among problems, solutions, and other elements that they frequently refer to in policy discussions. Structuring and explicating arguments and reasoning will help an analyst to identify those assumptions and claims that are critical in shaping different positions in a policy discourse. These insights can be used to identify areas that need specific attention in analysis, as well as areas of dispute that are so value laden that further analysis cannot be expected to contribute much to an agreement or reconciliation. These insights also can be used to make more fundamental changes to existing problem formulations, reframing or recasting policy problems in a way that makes them more tractable to analysis, as research by van Eeten (2001, 2006) demonstrates (see Box 8.1).

Box 8.1: Discourse analysis applied to the expansion of Schiphol Airport

Q-methodology in combination with narrative analysis was used to analyze the policy debate over the controversial expansion of Amsterdam's Schiphol Airport (van Eeten 2001; van Eeten 2006). As already described in Chap. 3, the analysis identified five independent policy arguments adhered to by different actors in the debate. Whereas the current policy agenda revolved around two opposing arguments about airport expansion—as an economic necessity or as an unjustified use of public funds—the Q-analysis identified three additional policy arguments, independent from the prevailing arguments, in favor of, and against airport expansion. These additional policy arguments focused on the societal integration of the airport, the need for an ecological modernization of the civil aviation sector, and the need to find a way to meet the growing demand for mobility. Obviously, the airport played a critical role in these three policy arguments, but airport *expansion* was not a core issue in any of them. These insights helped to recast the policy problem by suggesting that the expansion decision be decoupled from the other policy arguments. This way, the value-laden controversy over airport expansion would not hold hostage the complete civil aviation debate.

Models that analyze problem perceptions at the level of individual actors often use cognitive mapping methods to capture the perceptions of actors in causal relation diagrams. Such diagrams contain the most important factors and the causal relations among these factors. Cognitive maps were used in policy studies in the 1970s by Axelrod (1976), and since then have provided the basis for analysis methodologies such as Strategic Options Development and Analysis (SODA) (Eden 1989), Self-Q interviews (Bougon et al. 1990), comparative cognitive mapping (Jenkins 1992), and Dynamic Actor Network Analysis (DANA) (Bots et al. 2000). SODA and Self-Q interviews use cognitive mapping as a way to include a broad knowledge base in the analysis and aim to integrate the different individual maps into a single overarching group map. DANA and comparative cognitive mapping use the different cognitive maps as a basis for comparative analysis, focusing on similarities and differences in the perceptions of the individual actors. They can help the identification of areas of agreement as well as competing claims and important conflicting interests. Also, they can support the development of a common, agreed upon problem formulation, as illustrated by an example on river basin management in Turkey (see Box 8.2).

Box 8.2: Cognitive mapping applied to integrated river basin management in Turkey

DANA was used to support problem formulation in the early stages of the participatory development of an integrated river basin management plan for the Büyük Menderes river basin in Turkey (Hermans 2005). The initial problem formulation focused on water quality issues and on the establishment of a river basin management authority, driven by the requirements of the EU Water Framework Directive (2000/60/EC). A comparative analysis of the cognitive maps of various actors in the river basin, however, suggested that some specific problems stood out in terms of priority, such as the issue of boron pollution from geothermal power production and water scarcity problems related to agriculture in the basin. Rather than treating all pollutants equally, specific attention to boron thus seemed warranted, as well as an expansion of the focus to include water quantity issues in addition to water quality. Also, the outcomes from the DANA study suggested that the introduction of a new river basin management institution was not recognized as an urgent item on the policy agenda. Thus, it might not be possible to expect or pursue significant advances in this direction within the 2-year time frame of the pilot project.

The studies reviewed here suggest that discourse analysis is useful to analyze policy debates over large controversial policy issues with significant societal relevance, where incompatible beliefs, values, and moral judgements cause deep-rooted value-laden conflicts in the policy debate (Roe 1994, p. 4; van Eeten 2006). Cognitive mapping approaches have been used more often to analyze actor perceptions in relation to more specific policy programs that involve scientific uncertainty and moral judgments and that may have significant societal relevance, but where policy debate is limited to a more specific group of experts or stakeholders, with less priority on the political agenda, and less visibility for the general public.

8.3.2 Actor Models that Aid Understanding of the Implementability of Policy Alternatives

Actor models can help policy analysts to understand the issues and mechanisms associated with the feasibility and implementability of policy instruments and management strategies. Such understanding generally requires insight into the interests, potential conflicts, and influence of different actors and stakeholders. This makes actor models that focus on resources and interests potentially useful. Most of these models have been developed, and are being used most extensively, to support policy analysts in more process-oriented tasks, such as mediation and

Table 8.3 Models of System Actors

		Level of Intentionality	
		Light	Heavy
Degree of Certainty	Low	Stochastic agents models	Consumer choice models
	High	Agent-based models	Game and market models

offering strategic advice on how to maneuver in a policy process. Therefore, these models are discussed later in this chapter (in Sect. 8.5). Nevertheless, it is worthwhile to note that these models can also be used to support the more substantive-oriented parts of a rational style policy analysis,[4] by offering insights into the support for various policy instruments and the interdependencies among actors, as illustrated by cases in water resources management in Egypt and Philippines (Hermans 2005).

8.4 Actor Modeling to Analyze the System Domain for Policies

Very few systems of interest to policy actors are completely lacking in human involvement or human impact. Therefore, in creating a useful system model, it is often desirable to model the social as well as the technical components of the system. The human elements within the system are named *system actors*. A person or organization may be both a policy actor and a system actor. But, their roles in each case are different, and they are modeled in different ways in each role. The concept of *role* helps us distinguish among actors who may appear in both the policy arena as well as in the system domain. In this section we examine the system parts of the policy analysis framework, taking special care to examine the role of actors and actor models. Regardless of the choice of actor model, all of the techniques discussed in this section fit into the policy analysis framework, and can assist in providing *outcomes of interest* from the system that can be useful to the decisionmaker.

8.4.1 Models of System Actors

While all actors are intentional, it may be impossible to fully fathom the behavior of a system actor. Furthermore, even if the intentions of a system actor are known, it may not be necessary for policy purposes to fully represent these intentions.

[4] For instance, van der Lei and Thissen (2009) discuss some of the methods contained in Sect. 8.5 as 'problem structuring methods', emphasizing their use for problem formulation and substantive analysis more than their use for process management.

Models of system actors may, therefore, be distinguished along two dimensions: *certainty* and *intentionality*. Models of the system actor may be lightweight, needing to represent little intentionality on the part of the actor. These models may also prefer to incorporate only limited certainty about the intentions—i.e., limited assumptions about the rationality or information processing capability of the actor. In contrast, other models may require a more detailed, or heavy, representation of actor intentions and/or certainty about the intentions. The intersection of certainty and intentionality leads to the 4-fold typology of models useful for modeling system actors shown in Table 8.3.

Stochastic agents models represent light representations of intentionality, as well as a low degree of certainty about the intentions of any given actor. Many of these models utilize stochastic differential equations, and borrow tools, techniques, or philosophies from statistical mechanics. The domain of econophysics, for instance, makes extensive use of stochastic agents. Stochastic agents are also used in transport simulations—for instance, models incorporating pedestrian or motorist behavior. These models are attractive because they presume little about actor behavior, and yet are sometimes able to create models of human behavior that are often general in character. Social network models often fall into this category, especially when formation mechanisms are being explicitly modeled (Carrington et al. 2005). As an example of a stochastic agent's model, Ellison and Fudenberg (1995) built a model of inter-agent communication and learning. The agents have only limited rational capabilities, and can select only a few other agents at random with which to communicate. Nonetheless, in this model the distributed learning is successful and leads to socially optimal outcomes. Dorogovtsev and Mendes (2002) offer a general model of evolution in social and technical networks. The model is relevant to organizations and infrastructure that are resilient to failure or deliberate sabotage.

There is a class of models with a heavy representation of actor intentionality, but also admitting relatively low levels of certainty about the exact intentions of any given actor. These models are known under a variety of names, such as consumer choice models, gravity models, conjoint analysis, and hierarchical modeling. They rely upon the empirical analysis of collected data, but can also provide reasonable depictions of choice under uncertainty. Data for these models may be collected via experiment or through stated preference surveys. Policy experiments are made against the inferred preferences to determine the choice and satisfaction of system actors given future changes to the system. This is a broad class of models, of wide applicability across a range of application areas. Morrison et al. (1999) used stated preference surveys in exploring environmental values for Australian wetlands (see Box 8.3).

Box 8.3: Stated preference surveys used to set objectives for a nature reserve in Australia

> The Macquarie marshes, a nature reserve in New South Wales, were adversely affected by the building of Burrendong Dam in 1967. Subsequently, some of these marshlands were turned into large areas of irrigated agriculture. Irrigation licenses exceeded original plans, resulting in a conflict between economic and environmental values. Declines in the size and health of the marshes created a call for the New South Wales Government to create a systematic process for evaluating river flow. Morrison et al. (1999) describe a study to support the objectives-setting process involving surveys of stated preferences for environmental and economic values. Four hundred and sixteen respondents were queried, and the responses were stratified according to socio-demographic characteristics. The surveys were used to evaluate preferences for water rates, irrigation-related employment, extent of wetlands, and protection of endangered species. A set of utility functions was estimated from the data using a multinomial logit model. Explicit estimates of household willingness to pay were estimated from the resulting utility functions. Water managers can use these value estimates to create strategies that are likely to have the greatest net benefits for the community.

Agent-based models presume a high level of certainty about the choices of a given system actor, but utilize only a light representation of intentionality. Shoam (1993) describes the field as 'an extension of object-based programming'—a form of highly reusable software design. Such models are attractive for their ability to provide insight into how complex behaviors may emerge from the interaction of simple rules. Agent-based models have been used in a wide variety of domains, particularly in the study of complex systems. Fox et al. (2000) used an agent-based approach to design a strategy for supply-chain management. The model supports cooperative decisionmaking in the face of noise and perturbation. Nikolic and Dijkema (2006) studied industrial ecology through the use of agent-based systems, seeking viable, and sustainable long-term futures for regional clusters of chemical firms. Saelensminde (1999) similarly explored the choice tradeoffs among noise, pollution, congestion, and automotive mobility.

Game and market models provide a detailed representation of actor intentions, but also require a high degree of certainty in modeling the choices of specific actors. Such models have merit in mechanism design—the art and science of creating rules to drive specific desired outcomes. However, it may be difficult to calibrate these models to the behavior of specific actors. Controlled experiments, such as experimental economics, may be used in an effort to better understand actor choice. Techniques in this category include linear complementary problems, general equilibrium models, public choice models, and game theory. System dynamics models of actor decisionmaking also fall within this category (Sterman

2000). Yücel (2010) combined system dynamics models and agent-based models to analyze transitions in socio-technical systems. Nordhaus and Yang (1996) created a model of future climate change that incorporates rich depictions of multiple actors across the world. Ostrom (2000) considered the interplay between social norms and the provision of public goods.

8.4.2 Gaming and Simulation: A Versatile Technique

Gaming and simulation is an unusually versatile technique for policy analysis. It does not deal exclusively with either system actors or policy actors. In fact, it is often used to bridge the gap between the policy arena and the system domain. The technique has been used to anticipate the actions of other actors in the policy arena, develop robust plans in response to a range of external forces, model emergent social forces, and assist decisionmakers in learning how to operate a system and how it works. In this last application, it is particularly attractive to have a human player be the decisionmaker and the computer simulation model be the system.

Games to support policymaking in multi-actor settings are known to have three main purposes: education, research, and action/intervention (Mayer and Veeneman 2002; Guyot and Honiden 2006). Although in many cases these three purposes will all be served to some extent in an application, the focus here is on games that are developed and used mainly for research purposes. In this case, the main intention of game design and use is to gain substantive insights into the system being studied, assuming that participants behave in a game as they would in real life (Guyot and Honiden 2006).

Kuit et al. (2005), for instance, use a simulation and gaming technique to assess decisionmaking, emergent actor, and system actor responses to a range of future energy deregulation strategies in the Netherlands. The game uses different simulation runs, with real-world actors and with students, to learn more about the energy systems and the possible impacts of different institutional arrangements. Somewhat similarly, Bekebrede (2010) reflects on the use of 'serious games' to understand infrastructure development—in particular, the development of a new area within the Port of Rotterdam.

Van Eeten et al. (2002) use examples from water management in the United States to show that extended gaming exercises, covering several days, can also be used to link various simulation models. In their case, participating agency officials and stakeholders used their own models while playing the game. In this way, the gaming itself provides the linked, comprehensive model, which has been a long-time goal of both decisionmakers and policy analysts. The game itself becomes the system model, which includes both the physical and human (multi-actor) components.

8.5 Actor Modeling to Support Process Management

Policymakers may seek advice or support in managing or maneuvering in the multi-actor policymaking process. Such advice or support is different from support in dealing with substantive policy questions, which are the focus of the rational style of policy analysis and important parts of the argumentative and client-advice styles identified in the hexagon model presented in Fig. 3.2. The process support fits mostly within the process, interactive, and participatory styles of policy analysis, as identified in the hexagon model. Actor analysis and actor models in such situations would be helpful, for instance, to provide advice to policymakers with a certain responsibility in a multi-actor arena who wish to initiate or facilitate a discussion or negotiation among various actors concerning a policy issue. When the focus is on process management, a conceptual focus on the resources and interests of actors is often most appropriate, as this helps to gain insights into interdependencies, conflicting interests, powerful actors, and possible coalitions. Three different types of models with such a focus are discussed in this section: stakeholder analysis, conflict models, and transactional models. When the focus is on interaction and participation, the use of intervention games can be beneficial.

8.5.1 Stakeholder Analysis

Stakeholder analysis is rooted in the strategic management domain (Mitroff 1983; Freeman 1984), where it is used extensively (e.g. Johnson et al. 2005). Also in public management, it is probably the most used method in practice (e.g., Grimble and Chan 1995; Brugha and Varvasovszky 2000; Bryson 2004). Most methods describe a sequence of steps to guide the analysis activities, but offer little support in the construction of analytical models. Generally, a stakeholder analysis involves a rough mapping of the power and interests of stakeholders, resulting in a diagram known as a 'stakeholder map' or 'power-interest matrix' (Bryson 2004; Johnson et al. 2005). These diagrams subsequently help to fill predefined 'participation planning matrices'. The latter categorize stakeholders in terms of their participation in policymaking or project development, ranging from informing stakeholders to empowering stakeholders (Bryson 2004).

Although one can make elaborate stakeholder analyses, they are typically used as 'quick-and-dirty' methods, offering check-lists or 'laundry lists' (Mitroff 1983, pp. 9, 46; Grimble and Chan 1995) that analysts can use to guide a rough and eclectic reflection on their stakeholder environment. Thus, we regard them as being on a different analytical level from most of the other actor modeling approaches in this chapter—comparable to a SWOT analysis[5] in systems modeling. Usually, stakeholder analysis methods are employed in a desk-oriented style by a single analyst, but they can be used also interactively (Enserink and Mayer 2002). In such cases, they can offer direct contributions to policy processes, offering a vehicle for discussion and debate among participating actors.

8.5.2 Game Theory and Conflict Models

Conflict analysis emerged as the practical application of game theory, using the theoretical notions of game theory to analyze real-world conflicts (Fraser and Hipel 1984). Conflicts are analyzed by investigating the actors, their preferences, binary options (i.e. yes/no options), and the rules of the game. The preferences are usually incorporated in the analysis through the ordinal preferences of actors for certain outcomes over other outcomes. The advantages of conflict analysis models over traditional game theoretic models are that binary options and ordinal preferences are relatively easy to define, analysis can be done in an iterative process, and even very incomplete assumptions often allow some meaningful conclusions to be drawn (Bennett 1998). Examples of conflict analysis models are analysis of options and metagame analysis (Howard 1971, 1989), hypergame analysis (Bennett et al. 1989), the Graph Model for Conflict Resolution (Fang et al. 1993; Kilgour and Hipel 2005), the expected utility model of Bueno de Mesquita (Thomson et al. 2003), and drama theory and confrontation analysis (Bennett 1998; Bennett et al. 2001).

These models and methods are often used to give strategic advice to one actor, who can be a party in a conflict, a mediator, or an interested third party, by identifying promising courses of action that might lead to favorable and stable outcomes (including coalition formation), by anticipating the possible actions of other actors, and by providing interests in the strategic dilemmas faced by the various actors involved in the conflict or negotiation (Bennett et al. 2001; Obeidi et al. 2002; Kilgour and Hipel 2005). Conflict analysis models are powerful tools to show the impacts of noncooperation, clearly pointing out what opportunities are missed through a persistent lack of cooperation, and where opportunities exist for cooperation that might lead to outcomes that are mutually preferred by both sides—in effect, classic 'win–win' solutions. A clear example of such an insight can be found in a case discussed by Obeidi et al. (2002) (see Box 8.4).

[5] Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis, which is a popular tool for analysts, managers, and decisionmakers as an organizing framework for intuitive information (Jacobs et al. 1998).

Box 8.4: The Graph Model for Conflict Resolution applied to an international trade dispute

The Graph Model for Conflict Resolution was used to analyze a complicated international trade dispute between the US company, Sun Belt Water, Inc., and the Federal Government of Canada over bulk water exports (Obeidi et al. 2002). This conflict can be traced back to the 1980s, when there was a perception of surplus fresh water in British Columbia (BC). The BC Government granted a license for bulk water export to ship bulk water to the United States. The initial license was too small to make the business economically feasible, so an expansion was requested for this license. After stiff opposition from the general public, the BC Government placed a temporary moratorium on new licenses and license expansions. This moratorium was later made permanent by a provincial Water Protection Act. In response, the US company alleged that Canada had breached its trade obligations, and threatened to submit a claim to a North American Free Trade Agreement (NAFTA) tribunal. Thus, also the Federal Government of Canada got involved, through its binding commitment to NAFTA and through the fact that the BC provincial water export prohibition policy defied the Federal Government's policy. The situation for the Federal Government was further complicated by a disagreement among other Canadian provinces over the desirability of water exports.

This conflict was modeled as a dynamic sequence of five phases in which, for the last two phases, the conflict was modeled as a two-level game, using two models to analyze each of the phases. The results of the analysis could have helped Canada's Federal Government to assess the likely consequences of certain actions. For instance, the Federal Government approached the provincial governments with an accord on bulk water exports, not appreciating that some provinces were adamantly opposed to bulk water exports or distrusted the Federal Government's intentions. Similarly, the analysis showed that the actual outcome of the fourth phase of the conflict, although it was stable, was less preferred by both Sun Belt and the Federal Government to another stable state. In the actual outcome, Sunbelt took its case to NAFTA arbitration, with the Federal Government delaying the case. This further deepened the dispute. There was also a stable outcome in which Sunbelt would not take its case to NAFTA arbitration, and where the Federal Government, logically, would not delay the case. Both would still implement other options to pursue their—still conflicting—interests, but at least the conflict would not be at risk of escalation. Thus, better communication and cooperation would have allowed them to jointly realize a more preferred outcome in this phase of the conflict.

8.5.3 Transactional and Exchange Models

Transactional models view social interactions among actors fundamentally as transactions in which actors exchange resources in various shapes and forms (Coleman 1990). Similar to conflict analysis models, transactional models are based on the assumption of actors as rational agents, who choose their actions to maximize utility. The power of actors stems from their control over important resources, and their interests and expectations determine whether or not they will use this power. Transactional methodologies and models are inspired by Coleman's social theory (Coleman 1990). Algebraic models are used to capture the causal relations in actor networks and to model interaction processes.

Transactional models are used to explain or predict the outcomes of negotiations or conflict situations. Examples include the exchange models described and used by Pappi and Knoke (1991), Stokman and van Oosten (Stokman 1994), and Timmermans (2004). These are fairly abstract models of the exchange of control over issues of interest among actors. They can be used to predict outcomes of very formal decision procedures (Stokman 1994), but they are mainly used to produce insights into interdependencies among actors, and the power of actors in relation to other actors and important issues (Pappi and Knoke 1991). Transactional models can also be used to identify configurations of actors that might cooperate, suggesting participants, and agenda items for discussions. When used interactively, with actors as participants in the analysis, this may support the realization of a constructive discussion among actors, fostering agreement and creative solutions on specific issues (Timmermans and Beroggi 2000; Timmermans 2004) (see Box 8.5).

