

## Implementation of VIP Analysis for Decision Deck 1.1



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# Plan of the presentation

## Ø Introduction to VIP Analysis

- Ø Methodology
- Ø Original software implementation

## Ø The VIP Analysis plug-in for Decision Deck 1.1

- Ø Brief Introduction
- Ø Short demonstration

## Ø The implementation process

- Ø barriers to new implementers
- Ø possible solutions

## Ø Vip Analysis (D2 vs Delphi version)

# Introduction to VIP Analysis

# Introduction to VIP Analysis 1:

## What is VIP Analysis?

- ∅ VIP Analysis is an existing multicriteria DSS for choice problems
- ∅ based on additive utility (or value) functions

$$V(a_x) = k_1 \cdot v_1(a_x) + k_2 \cdot v_2(a_x) + \dots + k_n \cdot v_n(a_x)$$

- ∅ which accepts imprecise information on the scaling coefficients associated with the criteria, e.g., a ranking of these coefficients

$$k_1 \geq k_2 \geq \dots \geq k_n$$

- ∅ or any other linear constraints, including holistic comparisons of alternatives, trade-off bounds, etc. to define a domain  $T$  of acceptable parameter values.

- ∅ Rather than selecting the centroid  $(k_1, \dots, k_n)^*$  of  $T$ ...

- ∅ it computes the range of results compatible with that information, to look for conclusions that hold for every  $(k_1, \dots, k_n)^* \in T$  ("robust conclusions").

# Introduction to VIP Analysis 2:

## VIP Analysis Inputs

The screenshot displays the V.I.P. Analysis software interface. The main window is titled "V. I. P. Analysis - C:\LuisDias\VIP\ExampleTwo.ch.vip". The "Constraints" dialog box is open, showing a table of constraints for six criteria. A red circle highlights the "Constraints" tab in the main window, and a red arrow points from it to the dialog box.

| Crite | Crit1 | Crit2 | Crit3 | Crit4 | Crit5 | Crit6 | Impc |
|-------|-------|-------|-------|-------|-------|-------|------|
| a1    | 715   | 0.98  | 0.81  | 0.73  | 0.98  | 0.95  |      |
| a2    | 0.8   | 0.98  | 0.81  | 0.71  | 0.98  | 1     |      |
| a3    | 0.87  | 0.98  | 0.80  | 0.71  | 0.86  | 0.96  |      |
| a4    | 0.76  | 0.99  | 0.63  | 0.59  | 0.88  | 0.95  |      |
| a5    | 0.78  | 0.99  | 0.46  | 0.68  | 0.76  | 0.72  |      |
| a6    | 0.88  | 0.99  | 0.46  | 0.56  | 0.98  | 0.60  |      |
| a7    | 0.74  | 0.99  | 0.73  | 0.57  | 1     | 0.89  |      |
| a8    | 0.94  | 0.99  | 0.79  | 0.52  | 1     | 0.76  |      |
| a9    | 0.91  | 0.99  | 0.91  | 0.66  | 1     | 0.75  |      |

