Indicators for Sustainability Assessment in the Procurement of Civil Engineering Services

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1 Background

„Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Commission 1987

Agenda 2030

- Passed on by the UN in 2015 for a joint solution for global challenges
- Definition of 17 Sustainable Development Goals (SDG) with ecological, economical and social aspects
- Member states declare themselves ready to comply to implement the SDG on a national level and report the progress on an international forum
- Implented into the German Sustainability Strategy in 2017

→Further incorporation into society necessary

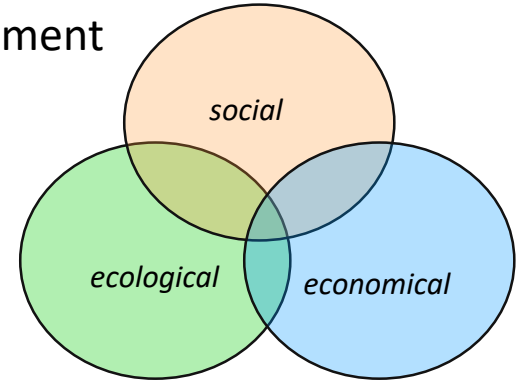


Fig.1 Triple Bottom Line of Sustainability

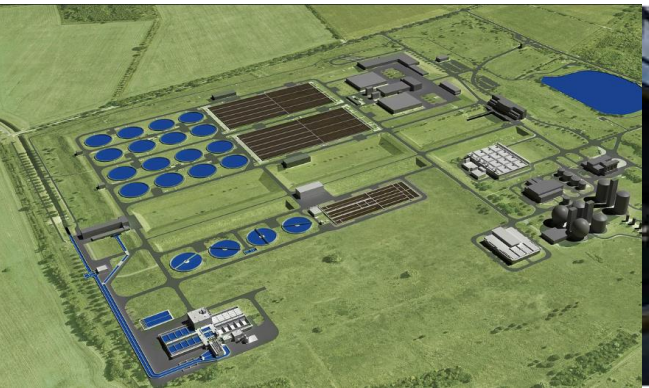
Berliner Wasserbetriebe 2 AIM

Technische Universität Berlin

Berlin Water Company

Tab. 1 Frameworks for the procurment of civic engineering services in the BWB

Regional framework	- Administrative provision procurement and environment (VwVBU) - Order and procurement regulations of Berlin
Legal framework	- Procurement regulations - Environmental regulations
Company intern framework	- Sustainability indicators of the company



2 AIM

Implementation of sustainable Indicators

into the procurement of civil engineering service

1. How can sutainable Indicators together with other Indicators be implemented?
2. How can the developed Multi-Indicator System be assessed?

3 Method

Implementation of sustainable Indicators

→ How can sustainable indicators be implemented?