Box 8.5: Coleman's Linear System of Action applied to recreation and tourism in Rhenen

Timmermans (2004) describes an operationalization of Coleman's Linear System of Action into an interactive, computer supported, model that can be used in real-world policy processes. The model was used to support a 1-day workshop on the development of the recreation and tourism sector in Rhenen, a municipality in the Netherlands, with the aim to indicate cooperation potential among actors. The workshop helped to make actors aware of their interdependencies and the benefits from cooperation. The analysis resulted in the identification of four negotiation clusters of actors and issues that offered good potential for cooperation. For instance, the municipality, the local zoo, and the city center retailers had room for exchange on issues of recreation and tourism product development and cultural–historical identity. This cluster could be understood in light of the weak relation between the zoo, which was located two kilometres away from the town, and the town center. If more tourists could be persuaded to make combined visits to both locations, for instance through combined tourist packages, all three groups of actors could benefit. Strengthening the cultural–historic identity of the town center would lead to an increase in the total number of visitors and would, thus, be interesting to both the zoo and the city center retailers.

8.5.4 Intervention Games

When joint understanding and analysis is a main purpose of a policy analysis, and when the interdependencies among actors are an important feature of the problem or process to be analyzed, simulation games, role-playing games, or serious games, can offer useful support for intervention (Mayer and Veeneman 2002; Guyot and Honiden 2006). As discussed in Sect. 8.4.2, simulation games can be used to model system actors, to learn about system behavior, and to model possible outcomes of interest from a system. However, similar games can also be used to support process interventions. Games for research and systems analysis purposes may be usefully run with students or other outsiders in the role of certain actors, but intervention games, by definition, require the participation of a (part of) the real-world actors, even if they are assigned different roles.

Intervention games can be designed and implemented using different modeling approaches and making use of ICT in various degrees. Games can be based on an underlying multi-actor model—for instance on an agent-based model, as in the Companion Modeling approach (Barreteau 2003; Gurung et al. 2006) and agent-based participatory simulations (Guyot and Honiden 2006)—or on a conflict analysis (metagame) model (Hermans and Bots 2002). Games can be based on a combination of gaming techniques with underlying domain specific computer models and decision support systems, such as applications reported in transport policy (Duijn et al. 2003), urban renewal (Mayer, et al. 2005), water management (van Eeten et al. 2002; Harteveld 2011), and natural resources management more generally (Bots and van Daalen 2007). In addition, with less extensive use of the computational functionalities offered by ICT, games can be based on video films (Witteveen and Enserink 2007), simple physical models (Watson and Lankford 2007), or spatial maps (Carton 2007), to name but a few possibilities.

The list of models and methods that can be used is long, but they all have in common that they are used to support ongoing policymaking processes. The games generally help actors build a shared understanding of the complexity of the policy problem at hand, of each other's positions, and/or of intervention possibilities, as a useful basis for further interactions and communications (e.g. Mayer et al. 2005; Gurung et al. 2006; Guyot and Honiden 2006; Barreteau et al. 2007; Carton 2007). Thus, their substantive focus is similar to that of the actor models to support problem formulation in multi-actor settings that were discussed in Sect. 8.3. However, games put much more emphasis on the participatory process aspect. Ultimately, the success of intervention games is measured by their impacts on the policymaking process rather than by the substantive insights gained in a multi-actor system—although the latter may occur as a useful side effect. An example of a game that made a clear contribution to a policymaking process, since it triggered the creation of a new local institution, is provided by Gurung et al. (2006) (see Box 8.6).

Intervention games offer a powerful tool to support multi-actor policymaking processes. The researchers or analysts who design the games and interventions have an important influence on the outcome of the process (Barreteau et al. 2007).

This influence is not always recognized, but may work through the selection of participants, the system representations modeled in the games, the medium used, the time, and locations of a game session, etc. This gives those policy analysts a 'superseding position and framing power' (Barreteau et al. 2007). With this comes a responsibility to reflect explicitly on the legitimacy and consequences of their interventions.

Box 8.6: Companion modeling applied to a watershed problem in Bhutan

The Companion Modeling approach was used to facilitate water management negotiations in a local watershed in Bhutan (Gurung, et al. 2006). In this watershed, six villages share water from a stream that serves five irrigation systems. Customary water sharing regimes favor upstream communities and historic users. With increasing water demands, this regime works to the disadvantage of downstream communities and newcomers, and results in conflicts within and between villages. After a preliminary analysis of the local watershed conditions, the communities, and the farming systems, a role playing game was developed by a local research extension team. Two three-day game sessions were organized in 2003, with farmers from each of the six villages as players, and with members of the local development committee as observers. During the game, several cropping seasons were simulated, using rainfall and farm market prices as the main chance factors. Players could decide what crops to grow on the plots in each season and, in different sessions, different modes of communication among farmers were allowed, through which they could discuss water sharing arrangements. The games were supported by computer simulations to determine the collective impacts of the players' decisions after each time step. The game evaluation indicated that the game supported learning among the participants, and triggered informal discussion among the communities in the period between the two game sessions. An important lesson for both participants and researchers was that local improvements depended critically on defining better communication protocols. Building on these experiences, a game was designed around different communication modes, and another workshop was organized in 2005. The second session resulted in a work plan, which led to the formal establishment of a Watershed Management Committee seven months after the game. The game was not an isolated intervention, but occurred in a larger process of community-based natural resources management that was initiated in the 1990s by the local Renewable Natural Resources Research Center. Nevertheless, it clearly supported this process in reaching another stage, which materialized through the official creation of a local watershed committee.

8.6 Reflections on Actor Models

8.6.1 Actor Models and Their Uses in Policy Analysis

The previous sections have covered a range of models, structuring their presentation and discussion around three different purposes for actor modeling in policy analysis. The models and purposes as matched here are, although in line with dominant usage, not necessarily fixed, and other combinations are possible, do occur, and may be very useful in certain situations. This is perhaps most visibly the case for gaming and simulation approaches, which have been discussed in two different sections of the chapter, and which are known to support a range of policy analysis activities (Bots and van Daalen 2007). However, other approaches can also be used to serve more than one purpose. For instance, social network analysis can be used to analyze the decisionmaking context, either for problem framing or process management purposes (Termeer 1993; Klijn et al. 2000), or it can be used to analyze the substantive policy domain, for instance the diffusion of innovations (Valente 2005). Also, stakeholder analysis can be used for problem diagnosis.

At this point, we also wish to clarify the relation between the purposes of actor modeling approaches we have used as basis for our discussion and the different dimensions of policy analysis that have been discussed elsewhere, notably in the 'hexagon model' presented in Chap. 3. The three different purposes for which actor models can be used by policy analysts, as used to structure this chapter (Sects. 8.3–8.5), can be related fairly easily to the different types of policy analysis activities identified in the hexagon model. Actor models that support problem diagnosis, by providing insight into the decisionmaking context of a substantive policy problem, are generally compatible with 'clarify values and arguments', 'research and analyze', and 'design and recommend' policy analysis activities. Actor models that support system modeling clearly emphasize the 'research and analyze' activities of policy analysis, possibly complemented by 'design and recommend'. Actor models that are used to support process management fit well with 'democratize' and 'mediate'.

Although certain actor models are more logically combined with certain purposes or styles of policy analysis, matching the use of actor models to specific purposes and situations remains difficult (see also van der Lei 2009). Not only can most actor models be used in different ways for different purposes and situations, but the choice for a modeling approach has to be made under uncertainty—i.e., the nature of the actor processes that are to be modeled often is not fully understood at the time when a modeling approach has to be selected.

8.6.2 Actor Model Uncertainty

The actor models presented here share some important characteristics, which, although they are common to all models in policy analysis, are even more pertinent for actor models. The most notable of these characteristics is the uncertainty and limited validity of actor models. Although there is a great deal of uncertainty about any policy analysis model (see Chap. 9), its pervasiveness is arguably greater for most actor models. Policy actors, whether they are individuals, groups, or organizations, are characterized by their capacity to learn, modify their perceptions, change value priorities, and manipulate their environments. Not only are actors, their attributes, and their relations highly dynamic, they are also highly unpredictable. This is no secret; it is clear to everyone, and certainly to those exposed to real-world politics and decisionmaking. Thus, the uncertainty in actor models is immediately recognized by analysts and audiences alike, which is both a blessing and a curse for the modeler. It is a blessing, since it eases the modeler's task of communicating the existence of uncertainties to decisionmakers and other interested parties. It is a curse, since it may make it more difficult to convince clients that, despite its limitations, there still is value in the model and its outcomes.

No one has yet been able to model with certainty the exact decision procedures through which the perceptions, values, and resources of actors lead to actions, and it is likely that no one ever will. Does this mean that actor modeling is not worth doing? No. First, it is sometimes the case that actors and actor networks are such important features of a policy domain or a policymaking process that any attempt to reflect on their role and impact is better than ignoring them. Second, even if actor models remain flawed and limited, they help to structure and analyze the information that we have. Actor models help us to make explicit our expectations and presumptions, thus enabling us to learn about multi-actor systems, even if learning implies a falsification of those initial expectations and presumptions. Actor models also help to delineate the space of uncertainty. Even if actor models cannot predict what will happen or how actors will behave, they sometimes can predict what will certainly not happen, because of logical impossibilities or implausibilities. Similarly, actor models can help distinguish inferior strategies from more promising ones. Even if the models can offer no complete certainty, they can be quite compelling in their suggestions that certain actions should not be implemented if a policymaker wishes to stand some chance of realizing his objectives in a multi-actor setting.

Thus, actor modeling is clearly useful to policy analysts in many situations. However, the limitations of most models, and the wide range of modeling approaches available, mean that it is all the more important to keep the limitations of actor models in mind and to focus modeling efforts on those aspects that are most relevant, choosing modeling tools and approaches that correspond well to the specific purpose for which the actor model is being employed.

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Chapter 9
Uncertainty in the Framework of Policy Analysis

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Main Entry: un-cer-tain-ty
Function: noun
1: *the quality or state of being uncertain**: doubt***
2: *something that is* ***uncertain***
Synonyms: uncertainty, doubt, dubiety, skepticism, suspicion, mistrust, *mean lack of sureness about someone or something.* ***Uncertainty*** *may range from falling short of certainty to an almost complete lack of conviction or knowledge especially about an outcome or result.* ***Doubt*** *suggests both uncertainty and inability to make a decision.* ***Dubiety*** *stresses a wavering between conclusions.* ***Skepticism*** *implies unwillingness to believe without conclusive evidence.* ***Suspicion*** *stresses lack of faith in the truth, reality, fairness, or reliability of something or someone.* ***Mistrust*** *implies a genuine doubt based upon suspicion.* [*Merriam-Webster Online Dictionary*]

9.1 Why do We Care About Uncertainty in Policy Analysis?

9.1.1 Introduction

A few elements of the above definition of uncertainty are worth highlighting. First, this definition says uncertainty is a "… a lack of conviction or knowledge especially about an outcome or result." The word conviction suggests that uncertainty is somehow related to the beliefs we hold. The word knowledge

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suggests that the level of uncertainty is related to the state of our knowledge. These two elements, conviction (strength of our belief) and knowledge are essential to what we present in this chapter; we come back to them a little later.

One of the most important roles that a policy analyst plays is to provide assistance to policymakers in choosing a preferred course of action given all of the uncertainties surrounding the choice. That uncertainties exist in practically all decisionmaking situations is generally understood by most decisionmakers, as well as by the analysts providing decision support. But there is little appreciation for the fact that there are many different dimensions of uncertainty, and there is a lack of understanding about their different characteristics, relative magnitudes, and available means for dealing with them. Also, it is widely held that decisionmakers expect analysts to provide certainties, and hence dislike uncertainty in the scientific knowledge base.

Sometimes, policymakers are able to ignore uncertainties when making policies, or base them on intuition or heuristics learned over time. Sometimes, however, the magnitude of uncertainty can be so large that heuristics can no longer be used, and the potential consequences of ignoring them could be devastating. The aim of this chapter is to provide a basis for the systematic treatment of uncertainty in policy analysis in order to improve the management of uncertainty in policymaking. Understanding the various types and sources of uncertainty would help in identifying and prioritizing critical uncertainties and would make a major contribution to structuring the work in a policy analysis project. It would also help in specifying policies to be considered in the analysis and in choosing appropriate policies to be implemented.

In policy analysis, perhaps more than in other disciplines, considering uncertainty is essential. There are many reasons and arguments for considering uncertainty. These different reasons are highlighted by a few examples. The first example comes from drug policy; the second from infrastructure projects, the third from aviation policy in the Netherlands, the fourth from the current climate change debate, and the final from the recent global financial crisis.[1]

In the 1960s, a pharmaceutical company called Merrill developed a sleeping pill that when administered to pregnant women caused serious side effects, such as birth deformities. The effects of the sleeping pill on pregnant women had not been tested; in other words, the model that was used to determine that the drug was safe was incomplete. The large number of children born with serious birth defects moved governments to institute an extensive testing regime to determine that a drug is both safe and effective (Temin 1980, p. 2). Over the years this testing regime has become ever more stringent. One rationale for a government's drug regulation policy is the desire to minimize uncertainty about the effect of a drug on

[1] For a list of real world policy cases in which policymakers ignored uncertainty, acting as if the evidence was more certain than was the case, and were confronted with the consequences of their doing so, see (EEA 2001).

people—people can get ill and even die from taking a drug, and most governments want to avoid this.

In a recent book, Flyvberg et al. (2003) review the underlying analyses making the case for several megaprojects (very large infrastructure projects). The results of their study are startling. The decision to undertake a megaproject requires a detailed assessment of costs and benefits of the project. Megaprojects are extremely expensive, and governments are almost always the initiators and financers of such projects. Megaprojects also have the potential to dramatically change their surroundings. Given the large costs and potentially large consequences, governments have a responsibility to make sure that only the megaprojects whose costs exceed their benefits are undertaken. What Flyvberg et al. found was that in almost every case they reviewed, the economic and environmental costs were systematically underestimated, while the revenues and economic benefits were systematically overestimated. One could endlessly analyze the reasons for why this happened, but here we simply note that the cost and benefit estimates of these megaprojects were almost always point estimates (single numbers!), and there was little consideration of the underlying uncertainties that could make these estimates wrong.

In 1995, after a 2-year multiphased deliberative process known as "physical planning key decision Schiphol" (PKB-Schiphol), some major decisions were made by the Dutch Parliament that were intended to guide the growth of civil aviation in the Netherlands to the year 2015. One of the outcomes of the PKB-Schiphol process was the decision to constrain the number of passengers at Schiphol to no more than 44 million passengers per year. This constraint was supposed to be more than enough to accommodate the most optimistic estimates of passenger growth until at least the year 2015. This limit was actually reached in 2004. And the noise limits, also expected to be reached no sooner than 2015, were reached in 1999.

How did such a long, costly, and deliberate planning process do such a poor job in forecasting the growth in air traffic at Schiphol? The passenger and noise projections were based on passenger forecasts that were produced by a model developed by the Central Planning Bureau (Centraal Planbureau 1992). This model assumes that the number of passengers passing through Schiphol is directly related to the value of the Netherlands' Gross National Product (GNP). This assumption was based upon the fact that, up until the time the model was built, there had been a very close relationship between the GNP and the number of passengers passing through Schiphol. Of course, no one knows with certainty what the GNP will be in 2015. So, the CPB developed three scenarios, each with a different value of GNP, which were then used to produce three forecasts of the number of passengers at Schiphol in 2015. The 44 million figure corresponds to the forecast based on the highest GNP growth rate of the three scenarios. The actual growth of GNP through 1999 was closest to the assumptions in the *low-growth* scenario. Nonetheless, (as shown in Fig. 9.1) the growth in the number of passengers during this period was significantly more than what was forecasted using the assumptions from the *high-growth* scenario—called Balanced Growth.

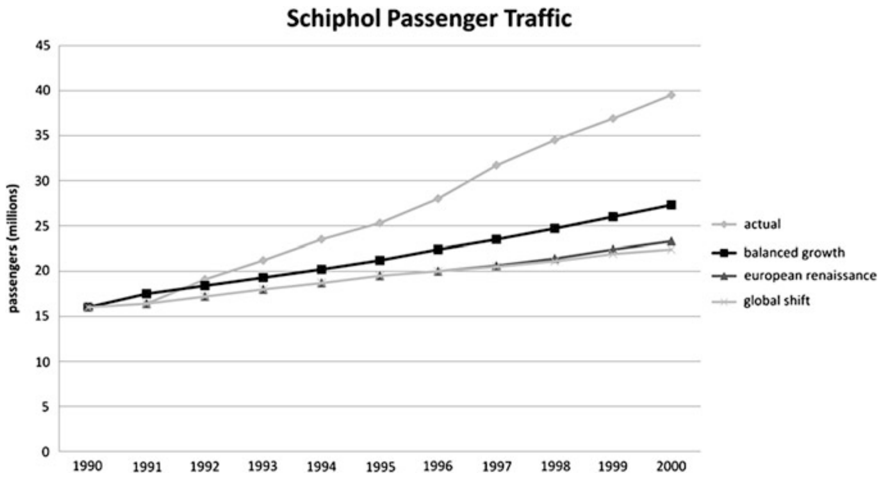


Fig. 9.1 Actual and projected growth of passenger traffic at Schiphol Airport (1990–2000)

What happened was that a number of trend breaks—unanticipated changes in the world of civil aviation—occurred after the forecasts had been made. The forecasts had assumed that the future would be a continuation of the past. But, in fact, three factors having little to do with GNP growth rates were responsible for the rapid growth of air traffic at Schiphol:

- The growth of hub-and-spoke networks, with Schiphol becoming a hub airport for KLM, where it cross-connects transfer passengers whose destination is not Amsterdam, but some other KLM city. Most of the growth in passenger traffic through Schiphol came from an increase in the number of transfer passengers carried by KLM. (The transfer traffic at Schiphol grew from 27 % in 1990 to 43 % in 1998)
- A code-sharing alliance between KLM and Northwest Airlines, which fed Northwest's European traffic through KLM, and therefore through Schiphol.
- The European Union's decision to liberalize the air transport industry—to reduce national monopolies and increase competition among airlines. As a result of this decision, European airlines began to face competitive pressures that they did not have to face in the past, fares fell, and the demand for air travel increased.

As a result, policymakers were forced to revisit their air transport policy (something they thought they would not have to do until 2015).

Another example of why uncertainty matters is climate change. Climate change research is plagued by imperfect and incomplete understanding about the functioning of natural (environmental) phenomena and processes, about how changes in these phenomena and processes translate into increases in global temperatures, and the economic and social consequences of such an increase in temperature. For a long time, the presence of these uncertainties allowed the very existence of global climate change to be denied. Now, the uncertainty as to whether climate change is taking place has been largely removed (Stern 2006). There is, however, considerable uncertainty about:

- The magnitude of climate change (there are a whole range of future scenarios that describe very different increases in average temperatures);
- The speed of climate change (which determines how quickly policy actions need to be taken);
- What this means for specific areas and regions (the effects of climate change are potentially larger for countries like Bangladesh and the Netherlands than for countries like Mongolia);
- What should be done to mitigate climate change and its adverse consequences (because there is a lack of knowledge about the costs and benefits of different alternatives for protecting ourselves from the adverse consequences of climate change).

A final example of why acknowledging uncertainty and dealing with it is of great importance is the experience of the financial crisis that gripped the world in 2008–2009. The speed and the severity of the decline in world economies was unprecedented, but policymakers did not see it coming and were unprepared to deal with it. As Alan Greenspan admitted (Committee Hearings of the US House of Representatives 2008): "I found a flaw in the model that I perceived is the critical functioning structure that defines how the world works… I was shocked, because I had been going for 40 years or more with very considerable evidence that it was working exceptionally well."

The above examples have suggested why we believe that considering uncertainty is essential in a policy analysis. First, it should be clear that uncertainty is at the heart of the very nature of policy analysis. The objective of policy analysis is to help policymakers make decisions about the future—decisions that affect (positively or negatively) people. The future is impossible to predict. But, that is no reason to throw up one's hands and decide to ignore uncertainty. Quite the opposite. Ignoring uncertainty could lead to large adverse consequences for people, countries, and the Earth, and policymakers have an interest in minimizing the possibility of such adverse consequences happening.

So, it is important for policy analysts and policymakers to accept, understand, and manage uncertainty, since:

- given the lack of crystal balls, uncertainties about the future cannot be eliminated;
- ignoring uncertainty can result in poor policies, missed chances and opportunities, and lead to inefficient use of resources; and
- ignoring uncertainty could mean that we limit our ability to take corrective action in the future and end up in situations that could have been avoided.

