Weighting and aggregation

Workshop on SB Assessment Methods and Tools
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Why aggregation

Need for:

- Summary of assessment result
- Simple comparability of results
- Help with prioritisation - Decision support
- Goal setting at aggregated levels

But

Conceals individual results
Bias conclusions
Is generally not possible to influence

Kuggen, Miljöbyggnad, GOLD

Applying aggregation

A prerequisite for aggregation is the same unit of elements that should be aggregated.

This can be achieved by:

- Normalization – dividing with a reference value with the same unit - gives dimensionlessnes
- Assessment direct in the same unit (e.g. Points, marks,..)

Normalised values means:

- Understanding of relative magnitudes are improved
- The result is biased by the chosen reference value
- Still comprehensible and transparent

Assigning points means:

- Simplicity
- A value based choice
- Justification of assigning a specific number of points to an issue is difficult

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Weighting

The aim of weighting is to compensate for differences in significance regarding contribution to an overarching target.

To reach target T, issue A is X% more important than issue B with reference to **aspect** 1, 2, 3,... (answer: how much and **why**)

Weighting can be performed by:

- Numerical factors
- Assigning different number of available points to different issues

In LCA weighting is considered as value-based and should be avoided if possible.

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Weighing structure

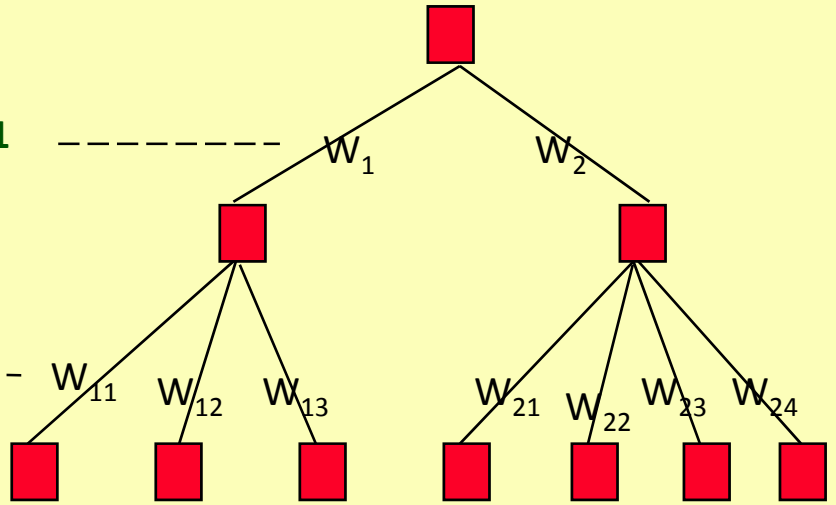
Main target/problem

Weighting - level 1

Contributing Issues

Weighting - level 2

Indicators/Parameters



Sum of weights under each node = 1,0

Measures/scores

- Issues on the same level should have similar significance and be independent
- Find weighting aspects and method to transfer verbal scales into values

The more weights, weighting levels the more difficult it is to understand the meaning of the aggregated result.

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Finding weighting factors

Some methods to arrive at weighting factors:
(Multiple Criteria Decision Analysis, MCDA)

- Analytic Hierarchy Process (AHP)
- Potentially all pairwise rankings of all possible alternatives (PAPRIKA)
- Analytic network process (ANP — extension of AHP)
- Multi-attribute utility theory (MAUT)

+

A number of tools

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Calculations or opinions?

Weighting base	Example	
money	willingness to pay	S
	costs for elimination	O/S
	loss of production/income	O
damages	what nature can sustain	S/O
	documented damages	O
	projections of damage	S/O
environmental goals	international agreements	O
	national goals	O
	sector goals	O
opinions	panel of experts	S
	group of stakeholders	S
	public opinion	S

O = mostly objective
S = mostly subjective

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Weighting aspects related to potential harm/damage

• intensity/severity	degree of harmfulness to man
• extent	number of individuals hurt
• duration	time during damage occur
• probability	the likelihood for damage to occur

The more the worse

The weighting aspects can be applied on local, regional, country or global level.

