MULTICRITERIA DECISION MAKING

Business Decision Making

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THE **STRUCTURE**

Context

1. The context of the topic
   A. Multi-criteria decision making (MCDM)
   B. SAW – simple additive weighting

Basics

2. Foundations of the pairwise comparisons method
   A. Saaty scale
   B. Transitivity concept

Procedure

3. Pairwise comparisons procedure
   A. Calculating the weights/priorities
   B. Calcualting the inconsistency in giving judgements

Usage

4. Using the PC procedure
   A. Methods
   B. Applications

THE **CONTEXT** OF THE TOPIC

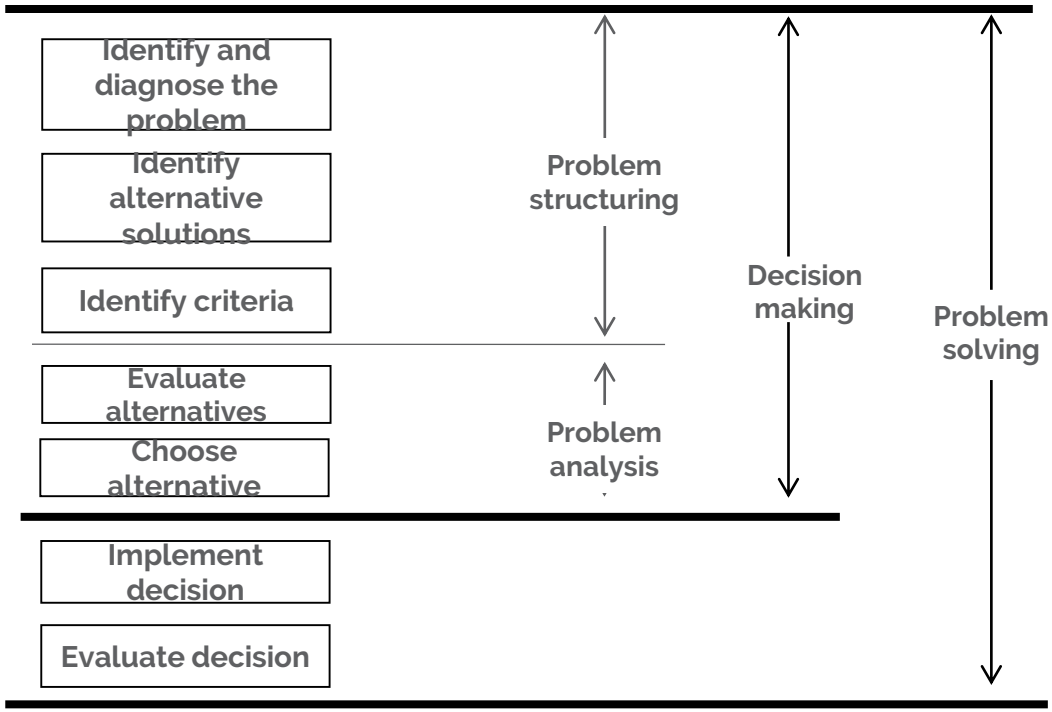
Context

Basics

Procedure

Usage

- PrOACT approach: decomposition od DM problem into elements
  - **Basic elements**: **Pr**oblem, **O**bjectives (criteria, attributes), **A**lternatives, **C**onsequences and **T**radeoffs
  - **Elements for decision making in turbulent environment**: Risk tolerance, Uncertainty, Linked decisions



THE **CONTEXT** OF THE TOPIC

Context

Basics

Procedure

Usage

- Two decision-making methods groups
  - Methods that support **multicriteria decision making** (basic PrOACT elements)
  - Methods that support **decision making under uncertainty and risk** (PrOACT elements for decision making in turbulent environment)
- Multi-criteria decision-making (MCDM)
  - Decomposition of the main decision-making goal into several sub goals that are described with criteria (attributes)
  - The MCDM problems can be easily described by using the table od values (matrix of decision-making)
  - Alternatives (3), Criteria (3), Consequences/Values (9)

	Education	Experience	CV
Candidate 1	High	5 years	5
Candidate 2	Secondary s	0 years	6
Candidate 3	Secondary s.	2 years	7

THE **CONTEXT** OF THE TOPIC

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- Two decision-making methods groups
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THE **CONTEXT** OF THE TOPIC

