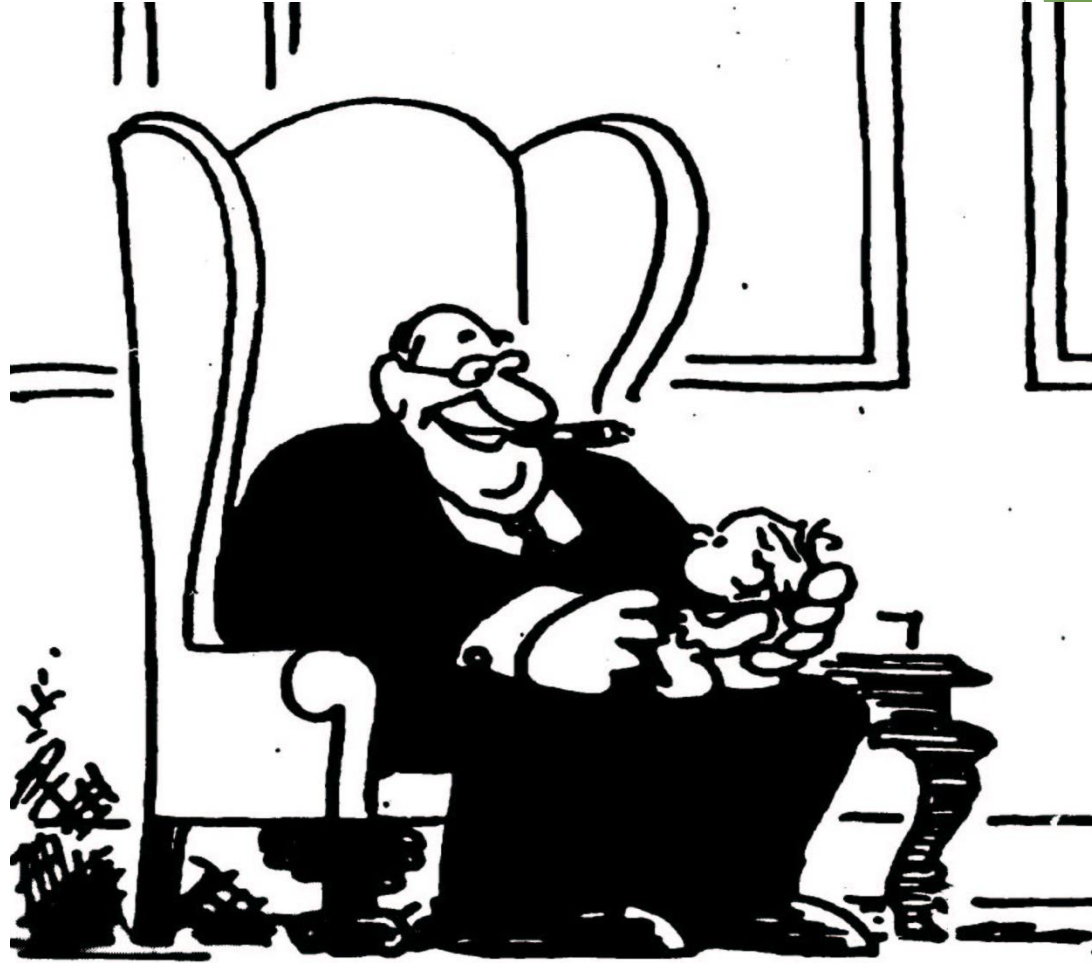


# Critical Thinking & Problem Solving

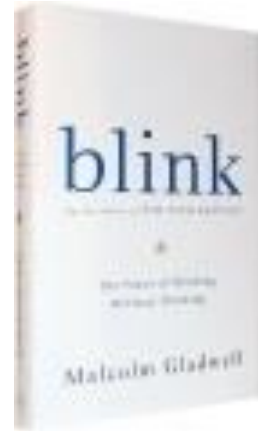
*Dr. Bektash Berdiev*

Personal Decision-Making Styles that Seem to be  
Tailormade for You

**"Today, I'm going to tell you all you'll need to know about 'decision analysis.'"**



Many day-to-day decisions can be made in the “Blink” of an eye or following a routine.



