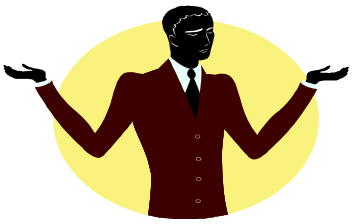
Systems Thinking and Beyond

Module 5: Decisions and decision making: Session 2 of 2

Rev. 1.5.13

Topics

- ~~Uncertainties and risks~~
- ~~Decision traps~~
- ~~Subjective trade-off methods~~
- ~~Quantitative and qualitative decisions~~
- ~~Decision tree analysis~~
- ~~Indirect techniques~~
- **Selection criteria**
- Tabular methods and Multi-attribute Variable Analysis
- Value functions and utility curves
- Decision outcomes
- Exercises



Example : Lunar exploration

- Problem (create the situation)
  - "before this decade is out, of landing a man on the moon and returning him safely to the earth"
    - May 25, 1961

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- Problem (create the situation)
  - "before this decade is out, of landing a man on the moon and returning him safely to the earth"
    - May 25, 1961
  - Watch full 4-minute speech on YouTube
  - https://www.youtube.com/watch?v=GhgVZLrxiu0

Options

1. Single stage vehicle earth-moon-earth
   - Classic science fiction
2. Traditional exploration approach
   - Base stations along the way
   - Used in polar exploration
   - Low Earth orbit, lunar orbit
3. Throw away approach
   - Use and dispose along the way
4. Others

Solution selection criteria include …

- Number of men on the moon
  - Are spares needed, and what for?
  - Men or men and women?
- Amount of equipment and supplies
  - Air, food, etc. for how long
- Time of journey
  - Fast, slow
- Flexibility for other missions
  - Mars, asteroid exploration, science, manufacturing
- Use of resources
  - e.g. fuel, number of people supporting mission
- Development schedule
  - Can be perfect but if not ready in time would be useless

Types of solution selection criteria

- Cost
- Performance
- Urgency
  - Development time (Schedule)
- Effect of not having solution system
- User friendliness
  - Learning, operating
- Complexity
- Compatibility with existing systems
- Technology Availability Window of Opportunity (TAWOO) **in Module 8**

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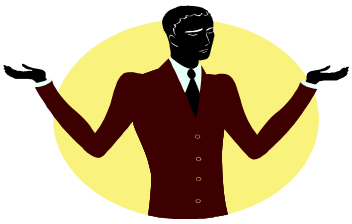

Multi-attribute Value Analysis (MVA)

- Based on constructing an *objective function* (equation) that combines the selection criteria taking into account
  - their relative importance and
  - the utility of solutions against the criteria
- MVA is one of many approaches with similar aims
- Uses utility curves when weighting of importance is not a constant
- Use spreadsheet or tool

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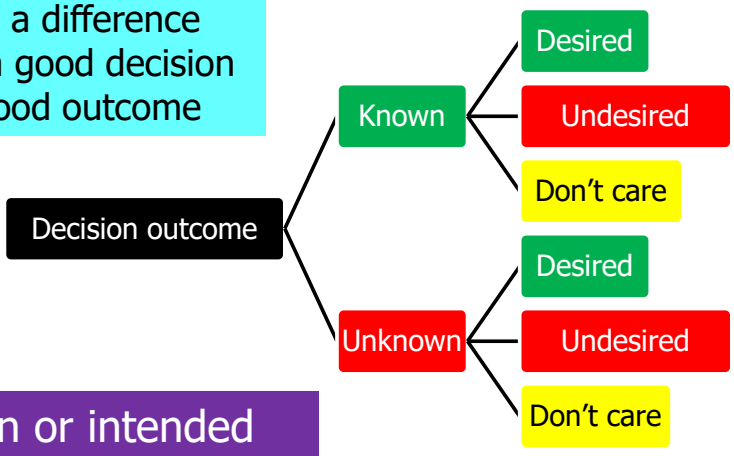
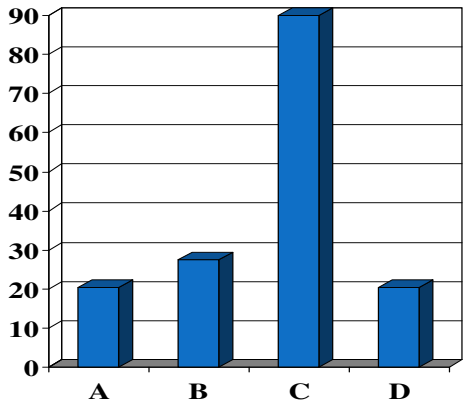
Decision outcomes *Continuum* HTP