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Some consequences of weighting and aggregation

- Creates a simple summary
- Suitable for decision making

- Scoring via criteria reduces accuracy
- Each weighting level reduces accuracy
- A hierarchy is rigid since adding problems displace the result
- Single aspects become blurred
- The result becomes biased
- Indicators contributing to final result with < 5% almost meaningless
- Altering weights reduce comparability
- The meaning of the weighted result becomes more difficult to understand
- Decision makers may not understand or agree with the weights

Means to reduce subjectivity:

- Avoid weighting, use e.g. outranking for aggregation
- Choose a less subjective weighting basis
- Apply a comprehensive MCDA technique

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Applied weighting and aggregation

Assessment method	Weighting: Assigning points	Weighting: Extra points available	Weighting: Weighting Issues	Weighting: Weighting Categories	Weighting: Normalisa-tion + weighting	Aggregation: Sum of points	Aggregation: Sum of weighted points	Aggregation: Sum of weighted values	Aggregation: Outran-king	Who sets the weights?
Leed 2009 (US)	x	x				x				Partly TRACI/BEES
Leed 2012 (US)	x	x		x			x			Leed Steering committee & Expert Consultants
Breeam NC (GB)	x			x						"Consensus based weightings and ranking by a panel of experts"
Green Star (AU)	x	x		x			x			Broad Questionnaire, Tool Developing groups
DGNB (D)			x	x				x		DGNB organisation?
SBTool			x	x				x		Development teams
Miljöbyggnad (S)									x	-
EcoEffect (S)					x			x		Potential damage calculated by researchers

Weighting and aggregation is performed in a very different way by different methods

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Example 1

No weights - aggregation through outranking

”Miljöbyggnad” is a Swedish assessment system that covers the categories Energy use, Indoor environment and Materials & Chemicals
Only the building is assessed.

Aggregation principle 1. Worst score outranks higher scores
Aggregation principle 2. If majority of scores are higher than worst score the label becomes one level higher than worst score

Principle 1 ← **Principle 2** ← **Principle 1**

Building	Area	Score	Aspect	Score	Indicator	Score input
SILVER	Energy	GOLD	Energy use	GOLD	Bought energy	GOLD
			Energy need	SILVER	Heating power requirement	SILVER
					Solar heat load	SILVER
			Energy source	GOLD	Fraction of energy carriers	GOLD
	Indoor environ-ment	SILVER	Sound quality	GOLD	Noise protection	GOLD
			Air quality	BRONZE	Radon content	BRONZE
					Ventilation rates	GOLD
					N2O to indoor air	GOLD
			Moisture	SILVER	Moisture prevention	SILVER
			Thermal climate	GOLD	Thermal climate winter	GOLD
					Thermal climate summer	GOLD
			Daylight	SILVER	Daylight	SILVER
			Water	SILVER	Legionella	SILVER
	Material & chemicals	GOLD	Documentation	GOLD	Documentation of materials and their content	GOLD
			Verification	SILVER	Absence of hazardous substances	SILVER

Example 2

Calculated weights based on harm to man

”EcoEffect” is a Swedish assessment system that covers exterior and interior impacts partly based on LCA. It contains Design and Operation modules. Building and site are assessed. The DALY concept is used for setting weights.

