MAKING HARD DECISIONS

with the Decision Tools® Suite

3rd Edition

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CHAPTER 1

Modeling Decisions

Overview of Chapter 1

Decision analysis is a process that provides a structured method along with analytical tools designed to improve one's decision-making skills.

- It enables you to base your decisions on more than intuition or hunches.
- It teaches you how to rigorously analyze decisions to gain helpful insights.

Rice University Faces a Difficult Decision

In 2004, Rice University's Board of Regents was looking at a football program with a $4 million deficit, an amount expected to grow and that Rice could not afford yearly.

- The Board had a fiduciary (الائتمانية trust) responsibility to reduce the football program's sizable deficit.
- On the other hand, football's value extended beyond simple cost accounting to include important but **intangible** benefits.
  - Boosting school spirit and ***pride***, improving alumni ***relations***, and supporting local ***businesses***.

Rice University, continued

Thus, Rice's Board needed to understand and preserve the value of these intangible benefits while coming up with cost-cutting proposals.

- One option: Move to a lower division (they are currently registered in a very high football division which is costing them too much).
  - This would lower costs, gain prestige by association, and emphasize academics over athletics, more in tune with the university's spirit.
  - However, this was strongly opposed by many fans, supporters and alumni.
- Such difficult and complex decisions are common and need to be analyzed thoroughly and systematically.
  - Far too risky to rely on "hunches," "snap judgments," intuition or emotions

Decision Analysis – Good News

- Decision analysis adds clarity and insight.
  - Uses a conceptual framework for thinking **systematically**
  - **Breaks** the problem down into **smaller**, more easily understood units for individual analysis (can you think of a well known technique that applies that?)

- Decision analysis supplies analytical tools that improve insight and understanding of the problem.
  - **Sensitivity analysis** helps us see which inputs are most important and deserving of further attention (????).

- Decision analysis instills a sense of confidence in the solution we choose to enact.

Decision Analysis – Bad News

- Decision analysis cannot make hard decisions completely easy.
  - Even after analysis, hard decisions are still difficult to decide (mainly due to uncertainty, multiobjectives, and incomplete data).
  - We must think through all the various aspects of the decision.

- Decision analysis cannot provide us with "**the unique**" answer.
  - We cannot simply feed our inputs into a computer and out pops the one and only answer.
  - Decision analysis provides us with **alternatives** to choose between.

Why Are Decisions Hard?

Complexity (dimensionality: e.g. number of decision variables and number of constraints)

- Can quickly overload the decision maker
- Decision analysis reduces complexity.
- Able to isolate and analyze individual parts of the decision separately

Why Are Decisions Hard?

Uncertainty

- There is no way to know precisely how all of the factors not under your control will play out.

- Decision analysis addresses uncertainty by allowing us…
  1. …to break each uncertainty down by listing the different outcomes that could occur
  2. …and to determine both the consequence and the likelihood of that outcome occurring.

- Such analysis does not lead to immediate clarity, but it can provide a richer understanding of the problem and its alternative solutions.

Why Are Decisions Hard?

Multiple Objectives

- In most cases, decision makers face trade-offs between several goals. Rarely does a problem involve only one goal.
  - Financial goals versus non-financial goals
  - Short term goals versus long-term goals

- Decision analysis provides both a framework and specific tools for dealing with multiple objectives.
  - Make the goals explicit
  - Rank them in order of importance