The remainder of this chapter is divided into five sections. Section 9.2 introduces the framework for policy analysis that is used to define and specify different types of uncertainty. Based on this framework, different ways of dealing with uncertainty in conducting a policy analysis are discussed in Sect. 9.3. While a variety of approaches are mentioned, the section focuses on ways to address what is called 'deep uncertainty'. Section 9.4 provides an in-depth treatment of one of these approaches—the use of flexible, adaptive policies. Section 9.5 provides a summary and some conclusions.

9.2 What is Uncertainty?

9.2.1 Defining Uncertainty

The notion of uncertainty has taken different meanings and emphases in various fields, including the physical sciences, engineering, statistics, economics, finance, insurance, philosophy, and psychology. Analyzing the notion in each discipline can provide a specific historical context and scope in terms of problem domain, relevant theory, methods, and tools for handling uncertainty. Such analyses are given by Agusdinata (2008), van Asselt (2000), Morgan and Henrion (1990), and Smithson (1989).

In general, uncertainty can be defined as limited knowledge about future, past, or current events. With respect to policymaking, the extent of uncertainty clearly involves subjectivity, since it is related to the satisfaction with existing knowledge, which is colored by the underlying values and perspectives of the policymaker (and the various actors involved in the policymaking process).

Shannon (1948) formalized the relationship between the uncertainty about an event and information in his 1948 paper "A mathematical theory of communication." He defined a concept he called entropy as a measure of the average information content associated with a random outcome. Roughly speaking, the concept of entropy in information theory describes how much information there is in a signal or event and relates this to the degree of uncertainty about a given event having some probability distribution.

Uncertainty is not simply the absence of knowledge. Funtowicz and Ravetz (1990) describe uncertainty as a situation of inadequate information, which can be of three sorts: inexactness, unreliability, and border with ignorance. However, uncertainty can prevail in situations in which ample information is available (Van Asselt and Rotmans 2002). Furthermore, new information can either decrease or increase uncertainty. New knowledge on complex processes may reveal the presence of uncertainties that were previously unknown or were understated. In this way, more knowledge illuminates that our understanding is more limited or that the processes are more complex than we previously thought (van der Sluijs 1997).

Uncertainty as inadequacy of knowledge has a very long history, dating back to philosophical questions debated among the ancient Greeks about the certainty of knowledge and perhaps even further. Its modern history begins around 1921, when Knight made a distinction between risk and uncertainty (Knight 1921).

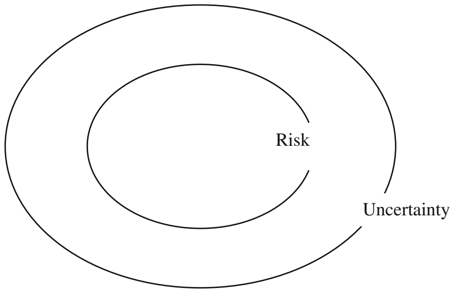


Fig. 9.2 Risk and uncertainty

According to Knight, risk denotes the calculable and thus controllable part of all that is unknowable. The remainder is the uncertain, incalculable and uncontrollable. Luce and Raiffa (1957) adopted these labels to distinguish between decisionmaking under risk and decisionmaking under uncertainty. Similarly, Quade (1989) makes a distinction between "stochastic" uncertainty and "real" uncertainty. According to Quade, stochastic uncertainty includes frequency-based probabilities and subjective (Bayesian) probabilities. Real uncertainty covers the future state of the world and the uncertainty resulting from the strategic behavior of other actors. Often, attempts to express the degree of certainty and uncertainty have been linked to whether or not to use probabilities, as exemplified by Morgan and Henrion (1990), who made a distinction between uncertainties that can be treated through probabilities and uncertainties that cannot. Uncertainties that cannot be treated probabilistically include model structure uncertainty and situations in which experts cannot agree upon the probabilities. These are the more important and hardest to handle types of uncertainties (Morgan 2003). As Quade (1989, p. 160) wrote: "Stochastic uncertainties are therefore among the least of our worries; their effects are swamped by uncertainties about the state of the world and human factors for which we know absolutely nothing about probability distributions and little more about the possible outcomes." These kinds of uncertainties are now referred to as deep uncertainty (Lempert et al. 2003), or severe uncertainty (Ben-Haim 2006).

Knight saw risk and uncertainty as being disjoint—with risk being calculated as the probability of an event times the loss if the event occurred. We prefer to treat risk as one kind of uncertainty—a low level of uncertainty, that can be quantified by using losses and probabilities. The remaining uncertainties are 'deeper', and do not have probabilities associated with them. That is, uncertainty is a broader concept than risk (see Fig. 9.2).

Formally, as defined by Walker et al. (2003), we will consider uncertainty to be "*any departure from the (unachievable) ideal of complete determinism*." Or, in mathematical terms:

Let Y be some event. If Probability(Y) $\neq$ 0 or 1, then the event Y is uncertain.

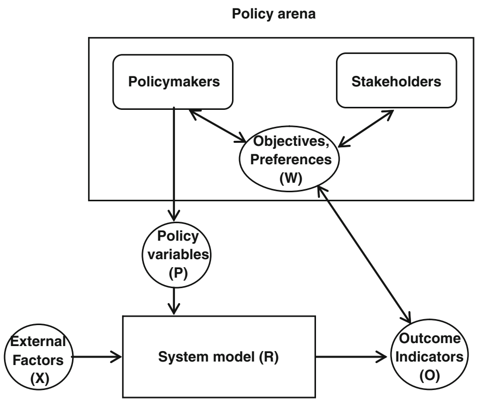


Fig. 9.3 Framework for model-based policy analysis

9.2.2 The Dimensions of Uncertainty in Policy Analysis

To aid in the decisionmaking process, policy analysts assess the outcomes of alternative policies. As described in previous chapters and as detailed by Walker (2000a), a common approach to rational-style policy analysis is to create a model of the system of interest that defines the boundaries of the system and describes its structure and operations—i.e., the elements, and the links, flows, and relationships among these elements. In this case, the analysis is referred to as being model-based. The system model is usually, but not necessarily, a computer model. This chapter is all about uncertainty in model-based policy analysis.

As described in previous chapters and in the introduction to Part II, the traditional policy analysis approach is built around an integral system description of a policy field (see Figs. II.2 and II.3; Fig. 9.3 is basically Fig. II.2 with capital letters added to identify some of the elements that will be referred to below.) At the heart of this view is the *system* comprising the policy domain, defined by distinguishing its component elements (or subsystems) and their mutual interrelationships (R). The system model represents the cause–effect relationships characterizing the system. In a mathematical model, the relationships among the various components of the system are expressed as functions. A computer model is a translation of the mathematical model into computer code. As explained in Chap. 7, the resulting system model generally represents a compromise between desired functionality, plausibility, and tractability, given the resources at hand (data, time, money, expertise, etc.).

The results of these interactions (the system outputs) are called *outcomes of interest* (O) and refer to the characteristics of the system that are considered relevant criteria for the evaluation of policies. The *valuation of outcomes* refers to the (relative) importance given to the outcomes by crucial stakeholders, including policymakers, reflecting their goals, objectives, and preferences. These involve the tradeoffs stakeholders make among the different outcomes of interest and are often represented by giving weights (W) to the outcomes of interest. In case there is a gap between (some of) the system outcomes and the goals, *policies* (P) are implemented to influence the behavior of the system in order to help to achieve the goals. If policies were the only forces affecting the system we would have a 'closed loop' system, based upon which the policymakers and stakeholders could fully control the system in order to reach their desired goals. However, in reality, there are also *external forces* (X) influencing the system. External forces refer to forces that are not controllable by the policymakers or stakeholders but may influence the system significantly (e.g., technological developments, demographic developments, economic developments). As such, both policies and external forces are developments outside the system that can affect the structure of the system and, hence, the outcomes of interest to policymakers and other stakeholders.

In policy analysis, the following basic questions are addressed:

- What is the effect of external forces on the system? (So, what will the future system look like, without new policies?):

$$R_1 = f_1(X, R) \text{ (Reference case)}$$

- What is the effect of policy measures on the future system?:

$$R_2 = f_2(P, R_1) \text{ (Policy cases)}$$

- What is the effect of changes in the system on the outcomes of interest?:

$$O_1 = f_3(R_1);\ O_2 = f_4(R_2)$$

Based on the policy analysis framework, a classification of uncertainties with respect to policymaking can be made. Such a classification has been developed by Walker et al. (2003). Their classification has two fundamental dimensions:

- *Location*: where the uncertainty manifests itself within the policy analysis framework.
- *Level*: the magnitude of the uncertainty, ranging from deterministic knowledge to total ignorance.

This produces a 2D matrix of uncertainty types. Uncertainty can manifest itself in several locations (specifically, in the external factors (X), the system (R), and the weights (W)). And the uncertainty found at each location can be any one of the levels. The following two subsections discuss the uncertainties in these two dimensions.

The explanation of uncertainty within each cell of this matrix can be distinguished by what Walker et al. call its *nature*. The nature of an uncertainty can be due to the imperfection of our knowledge (also called *epistemic* uncertainty) or to the inherent variability of the phenomena being described (also called *aleatoric* or *ontic* uncertainty). Dewulf et al. (2005) add a third nature of uncertainty:

ambiguity, which is defined as '*….the simultaneous presence of multiple equally valid frames of knowledge*'. Uncertainty about whether a Las Vegas hotel will collapse due to a structural defect is an epistemic uncertainty; uncertainty about the next poker hand to be dealt in a specific game in a Las Vegas casino is an aleatoric uncertainty; ambiguity arises when there are many interpretations of a situation (e.g., by different stakeholders). In the epistemic case, the uncertainty can be reduced (by collecting more information, or by waiting until the future becomes known). In the aleatoric case, some uncertainty must remain (although in some cases it can be reduced by additional observations and/or experiments). Aleatoric uncertainty in model-based policy analysis can be handled through use of the traditional tools of probability and statistics, for which there are many books.[2] Ambiguity has been partially addressed in the chapters dealing with the policy process (Chap. 6) and actor models (Chap. 8). It will also be addressed in this chapter in the discussion about uncertainty about the appropriate system model. So, in the remainder of this section we focus on the location and level dimensions of uncertainty, and assume that we are dealing with epistemic uncertainty.

9.2.3 The Location of Uncertainty

In terms of the policy analysis framework of Fig. 9.3, one can identify four primary locations of uncertainty that affect the choice of an appropriate policy:

(1) *uncertainty about the external factors* (X);
(2) *uncertainty about the system response to the external factors and/or policy changes* (R);
(3) uncertainty in locations (1) and (2) combine to produce *uncertainty about the system outcomes* (O) or, in the case of model-based decision support, *model outcome uncertainty*;
(4) *uncertainty about the relative importance placed on the outcomes by the participants in the policymaking process* (their weights (W) or valuation of the outcomes).

These four locations of uncertainty are highlighted in Fig. 9.4 and are discussed in more detail below.

Model outcome uncertainty is sometimes called *prediction error,* since it is the discrepancy between the true value of an outcome and the model's predicted value. If the true values are known (which is rare, even for scientific models), a formal validation exercise can be carried out to compare the true and predicted values in order to establish the prediction error. However, practically all policy analysis models are used to extrapolate beyond known situations to estimate outcomes for situations that do not yet exist. For example, the model may be used to explore

[2] One of the best of such book is (Morgan and Henrion 1990)

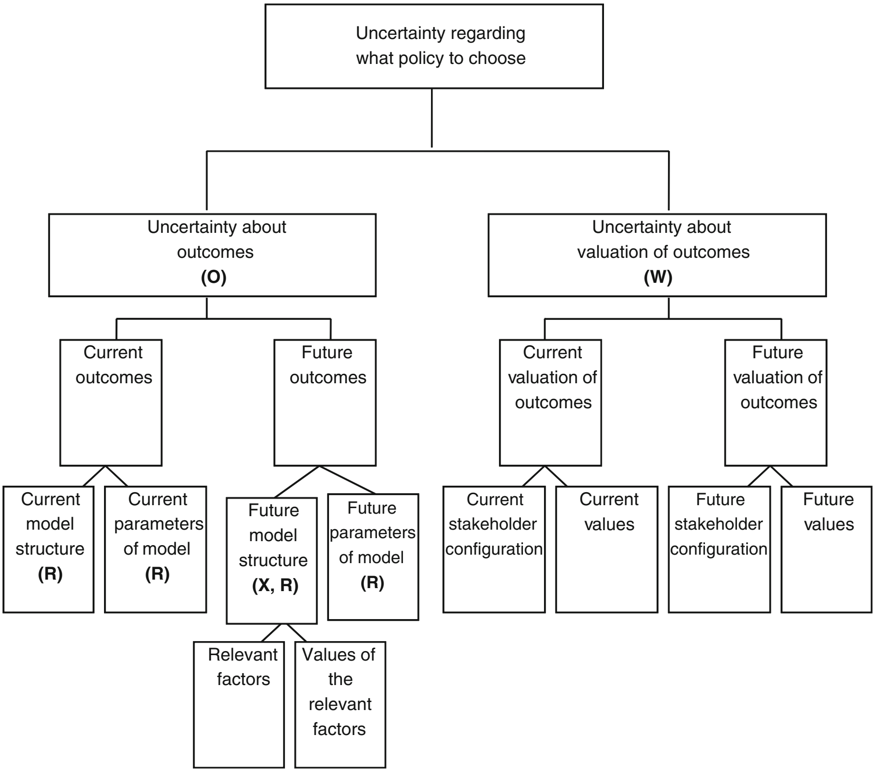


Fig. 9.4 Uncertainty locations

how a policy would perform in the future or in several different futures. In this case, in order for the model to be useful in practice, it is necessary to (1) build the credibility of the model with its users and with consumers of its results [see, for example, (Bankes 1993)], and (2) describe the uncertainty in the model outcomes (e.g., using a typology of uncertainties such as that presented in (Walker et al. 2003)). (Issues surrounding system model validation are discussed in more detail in Chap. 7). Model outcome uncertainty is the accumulated uncertainty caused by the uncertainties in the locations *external factors* and *system domain for policies* that are propagated through a model and are reflected in the resulting estimates of the outcomes of interest.

There are two major sources of model outcome uncertainty: (1) uncertainty about the external factors (X), and (2) uncertainties about the new system (and, therefore, the system model) that results from these external factors (R). Uncertainty about the *external factors* that are not under the control of the policymakers and that produce changes within the system (the relevant scenario variables) are of particular importance to policy analyses, especially if they are likely to produce large changes in the outcomes of interest.

Not only is there often great uncertainty in the external factors and their magnitudes, there is also often great uncertainty in the *system response* to these factors. There are two major categories of uncertainty within this location of uncertainty: (1) *model structure* uncertainty, and (2) *parameter* uncertainty. *Model structure uncertainty* arises from a lack of sufficient understanding of the system (past, present, or future) that is the subject of the policy analysis, including the behavior of the system and the interrelationships among its elements. Uncertainty about the structure of the system that we are trying to model implies that any one of several model formulations might be a plausible representation of the system, or that none of the proposed system models is an adequate representation of the real system. We may be uncertain about the current behavior of a system, the future evolution of the system, or both. Model structure uncertainty involves uncertainty associated with the relationships between inputs and variables, among variables, and between variables and output, and pertains to the system boundary, functional forms, definitions of variables and parameters, equations, assumptions, and mathematical algorithms.

Parameters are constants in the model, supposedly invariant within the chosen context and scenario. There are the following types of parameters:

- *Exact parameters,* which are universal constants, such as π and e.
- *Fixed parameters,* which are parameters that are so well determined by previous investigations that they can be considered exact (e.g., the acceleration of gravity (g)).
- A priori *chosen parameters,* which are parameters that may be difficult to identify by calibration and are chosen to be fixed to a certain value that is considered invariant. However, the values of such parameters are associated with uncertainty that must be estimated on the basis of *a priori* experience or by expert judgment.
- *Calibrated parameters,* which are parameters that are essentially unknown from previous investigations or that cannot be transferred from previous investigations due to lack of similarity of circumstances. They must be determined by calibration, which is performed by comparison of model outcomes for historical data series regarding both input and outcome. The parameters are generally chosen to minimize the difference between model outcomes and measured data on the same outcomes.

One of the best treatments of uncertainty about system model uncertainty and how to deal with it is given in (Morgan and Henrion 1990, Chap. 8, which is entitled "The propagation and analysis of uncertainty"). It has also been touched upon in Chap. 7 of this book. In terms of location, this chapter will focus on uncertainty in the external factors, the system response to these factors, and how to deal with these in making policies.

The third location of uncertainty in model-based policy analysis refers to the *valuation of outcomes*: i.e., the (relative) importance given to the outcomes by policymakers and crucial stakeholders (the weights). One can distinguish uncertainty about the *current stakeholders' configuration and their current values* as well as the *future stakeholders' configuration and their future values.* Even if the people who are affected by a policy are clear, there might still be uncertainty about how each of these stakeholders currently value the results of the changes in the system. The uncertainty about current values is related to different perceptions, preferences, and choices the system's stakeholders currently have regarding outcomes. And, even if the outcomes are known and there is no uncertainty about the current stakeholders' configuration and their valuation of outcomes, in time, new stakeholders might emerge and the values of the current stakeholders may change over time in unpredictable ways, leading to different valuations of future outcomes than those made in the present. For instance, the occurrence of a specific event (e.g., disaster), unexpected cost increases (e.g., in the price of oil), or new technologies (e.g., mobile telephony) can lead to changes in values. These changes in values can affect policy decisions in substantial ways.

9.2.4 The Level of Uncertainty

In order to manage uncertainty, one must be aware that an entire spectrum of different levels of knowledge exists, ranging from the unachievable ideal of complete understanding at one end of the scale to total ignorance at the other. Policy analysts have different methods and tools to treat the various levels. The range of levels of uncertainty, and their challenge to decisionmakers, was acknowledged by Donald Rumsfeld, who famously said:

> As we know, there are known knowns—these are things we know we know. We also know there are known unknowns—that is to say we know there are some things we do not know; but there are also unknown unknowns—the ones we don't know we don't know…. It is the latter category that tends to be the difficult one.[3]

For purposes of determining ways of dealing with uncertainty in developing public policies or business strategies, one can distinguish two extreme levels of uncertainty (complete certainty and total ignorance) and several intermediate levels (e.g., Courtney 2001; Walker et al. 2003; Makridakis et al. 2009; Kwakkel et al. 2010b). We define five intermediate levels. In Fig. 9.5, the intermediate levels are defined with respect to the knowledge assumed about the four locations of uncertainty: (a) the future world (X), (b) the model of the relevant system for that future world (R), (c) the outcomes from the system (O), and (d) the weights that the various stakeholders will put on the outcomes (W). The levels of uncertainty are briefly discussed below.

Complete certainty is the situation in which we know everything precisely. It is not attainable, but acts as a limiting characteristic at one end of the spectrum.

Level 1 uncertainty represents the situation in which one admits that one is not absolutely certain, but one is not willing or able to measure the degree of uncertainty in any explicit way (Hillier and Lieberman 2001, p. 43). Level 1

[3] Donald Rumsfeld, Department of Defense news briefing, Feb. 12, 2002.

Complete Certainty → Total ignorance

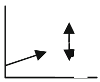
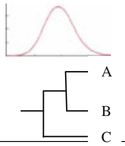
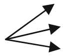
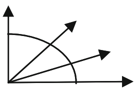
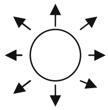
	Level 1	Level 2	Level 3	Level 4	Level 5
Context	A clear enough future (with sensitivity) 	Alternate futures (with probabilities) 	Alternate futures (with ranking) 	A multiplicity of plausible futures (unranked) 	Unknown future 
System model	A single system model	A single system model with a probabilistic parameterization	Several system models, one of which is most likely	Several system models, with different structures	Unknown system model; know we don't know
System outcomes	Point estimates with sensitivity	Several sets of point estimates with confidence intervals	Several sets of point estimates, ranked according to their perceived likelihood	A known range of outcomes	Unknown outcomes; know we don't know
Weights on outcomes	A single set of weights	Several sets of weights, with a probability attached to each set	Several sets of weights, ranked according to their perceived likelihood	A known range of weights	Unknown weights; know we don't know

Fig. 9.5 The progressive transition of levels of uncertainty from complete certainty to total ignorance

uncertainty is often treated through a simple sensitivity analysis of model parameters, where the impacts of small perturbations of model input parameters on the outcomes of a model are assessed.