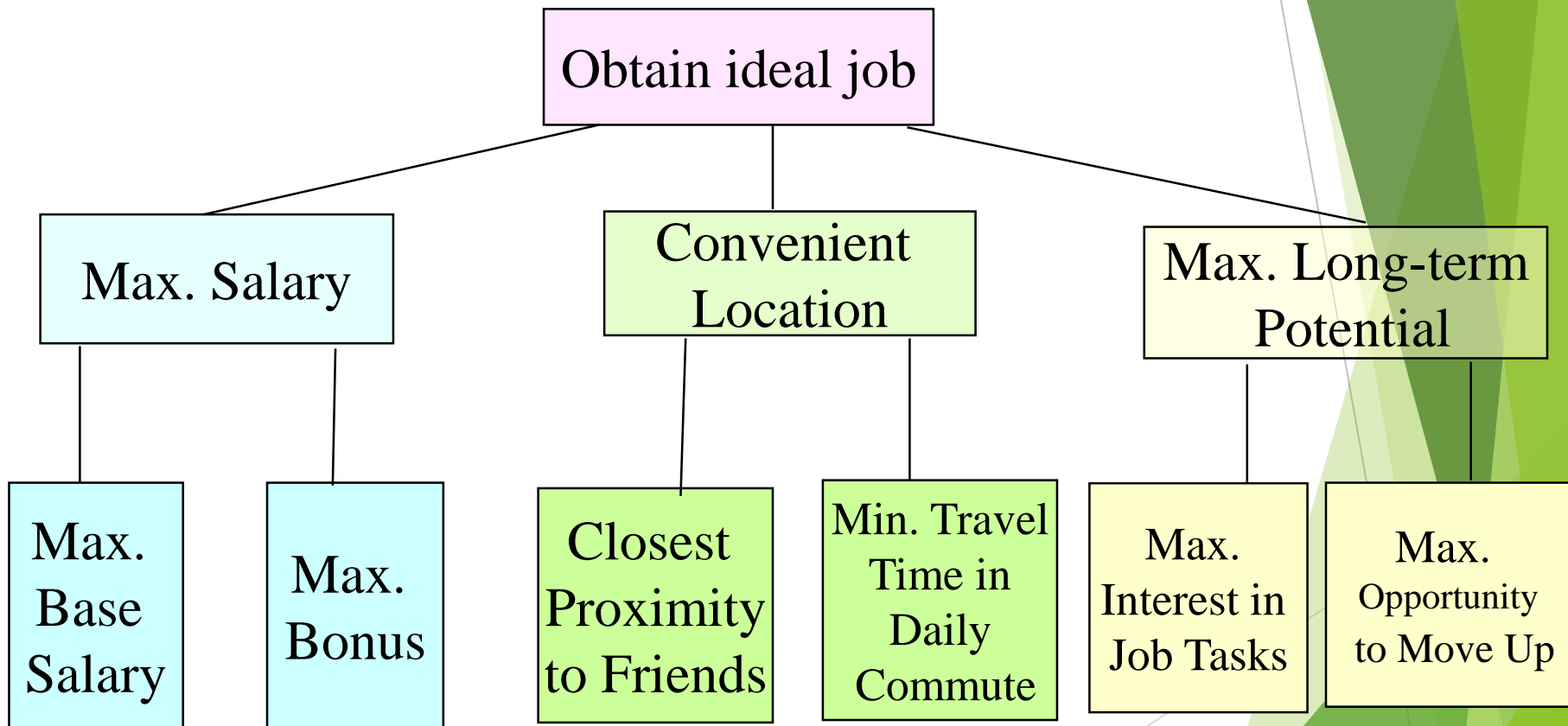
Others merit careful analysis.



# DESCRIBE YOUR IDEAL JOB

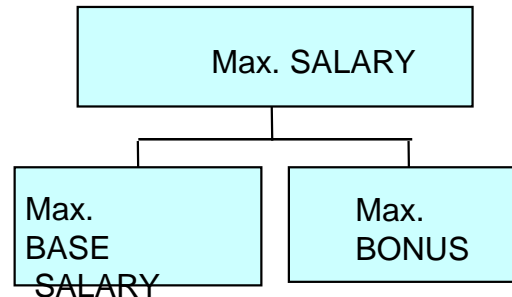


# STRUCTURE FUNDAMENTAL OBJECTIVES IN OBJECTIVES HIERARCHY



# Properties of Hierarchy of Objectives

1. The objectives on the lowest level of the hierarchy can be used to evaluate possible consequences by creating a scale to measure them.



It is wise to specify the direction (maximize/minimize/maintain) that makes your attainment of the objective better.

A consequence with a specific job might be a salary level of \$100,000 and a bonus level of \$50,000. Do not put the different possible salary levels at the bottom of the hierarchy.

2. We will see that you can attach a rating to how good the level is (i.e., salary level of \$100,000).

The rating may be qualitative (+, -, 0 in StarKist case)  
or numerical (from -2 to +2 in INFORMS merger).

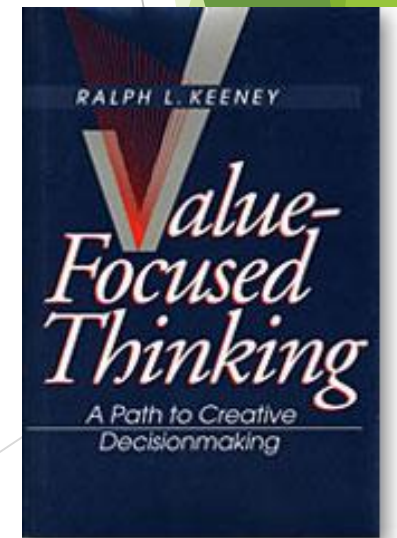
*“It’s not hard to make decisions when you know what your values are.”*

*Roy Disney*

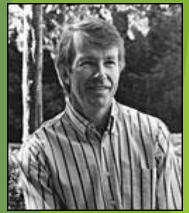
*Decision Analyst  
Ralph Keeney  
advises us to practice  
Value-Focused Thinking*



*Thinking about what we value  
as expressed in our objectives*



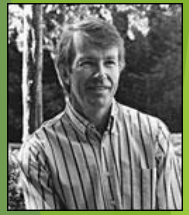
# *Keeney's Personal Objectives*



## **Maximize my quality of life**

- 1. Enjoy life**
- 2. Be intellectually fulfilled**
- 3. Enhance the lives of family and friends**
- 4. Contribute to society**