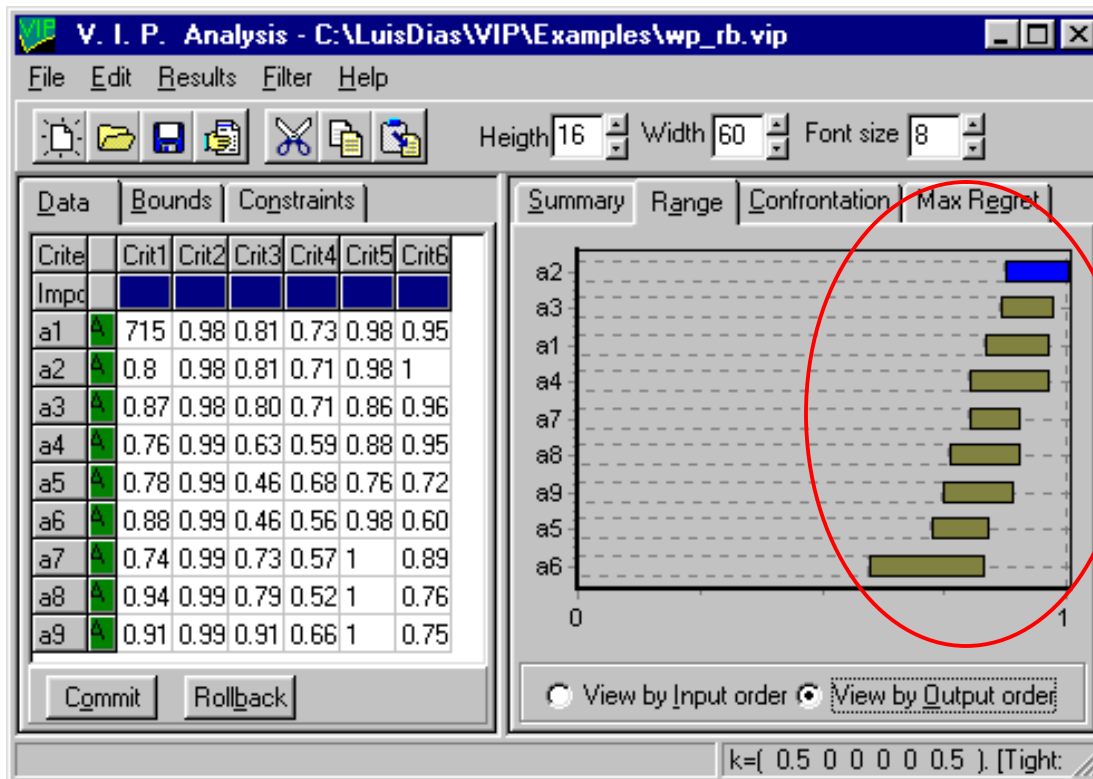
| Crit1 | Crit2 | Crit3 | Crit4 | Crit5 | Crit6 | <=,= | RHS |
|-------|-------|-------|-------|-------|-------|------|-----|
| 1     | 1     | 1     | 1     | 1     | 1     | =    | 1   |
| 1     |       |       |       |       | -1    | <=   | 0   |
| -1    | 1     |       |       |       |       | <=   | 0   |
|       | -1    |       | 1     |       |       | <=   | 0   |
|       |       |       | -1    | 1     |       | <=   | 0   |
|       |       | 1     |       | -1    |       | <=   | 0   |

# Introduction to VIP Analysis 3:

## VIP Analysis Outputs

Minimum/maximum value for each alternative.

$$\min \{V(a_x) : (k_1, \dots, k_n) \hat{I} T\}, \max \{V(a_x) : (k_1, \dots, k_n) \hat{I} T\}.$$



# Introduction to VIP Analysis 4:

## VIP Analysis Outputs

Maximum advantage of  $a_x$  over  $a_y$

$$M_{xy} = \max \{V(a_x) - V(a_y) : (k_1, \dots, k_n) \hat{I} T\}.$$

→ *Relative dominance*

(e.g.,  $a_1$  dominated by  $a_2$ )

→  $\max \{M_{xy} : y^1 x\} \leq 0 \Leftrightarrow$

$\Leftrightarrow a_y$  is "optimal"

|       | a1     | a2     | a3     | a4     | a6    | a7     | a8    |
|-------|--------|--------|--------|--------|-------|--------|-------|
| a1    |        | -0.018 | -0.004 | 0.061  | 0.357 | 0.06   | 0.196 |
| a2    | 0.064  |        | 0.032  | 0.08   | 0.4   | 0.102  | 0.239 |
| a3    | 0.085  | 0.021  |        | 0.065  | 0.368 | 0.103  | 0.207 |
| a4    | 0.024  | -0.024 | -0.008 |        | 0.359 | 0.062  | 0.198 |
| a6    | -0.06  | -0.091 | -0.076 | -0.033 |       | -0.036 | -0.04 |
| a7    | -0.009 | -0.051 | -0.04  | 0.021  | 0.297 |        | 0.136 |
| a8    | 0.017  | -0.031 | -0.032 | 0.033  | 0.161 | 0.034  |       |
| Max F | 0.085  | 0.021  | 0.032  | 0.08   | 0.4   | 0.103  | 0.239 |