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Usage

- Multi**criteria** decision making is … about criteria
- Criteria = attributes
- Types of the criteria:
  - Qualitative (words): color, design, …
  - Quantitative (numbers): price, weights, height … two subtypes:
    - Min criteria (criteria of costs): price (when we buy), fuel consumption, …
    - Max criteria (criteria of benefits): price (when we sell), quality, …
- Types of the criteria 2:
  - Natural – price, consumption, …
  - Constructed scale – measuring the properties on some scale
  - Proxy criteria – quality of life is measured with GDP

THE **CONTEXT** OF THE TOPIC

Context

Basics

Procedure

Usage

- Multi-criteria decision making

	Time	Cost	Satisf.
Make	100	50	High
Buy	10	150	High
SQ	0	0	OK

	Time	Cost	Satisf.	TP
M				
B				
SQ				

- **Table of decision making**: alternatives, criteria and consequences
- **Methods**: Evenswaps, Electra, Promethee, Topsis, AHP, ANP, **SAW**, Dex method, VIKOR, WINGS, SNAP…
- The **results**:
  - Criteria weights
  - Local priorities of the alternatives per each criterion
  - Total priorities of the alternative – DECISION!

THE **CONTEXT** OF THE TOPIC

Context

Basics

Procedure

Usage

- Simple additive weighting (SAW)

	Time	Cost	Satisf.
Make	100	50	High
Buy	10	150	High
SQ	0	0	OK

	Time	Cost	Satisf.	TP
M				
B				
SQ				

- Criteria weights … 5 procedures
- Local priorities of the alternatives per each criterion … 7 procedures
- Total priorities of the alternative – DECISION!

$$s_i = w_1 r_{i1} + w_2 r_{i2} + \ldots + w_m r_{im} = \sum_{k=1}^{m} w_k r_{ik}$$

THE **BASIC FOUNDATIONS** OF THE TOPIC

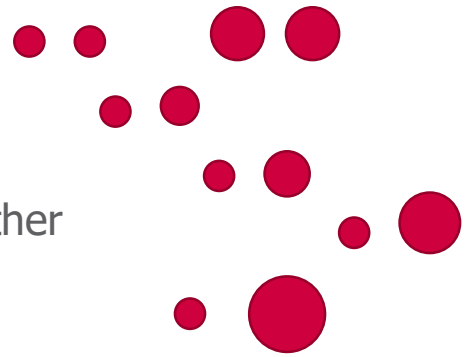
Context

Basics

Procedure

Usage

- **Saaty's scale**
- Founder: prof. Thomas Saaty
- It describes the relation between two elements
- Values of the scale:
  - 1 = Two elements are equally important
  - 3 = Weak importance of one element over another
  - 5 = Strong importance of one element over another
  - 7 = Demonstrated importance of one element over another
  - 9 = Absolute importance of one element over another
  - All real values from scale [1;9] can be used
  - Reciprocal values are used when a certain element is dominated by another element



THE **BASIC FOUNDATIONS** OF THE TOPIC

Context

Basics

Procedure

Usage

- **Transitivity concept (math)**

Donald

Boris

Zuzzana

$$(D > B \quad \wedge \quad B > Z) \quad \Rightarrow \quad D > Z$$

THE **BASIC FOUNDATIONS** OF THE TOPIC

Context

Basics

Procedure

Usage

- **Transitivity concept (math) + Saaty's scale**

Donald

Boris

Zuzzana

$$(D >_3 B \quad \wedge \quad B >_2 Z) \quad \Rightarrow \quad D >_5 Z$$

IN/CONSISTENCY

THE **PAIRWISE COMPARISON** PROCEDURE

Context
Basics
Procedure
Usage

- Calcualting the criteria weights

	Time	Cost	Satisf.
Make	100	50	High
Buy	10	150	High
SQ	0	0	OK

	Time	Cost	Satisf.	TP
	0.43	0.43	0.14	
M				
B				
SQ				

	T	C	S
T	1	1	3
C	1	1	3
S	1/3	1/3	1
SUM	2.3	2.3	7

0.43	0.43	0.43	0.43
0.43	0.43	0.43	0.43
0.14	0.14	0.14	0.14

IN/CONSISTENCY

Input: PC matrix
Output: CR

CR<0.1

Additional reading

THE **PAIRWISE COMPARISON** PROCEDURE

Context

Basics

Procedure

Usage

- Calculate the alternatives' priorities (for each column)

	Time	Cost	Satisf.
Make	100	50	High
Buy	10	150	High
SQ	0	0	OK

	Time	Cost	Satisf.	TP
	0.43	0.43	0.14	
M				
B				
SQ				

Repeat the procedure three times – 3 columns of local priorities!

