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Potential alternatives

Example (Choose a new office site for a SME)

- A SME specialized in printing and copy services has to move into new offices.
- The CEO of the SME has gathered **seven potentials sites** :

Site	Code	Annual rent
A venue de la liberté	(A)	30 000 €
B onnevoie	(B)	15 000 €
C essange	(C)	5 000 €
D ommeldange	(D)	12 000 €
E sch-Belval	(E)	30 000 €
F entange	(F)	15 000 €
Avenue de la G are	(G)	10 000 €

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Decision objectives

Example (Choose a new office site for a SME – continue)

The CEO has identified **three objectives** to guide the choice of the new site. He wishes to :

1. minimize the **yearly costs** induced by the moving,
2. maximize the future **turnover** of the SME,
3. maximize the new **working conditions**.

Decision objectives

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Decision consequences to take into account

Example (Choose a new office site for a SME – continue)

1. minimize the **yearly costs** induced by the moving :

1.1 Annual rent

1.2 Functional costs (electricity, water, ..)

1.3 Cleaning costs

2. maximize the future **turnover** of the SME

3. maximize the new working conditions

3.1 maximize the new working conditions

3.2 Working space

3.3 Working conditions

3.4 Parking facilities

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2.1 Standing of the building

2.2 Standing of the neighborhood

2.3 Proximity with the customers

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3.1 Working space

3.2 Working environment

3.3 Working conditions

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3.1 Noise

3.2 Air quality

3.3 Light

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 - 3.2 Working Confort
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Measuring preferences on a qualitative consequence

The CEO of the SME may rank the seven potential sites from the best to the worst from the point of view of the standing of the building :

rank	alternative
1st	Avenue de la liberté
2nd	Esch-Belval
3rd	Fentange
4th	Dommeldange
5th	Avenue de la Gare
6th	Bonnevoie
7th	Cessange

The CEO is furthermore invited to place the individual sites along a 0–100 axis such that the numerical positions represent the apparent differences in standing he observes between the potential site buildings.

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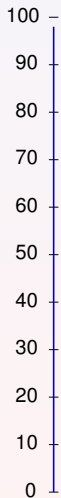
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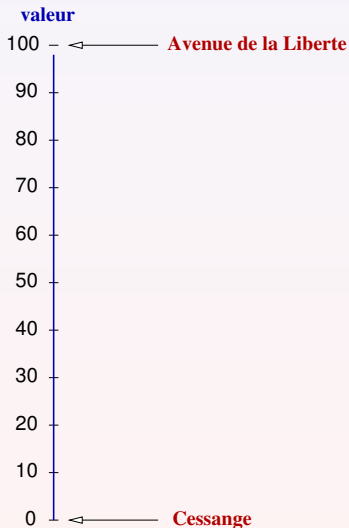
valeur



Positioning of the
potential sites :

1. A grade of 100 is given to the best site and a grade of 0 is given to the worst site.
2. The CEO then positions the other sites such that the numerical positions represent the apparent differences in standing he observes between the potential site buildings.

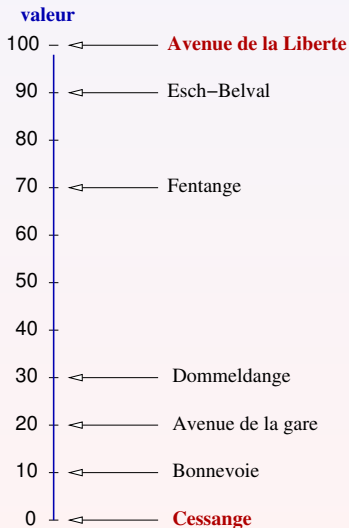
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Measuring preferences on a quantitative consequence

Let us now consider a qualitative consequence : **working space**, contributing to the evaluation of the performance of an alternative to objective : maximize working conditions.

alternative	Working space (in m^2)
A venue de la liberté	1000
B onnevoie	550
C essange	400
D ommeldange	800
E sch-Belval	1500
F entange	400
Avenue de la G are	700

An increase from 500 to 1000 m^2 is very attractive. The same increase from 1000 to 1500 m^2 is however not anymore so attractive.