There is a difference between a good decision and a good outcome



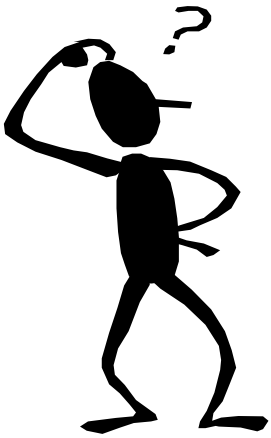
Known or intended
Unknown or unintended

Making the Decision (traditional)



- Identify desired alternatives
- Determine evaluation criteria
- Evaluate each alternative against criteria
  - Using decision making tool
- Make decision
- **Sensitivity analysis?**

It Depends



- Weighting can be subjective
- Results show difference in numbers
- Large differences
  - probably correct decision
- Small differences
  - **All are acceptable (Don't Care)**
  - Re-evaluate weightings
  - Sensitivity analysis
  - Try a different decision-making tool
- Use a spreadsheet or custom tool

Comments: selecting decision-making tools

- Qualitative and quantitative methods are used to select between options
- Quantitative methods are based on rich mathematical theory
- The many assumptions made can prove to be problematical
- MVA is widely used and is well accepted when used with care
- Use *Quantitative* HTP to think about which approach to use
- Use more than one if appropriate

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Exercise 5-21 introduction

- An Unmanned Aerial Vehicle (UAV) is to be selected for a mission

Exercise 5-21

1. An Unmanned Aerial Vehicle (UAV) is to be selected for a mission
2. Assume a mission
   - Reconnaissance, air defence, package delivery, communications relay, etc.
3. Add a new selection criterion in last row of next slide
4. Develop utility curves for criteria shown in next slide
5. Perform trade-off between the two candidates
6. Prepare <5 minute presentation covering
   1. This slide and the version number of the lesson
   2. The formulated problem according to the problem-formulation template
   3. Nature of mission
   4. =>3 of the utility curves and justification for shape of curve
   5. Candidate selection evaluation using relevant sections of template in next slide
   6. Lessons learned from exercise
   7. Formulated problem
   8. Compliance matrix
7. Save as a PowerPoint file as Exercise5-21-abcd.pptx
8. Post/email presentation as, when and where instructed

Candidate solutions

Criteria	Rank	Weight	W_1	A	B	UCW_A	UCW_B	A′	B′
Wing span (M)	n	w		1	3	u_a	u_b	u_aw	u_bw
Weight (Kg)				12	6				
Endurance (hours)				5	10				
Development schedule (months)				4	6				
Usability				Intuitive	1 day training				
Cost $X				100	50				
Ease of configuration between missions				Very hard	Nothing to it				
Team selected mission criterion									
TOTAL		100	1-10	N/A	N/A	N/A			

UCW: Utility Curve Weighting

Knowledge reading exercise 5-22

1. Prepare a brief on two main points in reading 0503 (< 5min)
2. Presentation to contain
    1. A summary of the content of the reading (<1 minute)
    2. The compliance matrix
    3. The problem formulated per the problem formulation template
    4. This slide and lesson version number
    5. A list of the main points
    6. The two briefings
    7. Reflections and comments on reading (<2 minute)
    8. Comparisons of content with other readings and external knowledge
    9. Why you think the reading was assigned to the module
    10. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise5-22-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Summary

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Meeting the objectives

1. Discussed the nature of, and made different types of decisions
2. Discussed and used different decision-making tools
3. Discussed evaluating decision making tools and determining the one most suitable for a decision
4. Made decisions
5. Discussed the nature of objective and subjective decision making

Any questions ?

1. Best
2. Worst
3. Missing

Email:
beyondsystemsthinking@yahoo.com
Subject: <class title> BWM Lesson #