# *Keeney's Professional Objectives*



**Maximize the contribution of professional activities to...  
my quality of life**

- 1. Maximize enjoyment**
- 2. Maximize learning**
- 3. Provide service**
- 4. Enhance professional career**
- 5. Maximize economic gain**
- 6. Build good professional relationships**
- 7. Minimize the time required**
  - 7.1. Minimize time required where I live**
  - 7.2. Minimize time required away from home**

# *Objectives for Keeney's son's name*

- ▶ 1. Single spelling
- ▶ 2. Not a unisex name
- ▶ 3. Reasonable initials
- ▶ 4. Understandable pronunciation
  - ▶ 4.2. With last name
  - ▶ 4.3. With middle and last name
- ▶ 5. No obvious “unwanted” nickname
- ▶ 6. Not unique
- ▶ 7. Not extremely common



# *Objectives for Keeney's son's name*

- ▶ 8. Not religious
- ▶ 9. Not named after anyone
- ▶ 10. Has a nice rhythm
  - ▶ 10.1. With last name
  - ▶ 10.2 With middle and last names
- ▶ 11. Nice-sounding in foreign languages
- ▶ 12. Appealing (i.e., you feel predisposed to talk to or meet the person)
- ▶ 13. No “ee” sounds



# Objectives for Keeney's son's name

- ▶ 8. Not religious
- ▶ 9. Not named after anyone
- ▶ 10. Has a nice rhythm
  - ▶ 10.1 With last name
  - ▶ 10.2 With middle and last names
- ▶ 11. Nice-sounding in foreign languages
- ▶ 12. Appealing (i.e., you feel predisposed to talk to or meet the person)
- ▶ 13. No “ee” sounds

▶ Keeney (1992), Value Focused Thinking



**The Winning Name is**

**Gregory**

# Decision Modeling Exercise

## CHOOSE A DECISION THAT SOMEONE IN THE GROUP FACES

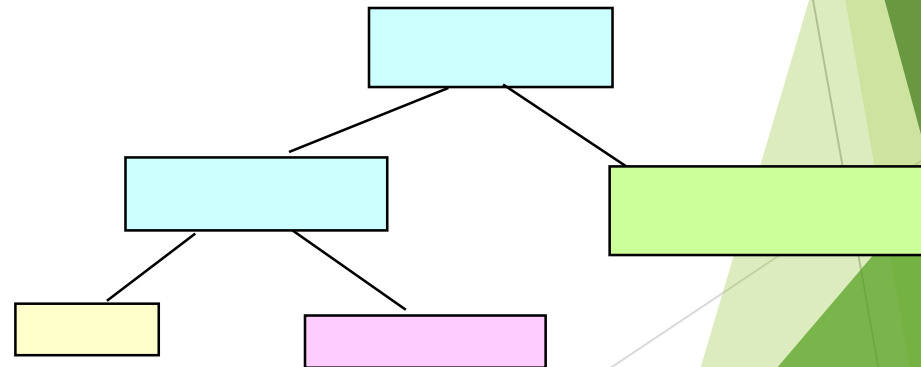
- ▶ CHOOSE AMONG SET OF ALTERNATIVES  
(and you can share)
- ▶ EACH ALTERNATIVE DESCRIBED BY SEVERAL OBJECTIVES
- ▶ DO NOT INCLUDE PROBABILISTIC UNCERTAINTY IN MODEL

# STRUCTURE OBJECTIVES IN HIERARCHY

- ▶ BRAINSTORM FOR ALL OBJECTIVES
- ▶ WHICH MIGHT BE USED TO CHOOSE AMONG OPTIONS
- ▶ CONSTRUCT HIERARCHY STRUCTURE FROM BOTTOM UP OR TOP DOWN

- ▶ Names of group members
- ▶ Brief description of decision situation
- ▶ Some of the alternative actions
- ▶ The objectives hierarchy structure, which you can list in an outline form or draw out

- ▶
  - 1. Objective 1
    - 1.1. Subobjective 1.1
    - 1.2. Subobjective 1.2
  - 2. Objective 2
    - 2.1. Subobjective 2.1



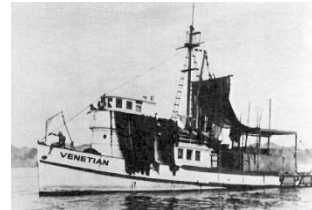
# Multiple-Stakeholder Decision Making

## The StarKist Tuna Fishing

Stakeholders  
Decision



<http://www.sandiegohistory.org/journal/81fall/images/piva.jpg>

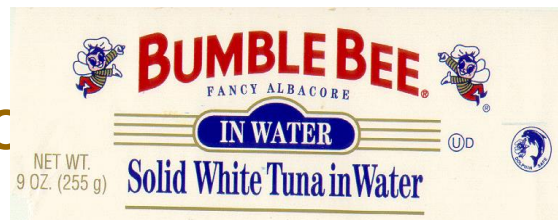


San Diego  
Tuna Fishing



<http://www.earthisland.org/index.php/donate/>

Competitor



Monika I. Winn and L. Robin Keller, "A Modeling Methodology for Multi-Objective Multi-Stakeholder Decisions: Implications for Research," Journal of Management Inquiry, vol. 10, no. 2, June 2001, 166-181.

