

# Innovation Dilemmas: An Info-Gap Perspective

## With Application to Water Supply Design

Yakov Ben-Haim

Technion – Israel Institute of Technology  
yakov@technion.ac.il, info-gap.com

Sde Boker, 24.5.2023

### Abstract

The search for ever better outcomes should guide the decision maker in engineering design, public policy, economics, medical decisions and many other areas of human endeavor. However, uncertainty, ignorance, and surprise may jeopardize the achievement of optimal outcomes.

The concept of an innovation dilemma assists in understanding and resolving the designer's challenge. An innovative and highly promising new concept is less familiar than a more standard approach whose implications are more familiar. The innovation, while purportedly better than the standard approach, may be much worse due to uncertainty about the innovation. The resolution (never unambiguous) of the dilemma results from analysis of robustness to surprise (related to resilience, redundancy, flexibility, etc.) and is based on info-gap decision theory.

Info-gap theory provides decision-support tools for managing the challenges of design and planning under deep uncertainty. We discuss the method of robustly satisfying critical requirements as a tool for protecting against pernicious uncertainty.

We will discuss an example of the info-gap analysis of innovation dilemmas. The example explores a simple innovation dilemma in long-term technological development for water supply. New and innovative supply technologies are predicted to provide water at lower cost than standard technologies, which could raise demand. However, the new and innovative technologies are less familiar than the standard methods. Furthermore, uncertain future water management policies could alter future demand unexpectedly. The example illustrates the quantification of the innovation dilemma, and its resolution, based on info-gap robust satisficing, with implications for water management policy and for water technology research.

**Selected References** (see also info-gap.com)

- Yakov Ben-Haim, 2006, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty*, 2nd edition, Academic Press.
- Yakov Ben-Haim, 2010, *Info-Gap Economics: An Operational Introduction*, Palgrave-Macmillan.
- Yakov Ben-Haim, 2018, *Dilemmas of Wonderland: Decisions in the Age of Innovation*, Oxford University Press.
- Keith W. Hipel and Yakov Ben-Haim, 1999, Decision making in an uncertain world: Information-gap modeling in water resources management, *IEEE Transactions on Systems, Man, and Cybernetics—Part C: Applications and Reviews*, vol. 29, No. 4, pp.506--517.
- Jim W. Hall, Robert J. Lempert, Klaus Keller, Andrew Hackbarth, Christophe Mijere, and David J. McInerney, 2012, Robust Climate Policies Under Uncertainty: A Comparison of Robust Decision Making and Info-Gap Methods, *Risk Analysis*, 32 (10): 1657-1672.
- Other applications at <https://info-gap.technion.ac.il/water-resource-engineering/>