Glossary

This document provides a glossary of terms commonly used in DMDU studies. Providing such a glossary is challenging for two reasons. First, many of these terms (e.g., uncertainty, scenario, policy) have different meanings across the different scholarly and practice communities with which DMDU analysts interact. Second, the terms in the glossary describe both aspects of the analysis and corresponding attributes of the real world. Nevertheless, we offer the following key to frequently used terms as a rough guide to better assist the reader in understanding the language used in DMDU studies, and its mapping to the real world facing decisionmakers.[1]

Adaptation Tipping Point (ATP) An ATP is reached when a policy is no longer able to achieve its objectives; i.e., the conditions under which the current policy starts to perform unacceptably (Kwadijk et al. 2010). (This is sometimes called a '**threshold**'.). An ATP is related to a '**trigger point**,' in that the adaptive policy should actually be changed (triggered) at a time sufficiently before the ATP that is greater than the lead time required to implement the change.

Adaptive policy A **policy** (see) that is designed *ex ante* to be changed over time as new information becomes available or as the situation changes (see also **flexible policy**).

Analytic model A model that is derived, often mathematically, from a theoretical statement of relationships that hold in the real world. The relationships are used to project how a policy will perform in a given **future** (see), evaluated according to the specified **outcome indicators** (see). The analytic model is

[1]We are aware that there is discussion on whether to write policy-making, policy making, or policymaking. (The same goes for decisionmaker and policymaker.) This is a question of style. There are a variety of style manuals available (e.g. Harvard, University of Chicago, RAND). However, there is one style manual that focuses on policy analysis—the RAND Style Manual. We, therefore, selected this style, and so we use policymaking, decisionmaking, policymaker, etc., as single, unhyphenated words.

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typically embodied in computer code. Bankes (1993) distinguishes between 'consolidative' and 'exploratory' models. The former are validated and predictive. The latter provide a mapping of assumptions to consequences without any judgment regarding the validity of alternative assumptions. DMDU analyses typically regard models as exploratory and use them in performing **Exploratory Modeling** (see).

Approach A process to design a plan or strategy to react to a **problem or opportunity** (see). It focuses on the steps to be taken in performing the study.

Case study This book includes several 'case studies,' which are applications of a DMDU approach to a specific real-world situation.

Case In DMDU analyses, the term 'case' has a very specific meaning. It is a run of the system model for one future (scenario) and one policy (strategy, plan). DMDU analyses typically generate a database of many model runs. Each entry in such a database is a case. Each database entry typically includes numbers describing the future, the policy, and the values of the outcome indicators that result from pursuing the policy in that future.

Deep uncertainty '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' (Lempert et al. 2003). In this book, deep uncertainty is seen as the highest of four defined levels of uncertainty.

Exploratory Modeling (EM) EM is a **tool** (see) that uses computational experiments to analyze complex and uncertain systems. In each experiment, a large number of runs are made over the input space in order to generate an ensemble of runs. Because it requires making a large number of runs, EM usually makes use of a '**Fast Simple Model'** (Kwakkel et al. 2009) (see).

Fast Simple Model (FSM) An FSM is 'a relatively small, simple model intended to mimic the behavior of a large complex model' (Davis and Bigelow 2003, p. 8; van Grol et al. 2006). In DMDU studies, FSMs are used to assess large numbers of alternative actions under a range of plausible futures. The main purpose of FSMs is not to provide 'the solution,' but to provide information on a (future) problem situation on which decisionmakers can base their decisions. FSMs are also sometimes called metamodels (Davis and Bigelow 2003), compact models (Gildenblat 2010), repro models (Meisel and Collins 1973), surrogate models (Razavi et al. 2012), emulation models (Machac et al. 2016), computationally efficient models, low-fidelity models, or screening models.

Flexible policy A flexible policy can be employed differently (or easily modified) to keep on meeting the desired objectives as new information becomes available or as the situation changes (see also **adaptive policy**).

Future A future, context, future state of the world (all synonymous terms) is a specific set of assumptions about the future (usually about the external environment of the system, but sometimes also about the internal structure of the system and stakeholder preferences among the outcome indicators). DMDU studies typically use sets of multiple futures to represent uncertainty. A DMDU analysis typically represents each future with a vector of specific values for each of the uncertain parameters of the model (see also **scenario**).