Level 2 uncertainty is any uncertainty that can be described adequately in statistical terms. In the case of uncertainty about the future, Level 2 uncertainty is often captured in the form of either a (single) forecast (usually trend-based) with a confidence interval or multiple forecasts ('scenarios') with associated probabilities.

Level 3 uncertainty represents the situation in which one is able to enumerate multiple alternatives and is able to rank the alternatives in terms of perceived likelihood. That is, in light of the available knowledge and information there are several alternative futures, different parameterizations of the system model, alternative sets of outcomes, and/or different conceivable sets of weights. These possibilities can be ranked according to their perceived likelihood (e.g., virtually certain, very likely, likely, etc.). In the case of uncertainty about the future, Level 3 uncertainty about the future world is often captured in the form of a few trend-based scenarios based on alternative assumptions about the external factors (e.g., three trend-based scenarios for air transport demand, based on three different assumptions about GDP growth). The scenarios are then ranked according to their perceived likelihood, but no probabilities are assigned [see, for example, Patt and Schrag (2003) and Patt and Dessai (2004)].

Level 4 uncertainty represents the situation in which one is able to enumerate multiple plausible alternatives without being able to rank the alternatives in terms of perceived likelihood. This inability can be due to a lack of knowledge or data about the mechanism or functional relationships being studied; but this inability can also arise due to the fact that the decisionmakers cannot agree on the rankings. As a result, analysts struggle to specify the appropriate models to describe interactions among the system's variables, to select the probability distributions to represent uncertainty about key parameters in the models, and/or how to value the desirability of alternative outcomes (Lempert et al. 2003).

Level 5 uncertainty represents the deepest level of recognized uncertainty; in this case, we know only that we do not know. We recognize our ignorance. Recognized ignorance is increasingly becoming a common feature of our existence, because catastrophic, unpredicted, surprising, but painful events seem to be occurring more often. Taleb (2007) calls these events "Black Swans". He defines a Black Swan event as one that lies outside the realm of regular expectations (i.e., "nothing in the past can convincingly point to its possibility"), carries an extreme impact, and is explainable only after the fact (i.e., through retrospective, not prospective, predictability). One of the most dramatic recent Black Swans is the concatenation of events following the 2007 subprime mortgage crisis in the United States. The mortgage crisis (which some had forecast) led to a credit crunch, which led to bank failures, which led to a deep global recession in 2009, which was outside the realm of most expectations. Another recent Black Swan was the level 9.0 earthquake in Japan in 2011, which led to a tsunami and a nuclear catastrophe, which led to supply chain disruptions (e.g., for automobile parts) around the world.

Total ignorance is the other extreme on the scale of uncertainty. As with complete certainty, total ignorance acts as a limiting case.

9.3 Policymaking in the Face of Uncertainty About the Future

High quality does not require the elimination of uncertainty, but rather its effective management… The objective of uncertainty management is to make sure that the users of information can assess its strength relevant to their purposes.

(*Funtowicz and Ravetz* 1990, p.1)

In most real world policymaking situations, decisions must be taken in spite of there being uncertainty about the future situation, about the outcomes from the decision, and about the future valuation of the outcomes. Here, decisionmaking is faced with the prospect of surprise—and the failure of policies that are based on assumptions that do not come to pass. It is in this gray area between the well known and what is not known that the location, level, and nature of uncertainty ought to affect the approach to decisionmaking. The ultimate goal of decision-making in the face of uncertainty should be to reduce the undesirable effects of negative surprises, rather than hoping or expecting to eliminate them, and to take advantage of positive surprises (Dewar 2002; McDaniel and Driebe 2005).

There are a variety of methods and tools that have been developed for dealing with uncertainty in conducting a model-based policy analysis study, such as the use of sensitivity analysis, probabilities, statistics, Monte Carlo simulation, scenarios, etc. These are not general purpose tools, but are useful for dealing with specific types of uncertainty in specific types of situations. One step in a policy analysis study should be an analysis of the uncertainties that the study will have to deal with. The typology presented in Sect. 9.2 can be used to provide a structured way of identifying these uncertainties. Once these uncertainties have been identified, the appropriate tools can be selected to deal with them.

Most of the quantitative analytical approaches deal with Level 1 and Level 2 uncertainties. In fact, most of the traditional applied scientific work in the engineering, social, and natural sciences has been built upon the supposition that the uncertainties result from either a lack of information, which "has led to an emphasis on uncertainty reduction through everincreasing information seeking and processing" (McDaniel and Driebe 2005), or from random variation, which has concentrated efforts on stochastic processes and statistical analysis. However, most of the important policy problems currently faced by policymakers are characterized by the higher, or deeper, levels of uncertainty (i.e., Levels 3, 4, and 5). These uncertainties cannot be dealt with through the use of probabilities and cannot be reduced by gathering more information, but are basically unknowable and unpredictable at the present time. And these higher levels of uncertainty can involve uncertainties about all aspects of a policy problem—external or internal developments, the appropriate (future) system model, the parameterization of the model, the model outcomes, and the valuation of the outcomes by (future) stakeholders. Many of the negative consequences from policy decisions described in Sect. 9.1.1 were due to the use of approaches that did not take into account the fact that they were facing conditions of Level 3 and higher uncertainty. New policy analysis approaches are needed to deal with these conditions.

We refer to Level 4 and Level 5 uncertainties as 'deep uncertainty'. Lempert et al. (2003) have defined deep uncertainty as "the condition in which analysts do not know or the parties to a decision cannot agree upon (1) the appropriate models to describe interactions among a system's variables, (2) the probability distributions to represent uncertainty about key parameters in the models, and/or (3) how to value the desirability of alternative outcomes." The 'do not know' portion of the definition applies to Level 5 uncertainties, and the 'cannot agree upon' portion of the definition applies to Level 4 uncertainties.

In this section, we first summarize traditional ways of dealing with uncertainty about the future in conducting a policy analysis study, including when they are appropriate and when they are not. We then devote the remainder of the chapter to ways of dealing with deep uncertainty.

The most common approaches for addressing these five levels of uncertainty are:

Level 1: Assume that the future is clear and base the policy on that assumption or on a single forecast. In this case, it is possible to use a single (perhaps, optimization) model to find the 'best' policy. Sensitivity analysis on the model's parameters can be used to explore how sensitive the policy results are to the assumptions about the future. This is sometimes called the 'predict-and-act' approach. The resulting policy is 'optimal', but is fragilely dependent on the underlying assumptions. This approach works best when dealing with Level 1 uncertainties.

Level 2: Assume that there are a few alternative futures that can be predicted well enough (and to which probabilities can be assigned). In this case, a model for each future can be used to estimate the outcomes of policies for these futures, or a decision tree can be constructed based on the probabilities. A preferred policy can be chosen based on the outcomes and the associated probabilities of the futures (i.e., based on 'expected outcomes' and levels of acceptable risk). These approaches work best when dealing with Level 2 uncertainties.

Level 3: There are no analytic methods directly tailored for treating Level 3 uncertainties. Typically, one tries to reduce a Level 3 uncertainty to a Level 2 uncertainty by assigning probabilities to the ranked likelihoods, or by treating all the possibilities as equal (i.e., increasing it to a Level 4 uncertainty). Conceptually, a Level 3 approach would be to identify a policy that will perform well in the most likely futures, and does not perform too poorly in the less likely futures.

Level 4: Identify a policy that is robust (i.e., works fairly well) across a range of plausible futures. This approach assumes that, although the likelihood of the future worlds is unknown, the plausible futures can be specified well enough to identify a (static) policy that will produce acceptable outcomes in most of them. We call this *static robustness*; it is more often called *scenario planning* (van der Heijden 1996). It works best when dealing with Level 4 uncertainties.

Level 5: Broadly speaking, although there are differences in definitions, and ambiguities in meanings, the literature offers three (overlapping, not mutually exclusive) ways for dealing with Level 5 uncertainty in making policies [see, for example, Leusink and Zanting (2009)]:

- *Resistance*: plan for the worst conceivable case or future situation
- *Resilience*: whatever happens in the future, make sure that you have a policy that will result in the system recovering quickly
- *Adaptive robustness*: prepare to change the policy, in case conditions change

The first approach is likely to be very costly and might not produce a policy that works well, because of Black Swans. The second approach accepts short-term pain (negative system performance), but focuses on recovery. The third approach appears to be the most robust and efficacious way of dealing with Level 5 uncertainties (Kwakkel et al. 2012).

We discuss the approaches identified above for the various levels of uncertainty in the following subsections. The first two are discussed fairly briefly, since they are well documented elsewhere. Given the lack of analytic approaches for Level 3 uncertainty, and a tendency to either treat it using Level 2 or Level 4 approaches, we do not discuss Level 3 in any more detail. We discuss Level 4 (scenario planning/static robustness) and Level 5 (adaptive robustness) approaches more extensively, since they are less well documented.

9.3.1 The Predict-and-Act Approach

As mentioned in Chap. 2, and described in more detail by Walker and Fisher (2001), policy analysis developed out of operations research and systems analysis. These disciplines generally study real world operational systems in order to develop "an overall understanding of optimal solutions to executive type problems" (Churchman et al. 1957, p. 7). They have to deal with Level 1 uncertainties, and, therefore, can apply a "predict-and-act" approach. The approach, however, is not generally useful for handling policy analysis problems.

Applying the 'predict-and act' paradigm to a policy analysis problem would include building a model of the system of interest in order to estimate the outcomes of alternative policies, assuming some future world. (The model might be a stochastic model if there were stochastic uncertainties.) The outcomes for different policies would then be valued using some form of cost–benefit analysis, multi-criteria analysis, or optimization technique in order to end up with a 'best' policy.

The usual approach for handling uncertainty in the predict-and-act approach is by means of sensitivity analysis—varying the assumptions and observing how the results would change (Saltelli et al. 2000).

This approach can work reasonably well for policy problems with a short planning horizon in which the system is reasonably stable. Within a narrow time frame, the range of possible futures is somewhat constrained, and it is possible to determine, within reasonable error bands, important policy-exogenous and policy-dependent events.

However, as the planning horizon stretches toward the distant future, the nature of the policy problem changes in a major qualitative manner. The "fan" of possible futures expands [Rosenhead (1989) calls this the "trumpet of uncertainty"], so that not only is prediction with certainty not possible, but even "coming close" is not attainable. Put in formal terms, the sensitivity of any predictions is so large that results from a best estimate model are not credible.

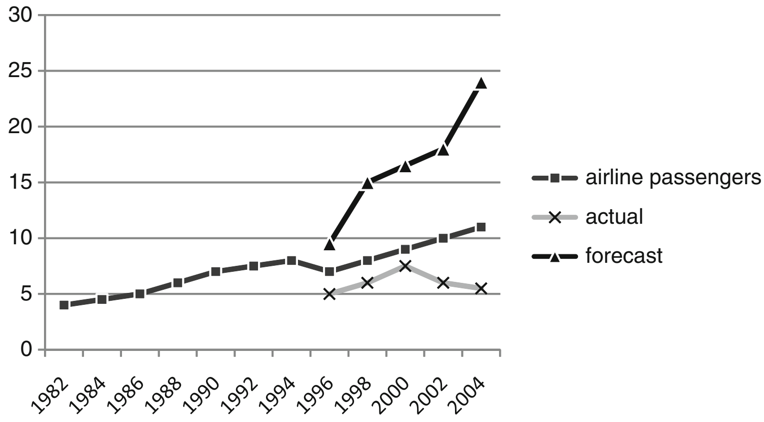


Fig. 9.6 Eurostar passengers: forecast and actual

Selecting policies on the basis of a maximum likelihood future means betting on a future that, although the most likely among the candidates proffered, still is almost certain not to occur. And the policy that works best for the maximum likelihood future may not work very well for many of the futures that could occur, whose collective likelihoods are non-negligible.

Quade (1989) uses the following example to warn policy analysts against basing a policy on a single set of best guesses about the future world:

> [S]uppose there is uncertainty about 10 factors and we make a best guess for all 10. If the probability that each best guess is right is 0.6 (a very high batting average for most best guesses), the probability that all 10 are right is about six-tenths of 1 %. If we confined the analysis to this one case, we would be ignoring a set of possibilities that had something like 99.4 % probability of occurring.

In this approach, the implicit assumption underlying the forecasts is generally that the future will look significantly like the past; the future world will be structurally more or less the same as the current world—perhaps more populated, richer, dirtier—but, essentially the same. Unfortunately, there is no particular reason why the future should look like the past. By assuming it does, we do not solve the uncertainty problem, we merely sweep it under the rug, often with serious consequences.

For example, the competition from low-cost air carriers and price reactions of ferries were not taken into account in planning for the railroad tunnel under the English Channel (see Fig. 9.6). This resulted in a significant overestimation of the tunnel's revenues and market position, with devastating consequences for the project.

9.3.2 The Expected Outcomes Approach

In this approach, policymakers make policy choices based on an assumption that the probabilities of different futures are known. In particular, several forecasts of the future are made, probabilities are assigned to the futures, and alternatives are evaluated based on their expected (probability-weighted) performance and/or 'confidence intervals' around the predicted outcomes. Not only may the futures be known probabilistically, but the other uncertainties (e.g., parametric uncertainty in the system model) may also be known probabilistically.

Referring to Fig. 9.3, if probabilities can be assigned to the scenarios (X), the system model and/or the parameters of the model (R), and/or the stochastic variables in the model, then probabilities can be assigned to the outcomes of interest (O) [see (Morgan and Henrion 1990), Chap. 8: "The propagation and analysis of uncertainty"]. In this case, policymakers and other stakeholders will be able to choose a preferred policy based upon the resulting outcomes and their probabilities. There are many methods that have been developed for doing so. Most of these are based upon the various policies' expected (probability-weighted) performance. In these cases, the preferred policy is usually chosen in a way that is similar to the way a policy is chosen in the predict-and-act approach—e.g., the one that has the highest weighted (using weights W) expected outcomes. Also, a cost–benefit analysis can be performed, using expected costs and expected benefits. The probability distribution of the outcomes can be used to place confidence intervals around the expected values. To take into account the dynamics of the effects of a policy and the time value of money, the Net Present Value (NPV) of the expected benefits minus the expected costs is often calculated. It discounts all future cash flows to their present value. However, as uncertainty increases, it becomes impossible to forecast future cash flows and their timing with any degree of confidence or to arrive at an appropriate discount rate.

An approach that uses these probabilities more directly in the analysis is Decision Analysis (DA) [see, for example, (Keeney and Raiffa 1976) and (Clemen 1996)]. DA commonly uses a graphical representation, such as a causal diagram or decision tree, to represent the alternatives available to a decisionmaker, the uncertainty being faced, and the resulting outcomes. Uncertainties are represented through probabilities (e.g., at the various branch points in the decision tree). A policy is valued by assigning weights to the various outcomes and choosing the policy that produces the best expected result (i.e., the 'maximum utility').

Another somewhat related approach is called Real Options Analysis (ROA) [Amram and Kulatilaka (1999); Trigeorgis (2000); Kodukula and Papudesu (2006)]. It is conceptually similar to DA, but is more narrowly focused on multi-stage, dynamic problems involving infrastructure planning or capital budgeting. Also, it takes into account uncertainty about the future evolution of the factors that determine the value of the project, and the decisionmaker's ability to respond to the evolution of these factors. The reason that it is called 'real options' is that it applies the concepts related to financial 'put' and 'call' options to infrastructure planning/capital budgeting decisions (so, 'real property' rather than 'financial instruments'). In finance, a financial option conveys the right, but not the obligation, to engage in a future transaction (e.g., the right to buy or sell stock within a predetermined period at a predetermined price). The value of a financial option reflects the stock's expected value development, including any uncertainties that surround this expectation. In other words, the value of a financial option can be seen as the price to be paid to reduce uncertainty and increase flexibility. The application of the same approach for valuing options involving real assets is called ROA. A real option is, therefore, the option to make or abandon a capital investment—e.g., the opportunity for an electricity utility to expand a power plant if the conditions are right.

As mentioned above, ROA enables the valuation of flexibility. The framework of options thinking recognizes that uncertainty adds value to options; i.e., uncertainty is a driver of value and can be viewed as a positive element. If NPV is the Net Present Value of an investment (this where the probabilities are applied), the value of flexibility (i.e., the value of the option) can be given as (Trigeorgis 2000):

Flexibility value = NPV (with flexibility)−NPV (without flexibility)

This formula entails the comparison of NPV between a project with an option and without one.

Another important aspect is that having an option comes at a cost. For example, creating a real option by over dimensioning an infrastructure project requires an extra investment cost (e.g., costs of building extra capacity to a power plant). As a general rule, under ROA, an option should be chosen as long as the benefits from the flexibility are greater than the costs of creating it.

Agusdinata (2008) provides an example of ROA applied to a power plant investment decision (to illustrate an option of initially building a power plant with more production capacity than necessary in order to be able to gain more profits if the circumstances change in the future). De Neufville (2003) illustrates the wide range of applications for ROA using cases from many fields of engineering.

9.3.3 Using Scenarios to Deal with Level 4 Uncertainty: The Traditional Scenario Planning Approach

When faced with Level 4 uncertainties, in which the predict-and-act approach and expected value approaches are not appropriate, policy analysts will generally use scenario planning. The core of this approach is that the future can be specified well enough to identify policies that will produce favorable outcomes in one or more specific plausible future worlds. The future worlds are called scenarios. {Börjeson et al. (2006) call these 'explorative scenarios' to differentiate them from 'predictive scenarios', which can be used to deal with Level 1 and Level 2 uncertainties, and 'normative scenarios', which use backcasting [see, for example, Quist (2007)] to determine how a specific desired target can be reached}. The use of the term *scenario* as an analytical tool dates from the early 1960s, when researchers at the RAND

Corporation defined states of the world within which alternative weapons systems or military strategies would have to perform. Since then, their use has grown rapidly, and the meanings and uses of scenarios have become increasingly varied. Here, we use Quade's (1989) definition: "A description of the conditions under which the system or policy to be designed, tested, or evaluated is assumed to perform".

Scenarios are "stories" of possible futures, based upon logical, consistent sets of assumptions, and fleshed out in sufficient detail to provide a useful context for engaging planners and stakeholders. A scenario in scenario planning includes assumptions about developments within the system being studied and developments outside the system that affect the system, but exclude the policy options to be examined. Because the only sure thing about a future scenario is that it will not be exactly what happens, several scenarios, spanning a range of developments, are constructed to span a range of futures of interest. No probabilities are attached to the futures represented by each of the scenarios. They have a qualitative function, not a quantitative function. Scenarios do not tell us what will happen in the future; rather they tell us what can (plausibly) happen. They are used in scenario planning to prepare for the future: to identify possible future problems, and to identify robust (static) policies for dealing with the problems.

Similar to the predict-and-act approach, in scenario planning policy analysts use best estimate models (based on the most up-to-date scientific knowledge) to examine the consequences that would follow from the implementation of each of several possible policies. But, in this case, they do this 'impact assessment' for each of the scenarios. The 'best' policy is the one that produces the most favorable outcomes across the scenarios. [Such a policy is called a *robust* (static) policy.]

There is no general theory that allows us to assess scenario adequacy or quality. There are, however, a number of criteria that are often mentioned in the literature as being important. Schwarz (1988) gives a brief summary of them. The most important of these are consistency, plausibility, credibility, and relevance.

- Consistency: the assumptions made are not self-contradictory; a sequence of events could be constructed leading from the present world to the future world;
- Plausibility: the posited chain of events *can* happen;
- Credibility: each change in the chain can be explained (causality);
- Relevance: changes in the values of each of the scenario variables is likely to have a large effect on at least one outcome of interest.

A structured process for developing scenarios consisting of a number of explicit steps has been used in several policy analysis studies. The steps, summarized by Thissen (1999), and based on the more detailed specifications of RAND Europe (1997), Schwartz (1996), and van der Heijden et al. (2002), are:

Step 1. Specify the system, its outcomes of interest, and the relevant time horizon. A *system diagram* can be used to identify what is considered inside and outside the system, the system elements that affect or influence the outcomes of interest, and their interrelationships.

