

A performance aggregation model for choosing a set of actions in a PETRA industrial improvement approach

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Summary

1. Industrial context

2. Problem

3. Case study

4. Conclusion

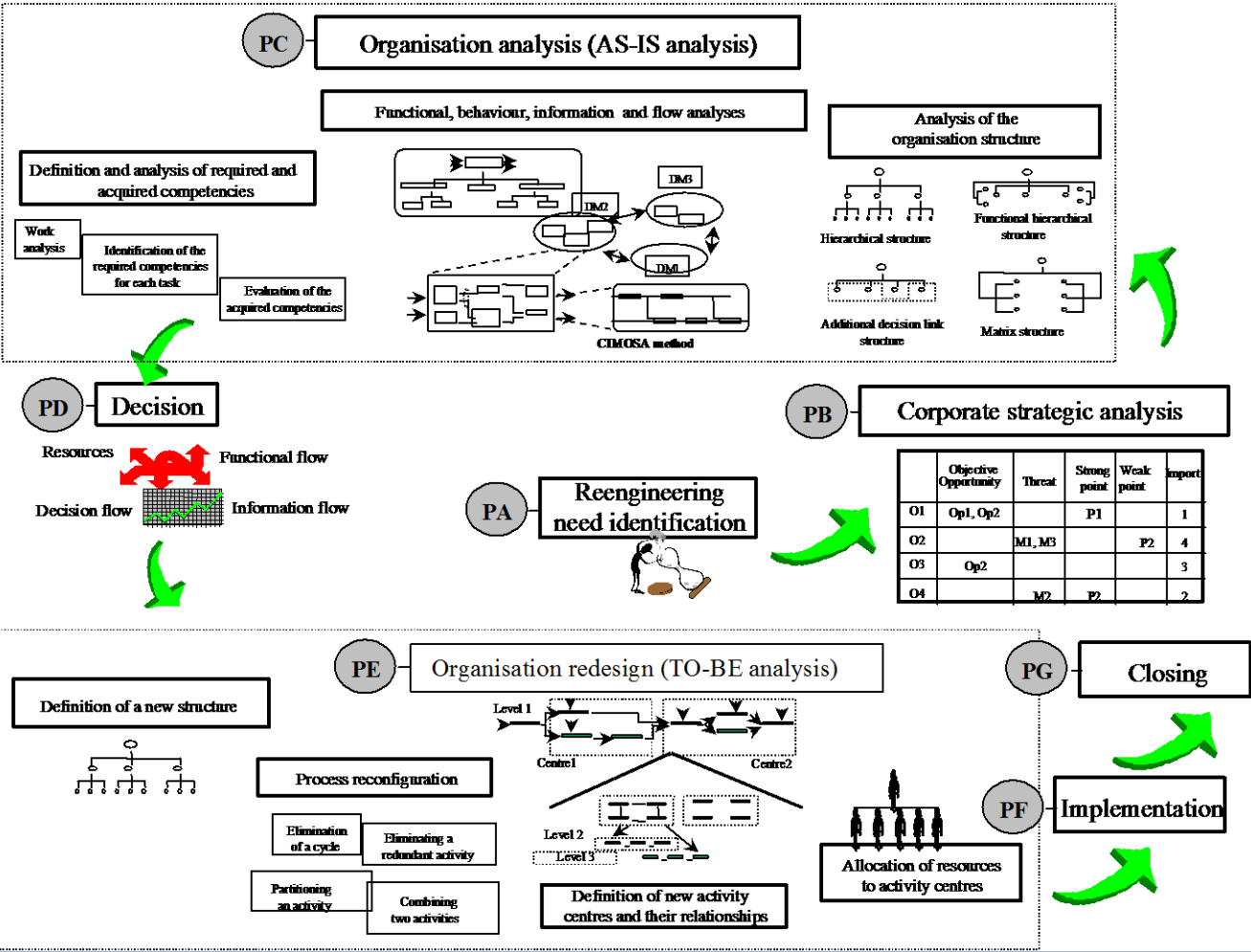
Post-taylorian context

Industrial performance is multi-level and multi-criteria

Improvement actions are various and uncertain

- Need for methodological framework for continuous improvement (PDCA)
- Need for decision support tools to develop continuous improvement strategies