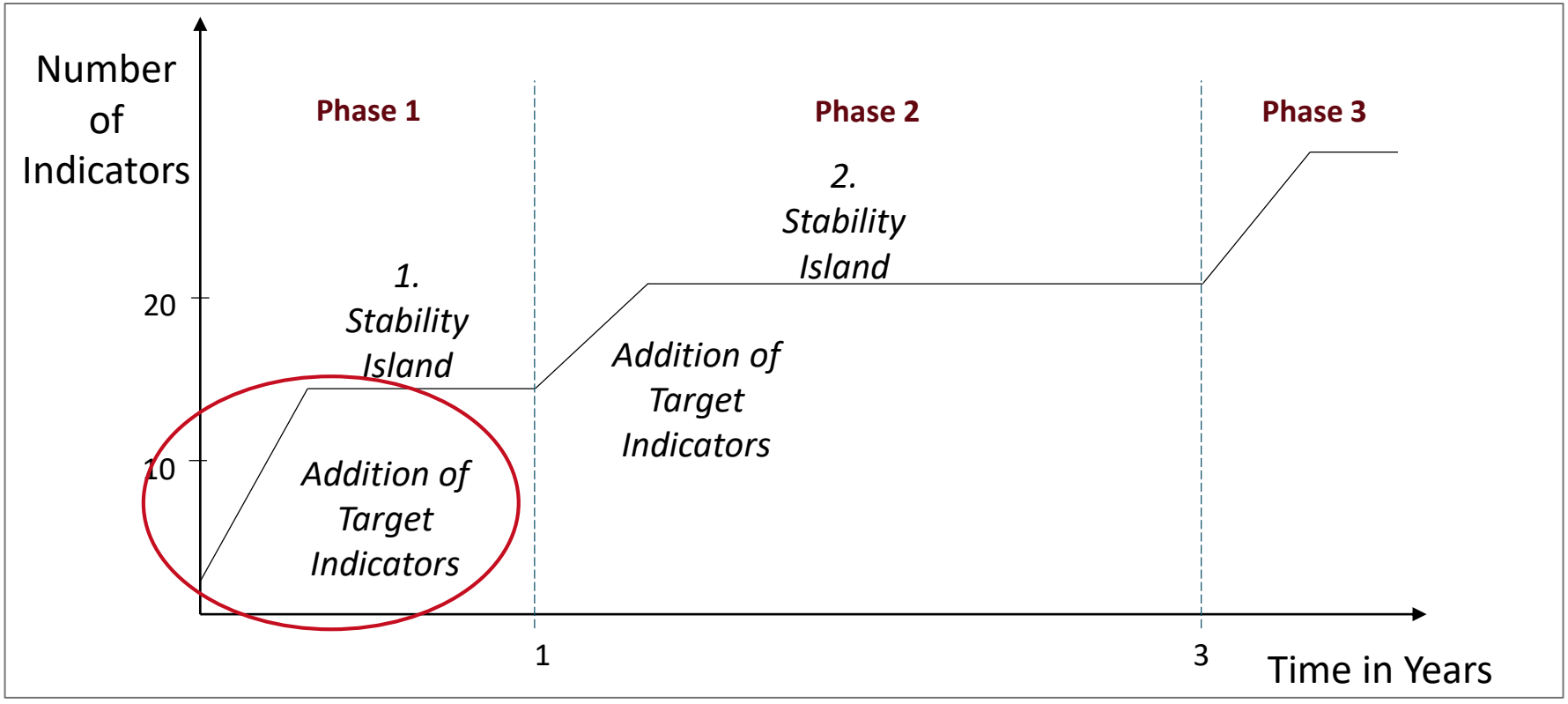


Fig.2 Implementation of Indicators over time

3 Method

Implementation of sustainable Indicators

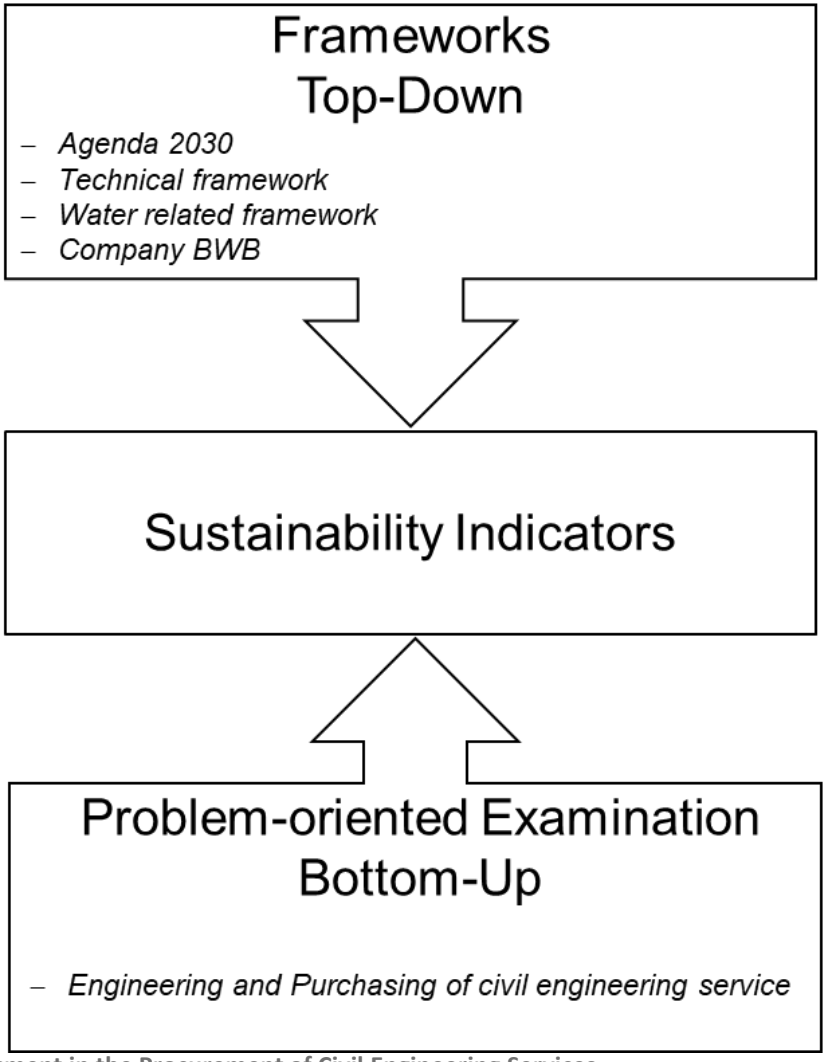


Fig.3 Method for the development of a Multi-Indicator System

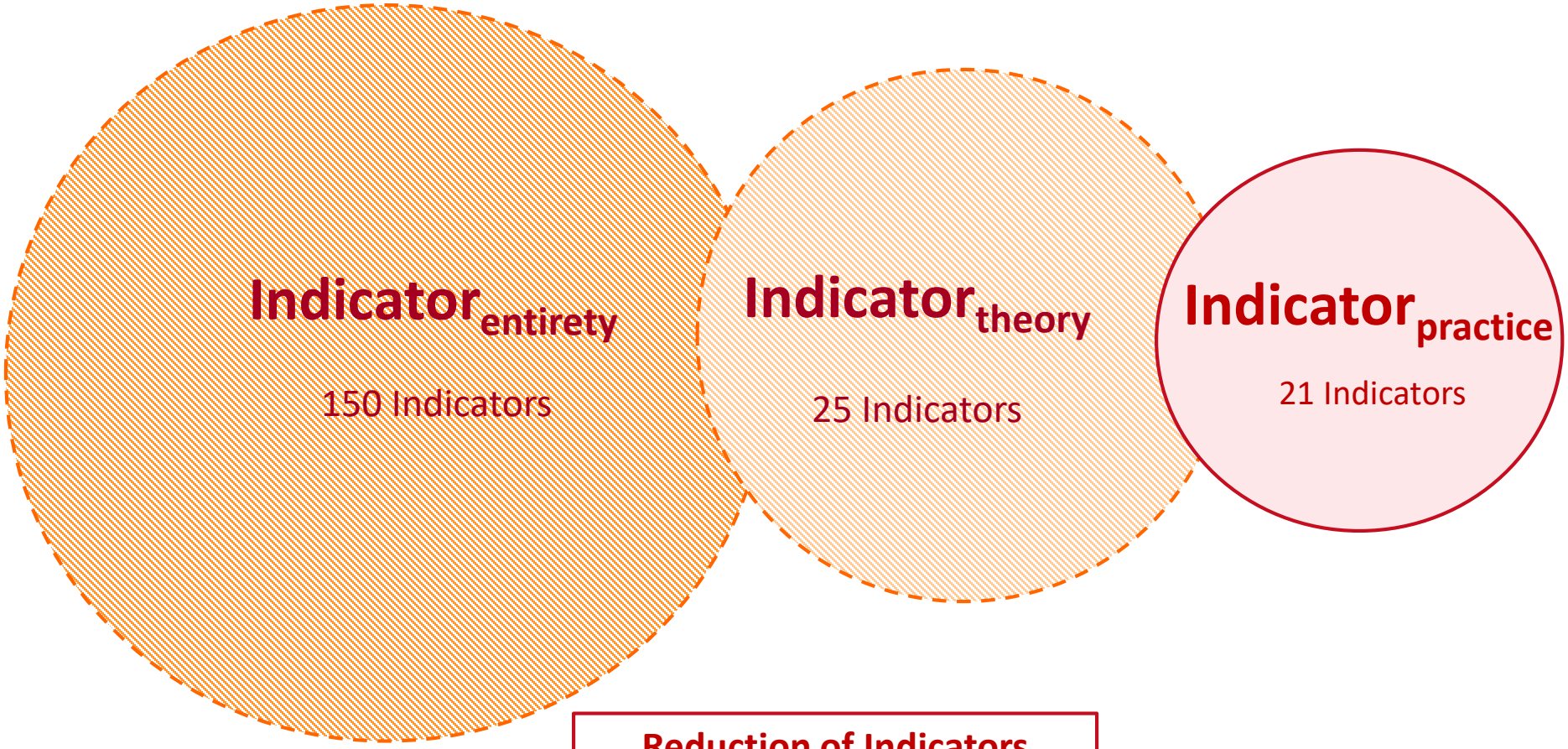
3 Method

Tab. 2 Frameworks for a MIS for the procurment of civic engineering services

National framework	- Sustainable Development Goals of Germany
Technical framework	- VDI-Indicators of the technical assessment guideline - NaCoSi-Indicators for the sustainability controlling of residential water management systems
Regional framework	- Administrative provision procurement and environment (VwVBU) - Order and procurement regulations of Berlin
Legal framework	- Procurement regulations - Environmental regulations
Company intern framework	- Sustainability indicators of the company