THE **PAIRWISE COMPARISON** PROCEDURE

- Agretating the criteria weights and local priorities in SAw

	Time	Cost	Satisf.
Make	100	50	High
Buy	10	150	High
SQ	0	0	OK

	Time	Cost	Satisf.	TP
	0.43	0.43	0.14	
M	0.1	0.2	0.4	0.19
B	0.3	0.1	0.4	0.22
SQ	0.6	0.7	0.2	0.59

Calculating the total priorities: $s_i = w_1 r_{i1} + w_2 r_{i2} + \ldots + w_m r_{im} = \sum_{k=1}^{m} w_k r_{ik}$

THE **USAGE** OF THE PAIRWISE COMPARISONS P

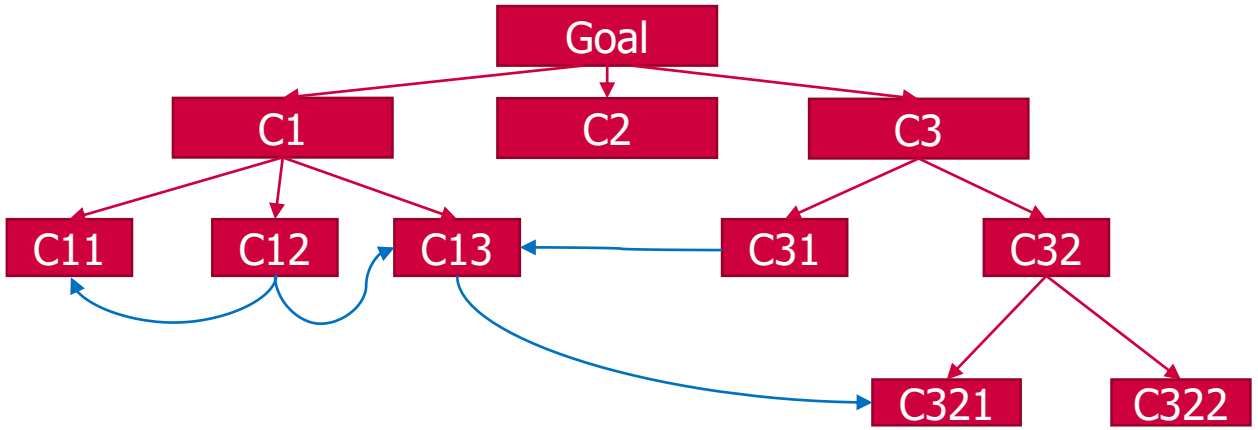
Context

Basics

Procedure

Usage

- **Methods**
  - **SIMPLE ADDITIVE WEIGHTING (SAW)**
  - **ANALYTIC HIERARCHY PROCESS (AHP)**
  - **ANALYTIC NETWORK PROCESS (ANP)**



THE **USAGE** OF THE PAIRWISE COMPARISONS P

Context

Basics

Procedure

Usage

- **Applications**
  - **Ranking the hospitals in Croatia**
  - **Planning the traffic in Croatia**
  - **Smooth vehicular flow and safe pedestrian crossing separately (Sri Lanka)**
  - **Garage-parking Facility Location Selection in Croatia**
  - **Planning the traffic safety in Turkey**
  - **Selecting the flight procedure design schemes in China**
  - **Prioritisation of the safety control criteria in maritime traffic**
  - **Evaluation Framework for Key Performance Indicators of Railway ITS**
  - **…**

LET'S **DISCUSS**

- Go to pollev.com/nikolakadoic424/
- Write your (nick)name

ASSIGNMENT

- 2 persons in group
- Choose any MCDM problem you want (4 criteria, 3 alternatives)
  - Make a decision-making table (table of alternatives, criteria and consequences/values)
  - Calculate the criteria weights using the PC procedure
  - Calculate the local priorities of the alternatives using the PC procedure
  - Calculate the total priorities of the alternatives
  - Make final qualitative analysis: are the criteria weights and total priorities as expected?


THANK YOU
FOR YOUR ATTENTION
ANY DOUBT
CONSULT GOOGLE