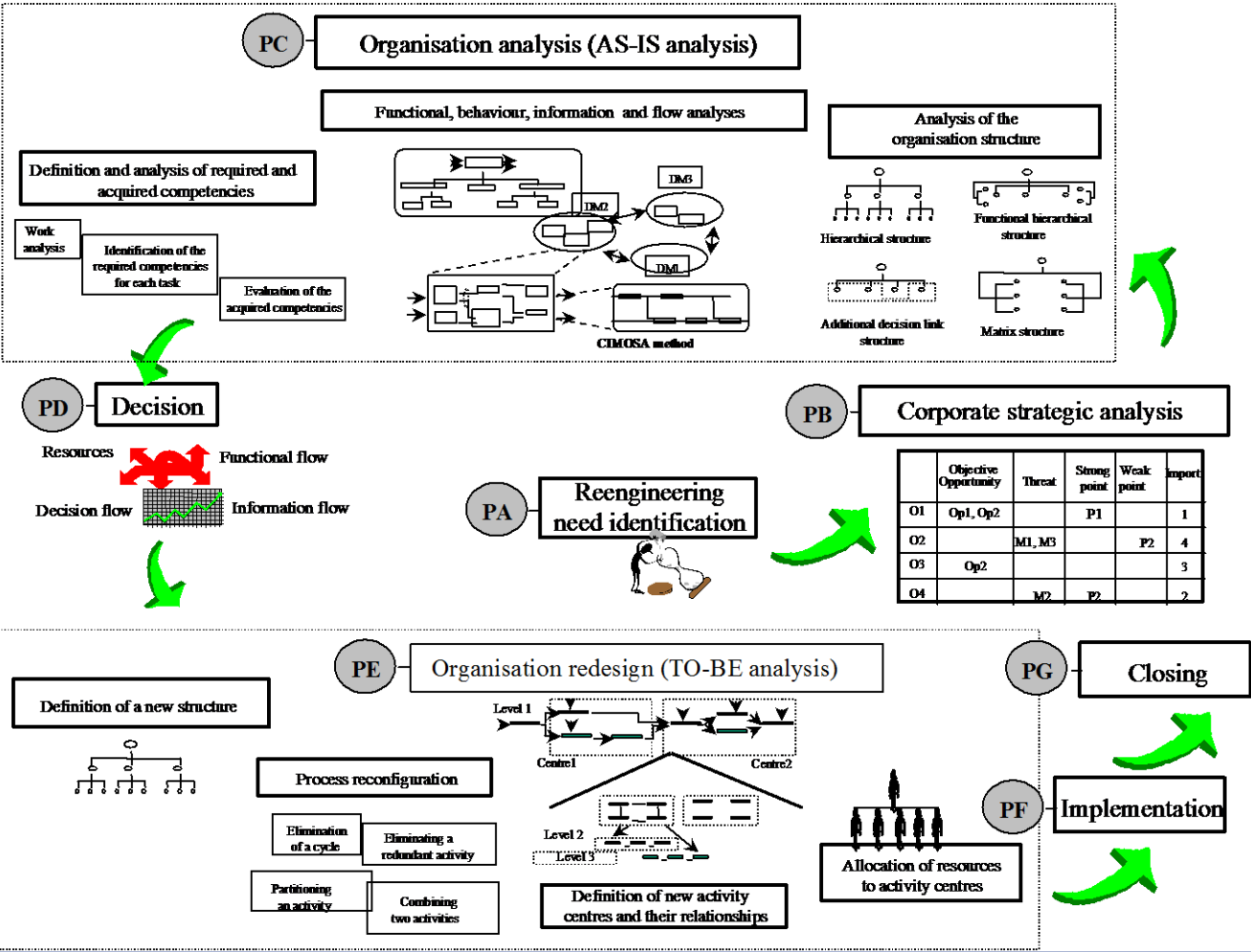
PETRA (LGIPM LISTIC 2000)



Performance Measurement System

- Set of performance expressions to be consistently organised with respect to the company objectives,
- Set of actions having an impact on the performance expressions
 - How to explain a (bad) overall performance, through the elementary ones?
 - Which (set of) action(s) to launch to achieve the expected improvements?