DALY = Disability Adjusted Life Years
covers

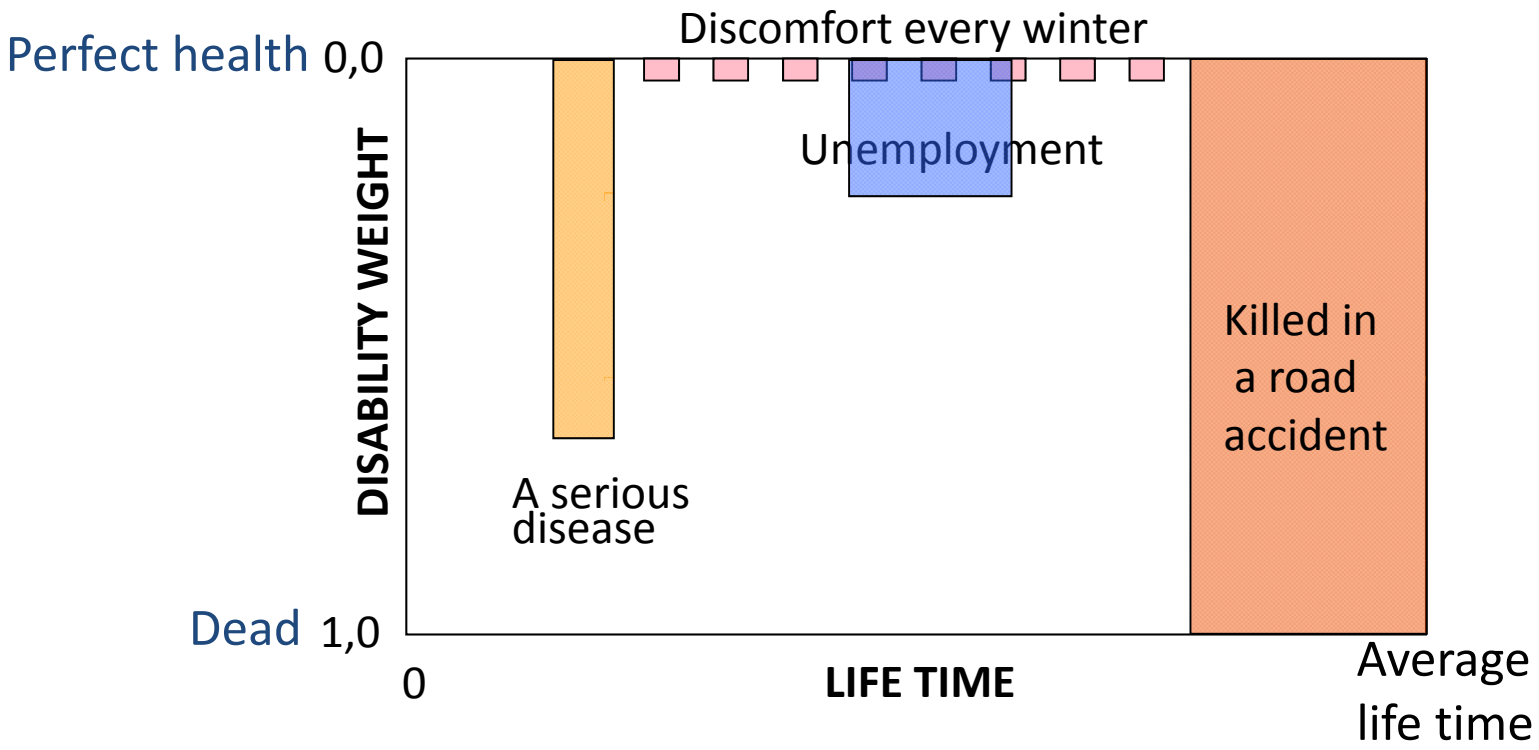
- Intensity/severity - disability weight
- Extent - number of harmed people
- Duration - time of suffering per person

All kinds of annoyance, inconvenience, illness etc. can get a disability weight i.e. psychological and physiological impact on people.

Example: Discomfort, Glare, Allergy, Unemployment, Reduced harvest, etc.

DALY per person = YLD + YLL, years
YLD = disability weight x duration time
YLL = Average life time – Years lived

DALYs for different problems



The coloured fields represents the harm to a person throughout the life span

With the DALY concept – large impact during a short time equals a small impact during a long time – even comfort problems can be compared with diseases

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DALYs as a basis for weights

Hundreds of disability weights for physiological and psychological diseases /states have been defined by WHO.

For diseases/states which disability weights are not found, they can be deduced for any state by European Quality of Life indicator .
Score: Mobility, Self-care, Usual activities, **Pain/Discomfort**, Anxiety/Depression, Cognition.

Then expected future DALYs can be calculated for any nuisance (end point problem) related to a building and be used as a basis for weights.

If impact on nature, as reduced biodiversity, is assumed to harm man and in the end meanreduced eco services, leisure quality, land value etc. the DALY concept reflects sustainability – ecologic, social and economic.

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Questions for discussion

1. How important is it to end in a single label?
2. Is it important to try to avoid subjective weights?
3. Is it important to try too minimize weighting?
4. If weighting, is it important to use an established MCDA?
5. Is it important that the weighting system is easy to understand for laymen?
6. Is loss of comparability a problem with tradable or extra points
7. Is it a problem that all systems apply different weighting/aggregation method?
8. Does it matter if the assessment scale is linear or not?
9. Is it a problem if clients give priority to cheap points?

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