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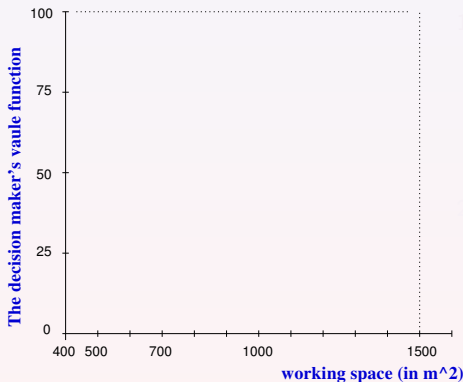
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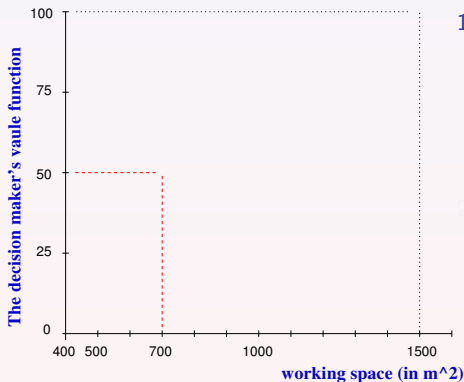
Here the conversion the CEO is proposing.



1. A working space of 700 m^2 is considered to be situated right in the middle between the maximum (1500 m^2 = 100 pts) and the minimum available surface (400 m^2 = 0 pts).
2. A working space of 1000 m^2 is considered to be situated right in the middle between the previous middle (700 m^2 = 50 pts) and the maximum available surface (1500 m^2 = 100 pts).

The preference value of the working surface thus becomes an interval scale.

Measuring preferences on a quantitative consequence

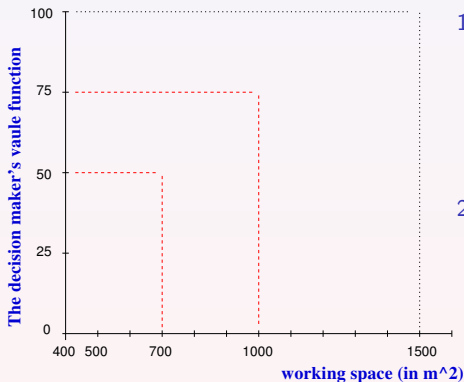


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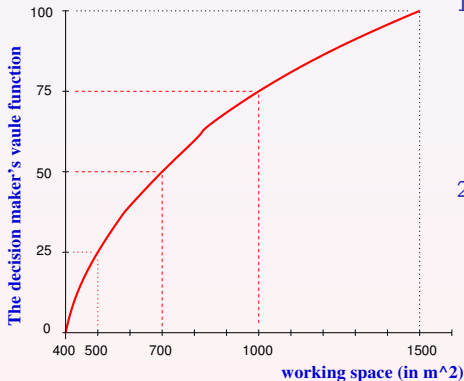


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Measuring preferences on a quantitative consequence



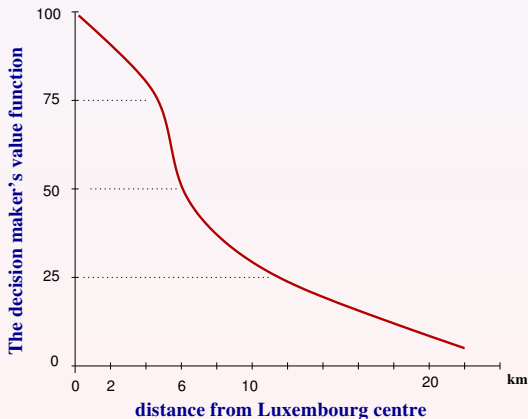
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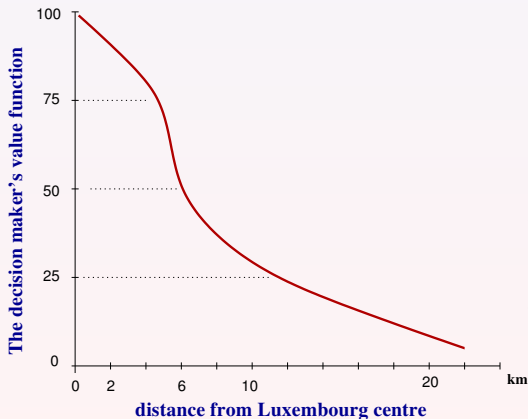
Measuring preferences on a quantitative consequence

A similar procedure allows to measure the preference value of the **customers proximity** consequence :



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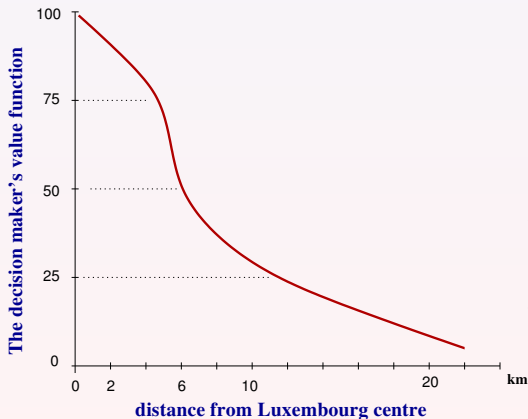


The preference value is maximal = 100 in the city centre.