PETRA (LGIPM LISTIC 2000)



Decision in continuous improvement

- Diagnosis of the overall unsatisfactory performance
 - Opportunity choice
 - Diagnosis refinement according to the different points of view
 - Action choice
 - Action implementation control (possibly revision)
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Requirements for PMS in CIP

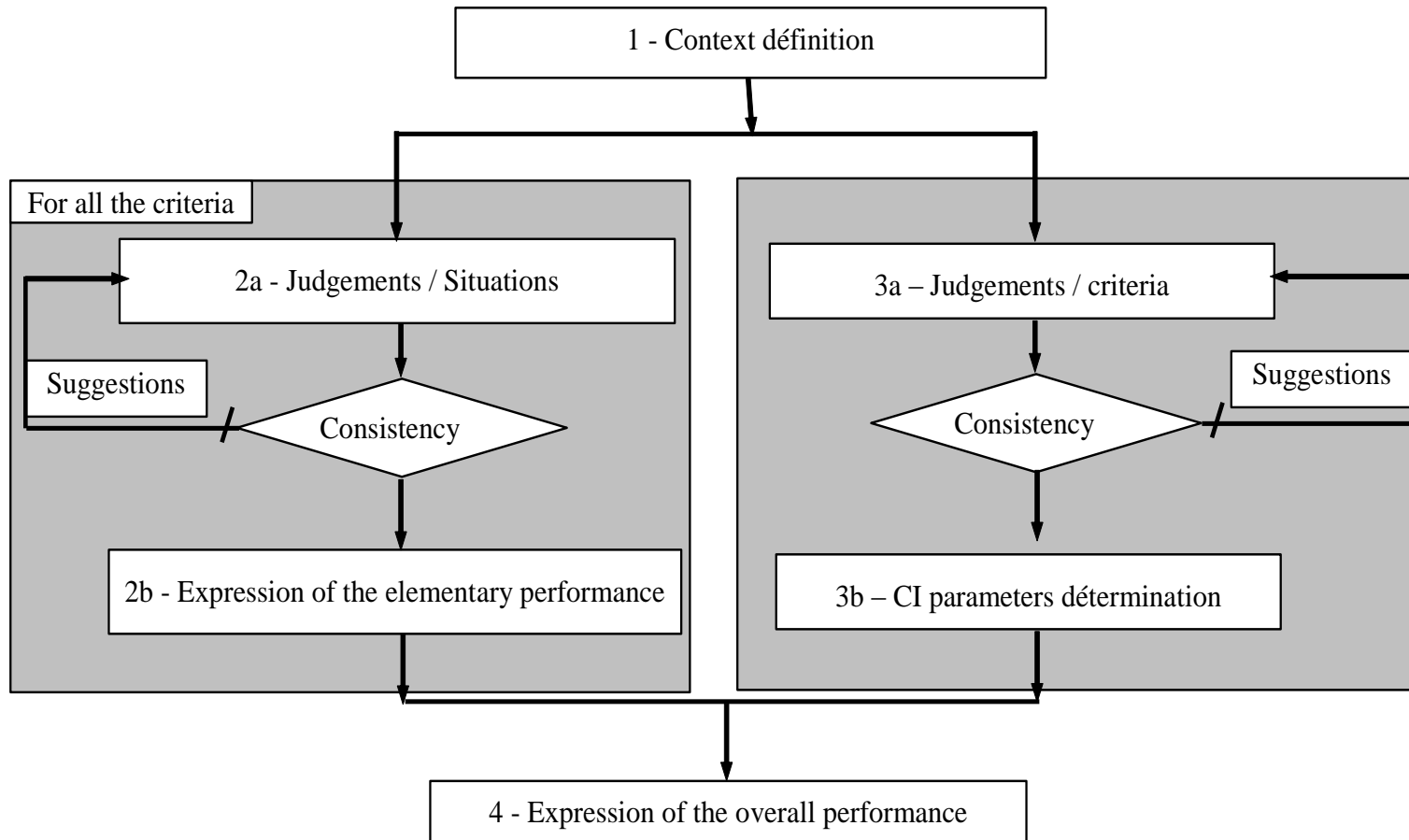
- Aptitude for choice and diagnosis
 - Multicriteria aspects of the industrial performance
 - Relevance during the whole duration of the CIP
 - Understanding of both results and information processing
 - Aptitude for the industrial DMs knowledge
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PMS based on MACBETH (2004)