3 Method

Implementation of sustainable Indicators



3 Method

Implementation of sustainable Indicators

$Indicator_{entirety}$ → $Indicator_{theory}$

Involvement of Employees

- Involvement of professionals from different departments
- Face-to-Face questioning for a general understanding
- **Collective selection round** with scoring of indicators
- Each participant was given 10 points to mark relevant indicators

$Indicator_{theory}$ → $Indicator_{practice}$

Check on Applicability

- Check of selected indicators
- Screening for a causal relationship to civil engineering and purchasing

3 Method
Selected Indicators

Tab.3 Selected Indicators with with appointed sustainable dimensions (social: orange, green: ecological; blue: economical)

I1	tariff stability
I2	Air pollutants (health)
I3	worker safety
I4	competence management
I6	Free space loss
I8	acceptance
I9	Affected sources of water
I10	energy intensity
I11	power consumption
I13	GHG emissions
I14	other significant air emissions

I15	Biodiversity of water
I16	waste
I17	Secondary raw Materials
I18.1	investment costs
I18.2	operating cost
I19	Spending research and development
I20	creativity
I21	Environmental Management External
I22	Innovation and adaptability
I23	robustness

3 Method

Multi-Criteria Decision Analysis

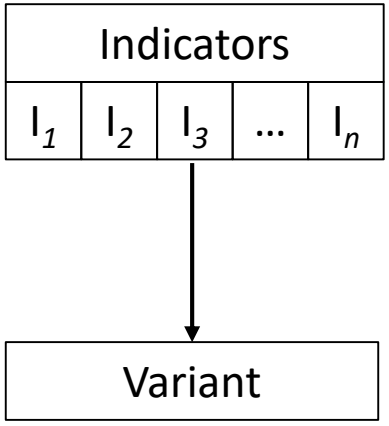


Fig.4 Assessment of a Variant with multiple Indicators

- Sustainability harbors different protection goals
- Analysis has to consider conflict of objectives
- Systematic assessement of a complex problem with multiple indicators [1]
- MCDA support the decision between variants

Example of MCDA

- Value Benifit Analysis
- Dashboard of Sustainability
- Partial Order

[1] Steinberg 2002

3 Method

Value Benefit Analysis

- Each indicator is allocated to a partial use value which can be summed to a total value for each variant[1]
- The use value comprised a certain weight for each indicator
- Weight can be derived by different methods (e.g. direct ranking)
- Direct ranking method gives each indicator a certain ranking, which determines the weight[2]

Dashboard of Sustainability

- Developed for the Millennium Development Goals (MDG)[3]
- The software was developed for the assessment of cities and countries and was also created for non-specialist users[4]
- The tool visualizes the results in a coloured dashboard[4]

[1] Zangemeister 1971.
[2] Žižović et al. 2017.
[3] Sachs 2012; Saltelli et al. 2005.
[4] O´Conner 2003.

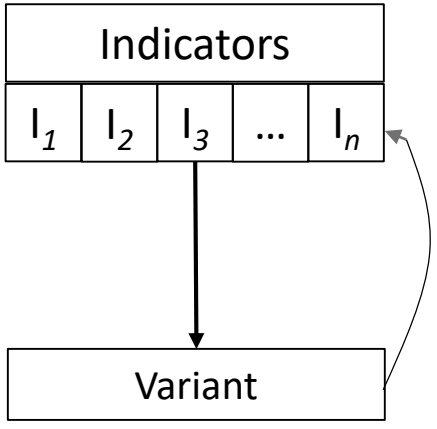
3 Method

Partial Order

- Non-parametric method were objects are related by the ≤-relation
- A poset is subject to the three axioms of reflexivity, antisymmetry and transitivity[5]
- The sorting of variants or objects using the ≤-relation results in a rating network with characteristic structures, a so-called Hasse Diagram (HD)[6]

Assessment of Indicators with PyHasse

- Indicators were treated as objects and the variants as attributes
- When the indicators are the objects, the variants can be used to characterize the indicators[7]
- For the assessment of the indicators the case examples were analysed in two different analysis