# DECISION ALTERNATIVES

## Legal Quota

Maintain current practices and stay within legal limits

## Limited Mortality

Step up efforts to reduce the number of dolphins killed

## Zero-Mortality

No fishing associated with setting nets on dolphins

### StarKist's (1991) Dolphin Safe Policy

"StarKist will not buy any tuna caught in association with dolphins in the Eastern Tropical Pacific."

# Decision Alternatives Rated with StarKist's "Business-As-Usual" Objectives Hierarchy

	Decision Alternatives		
	Keep Status Quo	Reduce Dolphin Mortality	Go Dolphin Safe
<b>MAXIMIZE PROFIT</b>	?	?	?
<b>B1. Minimize Cost</b>			
B1.1. Minimize Cost of Tuna	+	-	-
B1.2. Minimize Cost of Canning Operations	+	-	-
B1.3. Minimize Cost of Transportation Logistics	+	+	-
B1.4. Maximize Quality of Tuna and Operations	+	+	-
<b>B2. Maximize Revenue</b>			
B2.1. Maintain and Expand Brand Loyalty	?	0	+
B2.2. Increase Customers w/ Differentiated Product Line	?	?	?
<b>B3. Optimize Industry Competitive Position</b>			
B3.1. Capture "First Mover" Advantages	-	0	+
B3.2. Hold Market Share Leadership	?	?	?
<b>B4. Minimize Legal and Regulatory Interference</b>			
B4.1. Minimize Legal Liabilities	?	0	0
B4.2. Minimize Regulatory Intervention	-	-	+
<b>B5. Maintain Favorable Stakeholder Relations</b>			
B5.1. Maintain Good Supplier Relations	+	0	-
B5.2. Maintain Good Shareholder and Banking Relations	?	?	?
B5.3. Maintain Good Relations to Corporate Headquarters	?	?	?
<b>B6. Maintain Reputation as "Good Corporate Citizen"</b>	-	-	+

Key for Rating Alternative's Performance on Objective: "+" : favorable "0" : neutral or balanced  
 "-" : unfavorable "?" : insufficient information

# Decision Alternatives Rated for Fishing Fleet

Objectives Hierarchy	Decision Alternatives		
	Keep Status Quo	Reduce Dolphin Mortality	Go Dolphin Safe
<b>MAINTAIN VIABLE BUSINESS</b>	+	+	-
<b>F1. Maintain Profitability</b>			
F1.1. Maintain Lucrative Fishing Grounds	+	+	-
F1.2. Maintain Lucrative Fishing Methods	+	?	-
F1.3. Avoid Foreign Competition	+	?	-
<b>F2. Maintain Livelihood</b>			
F2.1. Maintain Fishing Grounds in East. Tropical Pacific	+	+	-
F2.2. Protect Large Investments in Boats	+	+	-
F2.3. Prevent Fishing Grounds from Depletion	?	+	-
<b>F3. Maintain Quality of Life in Local Community</b>			
F3.1. Protect Family-Owned Small Businesses & Heritage	+	+	-
F3.2. Maintain Positive Image in Community	?	+	+
<b>F4. Protect Positive Image as Good Global Citizen</b>			
F4.1. Legitimate Fishing Methods involving Dolphins	?	0	-
F4.2. Publicize Successes in Reducing Dolphin Mortality	0	+	+

# Decision Alternatives Rated for Environmental Interest Groups

Objectives Hierarchy	Decision Alternatives		
	Keep Status Quo	Reduce Dolphin Mortality	Go Dolphin Safe
<b>PROTECT MARINE MAMMALS</b>	-	?	+
<b>E1. Stop Killing of Dolphins</b>			
E1.1. Protect Intelligent Large Marine Mammals	-	-	+
E1.2. Protect Species from Extinction	-	?	+
<b>E2. Stop Cruelty to Dolphins</b>			
E2.1. Prevent Herding by Helicopter & Detonations	-	?	+
E2.2. Prevent Harm from Entangling	-	-	+
<b>E3. Generate Positive Public Image for Cause</b>			
E3.1. Maximize Favorable Media Coverage	+	+	+
E3.2. Generate Positive Public Sentiment	+	+	+
<b>E4. Improve Prestige of Special Interest Group</b>			
E4.1. Increase Financial Support	?	?	+
E4.2. Gain Support from Celebrity Spokespersons	+	?	+