- Performance expressions defined according to interval scales using the strength of preference notion

 - Aggregation operator: weighted mean, possibly 2 additive Choquet Integral
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The MACBETH methodology



The 2-additive Choquet integral

$$CI_g(p_1, p_2, \dots, p_n) = \sum_{i=1}^n p_i v_i - \frac{1}{2} \sum_{i,j} I_{ij} |p_i - p_j|$$

- v_i 's are the Shapley's parameters (equivalent to the weights w_i 's for the WAM)
- I_{ij} are the interaction coefficients ($I_{ij} = 0$ for the WAM)
- Conditions: $\sum_{i=1}^n p_i v_i = 1$ and $\left(v_i - \frac{1}{2} \sum_{i \neq j} |I_{ij}| \right) \geq 0$

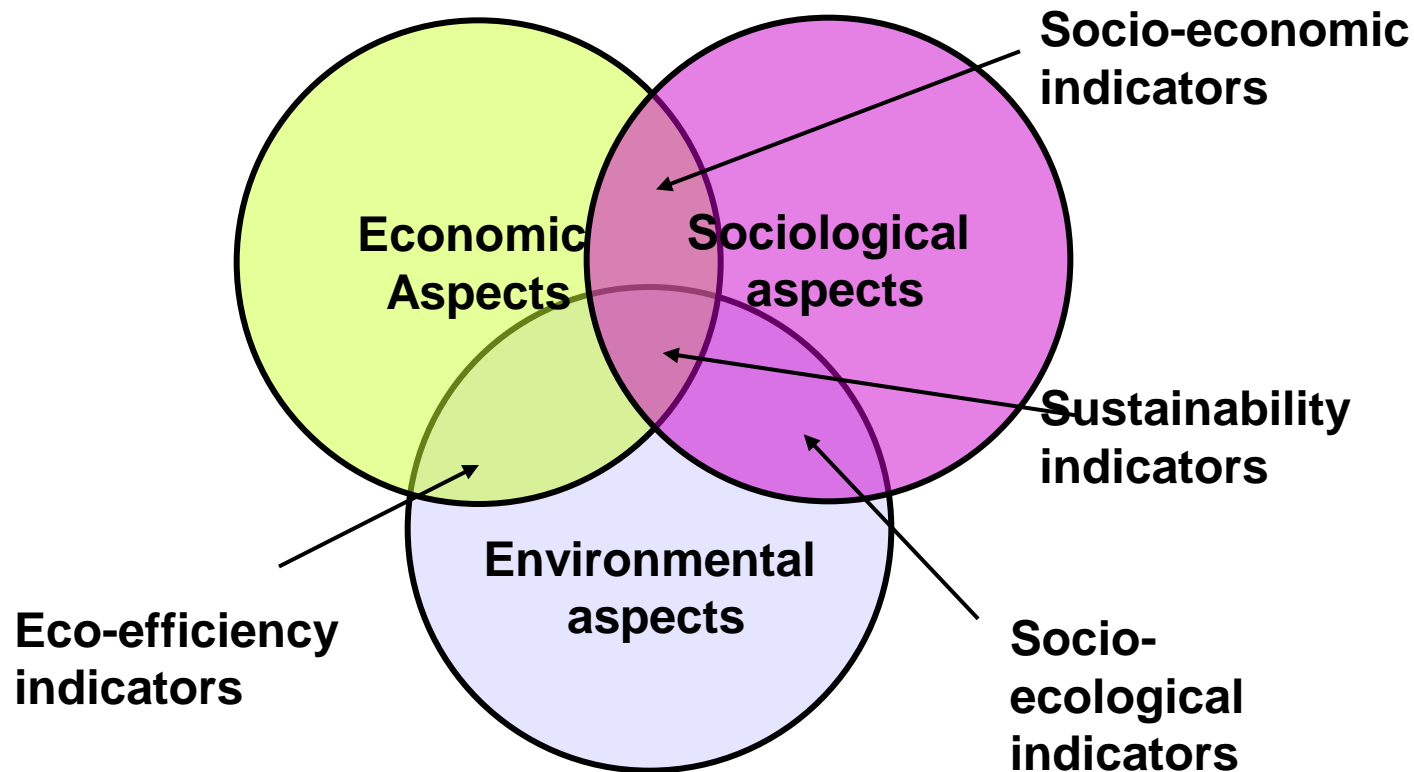