Tolerance

# Introduction to VIP Analysis 5:

## VIP Analysis Outputs

Tolerances w.r.t. maximum advantage of  $a_x$  over  $a_y$ .

→  $\Delta_\varepsilon$  : Quasi-dominance  
(e.g.,  $a_2 \Delta_{0.025} a_3$ )

→  $\max \{M_{xy} : y^1 x\} \notin e \Leftrightarrow$   
 $\Leftrightarrow a_y$  is “quasi-optimal”

|       | a1     | a2     | a3     | a4     | a6    | a7     | a8    |
|-------|--------|--------|--------|--------|-------|--------|-------|
| a1    |        | -0.018 | -0.004 | 0.061  | 0.357 | 0.06   | 0.196 |
| a2    | 0.064  |        | 0.032  | 0.08   | 0.4   | 0.102  | 0.239 |
| a3    | 0.085  | 0.021  |        | 0.065  | 0.368 | 0.103  | 0.207 |
| a4    | 0.024  | -0.024 | -0.008 |        | 0.359 | 0.062  | 0.198 |
| a6    | -0.06  | -0.091 | -0.076 | -0.033 |       | -0.036 | -0.04 |
| a7    | -0.009 | -0.051 | -0.04  | 0.021  | 0.297 |        | 0.136 |
| a8    | 0.017  | -0.031 | -0.032 | 0.033  | 0.161 | 0.034  |       |
| Max F | 0.085  | 0.021  | 0.032  | 0.08   | 0.4   | 0.103  | 0.239 |

Tolerance:  x11

Tolerance: Current=0.025, Maximum=0.1

# Introduction to VIP Analysis 6:

## VIP Analysis use

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- ∅ Robust conclusions:
  - ∅ allow DMs to eliminate (quasi-) dominated alternatives,
  - ∅ and perhaps select a (quasi-) optimal one.
- ∅ Information on variability of results:
  - ∅ to know which alternatives are more affected by imprecision,
  - ∅ to guide the elicitation of further information,
  - ∅ to suggest further constraints on T.
- ∅ Therefore, allows DMs to learn about the model and the problem,
- ∅ and to postpone elicitation questions they find difficult

# Introduction to VIP Analysis 7:

## VIP Analysis Software

- Ø Programmed in Borland Delphi in the late 1990s for Windows
- Ø Distributed as a freeware (without sources) to those who request it
- Ø requested by 150+ users from several countries, besides Portugal: Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China & Taiwan, Colombia, Costa Rica, Cuba, Czech Rep., Ecuador, Egypt, Finland, France, Greece, Hungary, Indonesia, Iran, Italia, Japan, Lithuania, Malaysia, Maroc, The Netherlands, New Zealand, Poland, Rumania, Russia, Slovenia, Spain, Switzerland, UK, USA, Venezuela and Vietnam.

### Ø References:

Dias, L. C. and J. N. Clímaco, Additive Aggregation with Variable Interdependent Parameters: the VIP Analysis Software, *Journal of the Operational Research Society* 51 (9), 1070-1082, 2000.

Extension: Dias, L.C., J.N. Clímaco, Dealing with imprecise information in group multicriteria decisions: A methodology and a GDSS architecture, *European Journal of Operational Research* 160 (2), 291-307, 2005.