The preference value of the consequence decreases with the distance to the city centre, smoothly in the beginning, then sharply in the middle before decreasing smoothly again at the end.

Measuring preferences on a quantitative consequence

A similar procedure allows to measure the preference value of the **customers proximity** consequence :



The preference value is maximal = 100 in the city centre.

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Aggregating costs

All the costs categories taken into account : rent, cleaning and functional, may simply be summed up, as they are all expressed on the same **commensurable preference scale**, i.e. annual amounts of Euros.

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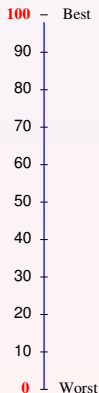
Weighing the benefits

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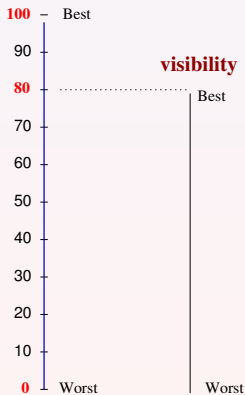
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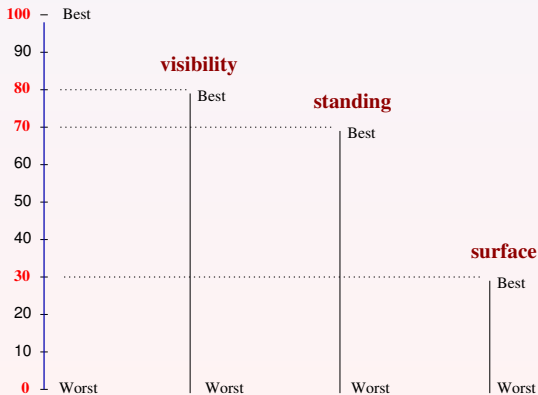
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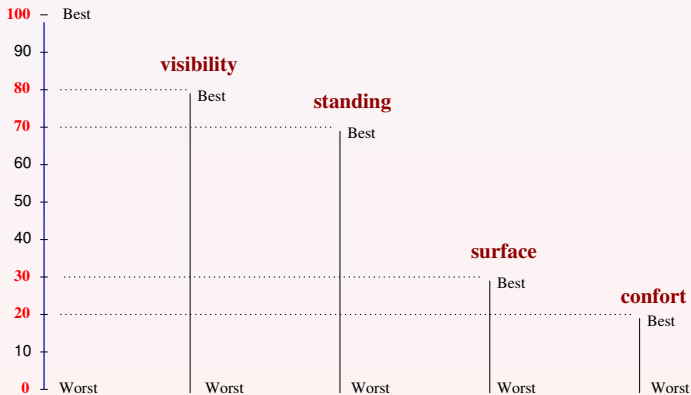
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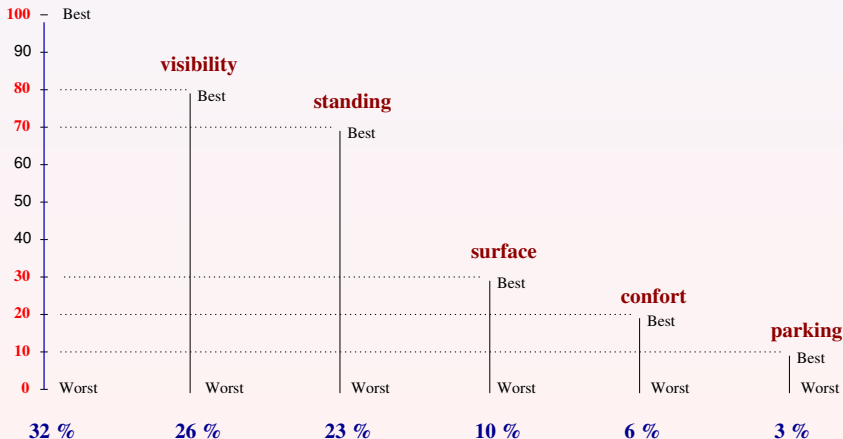
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Weighing the benefits – continue

Comment

- The consequence : *customer proximity* is considered to be the most important consequence.
- The regret to switch from the best to the worst on the consequence *visibility* is judged to be 80% of the regret to switch from the best to the worst on the most important consequence.
- These decreasing regret percentages (80%, 70%, etc) are then normalised on a 0 to 100 scale.