Industrial sustainability

Sustainability aspects increasingly important in industrial improvements

- Idea: supplying a PMS to help DMs during the different steps of the improvement approach
 - Proposition: identification of the preference model, particularly concerning the 2 additive CI parameters
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PMS for sustainable development

$$P_{Overall} = v_{Ec.}P_{Ec.} + v_{En.}P_{En.} + v_{SR.}P_{SR.} - \frac{1}{2} \left[I_{Ec-En} |p_{Ec.} - p_{En.}| + I_{Ec-SR} |p_{Ec.} - p_{SR.}| + I_{En-SR} |p_{En.} - p_{SR.}| \right]$$



(Sikdar, 2003)

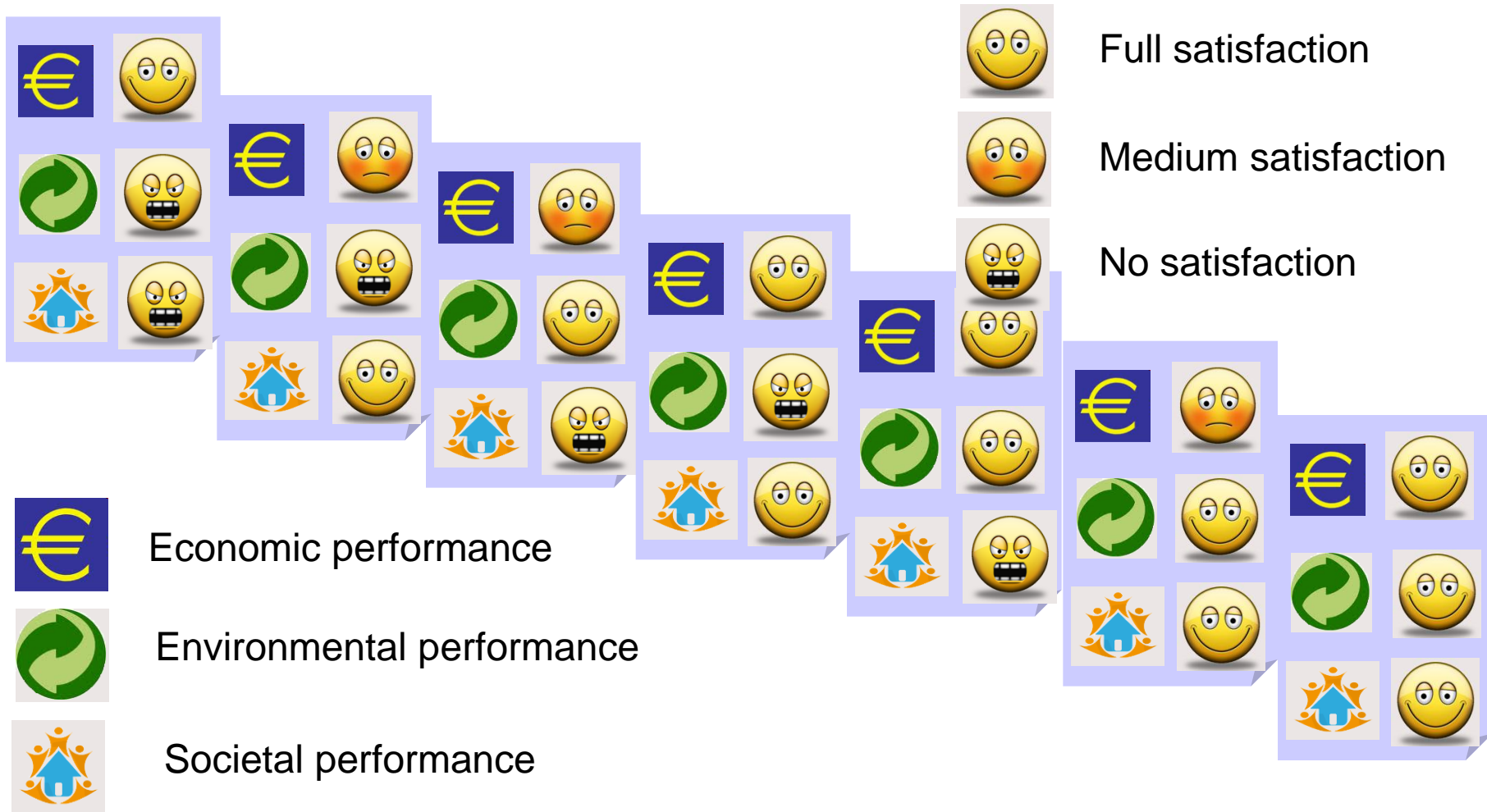
The observed companies (2010)