# StarKist's "Strategic Planning" Objectives Hierarchy

Objectives Hierarchy	Decision Alternatives		
	Keep Status Quo	Reduce Dolphin Mortality	Go Dolphin Safe
<b>MAXIMIZE PROFIT</b>	?	?	+
<b>S1. Minimize Operational Changes and Restrictions</b>			
S1.1. Manage Profit-Related Changes	+	+	-
S1.1.1 Minimize Restrictions on Fishing Territory	+	+	-
S1.1.2 Maintain Yield	+	+	?
S1.2. Maintain Good Supplier Relations			
S1.2.1 Maintain Control over Distant Fleet	+	+	-
S1.2.2 Minimize Strain on Relations with Local Fleet	+	+	-
<b>S2. Maintain Firm Profitability</b>			
S2.1. Minimize Cost (closely related to S1.1.)	+	+	-
S2.2. Maintain Revenue Stream	?	?	+
S2.2.1. Hold Tuna Price Down	+	+	?
S2.2.2. Avoid Boycotts of Canned Tuna	-	-	+
<b>S3. Maintain Favorable Industry Competitive Position</b>			
S3.1. Remain Market Share Leader	?	?	+
S3.1.1. Hold Leadership Position	?	?	?
S3.1.2. Lead Industry on Pricing and Policy	?	?	+
S3.1.3. Hold Leadership-Related Brand Loyalty	?	?	+
S3.2. Capture "First-Mover" Advantages	-	?	+
S3.2.1. Set Industry Standard on Dolphin Policy	-	+	+
S3.2.2. Maximize Positive Media Coverage	-	-	+
S3.2.3. Maintain Profit Margin with Higher Price	-	?	+
<b>S4. Minimize Government Regulation</b>			
S4.1. Minimize Regulation-Induced Cost Increases	-	+	+
S4.2. Minimize Constraints on Managerial Discretion	-	?	+
S4.2.1. Avoid Compliance or Forced Reactive Mode	-	-	+
S4.2.2. Avoid Regulation-Related Bureaucracy	-	?	+
<b>S5. Improve Firm Reputation &amp; Public Perception</b>			
S5.1. Enhance Image of "Good Corporate Citizen"	-	?	+
S5.1.1. Maximize Goodwill	-	?	+
S5.2.2. Ensure Perceived Legitimacy (Firm & Industry)	-	?	+
S5.2. Avoid Negative Press	-	?	+
S5.3. Minimize Uncertainty from Regulation	?	?	+
<b>S6. Minimize Impact on Marine Life</b>			
S6.1. Minimize Short Term Impact	-	?	+

# StarKist's "Crisis Mode" Objectives Hierarchy

Objectives Hierarchy	Decision Alternatives		
	Keep Status Quo	Reduce Dolphin Mortality	Go Dolphin Safe
<b>ENSURE FIRM SURVIVAL</b>	-	?	+
<b>C1. Sustain Profitability</b>			
C1.1. Maintain Favorable Industry Competitive Position	-	+	?
C1.1.1 Maintain Viable Cost Structure	+	+	?
C1.1.2 Maintain Revenue Stream	-	?	+
C1.2. Ensure Technological and Operational Feasibility	+	+	?
<b>C2. Minimize Interference from Government Regulation</b>			
C2.1. Minimize Regulation-Induced Cost Increases	-	+	+
C2.2. Minimize Constraints on Managerial Discretion	-	?	+
<b>C3. Maintain Organizational Legitimacy</b>			
C3.1. Maintain Image as "Good Corporate Citizen"	-	?	+
C3.1.1. Maximize Environmental Citizenship Image	-	?	+
C3.1.2. Maximize Social Citizenship Image	-	?	+
C3.2. Minimize Negative Perception at Critical Events	-	-	+
C3.2.1. Minimize Negative Environmental Perception	-	-	+
C3.2.2. Minimize Perception of Negative Social Impact	-	?	?

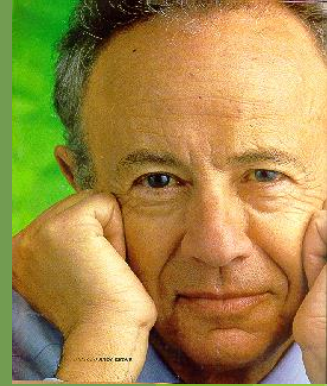
# Aiding Decision Making Using Objectives Hierarchies

## LA Unified desegregation plans

- main objectives included community acceptance, racial-ethnic composition
- 151 attributes at bottom of hierarchy of objectives
- desegregation plans evaluated by weighted average of scores on all attributes
- constitutionality left out of model

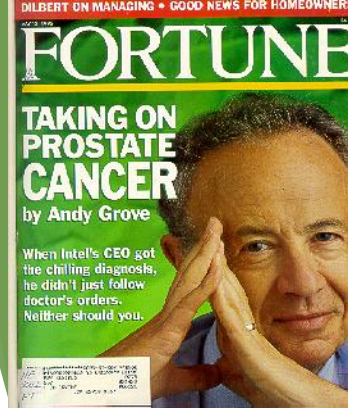
Capital Budgeting for hospitals (<http://www.strata-decision.com/>)

# Andy Grove's Prostate Cancer



- ▶ In the fall of 1994, Andy Grove- the former CEO of Intel- was faced with a difficult problem to solve. Initially, he was presented with an abnormal screening PSA (Prostate Specific Antigen) test that could represent the presence of cancer. His first reaction was to ask what to do with that information. At this point, he may or may not have had cancer.
- ▶ So, to better define if there was a required decision, he chose to gather further information. Some basic facts he obtained gave him a first understanding of the probabilities and outcomes he might face, finding that 200,000 men were diagnosed with prostate cancer in 1994 and that 38,000 would be expected to die, making prostate cancer the second leading cause of cancer deaths in men.
- ▶ Since his PSA result was just over the upper limit of normal, he elected to repeat the test in early 1995 in case his results were within the error margin of the test. The results suggested more strongly the presence of a tumor and he visualized a sugar-cube-sized tumor in his prostate. These tests results convinced him of the need to see the urologist for a biopsy to define if the test result was a true positive or a false positive.