	Change would lead to a low impact (for all outcomes of interest)	Change would lead to a **high impact** (on at least one outcome of interest)
Factor/change is **uncertain**	These factors/changes can be included (for 'color') or left out of the scenarios	**These factors/changes are candidates for scenarios**
Factor/change is fairly certain	These factors/changes can be included (for 'color') or left out of the scenarios	These factors/changes are included in all the scenarios as "autonomous developments"

Fig. 9.7 Selecting relevant factors/system changes for scenarios

Step 2. Identify external factors (X) driving changes in the system (R) (and, thereby producing changes in the outcomes of interest (O)). Whether or not a particular external factor is relevant depends on the magnitude of the change in the system and its implications for the outcomes of interest. There are many judgments involved in defining the system under consideration, the relationships among the subsystems, and the definition of what is relevant. Thus, the determination of relevant factors and changes is necessarily subjective. Potentially relevant factors and changes are often best identified by conducting a series of interactive brainstorming or focus group sessions involving experts and/or stakeholders.

Step 3. Categorize factors and resulting system changes as fairly certain or uncertain. The factors/system changes from Step 2 are placed into one of two categories—fairly certain or uncertain (see Fig. 9.7). Those factors/system changes about which we are fairly certain are placed into this category. The remaining factors/changes are placed into the uncertain category. The factors/system changes in the fairly certain category are included in all the scenarios. The uncertain factors/system changes are used to identify the most important and relevant uncertainties that have to be taken into account.

Step 4. Assess the relevance of the uncertain factors/system changes. The analyses should focus on the uncertain factors/system changes that have the largest effects on the outcomes of interest. To identify them, the impact of each uncertain factor/system change is considered with respect to each of the outcomes of interest. Based on the estimated impact that the resulting system change has on the outcomes of interest, the factor/system change is placed in either a high or low impact category (see Fig. 9.7).

The uncertain factors and system changes in the low impact category are dropped from further consideration. The uncertain factors and system changes in the high impact category (those that have a high impact on at least one of the outcomes of interest), along with the fairly certain elements, form the basis for the scenarios.

Step 5. Design several scenarios based on combinations of different developments in the external factors. These should provide strikingly different images of plausible futures. A brief but imaginative description of the essential characteristics of the future depicted by each of the scenarios should then be provided. Once the specific scenarios are identified, the values of the scenario variables can be used as inputs to the system model and/or the system represented by the scenario is used for the system model. This forms the basis for the subsequent assessment of policy options.

The benefits of using scenarios in policy analysis are threefold. First, it helps us to deal with situations in which there are many sources of uncertainty. Second, it allows us to examine the "what ifs" related to scenario uncertainties; it suggests ways in which the system could change in the future and allows us to examine the implications of these changes. Finally, scenarios provide a way to explore the implications of Level 4 uncertainty for policymaking (prepare for the future) by identifying possible future problems and identifying (static) robust policies for dealing with the problems.

However, from an analytic perspective the scenario approach has several problems. The first problem is deciding which future external developments to include in the scenarios. Typically, these developments are decided upon by experts (collectively and individually). However, in the face of uncertainty, no one is in a position to make this judgment. A second problem is that, even if we knew all of the relevant external factors, the values of these factors are likely to be uncertain. So, we have little idea about whether the range of futures provided by the scenarios covers all, 95 %, or some other percentage of the possible futures. Thus, even if we choose a policy that performs well in our scenarios, we do not know whether this policy will perform well in the future or not. A third problem with this approach has to do with the large range in the performance estimates generated by the scenarios. If the uncertainty included in this range is large, policymakers often tend to fall back on a single 'most likely' scenario (assuming Level 3 uncertainty), or the do-nothing approach, arguing that "we do not have sufficient information to make a decision at this time". The latter is probably the worst possible outcome—when the level of uncertainty is high, and the potential consequences are large, it would probably be better if policymakers acted rather than waited.

9.3.4 The Exploratory Modeling and Analysis Approach

An alternative scenario-related approach for Level 4 uncertainty (and for Level 5 uncertainty), which uses scenario variables in a different way, is the Exploratory Modeling and Analysis (EMA) approach (Agusdinata 2008), which is closely related to the Robust Decisionmaking (RDM) approach (Lempert et al. 2006).

EMA turns the 'predict-and-act' approach on its head. It begins by acknowledging the fact that a validatable predictive policy analysis model cannot be built (see Chap. 7). It then asks the question 'in that case, what can we do with our system model?'. As noted in Sect. 9.3.1, in situations with deep uncertainty, relying on a 'best estimate' model to predict system behavior can result in the choice of a very poor policy. Therefore, rather than attempting to predict system behavior, EMA aims to analyze and reason about the system's behavior (Bankes 1993; Kwakkel et al. 2010c). Under conditions of deep uncertainty, even a model that cannot be validated can still be useful (Hodges 1991). One use is as a hypothesis generator, to get insight into possible behaviors of a system. A combination of input and system variables can be established as a hypothesis about the system. One can then ask what the system behavior would be if this hypothesis were correct.

EMA supports this process of researching a broad range of assumptions and circumstances. In particular, EMA involves exploring a wide variety of scenarios, alternative model structures, and alternative value systems. The exploration is carried out using computational experiments. A computational experiment is a single run of a given model structure and a given parameterization of that structure. It reveals how the real world would behave if the various hypotheses presented by the structure and the parameterization were correct. By exploring a large number of these hypotheses, one can get insights into how the system would behave under a large variety of assumptions. To support the exploration of these hypotheses, data mining techniques for analysis and visualization are employed. How to cleverly select the finite sample of models and cases to examine from the large or infinite set of possibilities is one of the major issues to be addressed in any EMA application. A wide range of research strategies are possible, including structured case generation by Monte Carlo, Latin Hypercube, or factorial experimental design methods, search for extremal points of cost functions, sampling methods that search for regions of "model space" with qualitatively different behavior, or combining human insight and reasoning with formal sampling mechanisms. Computational experiments can be used to examine ranges of possible outcomes, to suggest hypotheses to explain puzzling data, to discover significant phases, classes, or thresholds among the ensemble of plausible models, or to support reasoning based upon an analysis of risks, opportunities, or scenarios. EMA aims to "cover the space" of possibilities, which can be described as the space being created by the uncertainty surrounding the many variables.

In EMA, relatively fast and simple computer models of the policy domain are applied. Because EMA aims to cover the whole space of possibilities, it is usually necessary to make huge numbers of computer runs (1,000–100,000 or more). With traditional best estimate models this would take too much time. With fast and simple models (low-resolution models), one can cover the entire uncertainty space, and then drill down into more detail where initial results suggest interesting system behavior (e.g., the boundaries between policy success and failure). Also, it is known that humans have a limited capability to process information (Simon 1978). Hence, to be able to base decisions on understandable logic implies not having too many variables or too much complexity. Thus, a relatively low-resolution model is preferable (Davis 2003).

The EMA practitioner is not interested in finding a single best policy given a validated predictive system model, but wants to display the pattern of policy performance over the entire uncertainty space of possible system models and external scenarios. Using a variety of visualization tools and analysis techniques, the results of the huge numbers of computer runs can be analyzed, displayed, and understood. Successfully applied algorithms in the context of EMA include the Patient Rule Induction Method (PRIM) (Friedman and Fisher 1999) and Classification and Regression Trees (CART) (Breiman et al. 1984). Increasingly, such algorithms are available in standard statistical data analysis software packages (e.g., SPSS). The Evolving Logic company (evolvinglogic.com) produced a software environment called the Computer Assisted Reasoning system (CARs), which supports the generation of the EMA cases to be run and the manipulation and display of the results of the runs. And researchers at the Delft University of Technology are developing a 'workbench' aimed at providing support for performing EMA using models developed in a variety of modeling packages and environments.

One of the foundations of EMA is the idea that under conditions of Level 4 (and Level 5) uncertainty, analysts should explore multiple hypotheses about the system of interest by broadening the assumptions underlying a system model (Bankes 1993). Each of the hypotheses serves as one 'mirror', allowing policy analysts to look at the behavior of the system, and multiple mirrors provide a more reliable 'picture' than a single mirror does. Because each model run is treated as a deterministic hypothesis about the system of interest, EMA does not require assignment of likelihood or probability to uncertainty variables.

EMA explores the uncertainty regarding the effect of external factors by, for example, making separate runs using combinations of scenario variables. Different policy options and different strategies (combinations of policy options) can be simulated. The system structure can be explored by varying the relationships among the system's elements. For example, alternative functional relationships can be considered (thus addressing model uncertainty). This principle also applies to alternative parametric values, behavioral rules, or even theories. In the case of vague relationships (e.g., uncertainty about how two factors are correlated—whether one factor is the effect or the cause of other factors), analysts may also need to consider varying the magnitude and sign of the correlation coefficient, and, when causality is involved, varying the sign and/or direction of the cause–effect mechanism. Different combinations of assumptions form the hypotheses about the system underlying the decision problem.

In making policy decisions about complex and uncertain problems, EMA can provide new knowledge, even where validated models cannot be constructed. For example, multiple models that capture different framings of the same policy problem can be run. Instead of debating which is the right model, the policy debate can shift to the identification of policies that produce satisfying results across the different models.

EMA has also been used successfully for 'scenario discovery' (Lempert et al. 2006). The aim of scenario discovery is to analyze the results from a series of computational experiments in order to reveal which combinations of hypotheses and guesses were responsible for generating the results of interest. Results of interest can be identified based on the performance of candidate policies, but other criteria can also be used. One common use of scenario discovery is to identify combinations of external events that would lead to the failure of the policy being investigated. Scenario discovery has been used in the context of water resource management in California (Groves and Lempert 2007), for evaluating alternative policies considered by the United States Congress while debating reauthorization of the Terrorism Risk Insurance Act (Dixon et al. 2007), and for assessing the impact of a renewable energy requirement in the United States (Groves and Lempert 2007).

Agustinata (2008), Brooks et al. (1999), Kwakkel et al. (2012), and van der Pas et al. (2010) supply examples of how EMA can be applied to policy analysis problems involving Level 4 and Level 5 uncertainty. There is also ongoing work on expanding scenario discovery and EMA to consider the dynamics of a system and its behavior over time, which has been labeled Exploratory System Dynamics Modeling and Analysis (ESDMA) (Pruyt and Hamarat 2010a, b; Hamarat and Pruyt 2011a, b).

9.3.5 The Dynamic Adaptive Approach for Dealing with Level 5 Uncertainty

It is not the strongest of the species that survive, nor the most intelligent, but the ones most responsive to change.
– Charles Darwin

You can't control the wind, but you can adjust your sails.
– Yiddish proverb

The concept of adaptive policies can be traced back to 1927, when John Dewey (1927) proposed that 'policies be treated as experiments, with the aim of promoting continual learning and adaptation in response to experience over time'.

Early applications of adaptive policies, called Adaptive Management, can be found in the field of environmental management (Holling 1978). Motivated by the complexity of the environmental system, managers resort to controlled experiments aimed at increasing their understanding of the system (McLain and Lee 1996). Or, as Lee (1993) puts it, adaptive policies are 'designed from the outset to test clearly formulated hypotheses about the behavior of an ecosystem being changed by human use'.

A large literature review conducted at the International Institute for Sustainable Development found that the literature relating directly to the topic of adaptive policies is limited (IISD 2006). Walker et al. (2001) propose a structured, stepwise approach for adaptive policymaking, which is called Dynamic Adaptive Policymaking (DAP). DAP differs from adaptive approaches in the field of environmental management in that most of the key sources of uncertainty are external factors outside the control of the policymakers, instead of arising out of the complexity of the system the policymakers are trying to manage (although it can also take into account uncertainties in the structure of the system). Since the key sources of uncertainty are different, the approach also differs in several important respects from Adaptive Management. Most importantly, the approach advocates not only the development of a monitoring system but also the prespecification of responses when specific trigger values are reached. Adaptive policies combine actions that are time urgent with those that make important commitments to shape the future, preserve needed flexibility for the future, and protect the policy from failure.

The basic concept of a dynamic adaptive policy is easy to explain (Walker 2000b). It is analogous to the approach used in guiding a ship through a long ocean voyage. The goal—the end point—is set at the beginning of the journey. But, along the way, unpredictable storms and other traffic may interfere with the original trajectory. So, the policy—the specific route—is changed along the way. It is understood before the ship leaves port that some changes are likely to take place—and contingency plans may have already been formulated for some of the unpredictable events. The important thing is that the ultimate goal remains unchanged, and the policy actions implemented over time remain directed toward that goal (if the goal is changed, an entirely new plan must be developed). An adaptive policy would include a systematic method for monitoring the environment, gathering information, implementing pieces of the policy over time, and adjusting and readjusting to new circumstances. The policies themselves would be designed to be incremental, adaptive, and conditional.

Guiding the ship of state in this adaptive way may be revolutionary in many policy areas. However, new approaches to dealing with Level 4 uncertainties are gradually being accepted as valid—and, indeed, necessary. For example:

- In the financial area, as the example of Allan Greenspan indicates, financial planners have already seen that their standard models based on statistics and probabilities are insufficient to deal with the recent 'Black Swans'—such as the subprime mortgage and the debt ceiling debacles in the United States and the Greek debt crisis in Europe.

- Defense planners are beginning to understand that current defense planning methodologies need to be changed. For example, a recent draft report from a respected defense planning organization says "our current defence planning methodologies which still focus primarily on… trends and drivers that we presume to 'know'… insufficiently take into account the true nature of today's deep uncertainty."
- In the area of water management and flood safety, a report from the National Research Council of the US National Academy of Sciences notes that water management systems have traditionally been designed based on the assumption of stationarity (which means that the variability in their statistical patterns does not change over time, so that flood protection norms can be confidently based on past statistics). But, it concludes that "continuing to use the assumption of stationarity in designing water management systems is no longer practical or defensible" [National Research Council, Committee on Hydrologic Science (2011), p. 8].

The analysis and choice of an adaptive policy requires a new process for policymaking and policy implementation that explicitly takes into account the uncertainties and dynamics of the problem being addressed. DAP can be divided into two phases: a policy design phase, and a policy implementation phase. The policy design phase consists of five steps (see Fig. 9.8)—one step (Step I) that sets the stage for policymaking, three steps (Steps II, III, and IV) for designing the portions of the adaptive policy that get implemented initially (at time $t = 0$), and one step (Step V) that designs the portions of the adaptive policy that may be implemented in the future (at unspecified times $t > 0$). So, the implementation phase consists of two parts—implementation of the portions of the policy that get implemented initially (the portions that were designed in Steps II-IV) and adaptation of the initial policy (taking the actions that were designed in Step V).

9.3.5.1 The Design Phase: Steps in Designing a Dynamic Adaptive Policy

Figure 9.8 illustrates the DAP process. In particular, the following steps summarize the process for designing a dynamic adaptive policy.

Step I (stage setting) and Step II (assembling a basic policy)

The first and the second steps are basically the same as those that are carried out in designing a static policy using the traditional policy analysis process. The first step constitutes the *stage-setting* step. This step involves the specification of the system boundary and the objectives, constraints, and available policy options. This specification should lead to a definition of success, i.e., the specification of desirable outcomes.

In Step II, a *basic policy* is assembled. This step involves (a) the specification of a promising policy and (b) the identification of the conditions needed for the basic policy to succeed. These conditions will be used in Step III to set up a monitoring

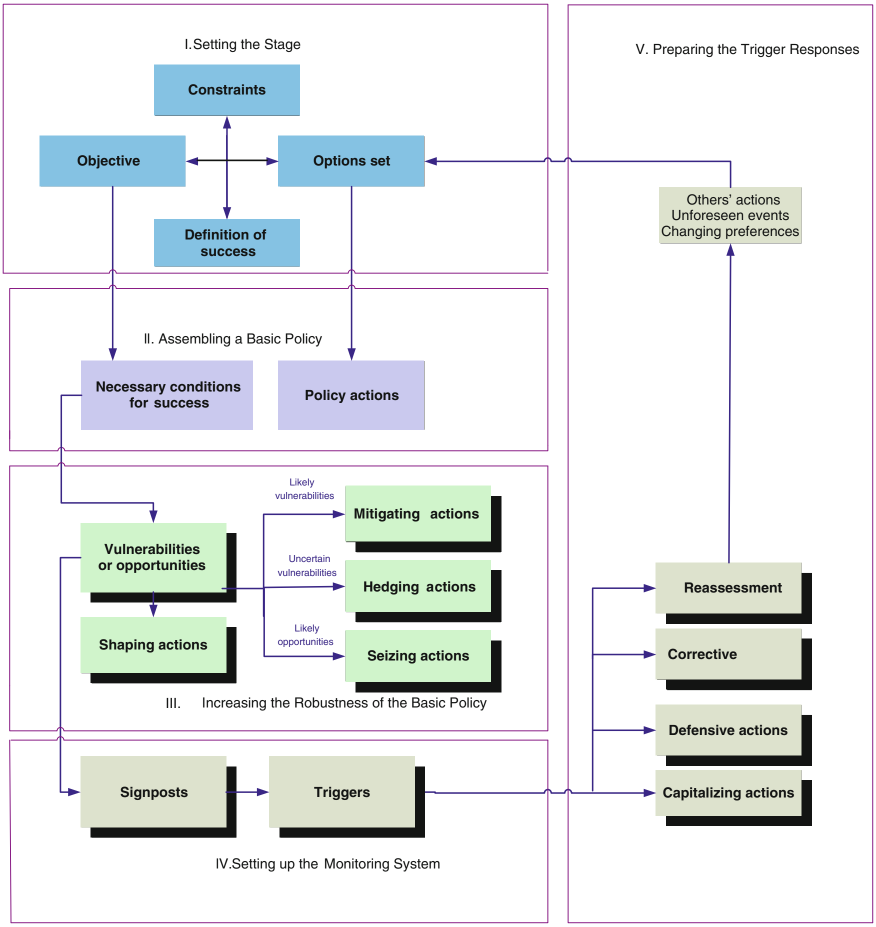


Fig. 9.8 The DAP process [*Source* Kwakkel et al. (2010a)]

system to provide advance warning in case conditions change and the policy might fail.

Step III (increasing the robustness of the basic policy)

In Step III of the DAP process, the actions to be taken immediately (i.e., at time t = 0) to enhance the chances of success of the policy are specified. This step is based on identifying in advance the vulnerabilities and opportunities associated with the basic policy, and specifying actions to be taken in anticipation (Step III) or in response (Steps IV and V) to them. *Vulnerabilities* are external developments that could degrade the performance of the policy so that it is no longer successful. *Opportunities* are external developments that could improve the performance of a policy so that it is more successful than it would have been without these external developments. Both likely and uncertain vulnerabilities and opportunities can be distinguished.

There are four different types of actions that can be taken in advance (at the time the basic policy is implemented—i.e., at time $t = 0$) in anticipation of specific contingencies or expected effects of the basic policy:

- *Mitigating actions* (*M*)—actions to reduce the *likely* adverse effects of the basic policy;
- *Hedging actions* (*H*)—actions to spread or reduce the risk of *uncertain* adverse effects of the basic policy;
- *Seizing actions* (*SZ*)—actions taken to seize *likely* available opportunities;
- *Shaping actions* (*SH*)—actions taken to reduce the chance that an external condition or event that could make the policy fail will occur, or to increase the chance that an external condition or event that could make the policy succeed will occur.

Mitigating actions and hedging actions prepare the basic policy for potential adverse effects and in this way try to make this policy more robust. Seizing actions are actions taken at $t = 0$ to change the policy in order to seize available opportunities. In contrast, shaping actions are proactive and aim at affecting external factors in order to reduce the chances of negative outcomes or to increase the chances of positive outcomes. As such, shaping actions aim not so much at making the plan more robust, but at changing the external situation in order to change the nature of the vulnerability or opportunity.

Scenarios are very useful for identifying vulnerabilities and opportunities, and for identifying mitigating, hedging, and seizing actions for handling them. We use van der Heijden's (1996, p. 5) definition of an "external scenario". He says "external scenarios… are created as internally consistent and challenging descriptions of possible futures… What happens in them is essentially outside our own control." The scenarios are used to identify the ways in which the basic policy could go wrong (i.e., not lead to success) or to identify emerging opportunities that should be seized. The primary focus should be on the "plot"—the story that connects the present with how the basic policy might fail, and what that failure would lead to.