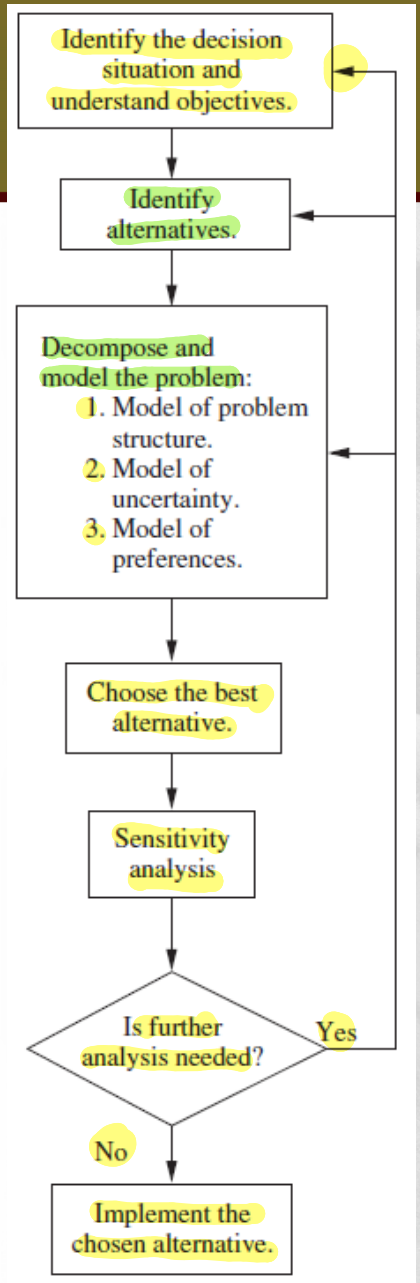
Why Are Decisions Hard?

Competing Viewpoints

- Often lead to:
  - Different inputs
  - Different goals or their relative importance
  - Different ways of solving the problem
  - Ultimately—radically different solutions
- Such conflicts are often made worse when more than one person is involved in the decision.

Figure Slide Content

- A decision-analysis process flowchart



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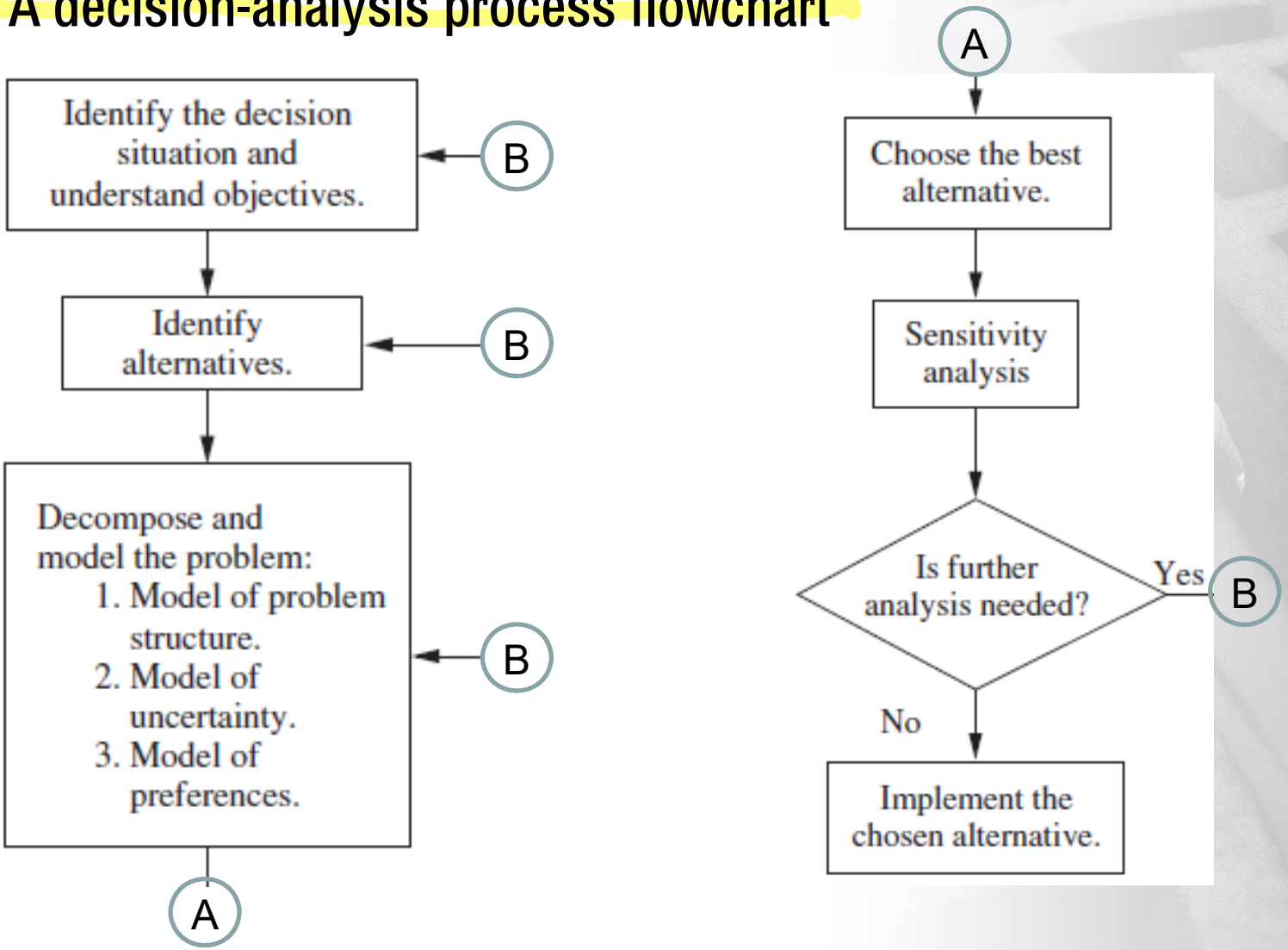
- A decision-analysis process flowchart