# Andy Grove's Prostate Cancer



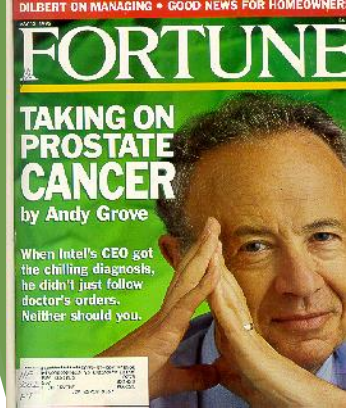
- ▶ The biopsy results indicated his PSA result was a true positive.
- ▶ He did have prostate cancer.
- ▶ This led to the formulation of his decision problem.
- ▶ What type of treatment should Mr. Grove pursue for treatment of his prostate cancer? There appeared to be four main decision alternatives. One option was to have the tumor and prostate gland surgically removed. This alternative can increase the survival rate and decrease the recurrence rate as well, however it will lead to a greater chance of being impotent after the surgery. Another alternative was to receive radiation treatments in the form of “seed” implantation to destroy the cancer cells. This option can increase the survival rate, but it also has serious side effects. A third alternative was cryosurgery, or freezing the tumor cells. Regarding this option, there was not enough information available to make an informed decision. The last option was to do nothing, taking the “wait and see” approach, which also carried much risk of losing his life if the cancer grew very quickly.
- ▶ Apparently, none of these alternatives was perfect. Furthermore, several other stakeholders were also very concerned with Andy Grove's situation. Andy's dilemma will be modeled as a multi-stakeholder decision problem. Those stakeholders are: **Andy Grove, Urologist, Oncologist, Andy's Family/Wife and Andy's Company - Intel.**

This case was written by L. Robin Keller and Tianjun Feng, of the UCI MSB, building upon the article by Andy Grove published in Fortune (1996), several case study reports by UCI HCEMBA students: L. Jeff Koh, Kenneth Rich, Suehei Lee, H. Ena Leo and others. See *TAKING ON PROSTATE CANCER by Andy Grove with reporter associate Bethany McLean*,

FORTUNE, May 13, 1996.

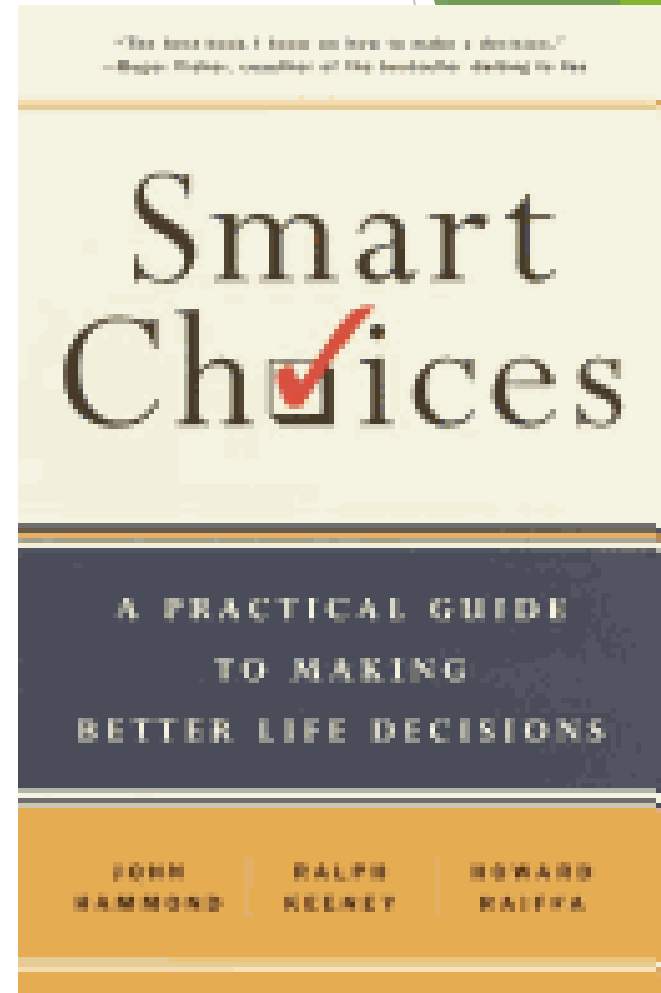
# Andy Grove's Prostate Cancer

- ▶ Divide into 5 groups.
- ▶ For your stakeholder group, use colored pens to rate each alternative on each objective, like in the StarKist case.
- ▶ Turn in one spreadsheet with your answers.



# The Structure of “Smart Choices”

- ▶ Problem
- ▶ Objectives
- ▶ Alternatives
- ▶ Consequences
- ▶ Tradeoffs



# Work on the Right Problem:

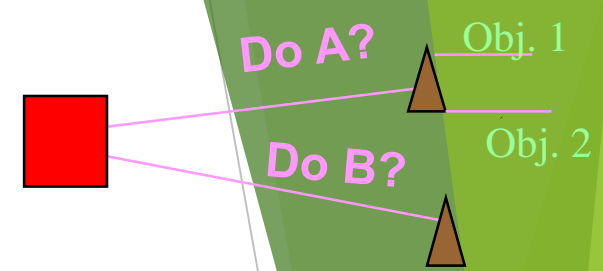


Do A?