The primary challenge in using scenarios in DAP is to make them credible. Often, the most credible scenario of the future will be the one that is most like the present. However, in DAP, since we are looking for changes in the world that can make the basic policy fail or produce unanticipated success, the scenarios should

[4] Thomas Schelling, in a Foreward to Wohlstetter's (1962) study *Pearl Harbor: Warning and Decision,* wrote "There is a tendency in our planning to confuse the unfamiliar with the improbable. The contingency we have not considered seriously looks strange; what looks strange is thought improbable; what is improbable need not be considered seriously".

differ from the present in major ways. Very negative scenarios are likely to lack credibility; research (see Janis and Mann 1977) suggests that people tend to view very negative scenarios as implausible and reject them out of hand. Nevertheless, they are crucial to an adaptive policy; having thought about a situation (no matter how implausible) in advance allows contingency plans to be formulated so that they are ready to be implemented in the (however unlikely) event they are needed.[4]

EMA is also a useful approach in this step and in Steps IV and V (see Chap. 7). EMA can be used for exploring the consequences of violating the assumptions underlying the basic policy. A single run of an assumed model structure and parameterization of that structure constitutes a computational experiment that reveals how the real world would behave if the various guesses were correct. By conducting a series of such computational experiments, one can explore the implications of the various assumptions and hypotheses. For situations that turn out very bad (or very good), actions can be taken to guard against them (or take advantage of them).

Step IV (setting up the monitoring system) and Step V (preparing the trigger responses)

Even with the actions taken in advance, there is still a need to monitor changes in the world and the performance of the policy and to take actions if needed to guarantee the policy's progress and success. In this step, *signposts* are identified that specify information that should be tracked, and critical values of signpost variables (*triggers*) are specified beyond which actions to change the policy should be implemented to ensure that the resulting policy keeps moving the system in the right direction and at a proper speed. The starting point for the identification of signposts is the set of vulnerabilities and opportunities specified in Step III.

There are four different types of actions that can be triggered by a signpost:

- *Defensive actions* (*DA*)—actions taken *after the fact* to clarify the policy, preserve its benefits, or meet outside challenges in response to specific triggers that leave the basic policy unchanged;
- *Corrective actions* (*CR*)—adjustments to the basic policy in response to specific triggers;
- *Capitalizing actions* (*CP*)—actions taken *after the fact* to take advantage of opportunities that further improve the performance of the basic policy;
- *Reassessment* (*RE*)—a process to be initiated or restarted when the analysis and assumptions critical to the policy's success have clearly lost validity.

9.3.5.2 The Implementation Phase

Once the basic policy and additional actions are agreed upon, the entire adaptive policy is implemented. In this phase, the actions to be taken immediately (from Step II and Step III) are implemented and a monitoring system (from Step IV) is established. Then time starts running, signpost information related to the triggers is collected, and policy actions (from Step V) are implemented.

After implementation of the initial mitigating, hedging, seizing, and shaping actions, the implementation process is suspended until a trigger event occurs. As long as the original policy objectives and constraints remain in place, the responses to a trigger event have a defensive or corrective character—that is, they are adjustments to the basic policy that preserve its benefits or meet outside challenges. Sometimes, opportunities are identified by the monitoring system, triggering the implementation of capitalizing actions. Under some circumstances, neither defensive nor corrective actions might be sufficient to save the policy. In that case, the entire policy might have to be reassessed and substantially changed or even abandoned. If so, however, the next policy deliberations would benefit from the previous experiences. The knowledge gathered in the initial policymaking process on outcomes, objectives, measures, preferences of stakeholders, etc., would be available and would accelerate the new policymaking process.

9.4 An Illustrative Example of DAP: Airport Strategic Planning[5]

Airport Strategic Planning (ASP) focuses on the development of plans for the medium- and long-term development of an airport. The dominant approach for ASP is Airport Master Planning (AMP). The goal of AMP is to provide a detailed blueprint for how the airport should look in the future, and how it can get there (Burghouwt and Huys 2003). In general, airports do not have a good track record for making good long-term decisions (Kwakkel et al. 2010a). Since a Master Plan is a static detailed blueprint based on specific assumptions about the future, the plan performs poorly if the real future turns out to be different from the one assumed. AMP results in poorly performing plans, primarily because it fails to take uncertainties about the future into account in a proper way. With the recent dramatic changes occurring in the context in which an airport operates (e.g., low-cost carriers, new types of aircraft, the liberalization and privatization of airlines and airports, fuel price developments, the European Emission Trading Scheme), the uncertainties airports face are increasing. Hence, there is an even greater need for finding new ways to deal with uncertainty in ASP. Static Master Plans are poorly equipped to deal with the many uncertainties. An alternative direction is to use DAP to develop an adaptive policy that is flexible and over time can adapt to the changing conditions under which an airport must operate.

Phase 1: Policy Design

Step I: Specification of objectives, constraints, and available policy options

[5] This section is based upon Kwakkel et al. (2010a).

The Schiphol Group is primarily interested in medium- to long-term developments through the year 2020. As outlined in its current long-term vision (Schiphol Group 2007), the main goals of the Schiphol Group are: (1) to create room for the further development of the network of KLM and its Skyteam partners, and (2) to minimize (and, where possible, reduce) the negative effects of aviation in the region. Underlying the first goal is the implicit assumption that aviation will continue to grow. However, in light of recent developments such as peak oil and the financial crisis, this assumption is questionable. It might be better to rephrase this first goal more neutrally as 'retain market share'. If aviation in Europe grows, Schiphol will have to accommodate more demand in order to retain its market share, while if aviation declines, Schiphol could still reach its goal of retaining market share.

There are several types of changes that can be made at Schiphol in order to achieve its goals of retaining market share and minimizing the negative effects of aviation. Schiphol can expand its capacity by using its existing capacity more efficiently and/or building new capacity. It can also expand its capacity or use its existing capacity in a way that mitigates the negative effects of aviation. More explicitly, among the policy options that Schiphol might consider are:

1. Add a new runway
2. Add a new terminal
3. Use the existing runway system in a more efficient way, in order to improve capacity
4. Use the existing runway system in a way that minimizes noise impacts
5. Move charter operations out of Schiphol (e.g., to Lelystad)
6. Move Schiphol operations to a new airport (e.g., in the North Sea)
7. Invest in noise insulation

Some of these policies can be implemented immediately (e.g., using the existing runway system in a more efficient way). For others, an adaptive approach would be to begin to prepare plans and designs (e.g., for a new runway), but to begin actual building only when conditions show it to be necessary (i.e., when it is triggered). The various options can, of course, be combined. The changes that can be made are constrained by the budget, spatial restrictions, public acceptance, and the landside accessibility of Schiphol. The definition of success includes that Schiphol maintains its market share and that living conditions improve compared to some reference situation (e.g., number of people affected by noise within a specified area).

Step II: A basic policy and its conditions for success

A basic policy might be to immediately implement existing plans for using the runways more efficiently (option 3) and in a way that reduces noise impacts (option 4). It might also include all policy options that focus on planning capacity expansions, without beginning to build any of them (i.e., options 1, 2, and 5). A final element of the basic policy might be option 7: invest in noise insulation. The choice for only planning capacity expansions but not yet building them is motivated by the fact that Schiphol is currently constrained by the environmental rules and regulations, not by its physical capacity. This also motivates the choice for options 3 and 4, which together can reduce the negative externalities of aviation.

In light of Schiphol's twin goals of retaining market share and minimizing the negative effects of aviation (Schiphol Group 2007), several necessary conditions for the success of the basic policy can be specified:

- Schiphol should retain its current market share
- The population affected by noise and the number of noise complaints should not increase
- Schiphol's competitive position in terms of available capacity in Europe should not decrease
- Schiphol's landside accessibility should not deteriorate

Step III: Vulnerabilities and opportunities of the basic policy, and anticipatory actions

The long-term development of Schiphol is complicated by the many and diverse trends and developments that can affect Schiphol. These developments and trends present both opportunities and vulnerabilities. Some of these vulnerabilities are relatively certain. These are given in Table 9.1. Two likely vulnerabilities are resistance from stakeholders and a reduction of the landside accessibility. The mitigating actions for addressing these vulnerabilities are very similar to actions currently being discussed by the Dutch Government. A shaping action for the vulnerability of landside accessibility is investment in research. In addition to vulnerabilities, there are currently also some opportunities available to Schiphol. First, recent work shows the potential for 'self-hubbing' (Burghouwt 2007; Malighetti et al. 2008). Self-hubbing means that passengers arrange their own flights and routes, using low-cost carriers or a variety of alliances, in order to minimize costs and/or travel time. Schiphol has a great potential for attracting such self-hubbing passengers, because it connects 411 European cities (Malighetti et al. 2008). Schiphol can seize this opportunity by developing and implementing services tailored to self-hubbing passengers, such as services for baggage transfer and help with acquiring boarding passes. Furthermore, Schiphol could take into account walking distances between connecting European flights when allocating aircraft to gates. A second opportunity is presented by the fact that airports in general, and Schiphol in particular, are evolving into 'airport cities'. Given the good transport connections available, an airport is a prime location for office buildings. Schiphol can seize this opportunity by investing in non-aeronautical landside real estate development.

Not all vulnerabilities and opportunities are likely. The real challenge for the long-term development of Schiphol is presented by the *uncertain* vulnerabilities and opportunities. Table 9.2 presents some of the uncertain vulnerabilities together with possible hedging (H) and shaping actions (SH) to be taken right away to handle them. The vulnerabilities and opportunities can be directly related and

Table 9.1 Likely vulnerabilities and opportunities, and responses to them

Vulnerabilities and opportunities	Mitigating (M), Shaping (SH), and Seizing (SZ) actions
Reduction of the landside accessibility of the airport	**M**: develop a system for early check-in and handling of baggage at rail stations **SH**: invest in R&D into the landside accessibility of the Randstad area
Resistance from Schiphol stakeholders (e.g., environmental groups, people living around Schiphol)	**M**: develop plans for green areas to compensate for environmental losses **M**: offer financial compensation to residents in the high noise zone
Rise of self-hubbing	**SZ**: design and implement a plan for supporting self-hubbing passengers with finding connection flights, transferring baggage, and acquiring boarding passes
Rise of the airport city	**SZ**: Diversify revenues by developing non-aeronautical landside real estate

categorized according to the success conditions specified in the previous step. With respect to the success condition of growing demand, air transport demand might develop significantly differently from what is hoped and anticipated. Schiphol can respond to this by making Lelystad airport suitable for handling non-hub-essential flights. Another vulnerability is that KLM might decide to move a significant part of its operations to Charles de Gaulle. This will leave Schiphol without its hub carrier, significantly reducing demand, and changing the demand to origin–destination demand. Schiphol could prepare for this vulnerability by making plans for adapting the terminal to the requirements of an O/D airport and by diversifying the carriers that serve Schiphol. Schiphol can also try to directly affect KLM by investing in a good working relationship, reducing the chance that KLM will leave. Currently, there is an ongoing debate about the future of the hub-and-spoke network structure. Due to the Open Sky agreements and the development of the Boeing 787, long-haul low-cost, hub bypassing, and self-hubbing become plausible, resulting in the emergence of long-haul low-cost carriers (LCCs) and increasing transfer between short-haul low-cost, and long-haul carriers (both LCC and legacy carriers). Schiphol can prepare for this by developing a plan to change its current terminal to serve a different type of demand and by taking these plausible developments into consideration when designing the new LCC terminal and its connection with the existing terminal. If a transformation to international origin–destination traffic and/or a no-frills airport is needed, this plan can be implemented, making sure that the transformation can be achieved quickly.

The second success condition is that the population affected by noise and the number of noise complaints should not increase. Vulnerabilities and opportunities associated with this condition are that the current trend of decreases in the

Table 9.2 Uncertain vulnerabilities and opportunities, and responses to them

Vulnerabilities and opportunities	Hedging(H) and Shaping(SH) actions
Retain market share	
Demand for air traffic grows faster than forecast.	**H**: Prepare Lelystad airport to receive charter flights
Demand for air traffic grows slower than forecast.	**SH**: Advertise for flying from Schiphol
Collapse or departure of the hub carrier (KLM) from Schiphol.	**H**: Prepare to adapt Schiphol to be an O/D airport. **H**: Diversify the carriers serving Schiphol **SH**: Develop a close working relation with KLM
Rise of long-haul low-cost carriers	**H**: Design existing and new LCC terminal to allow for rapid customization to airline wishes
Rise of self-hubbing, resulting in increasing transfers among LCC operations	**H**: Design a good connection between the existing terminal and the new LCC terminal, first with buses, but leave room for replacing it with a people mover
Population affected by noise and the number of noise complaints should not increase	
Maintain current trend of decrease of environmental impact of aircraft	**SH**: *N*egotiate with air traffic control on investments in new air traffic control equipment that can enable noise abatement procedures, such as the continuous descent approach **SH**: Invest in R&D, such as noise abatement procedures
Increase in the population density in area affected by noise	**H**: Test existing noise abatement procedures, such as the continuous descent approach, outside the peak periods (e.g., at the edges of the night) **SH**: Negotiate with surrounding communities to change their land use planning **SH**: Invest in R&D, such as noise abatement procedures
Change in the valuation of externalities by the public	**SH**: Invest in marketing of the airport to brand it as an environmentally friendly organization **SH**: Join efforts to establish an emission trading scheme
Schiphol's competitive position in terms of available capacity in Europe does not decrease	
Other major airports in Europe increase capacity	No immediate action required
Development of wind conditions due to climate change	**H**: Have plans ready to quickly build the sixth runway, but do not build it yet. If wind conditions deteriorate even further, start construction

environmental impact of aircraft changes, the population density in the area affected by noise increases, and the valuation of externalities (predominantly noise) by the large public changes. If the current trend of decreasing environmental impact slows down, the area affected by noise will not continue to shrink if demand stays the same. If demand increases, it is possible that the area affected by noise will also increase.

On the other hand, the trend could also accelerate, giving Schiphol the opportunity to expand the number of flights that is handled. Given the potential impact of this trend, Schiphol should try and shape its development by investing in R&D and negotiate with Air Traffic Control about testing noise abatement procedures, such as continuous descent approaches. If the population density changes, the situation is similar. If it increases, the number of people affected by noise will increase, while if it decreases, the number of people affected by noise will decrease. Schiphol can try and shape this development by negotiating with surrounding communities about their land use planning and invest in research that can make the area affected by noise smaller. It can also hedge against a growing population density by starting to test noise abatement procedures outside peak hours. This will make the area affected by noise smaller. Thus, even if the population density increases, the total number of people affected will not increase. A third uncertainty is how the valuation of noise will change in the future. If noise will begin to be considered more of a nuisance, complaints are likely to go up, and vice versa. Schiphol could try to affect this valuation by branding the airport as environmentally friendly and supporting the development of an emission trading scheme that also includes aviation.

The third success condition is that Schiphol's competitive position in terms of available capacity in Europe does not decrease. Schiphol is vulnerable to the capacity developments at other airports in Europe. The major hubs in Europe are all working on expanding their capacities, either by adding runways and expanding terminals, or by moving non-hub-essential flights to alternative airports in the region. Schiphol should monitor these developments closely and, if necessary, speed up its capacity investments. A second vulnerability is the robustness of Schiphol's peak-hour capacity across weather conditions. Under southwesterly wind conditions, Schiphol's hourly capacity is almost halved, resulting in delays and cancellations. If (e.g., due to climate change) these wind conditions were to become more frequent, Schiphol would no longer be able to guarantee its capacity. Schiphol should hedge against this by having plans ready for building a sixth runway.

Step IV and Step V: Adding adaptivity

Step IV sets up the monitoring system and identifies the actions to be taken when trigger levels of the signposts are reached. The vulnerabilities and opportunities are those presented in Table 9.2. Table 9.3 shows the signpost to be set up for each vulnerability and each opportunity, and the possible responsive actions in case of a trigger event. The numbers used as triggers are for illustrative purposes only. For example, if demand increases twice as fast as expected, this presents an opportunity and would trigger a capitalizing action. If demand grows 25 % slower than anticipated, this presents a threat to the policy. In reaction, investments in capacity should be delayed or even canceled. If demand fully breaks down or explodes, the policy should be reassessed.

Phase 2: Policy Implementation

In the implementation phase, the adaptive policy is implemented. This policy consists of the basic policy specified in Step II, the actions specified in Tables 9.1

Table 9.3 Adding adaptivity

Vulnerabilities and opportunities	Monitoring and trigger system	Actions [Reassessment (RE), Corrective (CR), Defensive (DA), Capitalizing (CP)]
Retain market share		
Demand for air traffic grows faster than forecast	Monitor the growth of Schiphol in terms of passenger movements, aircraft movements (and related noise and emissions), if double demand (trigger) take CP-action. If demand explodes, take RE-action	**CP**: Begin to implement the plan for the new terminal and the new runway **RE**: Reassess entire policy
Demand for air traffic grows slower than forecast	Monitor types of demand. If overall demand is decreasing by half of forecast, take D-actions. If demand fully breaks down, take RE-action. If transfer rate decreases below 30 % take CR-action	**DA**: Delay investments, and reduce landing fees **RE**: Reassess entire policy **CR**: Cancel terminal capacity expansions
Collapse or departure of the hub carrier (KLM) from Schiphol	Monitor the network of KLM-Air France, if 25 % of flights are moved take DA-action, if 50 % take CR-action, if 80 % or more take R-action	**DA**: Diversify the carriers that fly from Schiphol **CR**: Switch airport to an O/D airport by changing terminal **RE**: Reassess entire policy
Rise of long-haul low-cost carriers	Monitor development of the business model of low-cost carriers. If long-haul LCC carriers make profit for 2 years take CP-action	**CP**: Attract long-haul LCC by offering good transfer between LCC terminal and existing terminal and/or by offering wide body aircraft stands at the LCC terminal
Rise of self-hubbing, resulting in increasing transfers between LCC operations	Monitor transfer rate among LCC flights and between LCC and legacy carriers. If transfer rate becomes more then 20 %, take CP-action	**CP**: Expand transfer capabilities between the new LCC terminal and the existing terminal
Population affected by noise and the number of noise complaints should not increase		
Maintain current trend of decrease of environmental impact of aircraft	Monitor noise footprint and emissions of the fleet mix serving Schiphol and of the new aircraft entering service. If there is an increase of noise or emissions of 10 %, take CR-action	**CR**: Change landing fees for environmentally unfriendly planes
Increase in the population density in area affected by noise	Monitor population affected by noise. If population affected by noise increases by 2 %, take DA-action; by 5 %, take CR-action; by 7.5 %, take R-action. If population density decreases by 2 %, take CP-action	**DA**: Expand insulation program and explain basic policy again **CR**: Slow down of growth by limiting available slots **RE**: Reassess entire policy **CP**: If the population density decreases, make new slots available

(continued)

Table 9.3 (continued)

Vulnerabilities and opportunities	Monitoring and trigger system	Actions [Reassessment (RE), Corrective (CR), Defensive (DA), Capitalizing (CP)]
Change in the valuation of externalities by the large public	Monitor the complaints about Schiphol. If complaints increase by an average of 5 % over two years, take DA-action. If complaints increase by an average of 10 % or more over two years, take CR-action	**DA**: Increase investments in marketing and branding **CR**: Slow down the growth of Schiphol by limiting the available slots
Schiphol's competitive position in terms of available capacity in Europe does not decrease		
Other major airports in Europe increase capacity	Monitor declared capacity for the major airports in Europe. If declared capacity is up by 25 %, take D-action	**DA**: Speed up expansions
Development of wind conditions due to climate change	Monitor the prevailing wind conditions throughout the year. If for two years in a row the number of days with cross-wind conditions exceeds 50, take D-action	**DA**: Begin to implement the plan for the new runway

and 9.2, and the monitoring system specified in Table 9.3. Note that the new runway being planned in the basic policy is not built yet, but can be built when necessary in light of demand increases or capacity increases at other major European airports. As such, it is a 'real option'. The same is true of the new terminal. All the preparatory work should be started, including the clearing of the land, relocation of the current facilities on the location to other places, and putting in place the required utilities (e.g., electricity, sewers, water, space for a connection to the existing terminal, connections to the highway system and the rail system). Construction should begin if triggered by demand developments or capacity developments at other airports.