<http://www4.fe.uc.pt/lmcdias/english/vipa.htm>

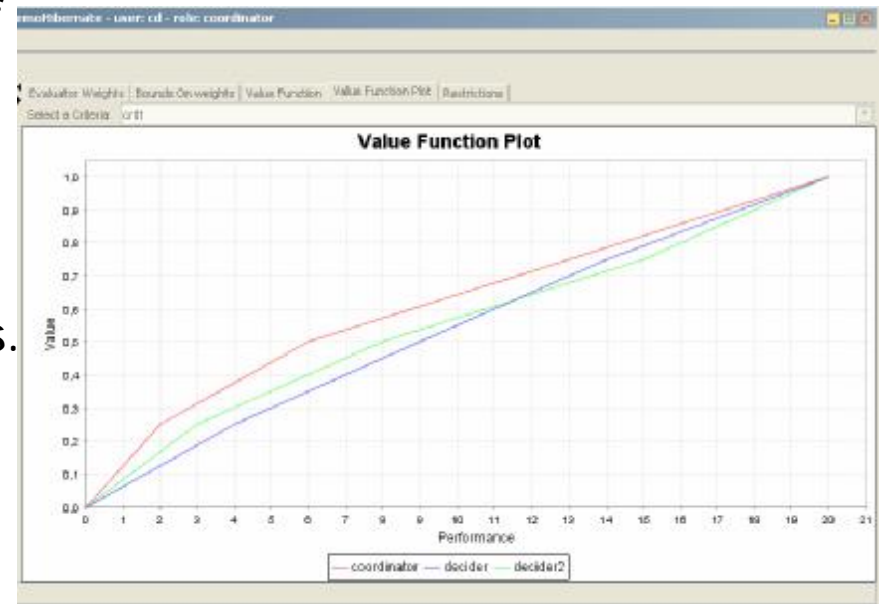
# The VIP Analysis plug-in for Decision Deck 1.1

(evolution of v1.0 to Hibernate)

# Brief Introduction 1:

## User roles: Coordinator, Evaluator, DM

- ∅ The Coordinator role encompasses the roles of Administrator, Alternatives designer, and Criteria designer.
  - ∅ As a Coordinator, the user can create a new problem, setting the problem's name, the names of the alternatives, and the names of the criteria, besides defining who are the other users and their roles.
  - ∅ A Coordinator can define the shape of value functions or allow the DMs to define their individual value functions.
  - ∅ A Coordinator can define weights for the evaluators or allow the DMs to define their individual evaluator weights.
- ⇒ the Coordinator can ensure that all DMs work with the same value scales and performances.