Do B?

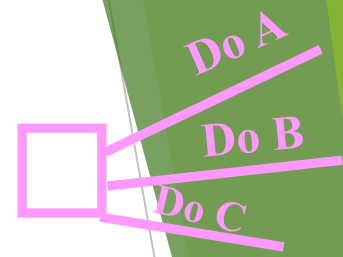
- ▶ The way you frame the **problem** determines how you find a solution
  - ▶ Which bookkeeping software should we use? OR
  - ▶ How should we keep our books?
- ▶ Be flexible, “play” with the **problem**, talk to others, seek advice
- ▶ Include all major stakeholders to create “buy-in”
- ▶ Working on the wrong **problem** is one of the main reasons why a decision analysis is not implemented

# Specify Your Objectives



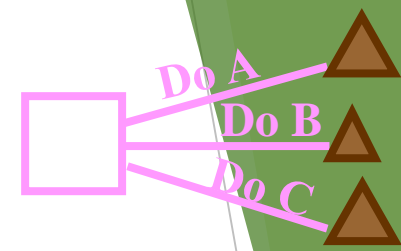
- ▶ A decision is a means to an end
- ▶ **Objectives** play a central role (“value-focused thinking”)
  - ▶ If you don’t care, you don’t have a problem
  - ▶ If you don’t know where you’re going, you might end up somewhere else
- ▶ **Objectives** guide all phases of the decision making process (including what information to seek and what other people to involve)
- ▶ Be creative and think without constraints

# Create Good Alternatives



- ▶ No decision can be better than the best **alternative**
- ▶ Use your **objectives** to create **alternatives**
- ▶ Don't get stuck with "obvious" **alternatives** (they might be obvious, but they might fall short of being the best)
- ▶ Look for combinations of **alternatives** (think win-win)

# Understand the Consequences

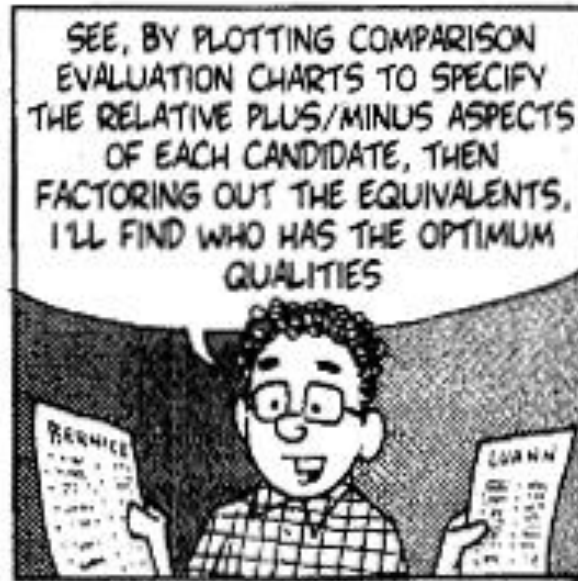


- ▶ Knowing where you want to go (**objectives**) and having means to get there (**alternatives**) allows you to describe and understand your destinations
- ▶ Lay out all **consequences** in a spreadsheet that describes how each **alternative** performs on each **objective**
- ▶ Study the **consequences**, they might help you consider more **objectives** and create more **alternatives**