The Decision-Analysis Process

- **Step 1**: Identify the decision situation and understand objectives
  - Define the problem as exactly as possible
  - Identify financial *and non-financial* objectives
  - Understanding objectives is critical to subsequent steps

- **Step 2**: Identify alternatives
  - Analysis of objectives may reveal alternative solutions not initially obvious

The Decision-Analysis Process

- **Step 3**: Decompose and model the problem
  - Decomposition entails structuring the problem into smaller and more manageable pieces.
  - Consider elements of uncertainty in the different pieces
  - Modeling involves reassembling the pieces of the problem into a simplified representation.
    - Keep the relevant pieces and discard the irrelevant ones
  - Models can be mathematical or graphical.
    - Mathematical models allow for formal analysis that can provide insights not otherwise obvious.

The Decision-Analysis Process

- **Step 4**: Choose the best alternative
  - Which model is "preferred"?
  - Remember that decision making requires human judgment and is not a process of "solving" a problem for *the* right answer (due to uncertainty, incomplete information, multiobjective, different viewpoints, … etc.) .
- **Step 5**: Sensitivity analysis
  - "What if" you change one of more aspects of the preferred model?

The Decision-Analysis Process

- **Step 6**: Is further analysis needed?
  - Sensitivity analysis often leads to new insights that may require repeating the previous steps.
  - **Decision-making cycle**: think of the overall decision making process as iterative
  - Usually necessary to cycle through the different steps several times
  - Continue iterations until you arrive at the **requisite decision model (the right/complete one)**, i.e., the model in which no new insights or intuitions are gained by another cycle of analysis, or which contains every essential for solving the problem

- **Step 7**: Implement the chosen alternative

Overview of Decision-Analysis Process

- **Decompose** the complex problem into smaller chunks for analysis
- Re-assemble these smaller pieces into one or more overall representations of the decision situation, i.e., **models**
- Pick a model and do **sensitivity analysis** of this model
- Repeat the **decision analysis cycle** until arriving at a **requisite decision model**
  - Contains the essential elements of the problem
  - Allows the decision maker to take action

Decision Tools Software

DecisionTools® Program	Where It Is Used in the Decision Process	Where in Text
PrecisionTree	Structuring the decision	Chapter 3
	Solving the decision	Chapter 4
	Sensitivity analysis	Chapter 5
	Value of information	Chapter 12
	Modeling preferences	Chapter 14
@RISK	Modeling uncertainty	Chapters 8 and 9
	Using data to model uncertainty	Chapter 10
	Simulation modeling	Chapters 11 and 13
RISKOptimizer	Optimizing Simulation Models	Chapter 13

Big Picture

Decision analysis not only provides a structured way to think about decisions, but also more fundamentally provides a structure within which a decision maker can develop beliefs and feelings, those **subjective** judgments that are critical for a good solution.

Summary

- Decision analysis
  - A framework and a tool kit for dealing with difficult decisions
  - Allows the decision maker to incorporate subjective judgments and preferences into the solution
  - An iterative process that enables the decision to gain more insights and develop a mature judgment
  - An art…and a science!