Weighing the benefits – continue

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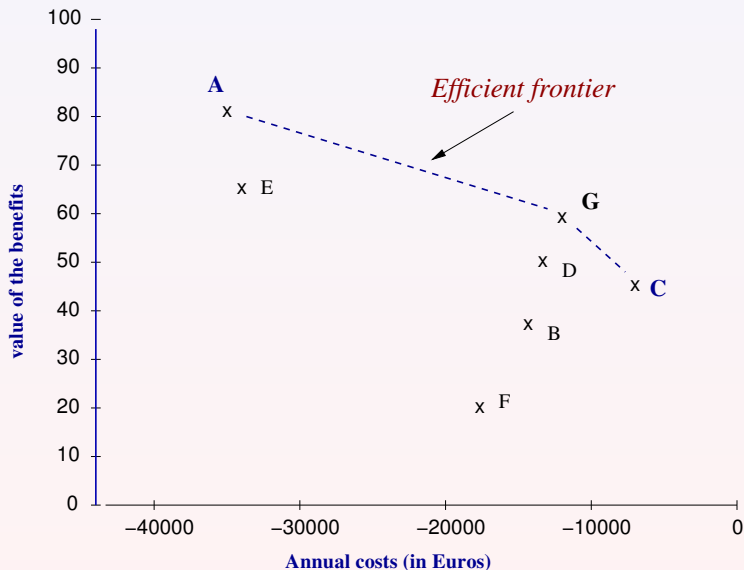
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Performances wrt the three objectives

Rank	Costs	Turnover	Work. Cond.	Total Benefit
1st	C (6 700 €)	A (70.6)	E (15.7)	A (80.8)
2nd	G (12 000 €)	G (49.8)	G (10.4)	E (64.8)
3rd	D (14 100 €)	E (49.1)	A (10.2)	G (60.2)
4th	B (17 800 €)	C (43.8)	D (10)	D (52.3)
5th	F (18 600 €)	D (42.3)	B (9.9)	C (47.4)
6th	E (34.800 €)	B (29.5)	F (4.8)	B (39.4)
7th	A (35 000 €)	F (16.1)	C (3.6)	F (20.9)

How to compensate between costs and benefits?



How to compensate between costs and benefits ?

Comment

- Three sites : *Avenue de la liberté* (A), *Avenue de la Gare* (G) et *Cessange* (C) appear non dominated. They represent potential candidates for the best choice.
- Consider first switching from alternative C to alternative G. We notice an increase in benefits from 47.4 to 60.2 points, whereas the costs increase consists in 5 300€. The marginal increase in benefits is hence $5300/12.8 = 414\text{€}$.

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- Similarly, switching from alternative G to alternative A increases the benefits by 20.6 points and the costs by 23 000€. The marginal increase in benefits costs here $23000/20.6 = 1117$ €.
- If the CEO considers that a benefit point is worth :
 - less than 414€ he will prefer the site Change (C).
 - equal to 414€ he will be indifferent between the two sites.
 - more than 414€ he will prefer the site Around (A).
- If the CEO considers that a benefit point is worth :
 - less than 1117€ he will prefer the site Around (A).
 - equal to 1117€ he will be indifferent between the two sites.
 - more than 1117€ he will prefer the site Change (C).

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- *If the CEO considers that a benefit point is worth :
 - less than 414€ he will prefer the site Cessange (C),
 - between 414€ and 1117€ he will prefer the site Avenue de la Gare (A),
 - more than 1117€ he will prefer the site Avenue de la Gare (A).*

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How to compensate between costs and benefits ?

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- *Similarly, switching from alternative G to alternative A increases the benefits by 20.6 points and the costs by 23 000€. The marginal increase in benefits costs here $23000/20.6 = 1117\text{€}$.*
- *If the CEO considers that a benefit point is worth :*
 - *less than 414€ he will prefer the site Cessange (C),*
 - *between 414€ and 1117€ he will prefer the site Avenue de la Gare (G),*
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How to compensate between costs and benefits? – continue

Example (Evaluate the marginal benefit increase in Euros)

- The decision maker is asked how much he would agree to invest in order to increase the standing of the new office **from the worst to the best**.
- Suppose he declares that he would for this purpose spend up 15 000€.
- The consequence "standing" representing 23% of the value of the benefits, the decision maker is thus ready to invest 15 000€ for getting an increase of 23 points in the benefits. He is hence ready to invest **652€** per point.
- On this base, the best choice is given with alternative Avenue de la Gare (G).