- ALCATEL ADIXEN which produces vacuum technology (600 employees),
 - FOURNIER which produces kitchen and bathroom furniture (1000 employees),
 - SNR which produces automotive and special bearings (4000 employees),
 - the Office National des Forêts (ONF) which handles public forests (300 employees) for the Savoie Area
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The used approach

- 1. Presentation of the 3 pillars and the main associated indicators**
 - 2. Explanation of the elementary performance expression mechanism using graphic representation**
 - 3. Presentation of the particular situations**
 - 4. Explanation of the comparison mechanism**
 - 5. Feedback on the operator identification**
 - 6. Expertise validation**
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The considered situations

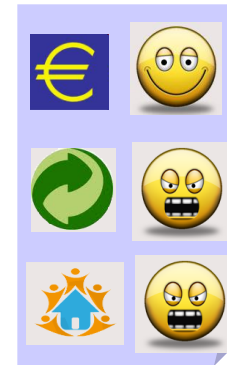


The comparison mechanism

Hypothesis: a DM is able to compare overall satisfaction corresponding to some particular situations, *i.e.* to express a judgement



is **worse** than



is “**weakly**” **worse**
than

This step is carried out according to the MACBETH method

An interview example

The difference of satisfaction between these situations is **weak**

Med.

Med.

Weak

Med.

Strong

Med.

The satisfaction corresponding to this situation

is **lower** than

the satisfaction corresponding to this one

Increasing satisfaction

Choquet integral parameters

	FOURNIER	ONF	SNR	ALCATEL
V_{Ec}	0.62	0.33	0.56	0.34
V_{En}	0.15	0.30	0.18	0.36
V_{SR}	0.23	0.37	0.27	0.30
I_{Ec-En}	-0.10	-0.05	-0.19	-0.11
I_{Ec-SR}	-	-0.05	-0.26	-0.11
I_{En-SR}	-0.05	-0.05	-0.09	-0.14

Pillar performances			FOURNIER		ONF		SNR		ALCATEL	
Ec.	En.	SR	Pag	IA	Pag	IA	Pag	IA	Pag	IA
	0	0	0,67	0,05	0,37	0,05	0,78	0,22	0.46	0.11
0,5	1	0	0,51	0,05	0,51	0,05	0,61	0,16	0.66	0.13
0,5	0	1	0,59	0,05	0,58	0,05	0,70	0,16	0.60	0.13
1	1	0	0,79	0,03	0,67	0,05	0,91	0,18	0.83	0.13
1	0	1	0,92	0,08	0,74	0,05	0,96	0,14	0.77	0.13
0,5	1	1	0,72	0,03	0,86	0,02	0,83	0,11	0.89	0.06
1	1	1	1,00	0	1,00	0	1,00	0	1.00	-

- Globally the requirements of PMS for CIP are ensured
 - Such PMS supplies interesting pieces of information for the CIP
 - The understanding of the preference model is not obvious for industrial DMs
 - Interest for alternative MCDA methods
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Work in progress

- UTA and ELECTRE application to take into account other types of knowledge
 - Extension of the PMS preference model to the optimisation and the contribution notions
 - Consideration of several DMs (at least 2) involved in the CIP, particularly in the Supply Chain improvement context
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