Implementation The entire process by which a change in policy is brought into practice. Implementation is mostly outside the scope of this book. However, the 'theory' part of the book (Part I) deals with the design of a policy, which might include some consideration of how the policy might be implemented (e.g., setting up a monitoring system); the 'practice' part (Part II) sometimes addresses implementation issues; and Part III of the book deals directly with policy implementation issues.

Objectives The set of outcomes (in general terms) that the problem owner and other stakeholders desire to achieve (sometimes called 'goals'). Sometimes, the objectives are related to preferences (weights) among the outcomes (which help to determine how the policy alternatives are to be ranked in order of desirability).

Outcome indicators The quantifiable (measurable) outcomes related to the objectives (which are generally the outcomes of the system models used in the analysis). These are the (measurable) results that the system models suggest would ensue were the policy to be adopted and implemented under the assumed conditions (they are also called 'metrics' or 'performance measures').

Policy analysis process: Most of the DMDU approaches apply the policy analysis process (Walker 2000), which is a methodical, iterative process for designing a policy, which involves choosing among alternative actions (policies) in a complex system. It is characterized by a series of steps that include identification of the problem and the objectives of the analysis, choosing policy evaluation criteria (**outcome indicators**), using a model of the system, and comparing the alternative policies.

Policy A policy (also often called a strategy or plan) represents a distinct choice facing a planner or decisionmaker. It is often defined by the amount, location, and timing of different interventions, programs, or regulations under the control of the actors in the policy domain whose decision is being analyzed. Different policies represent different alternative conceptions for a course of future actions (also called policy options or alternatives). A DMDU policy is often designed to be adaptive. In this case, it is composed of initial actions (implemented when the policy is first implemented) and contingent or long-term actions (implemented if an **Adaptation Tipping Point** (see) is reached).

Problem (or opportunity or question) This is both the catalyst and the guiding principle for a DMDU study. For such a study to be undertaken, someone or organization (the 'problem owner') must be dissatisfied with the current or

anticipated outcomes of a system (or must see opportunities for the future) and want help in discovering how to bring about more preferred outcomes. DMDU analyses can be used to present arguments and information to help win acceptance for a course of action (policy). Thus, DMDU analyses serve as decision support.

Resilient policy A resilient policy can resume meeting the desired objectives (or can 'bounce back') reasonably quickly after a shock to the system or as the situation changes (de Haan et al. 2011). Resilience can also be a property of the system itself.

Robust Policy A robust policy can keep on meeting the desired objectives as new information becomes available or as the situation changes.

Scenario Discovery (SD) SD is a **tool** (see) to distinguish futures in which proposed policies meet or miss their objectives. It begins with a large database of model runs (e.g., from **EM**, see) in which each model run represents the performance of a strategy in one future. The SD algorithms identify those combinations of future conditions that best distinguish the cases in which the policy does or does not meet its objectives.

Scenario A scenario (or decision-relevant scenario) may be used synonymously with **case** (see above) or even **future** (see above; but this usage is more usually found in the scenario planning literature.) Alternatively, in some DMDU studies the term is used to refer to a set of cases that share some decision-relevant attribute. For instance, a region in a plot of case outcomes where a strategy performs poorly might be considered such a scenario (this is the meaning of scenario in SD).

Threshold See Adaptation Tipping Point.

Tool A tool refers to the computational support, models, statistical analyses, etc., that can be used to carry out one or more steps of an **approach** (see).

Trigger point See Adaptation Tipping Point.

Uncertainty An uncertainty is a single factor affecting the future context (external to the system), model structure, model parameters, or stakeholder preferences among the outcome indicators that lie outside the control of the actors in the policy domain and about which the policy actors possess insufficient knowledge when the policy is being planned or implemented.

Vulnerability A vulnerability is a characteristic of a policy (strategy, plan) indicating that some plausible future situation might cause the policy to fail to meet its objectives. It is closely related to an **Adaptation Tipping Point** (see), which is reached when a policy is no longer able to achieve its objectives.

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