During the implementation phase, Schiphol would monitor developments. Suppose the signposts indicate that Schiphol is maintaining its position as a major airport for the Skyteam alliance and its partners and its demand is growing faster than anticipated in the plan, but that the boundaries set for safety, the environment, and quality of life, and spatial integration with its surroundings are being violated. Construction of the new terminal can start. In addition, actions need to be taken to defend the policy with respect to the negative external effects. The noise insulation program can be expanded and more investment can be made in branding and marketing that aim at explaining the policy. If these actions prove to be insufficient, the noise insulation program can be expanded, Schiphol should start to buy out residents that are heavily affected by noise, and increase landing fees for environmentally unfriendly planes. If this still is insufficient, Schiphol should consider limiting the number of available slots, especially during the night and edges of the night. If these actions are still insufficient, either because demand grows very fast or because the environmental impact grows too fast, the policy should be reassessed. In the case of reassessment, the decisionmakers would repeat the DAP steps in order to develop a new (adaptive) policy.

9.5 Conclusions

The world is undergoing rapid changes. The future is uncertain. Even with respect to understanding existing natural, economic, and social systems, many uncertainties have to be dealt with. Furthermore, because of the globalization of issues and the interrelationships among systems, the consequences of making wrong policy decisions have become more serious and global—potentially even catastrophic. Nevertheless, in spite of the profound and partially irreducible uncertainties and serious potential consequences, policy decisions have to be made. Policy analysis aims to provide assistance to policymakers in developing and choosing a course of action, given all of the uncertainties surrounding the choice.

That uncertainties exist in practically all policymaking situations is generally understood by most policymakers, as well as by most policy analysts. But there is little appreciation for the fact that there are many different dimensions of uncertainty, and there is a lack of understanding about their different characteristics, their relative magnitudes, and the available approaches and tools for dealing with them.

This chapter has shown that policy analysts already have many analytic tools and approaches for dealing with uncertain situations. They are still appropriate in many cases. However, before any one of them is used, it is important to identify the location, level, and nature of the uncertainties related to the particular case, and their relative importance, and only then to choose an appropriate approach.

There are many approaches that have been shown to be appropriate for handling Level 1 and Level 2 uncertainties. However, it is not appropriate to treat Level 3, Level 4, and Level 5 uncertainties with these same approaches. For example, an implicit assumption using Level 1 approaches is that the future world will be structurally more or less the same as the current world—perhaps more populated, richer, dirtier—but, essentially the same. If, in reality, the uncertainties are deeper, such an approach can have serious consequences. For example, as discussed by de Neufville (2000), the telephone company of France was a pioneer in the use of on-line interactive telecommunications. It committed itself, on the basis of the most careful analyses, to the development of the Minitel system. But, it failed to build in the capability to change as the world changed—to expand to more advanced platforms using improved technologies for the system. This resulted in a network that is obsolete in the Internet environment, and that cannot practically be adapted to the new technical realities. It became a dinosaur less than 30 years after its initiation and was completely abandoned in 2012.

The scenario approach may be appropriate for Level 3 and Level 4 uncertainties. The central assumption of this paradigm is that the future can be predicted well enough to identify policies that will produce favorable outcomes in one or more specific plausible future worlds. If this range of future worlds covers the full spectrum well, then the resulting policy has a fair chance of being successful. However, if some of the underlying assumptions about the future turn out to be wrong, the negative consequences can be as bad as if uncertainty about the future had been totally ignored.

Level 1, 2, 3, and 4 approaches are not appropriate in the face of Level 5 uncertainty. New approaches are needed. One possible approach is dynamic adaptation, which offers a clear structure and tools for thinking about and evaluating uncertainties and making explicit tradeoffs. While we may not be able to foresee all of the consequences of an uncertain future, dynamic adaptation offers a way to protect ourselves from nasty surprises and unforeseen contingencies, and to begin to implement a policy to address the problem right away.

DAP helps us make more robust plans by accepting uncertainty and acknowledging that we cannot know the future (even probabilistically). The approach calls for implementing a basic policy based on what we know today, and constructing a system for monitoring the (unpredictable) developments that could potentially affect the effectiveness of the chosen policy. The resulting policy is dynamic; the element of time and the possibility of learning are explicitly taken into account by the policy. Whereas, other approaches are based on the notion that policymaking is a discrete one-time event and that the resulting policy is static, dynamic adaptation is explicitly defined as a continuous process in time that involves monitoring and making prespecified changes to existing policy in response to unforeseen developments.

Dynamic adaptation has not yet been implemented in practice. However, in addition to the airport strategic planning case presented in Sect. 9.4, various other areas of application of DAP have been explored, including flood risk management in the Netherlands in light of climate change (Rahman et al. 2008), seaport planning (Taneja et al. 2011) and policies with respect to the implementation of innovative urban transport infrastructures (Marchau et al. 2008), congestion road pricing (Marchau et al. 2010), intelligent speed adaptation (Agusdinata et al. 2007), and 'magnetically levitated' (Maglev) rail transport (Marchau et al. 2010). In 2012, a pilot test of the DAP approach was made with respect to the management of the Rhine Delta region of the Netherlands in the face of deep uncertainty about global warming and sea level rise.

But, more research is required before DAP is ready for full implementation. First, its validity and efficacy needs to be established. This will be difficult to do since, as Dewar et al. (1993) have pointed out, ''nothing done in the short term can 'prove' the efficacy of a planning methodology; nor can the monitoring, over time, of a single instance of a plan generated by that methodology, unless there is a competing parallel plan.'' Nevertheless, evidence is being gathered through a variety of methods, including gaming and computational experiments using EMA. (Using Exploratory Modeling and Analysis, Kwakkel et al. (2012) demonstrate the efficacy of DAP for the airport strategic planning case in Sect. 9.4). Also, the costs and benefits of dynamic adaptation measures compared to traditional policymaking approaches need to be studied. (Using real options analysis, Yzer (2011) shows that, for the airport strategic planning case in Sect. 9.4, DAP is likely to be more cost-beneficial than traditional Master Planning). Finally, the implementation of dynamic adaptation will require significant institutional/governance changes, since some aspects of these policies are currently not supported by laws and regulations (e.g. the implementation of a policy triggered by an external event). Lempert and Light (2009) provide some suggestions about a governmental framework at the national level in the United States that could support the implementation of this type policymaking.

Nevertheless, the DAP framework offers several advantages over other approaches. Most important of these are (1) it does not ignore uncertainty; it acknowledges that we cannot know the future and bases policy on this assumption, and (2) it institutionalizes the process of ex-post policy evaluation and monitoring. As Nassim Nicholas Taleb (2007) has written: ‘‘It is often said that ‘is wise he who can see things coming.’ Perhaps, the wise one is the one who knows that he cannot see things far away.’’

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Appendix
Concepts and Methods for Policy Analysis

Niki Frantzeskaki and Warren E. Walker

This appendix presents a number of key concepts and methods for policy analysis that are used in this book in a systematic way. For each concept and method, we present its applicability, steps to conduct the method, strengths, pitfalls that should be avoided when using it, related methods, plus other key features. Most of the concepts and methods are illustrated using the 'FlyAway' airport expansion case introduced in Box 4.1 of Sect. 4.2.

A.1 System Diagram

Application: A system is a demarcated part of reality that is relevant given a certain problem framing. This leads to the demarcation being dependent on the problem owner and his problem perception. Thus, a system diagram is a conceptual model that is actor specific. The system diagram is a framework for the demarcation of the part of reality about which a problem is perceived (we will call this the *system domain for policies*) and the environment. A system diagram consists of a representation of what the system

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to be studied is [and, on its borders, three groups of factors[1]: the steering instruments of the problem owner (*policies*), the contextual factors (*external factors*), and the *outcomes of interest* (*criteria* for policy evaluation)].

Rules of the system diagram (see Fig. A.1a): The system borders are represented by solid or dashed lines, the factors by ovals, and the system and subsystems by rectangles. The arrows linking the factors and subsystems have no +'s and −'s, as opposed to the *causal relation diagram* (which is described later in this appendix).

Application rules: A system is the part of reality that is being studied as a consequence of the existence of a problem. In the representation of the system, elements and relations among them are often specified. These indicate which factors are central to the policy problem being addressed, and how they are mutually related. A causal relation diagram (see Sect. A.3) can help with filling in the system diagram.

System specification involves two main questions that comprise the starting steps of the analysis:

Step1: Which part of reality should be focused upon? Which actors and issues?
Step2: Which factors are relevant?

Applicability: The system diagram is used to:

- define the relevant system and its borders and to identify what falls within the system and what falls outside it
- define the structure and relations within the system
- identify the outcomes from the system (the *outcomes of interest*) that relate to the objectives of the problem owner and, possibly, other actors (and that will be used as *criteria* for policy evaluation)
- identify possible *policy options*
- identify relevant contextual factors (*external factors*)

Strengths of the method: By making system diagrams for different actors, the similarities and differences among the actors' perceptions can come to light. The system diagram can be used at several places in the policy analysis process. It can be used to communicate what the influential factors and variables are, which can serve as a starting point for determining policy options. The external factors can be used in the formulation of contextual scenarios. The system diagram also shows the criteria to be used as the basis for the choice among the various policy options (the 'outcomes of interest'). Thus, the system diagram provides an integrating framework connecting the results of the analysis of objectives, of causal mechanisms, and of actions available to a problem owner, in a consistent way.

Related methods: A system diagram is a tool that can be used at any point in the problem analysis. At the start of the analysis, a system diagram can be used to

[1] A *factor* is an attribute of an entity (a thing, a person, a process) for which a value can be established on a scale via direct or indirect measurement.

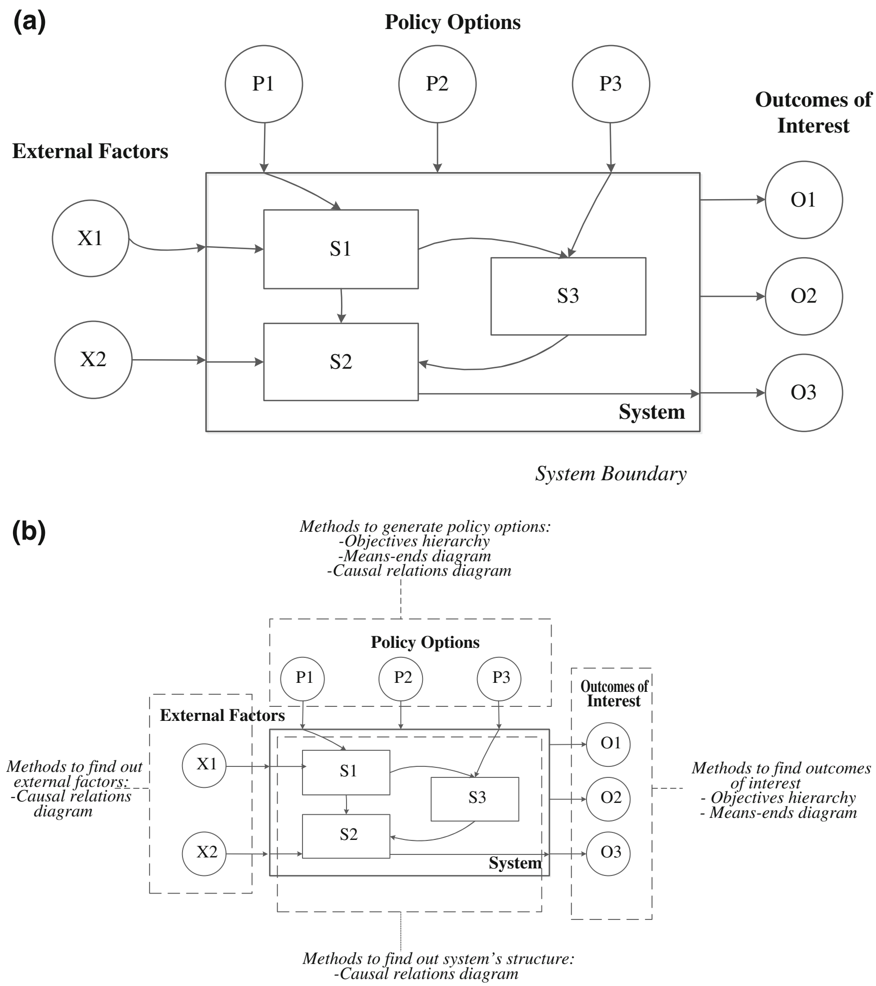

Fig. A.1 **a** A conceptual system diagram **b** A schematic presentation of the different methods that can provide information for the different concepts/factors included in the system diagram

introduce a problem perception quickly and clearly. Subsequently, it can be used in the analysis of objectives, causal analysis, actor analysis, and network analysis (other actors also have a view on the system, and this analysis can identify factors that have been overlooked earlier by the problem owner), and in the exploration of futures. As a result of these analyses, the different factors in the system diagram can be improved and modified. The objectives tree can lead to a sharpening of the criteria. From the causal analysis, new relevant factors can be added to the system diagram. After mapping out all the possible solutions, these can also be added to the system diagram, and contextual factors can be added from the exploration of the future. (Of course, the system diagram can also serve as input to these analyses.) So, the system diagram can be used, and continually updated, throughout the analysis (see Fig. A.1b).

In the end, the system diagram shows the system demarcation in a graphical way. Therefore, the diagram can also be used to give feedback to the problem owner on the choice of boundary and on the conclusions from the problem analysis.

Drawbacks and pitfalls: In the various traditions of systems thinking (e.g., control systems, information systems), different conventions have been established regarding the placement of control or steering factors and external influences in the diagram, and this may create some confusion. We suggest to always explicitly mention what convention is followed and to be consistent in its application. More importantly, in the approach we follow here, we place the policymaking process, the policy actors, and the policy decisions outside the system. Other system-based approaches (e.g., System Dynamics) do not follow that convention, and will often include decisions by policymakers in reaction to system outcomes as part of the system to be modeled.

A.2 Analysis of Objectives: Means–Ends Diagram and Objectives Tree

Beginning with the same single fundamental (end) objective (sometimes called a goal), a means–ends diagram presents a hierarchy of the system changes and, in the end, policy measures that can lead to the achievement of the fundamental objective, while the objectives tree presents a hierarchy of attributes, also called subobjectives (intermediate and low-level objectives) that express more precisely what is meant by the fundamental objective.

Means–Ends Diagram

Means–ends analysis is a systematic way of exploring the means that can be used to achieve the fundamental objectives of a specific actor. *Means* are activities or changes to the system. A *fundamental objective* is a specifically defined goal or desire of an actor, expressed as a noun with a direction—e.g., less energy consumption, higher accessibility in cities, etc.

Application: When used correctly, a means–ends diagram can be a useful tool to map out the relationship between the objectives and the instruments (means) for achieving those objectives. Starting from objectives, and asking the question “how (by using which means) can the objective be achieved?”, one can identify the means that may contribute to achieving the objective. A means–ends diagram can in principle cover the full spectrum from the fundamental objective to specific concrete means or actions.

Rules of the means-ends diagram: The arrows in a means–ends diagram are based on presumed causal relations. In a means–ends diagram, the elements are formulated as actions; therefore, verbs are used. The relationship in a means–ends diagram is often provided with a direction (the direction of support). Arrows are used to indicate how activity A can contribute to B (where B is a fundamental objective). In a means–ends diagram, one-to-one relationships as well as many-to-one and one-to-many relationships can occur. (I.e., a means or activity can support multiple objectives at the same time, and a single objective can be supported by several means).

Applicability: A means–ends diagram can be used as part of a problem analysis in two different ways:

1. *As a tool in demarcating the problem field and identifying the fundamental objective.* An analyst, should always ask the question: Why does the actor or client want to achieve this? What is the underlying objective or motive? This quickly leads to his or her more fundamental objective (goal).
2. *As an analytical tool.* A means–ends diagram can be used for systematically reasoning backwards from a chosen fundamental objective to map out a broad spectrum of policies and changes to the system that could contribute to the realization of the objective. A means–ends diagram shows how actions are connected to specific objectives, and the intended impacts of the actions presented in the diagram.

Strengths of the method: A strength of the method is its capability to communicate how actions or changes to the system are linked to the fundamental objective of the actor in a simple, diagrammatic, and systematic way.

Pitfalls: The choice of the level of the top-objective makes the analyst and client face a dilemma. On the one hand, setting an objective at a high level offers more variation of possible solutions than setting it at a lower level, since it broadens the space of policy options. But this can result in a high level of abstraction of the analysis that is practically unworkable and analytically not researchable. On the other hand, a seemingly simpler approach, strongly based on lower level objectives, entails the risk of a lack of flexibility and the overlooking of options, especially in a multi-actor context in which exchange possibilities are of great importance. The analyst will have to make a well-thought and explicit choice, in consultation with the client. There is no simple recipe for this choice. The analyst will usually do her client a disservice by simply accepting the problem owner's given objective.

Related methods: A distinction is made between a means–ends diagram and an objectives tree. The term 'objectives tree' will be reserved for the hierarchical structure that is used to specify the relevant attributes of the (key) objective up to a set of indicators that can be used to assess the degree to which the objective has been attained (see Sect. A.2.2).

All actions in the means–ends diagram that can be influenced by policies relate to factors that appear again in *the causal relation diagram* and the *system diagram*.

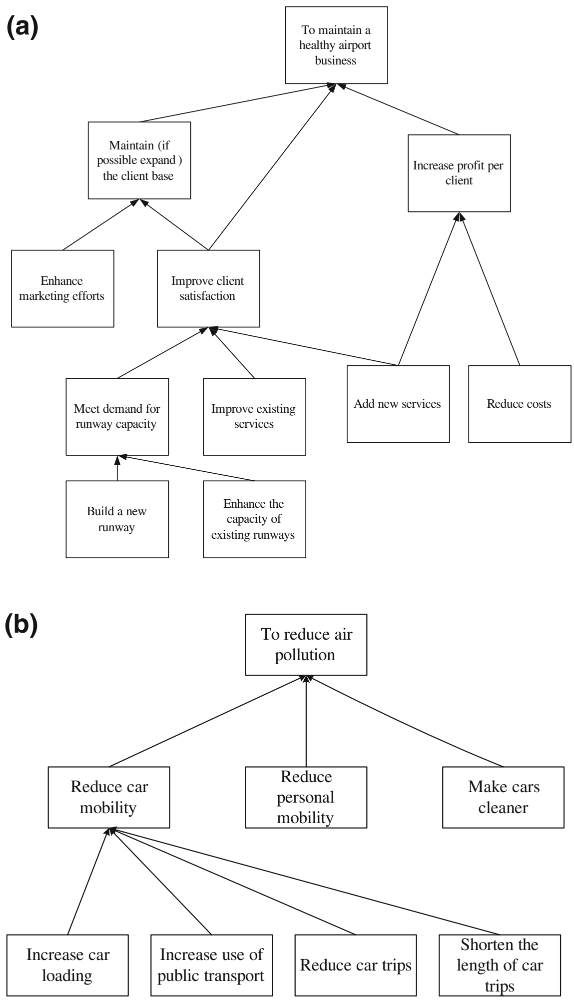

Fig. A.2 **a** Means–ends diagram for the ‘Flyaway’ airport expansion case. **b** Means–ends diagram for an air pollution problem in the mobility sector

These policy analysis tools all have to be consistent with each other. This means that, after each adjustment of one, all of the others have to be checked to see if they are still correct.

Figure A.2a is a means–ends diagram for the ‘FlyAway’ airport expansion case discussed in Chap.4. Figure A.2b is a means–ends diagram for an air pollution problem in the person transport sector. Another example can be found in Keeney (1996b, p. 75).

Objectives Tree (or Objectives Hierarchy)

Application: An objectives tree defines the fundamental objectives of actors in terms of specific attributes that can be measured. The analysis starts with the fundamental objective (or goal) and moves downwards toward more specific (intermediate and low-level) objectives. One of the main aims of an objectives tree is to specify actors' objectives in terms of their relevant attributes and to give an insight into the relationships between the goal and the more specific objectives. An objective is expressed as a noun with a direction—e.g., less energy consumption, higher accessibility in cities, etc.

The objectives tree is associated with a specific problem. It offers information about the desires and interests of one or more actors in a specific situation. "The objectives tree is a pictorial display of the overall structure of objectives and their relationships" (Dunn 1981, p. 252). In the objectives tree, the objectives are related with definitional relationships, not causal relationships. Moving from the top-level objective to the low-level objectives, the analyst asks "what does this (abstract) goal or intermediate objective mean in the specific context and system?" The top-level objective (goal) is the ultimate desire of the problem owner (or another actor) that relates to the specific system and the specific problem. The intermediate and lower level objectives are related to the more tangible and less abstract attributes of the top-level objective, and are split into more specific objectives until the level of measurable indicators is achieved. The lower level objectives reveal the multiple aspects that relate to the problem and to the respective subsystems. In the objectives tree, the lower levels have a definitional relationship to the upper levels, while in the means–end diagram, the lower levels have a presumed causal relationship to the higher levels.