# Brief Introduction 2:

## User roles: Coordinator, Evaluator, DM

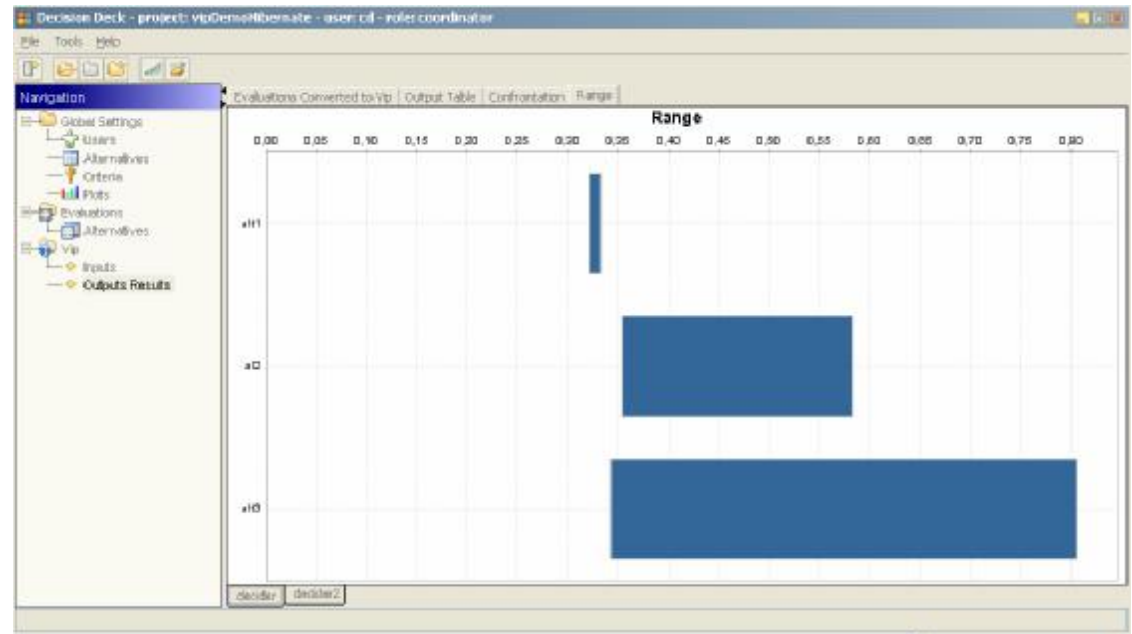
- ∅ as an Evaluator, the user can only indicate the performance of the each alternative on different criteria, according to his or her expertise.
- ∅ Since not all evaluators are supposed to be experts for all the evaluation criteria, an evaluator can leave the evaluations of the alternatives void on some criteria.
- ∅ A virtual evaluator is defined by a weighted average, using weights (set by the Coordinator or a DM) reflecting different degrees of confidence in the evaluations.



# Brief Introduction 3:

## User roles: Coordinator, Evaluator, DM

- ∅ as a DM, the user can specify value functions (if the Coordinator allows)
- ∅ and can also specify weights for the evaluators (again, if the Coordinator allows).
- ∅ The DM is the only role that can specify the method's preference-related parameters, i.e. the scaling weights  $(w_1, \dots, w_n)$  and/or constraints.
- ∅ Can compute outputs.
- ∅ Can submit outputs.



# Demonstration

# Implementation 1:

## Implementations barriers found:

### ∅ Learning process

- ∅ poor documentation
- ∅ complex Architecture
  - ∅ trying to fully understand it = wrong approach
- ∅ physical distance to core development team
- ∅ Weighted Sum plugin tutorial inadequate
  - ∅ plugin of poor complexity
  - ∅ tutorial like a recipe, lack of explanation
- ∅ Migration to Hibernate much more complex than what was described on website
  - ∅ previous meeting with G. Dodinet was a key factor for a successful migration

### ∅ D2 architecture

- ∅ 2 tiers
  - ∅ problems with concurrency and change control
  - ∅ Criteria Min-Max change example

# Implementation 2:

## Possible Solutions:

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### ∅ Develop quality documentation for Iris Plugin

#### ∅ D2 core too complex to document

- ∅ developers don't need to understand full architecture

- ∅ exception for some high and low level architecture diagrams

#### ∅ Iris has higher complexity than weighted sum

- ∅ good guide on how to interact with d2 core

#### ∅ guides a future developer through the correct path

#### ∅ future architecture upgrades easily demonstrated

- ∅ new interactions with D2 core easily shown

# VIP Analysis

(D2 Version Vs Delphi Version)

# Software Comparison:

## Gains and losses

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- + Distributed and concurrent access over a network
- + Different user roles
- + Specification of value functions by coordinator or DMs
- + Open source philosophy
- + Integration with other methods in D<sup>2</sup> within a coherent interface
- Installation requirements and procedure
- Some of the original functionalities were abandoned (but of little use)
- Saving, exporting, or importing data (but could be programmed)

# Software Comparison:

## Future

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- D2 makes sense in multi-actor settings
- Currently difficult to use as a GDSS: lack of communication and awareness mechanisms (Who is logged in? What are they doing? Why? What happened since I last logged out?, ...)
- Ø Web services for coordination
  - Ø bonus: browser-based interfacing
- Ø Traceability could also play an important role