How to compensate between costs and benefits? – continue

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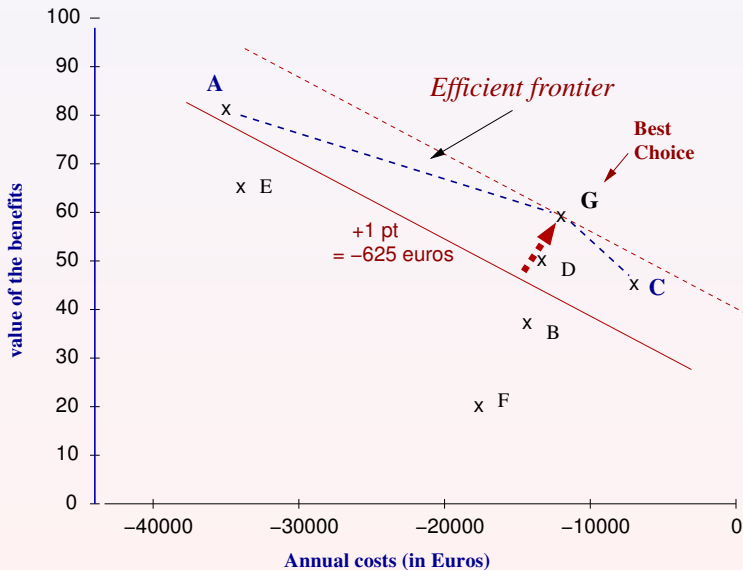
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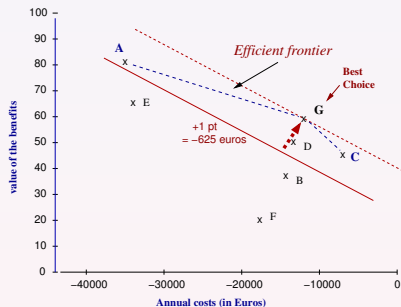
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How to compensate between costs and benefits? – continue



Performances wrt the decision objectives



Rank	Costs	Turnover	Work. Cond.	Total benefits
1st	C (6 700 €)	A (70.6)	E (15.7)	A (80.8)
2nd	G (12 000 €)	G (49.8)	G (10.4)	E (64.8)
3rd	D (14 100 €)	E (49.1)	A (10.2)	G (60.2)
4th	B (17 800 €)	C (43.8)	D (10)	D (52.3)
5th	F (18 600 €)	D (42.3)	B (9.9)	C (47.4)
6th	E (34.800 €)	B (29.5)	F (4.8)	B (39.4)
7th	A (35 000 €)	F (16.1)	C (3.6)	F (20.9)

Multiple Attributes Value Theory (MAVT)

Comment

- *In this lecture we illustrate a best choice decision algorithm which consists in constructing a commensurable numerical representation of all the consequences to be taken into account for choosing the best alternative.*
- *The **Multiple Attribute Value Theory** (MAVT), was initiated in 1976 by two American scientists : Ralph Keeney and Howard Raiffa.*

Contents	The problem	Performances	Agrégation	Discussion	Conclusion
○	○	○	○	○	○
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	○	○○○	○○○○○○○○○	○○	

Principles of MAVT – continue

Principle (Additivity)

If the decision maker prefers alternative A over alternative B, and alternative B over alternative C, then the difference in preference between A and C has to be greater than the differences between A and B, and, between B and C.

Comment

- *The differences in preference have to respect the rankings of the alternatives on each consequence, on each objective and globally.*
- *The appreciation of a preference difference between two alternatives must result from the comparison of their respective values on each consequence.*

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Principles of MAVT – continue

Principle (Transitivity)

If the decision maker prefers alternative A over alternative B, and alternative B over alternative C, then he must prefer alternative A over alternative C.

Comment

- *This principle is essential when representing preference with numerical values. All common number sets (integers, rationals, floats, reals, etc) verify this transitivity principle.*
- *Aggregating global preferences based on pairwise majority margins à la Condorcet does however not satisfy this principle.*

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Principles of MAVT – continue

Principle (Mutual preferential independance between the consequences taken into account)

Each consequence has to measure a specific performance which must be independent from the performances on the other consequences in order to avoid overlapping (and hence overweighing) of the performance in the global aggregation.

Comment

- *For instance, the consequence office visibility may only become relevant when the proximity with the customers is sufficiently small. Otherwise, this consequence should not count.*
- *This principle is usually not verified when evaluating consequences from common socio-economic indicators.*
- *However, one may control this principle with an ad hoc construction of relevant consequences.*

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