The objectives tree can play many roles in a policy analysis project. Its main role is to make the objectives of the actors explicit. In addition, an objectives tree contributes to the identification and delineation of outcomes of interest and outcome indicators.

Appearance rules of the objectives tree:

The terms used in specifying an objectives tree indicate the desired direction: increase, reduce, maximize, minimize, etc. A line (not an arrow, as in the means–ends diagram) connects a lower objective to the objective just above it.

Application rules of the objectives tree:

Step 1—Setting the fundamental objective (goal): This step is more elaborately described by Dunn (1981). The step starts by specifying a fundamental objective of the actor for the problem at hand. The goal should not be a solution, but a desire or an objective that relates to the system outcomes. This goal should be the same as the fundamental objective in the corresponding means–ends diagram.

Step 2—Moving downwards to intermediate and lower level objectives: To move from the fundamental objective to intermediate and low-level objectives, the analyst asks the question “in terms of what attributes can achieving this objective be described?”. It then becomes clear which aspects are involved in realizing the higher level objective. For each objective, the subobjectives should again comprise the key aspects of the higher level objective. Each objective in the objectives tree should, in the end, be related to one or more outcomes of interest. This will make it clear how its achievement will be measured (Keeney 1996, p. 89). The specification of these outcomes will be used to guide further elaboration of the causal analysis and the system diagram.

The hierarchy will look different for different contexts. For example, consider “sustainable city” as a top-level objective for the cities of Rotterdam and Berlin. The low-level objectives will differ for the two cases, since they will represent objectives relating to different contexts.

The usability of the objectives tree in the later phases of problem solving will depend upon:

- The extent to which all the relevant objectives have been identified. If the objectives of one of the key actors are overlooked, the chance exists that important criteria could be missed and that these actors will, therefore, reject the results of the analysis.
- The clarity with which the objectives are formulated. Cryptic or ambiguous phrases can lead to false conclusions.

Applicability: An objectives tree can be used:

- to define the assessment criteria (outcomes of interest or outcome indicators) that can be used by the analyst to evaluate policy options (for instance, using a scorecard). An objectives tree can also help the analyst to find, in a relatively simple way, an answer to the question: what do the actors want?
- to get an actor to formulate his or her objectives clearly and succinctly. This helps the analyst make a precise formulation of the problem and the outcomes of interest;
- to investigate the way in which the fundamental objective can be achieved without thinking in terms of policy options. By distinguishing subobjectives, and indicating how these, if realized, bring the main objective closer to achievement, the problem is divided into subproblems.
- to detect conflicts among the actors in their perceptions of the problem (what they think the problem is) and in their objectives (what is a desirable system state?) in order to contribute to a thorough and in-depth analysis of the problem, which can help produce a precise problem formulation. Keeney (1996b, pp. 86–87) presents the benefits of the objectives tree (or ‘fundamental objectives hierarchy’, as he calls it), and focuses on the role of the objectives tree in defining the problem and specifying objectives.

Strengths of the method: Developing an objectives tree makes clear the objectives of the actors related to a policy problem. One of the strengths of the method is that the objectives tree is a visual aid to spot similarities and points of potential conflict among the different actors related to a problem. In practice,

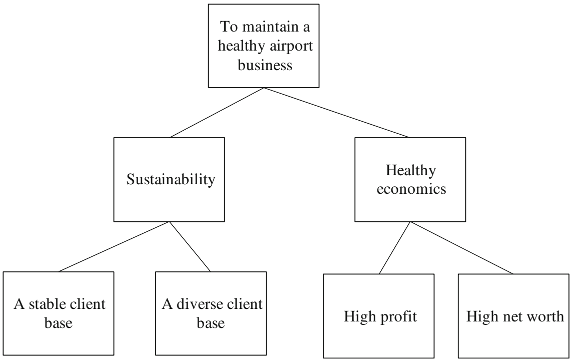

Fig. A.3 Objectives tree for the 'Flyaway' airport expansion case

actors do not have such a neatly structured model in their heads or an explicit opinion about the criteria. By viewing and understanding the objectives tree, the actors related to the policy problem may gain a better understanding of the problem. In this way, "this common understanding might help provide a basis for compromise when necessary, and consensus if possible." (Keeney 1988, p. 403).

It is likely that the resulting objectives tree is incomplete, because certain subobjectives or relations are missing or are wrongly specified. The validity and completeness can be improved by, among others, checking with the actors involved.

Weaknesses of the method:

- The resulting objectives tree depends on which actors are involved/interviewed.
- Hidden aspects of the problem may not be revealed, since actors usually reveal their values and interests, but not their expected gains.

Related methods: Evaluation criteria (outcomes of interest or outcome indicators) can be identified using the objectives hierarchy, and can then be included in a causal relation diagram. In the system diagram, these criteria are exhibited on the right side, outside the system boundary. The criteria will also be those included in a scorecard (see Sect. A.4) or multicriteria analysis. The same evaluation criteria will provide the structure of the scorecard (see Sect. A.4).

Figure A.3 is an objectives tree for the 'FlyAway' airport expansion case. See Keeney and McDaniels (1999) and Keeney (1996c, p. 75) for other examples.

A.3 Causal Relation Diagram

A causal relation diagram supports the definition of relevant factors in a problem situation and reflects insights into their mutual interrelationships related to a specific system.

Application: The objective of a causal relation diagram (also called simply 'causal diagram') is the specification of the relations between system factors,[2] including the way in which a change in a certain factor will influence the other factors. The main function of a causal relation diagram is the identification and visualization of relationships among factors. The causal diagram can also be used as a basis for learning and for building the associated system model to be used in the analysis. It can further be used as a communication device to explain the causal mechanisms of the system under analysis. In this way, the causal diagram enhances qualitative insight into the system's behavior and can facilitate the search for policy options. Finally, the causal relation diagram can aid the analysis of qualitative insights about mechanisms through which changes in the system produce the system's outcomes of interest.

Rules of the causal relation diagram: A causal diagram can answer the question "What happens qualitatively if this factor increases or decreases?" By following the arrows leading from the factor, it becomes clear which other factors will increase and decrease. The same question can be asked for each of these factors until no further outgoing arrows are found. Conversely, the diagram can also help answer the question "What needs to change to make this factor increase (or decrease)?"—a question that is particularly important when looking for solutions.

A causal relation diagram is also often used as a 'blueprint' for a mathematical model. The causal relation diagram helps identify endogenous and exogenous variables: factors without incoming arrows are exogenous variables (external factors); factors without outgoing arrows are output variables. Arrows with '+' and '−' labels can be 'translated' into mathematical relationships in a mathematical model.

Application rules: The main concept in the causal diagram is the concept of the 'factor'. In a causal diagram, the relevant factors of a system are represented in the form of ovals, and the links (interactions, influences) between the factors are represented as arrows between the ovals. An arrow from A to B means that factor A has a certain influence on factor B. This influence relationship is 'causal' in the sense that if A changes, then B will change as a result. A causal diagram displays the nature of the influences by labeling the arrows with a '+', '−', or '?'. A '+' next to an arrow from A to B indicates that if A increases, B will increase as well, and that if A decreases, B will also decrease. A '−' indicates that if A increases, B will decrease, and if A decreases, B will increase. There are possible factors that have a non-scalar value range. An example is 'choice of transport', with car, train, bus, or bike as possible values. With 'choice of transport', it is not meaningful to talk about increases or decreases, although the value of these factors can have an influence on those of the others (take for example the causal chain choice of transport on number of car kilometers of congestion). The nature of the influence is not simply a '+' or a '−'. Because of this, the influence arrows in these cases are labeled with a '?'.

[2] A *factor* is an attribute of an entity (a thing, a person, a process) for which a value can be established on a scale via direct or indirect measurement.

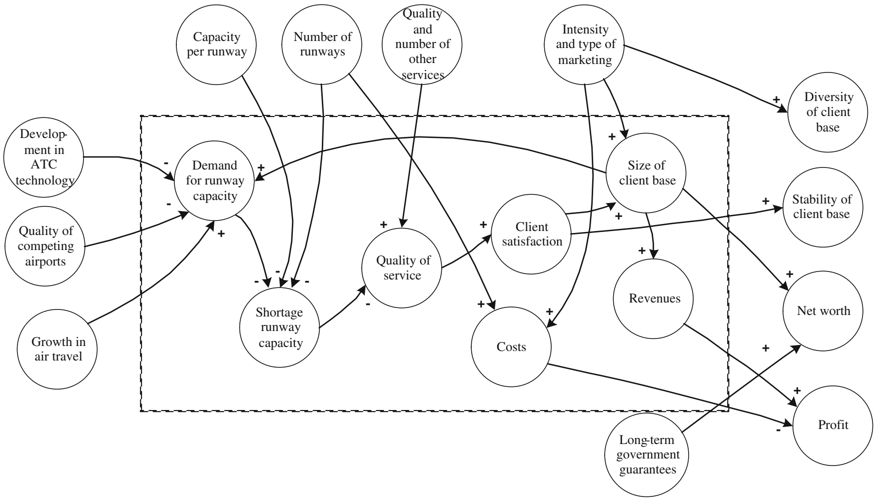

Fig. A.4 Causal relation diagram for the ‘FlyAway’ airport expansion case

An approach to developing a causal relation diagram that works well is ‘middle-out’, in the sense that a relevant factor is identified—‘congestion’ for instance—and then the diagram is developed in two directions:

- Forwards: “What does this factor have an effect on?” This leads to the identification of new factors. Congestion means traffic jams, and traffic jams mean longer travel times, so in the causal relation diagram an arrow labeled with a ‘−’ runs from ‘congestion’ to ‘accessibility of economic centers’. More traffic jams lead to longer travel times by car, through which the travel time relationship public transport/car decreases (‘−’). The slower the cars drive or the more they stand idle in a traffic jam, the more damaging the emissions are to the environment (‘+’).
- Backwards: “What influences this factor?” By this route, factors are identified that influence congestion, like ‘spread of transport demand over time’ (‘−’) and number of car kilometers (‘+’).

Figure A.4 is a causal relation diagram for the ‘FlyAway’ airport expansion case.

Consistency rules: A common fault is that the precise definition of a factor is unclear (Sterman 2000). Also with a causal diagram, a written explanation is indispensable. In addition, the following rules apply:

- Consistency check: The simplest test is to check whether the text in the oval fits the sentence “if the < text > increases, then…”. If that does not produce a logical sentence then the < text > probably does not represent a factor. A second test is to see if of a worthwhile unit for each factor exists, such as the number of vehicle hours lost or the average daily length of traffic jams for congestion.
- ‘Floating’ factors—ovals with no incoming or outgoing arrows—also indicate a problem with the diagram: a factor can be relevant only when it has some relationship to other factors in the system.

- Every arrow must be labeled with a '+', '−' or '?'.
- More than one arrow from A to B is incorrect: a second arrow with the same label is redundant; a second arrow with a different label is conflicting.

Applicability: The usability of a causal diagram is totally dependent on a correct specification of the relationships among the factors. With each arrow, it must be clear what underlying mechanism this relationship is based upon. A second way to check the usability of a causal diagram is that with each arrow the causality of the relationship raises the question: Is it really true that an increase in A causes a decrease in B? Or are we only talking about a correlation; and, is the cause of the increase in A and the simultaneous decrease in B, attributable to a third factor C? The more uncertain a relationship is, the less value can be attached to the inferences drawn from the diagram.

Strengths of the method: A causal relation diagram can be a very worthwhile communication tool, at a relatively low cost, and the results are easier to convey and less likely to be misunderstood than some other methods.

Weaknesses of the method: We mention three weaknesses associated with the causal relation diagram: (a) the results are usually based on qualitative, subjective information, (b) precise forecasts are not possible, given the qualitative nature of the diagram, and (c) good judgment and some experience are required to prevent overly complicated and detailed (and, therefore, hard to communicate) diagrams, or overly simplistic and trivial ones.

Related methods:

- Brainstorming, and/or brainwriting are useful methods to generate factors.
- Interpretive Structural Modeling (ISM) (Warfield 2003) is an alternative when a hierarchical rather than a feedback structure is studied.
- Typically, a causal diagram serves as a first step toward a mathematical or computer model of the system and as a communication tool concerning such a model.

Pitfalls: Try to avoid the use of non-scalar factors like 'choice of transport' in a causal diagram as much as possible. By choosing such factors, the influencing relationships become unclear and the use of the model becomes more limited. Often, by working out a factor in more detail, genuinely scalar factors can be found. In many cases relations between factors involve a possible decision by an actor. By looking at that actor's objectives, it may perhaps become clear how that decision will turn out, depending on the value of other factors (B and C, say). In this way, the factor may be removed from the diagram and the expected behavior of the actor is considered as a mechanism forming a relationship itself between factors A, B, and C.

After all relevant relations between possible measures and outcomes of interest have been conceptualized, another important question remains: "Do changes in the policy options and external factors have consequences for factors that have not yet been identified but are still important?" Typically, policy actions will have unintended but relevant side effects. Uncovering these requires 'forward' thinking, whereas up until now the main line of thought was 'backwards' from the criteria.

A.4 Scorecard

Application: The final stage of a policy analysis study is about selecting one policy from a large number of policy options. Many approaches have been developed for this purpose. (Walker 2000) identifies the theoretical and practical problems associated with these approaches in a multi-stakeholder context. The scorecard is a tool to make the comparison of different alternatives easier without passing judgment on the alternatives themselves. The main idea behind the scorecard is that the policy options formulated in the policy generation phase are compared to each other on the basis of criteria formulated in the conceptualization phase (e.g. with the aid of an objectives tree) using the output from the system model. The emphasis is on the word comparison: the point is not to say whether a policy option is 'bad' or 'good', but to present information about the different alternatives in such a way that comparison of the different policy options is facilitated. The scorecard gives a ranking of alternatives per criterion, highlighting the tradeoffs that need to be made in making a choice among the policy options. Although a scorecard is often filled in using quantitative data, the scores can be presented using only colors or qualitative information instead of 'hard' numbers.

Rules of the scorecard (after Patton and Sawicki (1986), pp. 275–278, Miser and Quade (1985), pp. 93–99, and Walker 2000, p. 17): Each column of a scorecard represents an outcome indicator (criterion) and each row represents a policy option. A cell of the matrix contains the estimated value of the outcome indicator for the given policy option in that scenario. An entire row shows all of the outcomes of a single policy; an entire column shows each policy option's value for a single outcome. Numbers or words appear in each cell of the scorecard to convey whatever is known about the size and direction of the outcome in absolute terms—i.e., without comparison between cells. Per criterion, the ranking of policy options can be shown using different colors, hatching, or grey tones. Although the (relative) colors are more important than the 'absolute' criterion scores, the latter should remain visible, because the information on the expected outcomes should not be lost. The scorecard can present the full range of outcomes, using the most natural description for each one. Therefore, some outcomes can be described in monetary terms and others in physical units; some can be assessed with quantitative estimates (e.g., air pollutant emissions) and others with qualitative comparisons (e.g., "the stakeholder acceptability for this tactic is high"). After filling in the scores for every policy option, color is used to identify the level of satisfaction for a given indicator across the policy options. For example, green can be used to identify the highest level of satisfaction, yellow for the medium/middle satisfactory level, and red for the lowest satisfactory level. Note that, if an alternative scores worst with regard to a certain criterion, then that alternative could still be very useful because of its scores on other criteria. A sample scorecard is presented in Fig. A.5.

	Alternatives		
	Closed Case	SSB case	Open case
SECURITY			
Land flooded (ha) in 1/4000 storm (90% prob.)	0	0	400
Technical uncertainty	None	Scour	Dikes
Expected land flooded during transition pd. (ha)	430	200	630
RECREATION			
Added shoreline (km)	1,7	11	6
Added sea beach visits (1000/yr)	338	0	0
Decrease in attractiveness of area	None	Minor	Major
Major tourist site created?	No	Yes	No
Decrease in salt-water fish quantity (%)	75	0	25
NATIONAL ECONOMY (peak year)			
Jobs	5800	9000	5700
Import (DFL million)	110	200	130
Production (DFL million)	580	940	560

Rankings:
Best Intermediate Worst

Fig. A.5 A sample scorecard from a project to evaluate three options for dealing with flooding in the Oosterschelde region of the Netherlands (see Goeller et al. 1977)

Consistency rules: The scorecard is a table with one row for each criterion and one column for each policy option. Colors should be chosen logically—for example, red for 'bad' or 'risky', and green for 'good'. Whatever colors are chosen, the color ranking must be explained using a legend. The color ranking must, of course, correspond to the ranking of the 'absolute' criterion scores. Two (almost) equal criterion scores should be assigned the same color for both alternatives—the shade which best shows the relative position of the criterion score with respect to the scores for the other policy options.

Applicability: The purpose of a scorecard is to establish a display for all of the criteria in one graphical overview in such a way that a useful comparison of all the policy options for a given scenario is possible. The criteria can vary greatly and their values will often be expressed in different units of measurement, such as euros, meters, decibels, or hectares. This means that it is impossible to 'simply add up and take the highest value' or combine all the scores over the various criteria. The scorecard highlights the tradeoffs that have to be made among the alternative policies. The function of a scorecard is, of course, to support the decisionmaker(s) in choosing one policy option from a collection of possible policy options, by highlighting the points on which the policy options differ. The use of colors, or grey tones, focuses the discussion on the relative scores per criterion across the policy options (ranking), and not on the scores themselves. The purpose of the scorecard is, first and foremost, to enable comparison. The process of comparing policy options can be structured even more by switching around the rows or columns. By putting the most important criteria at the top, and then ranking the alternatives in such a way that those that score highest on the most important criteria turn up on the left, you will make a table in which the 'most preferred' option is on the left, and the 'least preferred' option is on the right.

Strengths of the method: The scorecard method avoids the problems associated with aggregate methods of comparing policy options. In an aggregate approach, each impact is weighted by its relative importance and combined into some single, commensurate unit such as money, worth, or utility.

In contrast to these methods, the scorecard has the following advantages:

- It is easy to understand. Those who want to assess the policy options can get a quick overview of the consequences of the options for the entire range of criteria.
- It makes it possible to present a wide range of impacts (scores can be quantitative, qualitative, or even words) without losing information from the analysis by aggregation.
- It is a neutral tool for presenting information, adapting easily to the case of multiple actors. It does not require agreement on weights. Its strength is that it seeks agreement on a decision, not weights (or monetary values). It is generally much easier for a group of decisionmakers to determine which alternative they prefer (perhaps for different reasons) than what weights to assign to the various impacts.
- It helps the actors see the comparative strengths and weaknesses of the various policy options, to consider impacts that cannot be expressed in numerical terms, and to change their set of weights and note the effect that this would have on their final choices.

Weaknesses of the method: Those that must make a choice from the policy options can regard the fact that no weights are given to criteria, and that there is no attempt to express the impacts in financial terms, as a disadvantage of the method. Furthermore, if there are many policy options and/or many outcome indicators, the amount of information can become overwhelming (Patton and Sawicki 1986, p. 278). Also, certain aspects can be emphasized incorrectly as a result of overextensive separation of criteria, and also by color choice and accentuation.

Pitfalls: Just like all other models, the scorecard will have to be explained in terms of what the criteria are, where they came from, in which units of measurement the scores are expressed, and (most important) how a certain score was obtained. This is especially important if there is any room for doubt about the assumptions on which the ranking is based.

Related methods:

Two types of scorecards are discussed in the literature:

- Goeller scorecards (Miser and Quade 1985, pp. 105–107; Walker 2000), a matrix method where each criterion is measured in natural units for each alternative;
- Alternatives-consequences matrixes (Patton and Sawicki 1986, pp. 276–278), a matrix method in which criteria are displayed along the vertical axis and alternatives along the horizontal axis. Each cell in the matrix is filled in with

a pass-or-fail determination (for major criteria) or a numerical ranking (for minor criteria).

A related method is tradeoff analysis or Even Swaps: Hammond et al. (1998) present the Even Swaps method for the tradeoff stage, which is used to identify a preferred policy option after the consequences table (scorecard) has been produced. Even Swaps is an elimination process based on value tradeoffs [see e.g. (Keeney 2002)].

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Index

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