# Grapple With Your Tradeoffs

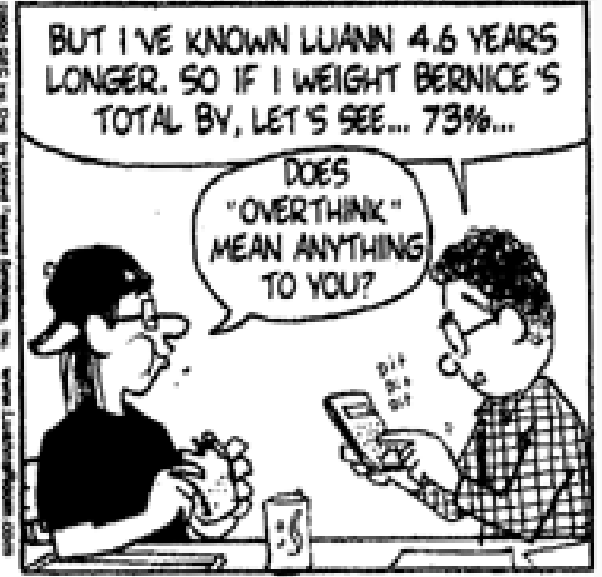
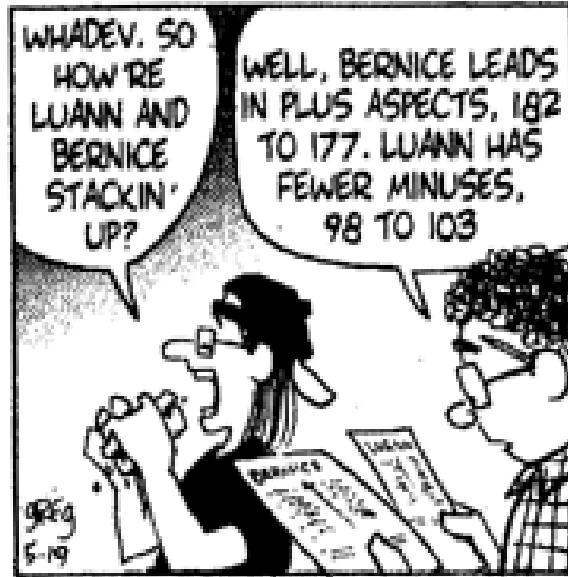
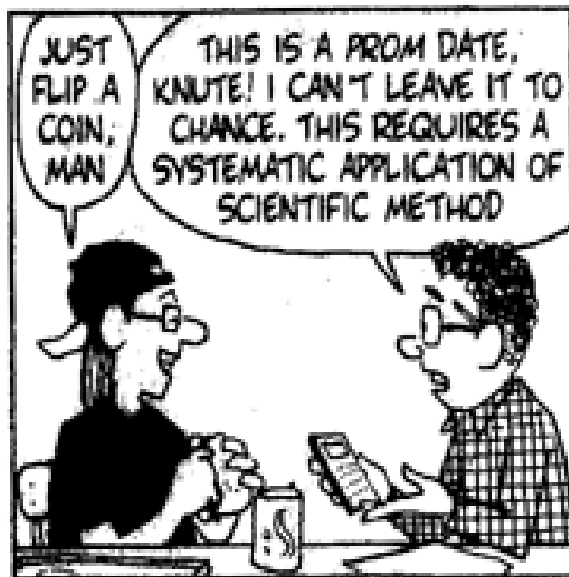
- ▶ Usually no one alternative outperforms all others on each objective
- ▶ Finding the best (albeit not perfect) alternative requires tradeoffs
- ▶ **Tradeoffs** depend on how you prioritize your objectives
- ▶ You can make these **tradeoffs** by **weighting objectives** by their importance

**LUANN** By GREG EVANS



OC Register 5-17-04

**LUANN** By GREG EVANS



# ProACT Now!!

- ▶ Take control by making good decisions
- ▶ Think about what matters most to you
- ▶ Run through the steps of making “Smart Choices” and concentrate on the key elements
- ▶ Be proactive and look for opportunities
- ▶ Don't be afraid to make decisions; if you don't make them, somebody else will ...

# Your Own Decisions

- ▶ You are encouraged to keep a personal “journal” to reflect and elaborate on how you might apply decision analysis in your own life.
- ▶ (Smart Choices, Chapter 11, gives suggestions for doing this “tune up” of your decision making process.)

# Your Own Decisions

<b>List 5 decisions you faced in the past.</b>	<b>1.</b>	<b>2.</b>	<b>3.</b>	<b>4.</b>	<b>5.</b>
<b>How did you make each decision?</b>					
<b>Did you experience a good outcome?</b>	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No
<b>Did you use a good decision process?</b>	Yes/No	Yes/No	Yes/No	Yes/No	Yes/No

List 10 professional or personal decisions you will face in the near future.

<b>Future decisions</b>	<b>Stakeholders</b>
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	



# Value-focused Thinking

- ▶ Consider each of your objectives separately. Generate alternative actions which will help you meet each objective.
- ▶ Then evaluate how well each alternative meets all your objectives simultaneously.

# Keep Your Own Decision Journal

- ▶ List uncertain events which could affect you and may occur in the next year, 5 years, 10 years, and 20 years. Identify “key” uncertain events that would have a large difference in the impact on you if the event occurs or doesn’t occur.
- ▶ Assess the probabilities of the “key” uncertain events you assessed. Draw decision trees if they help you.
- ▶ Choose a few planning situations you face often enough to benefit from thinking about them beforehand (i.e., planning vacations, deciding where to live, meeting new friends/colleagues,...). For each type of situation, generate your hierarchy of objectives.
- ▶ For the planning situations, think about your objectives and generate creative actions which will meet your objectives in a novel way.
- ▶ Having spent time thinking about your objectives, uncertain events, and alternatives, create a process for yourself to prompt you to keep making “smart choices.”

# Reference and sources

1. Critical Thinking and Problem Solving: Advanced Strategies and Reasoning Skills to Increase Your Decision Making. A System... by Carl Patterson, Chris del Camino
2. Critical Thinking and Problem Solving: Advanced Strategies and Reasoning Skills to Increase Your Decision Making. A Systematic Approach to Master Logic, Avoid Mistakes and Be a Creative Problem Solver by Carl Patterson, Chris del Camino
3. Thinking Skills: Critical Thinking and Problem Solving by John Butterworth and Geoff Thwaites | Apr 18, 2013
4. Critical Thinking: How to Improve Your Critical Thinking Skills, Problem Solving Skills, and Avoid the 25 Cognitive Biases in Decision-Making by Scott Lovell and Timothy Burke
5. Beginners Guide to Critical Thinking and Problem Solving: Become a Better Critical Thinker & Problem Solver, by Using Secret Tools & Techniques that Will .! by Pamela Hughes, Samantha Novak, et al.
6. Understanding A3 Thinking: A Critical Component of Toyota's PDCA Management System by Durward K. Sobek II and Art Smalley | Mar 7, 2008