[5] Bruggemann und Patil 2011.
[6] Steinberg 2002
[7] Bruggemann 2018

3 Method

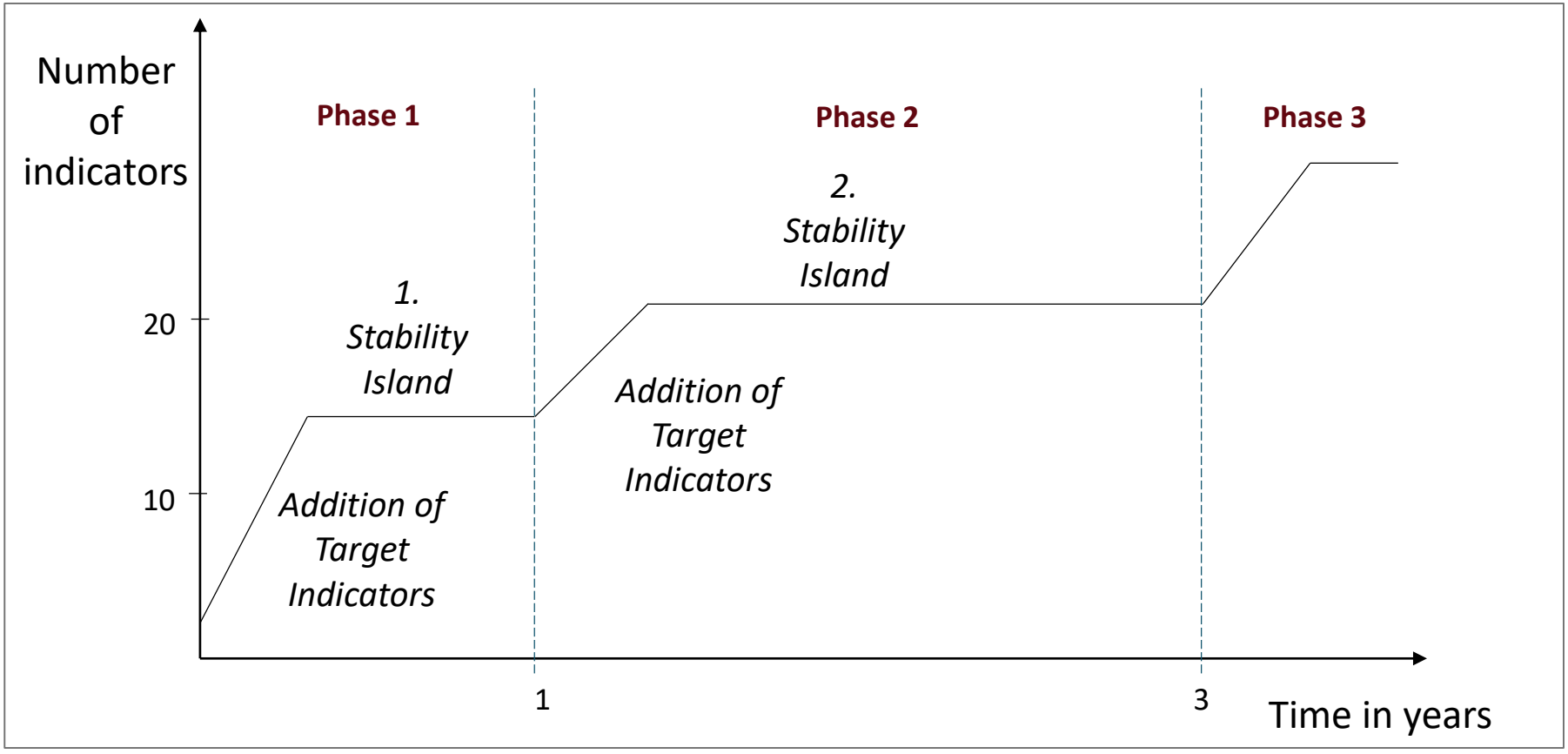


Fig.2 Implementation of Indicators over time

4 Case Examples

- Case examples were previous projects at the BWB[8]
- In each Case Example different variant were identified[8] :

1. ***Exhaust Air Treatment in a Wastewater Treatment Plant (WWTP)***

   -Variant 1 co-treatment in the aeration

   -Variant 2 fume scrubber

   -Variant 3 UV treatment

2. *Renewal of the Digester Chambers for the WWTP*
3. *Treatment of Process Water in WWTP*
4. *Sewer System Rehabilitation with Cured-in-place pipe (CIPP)*

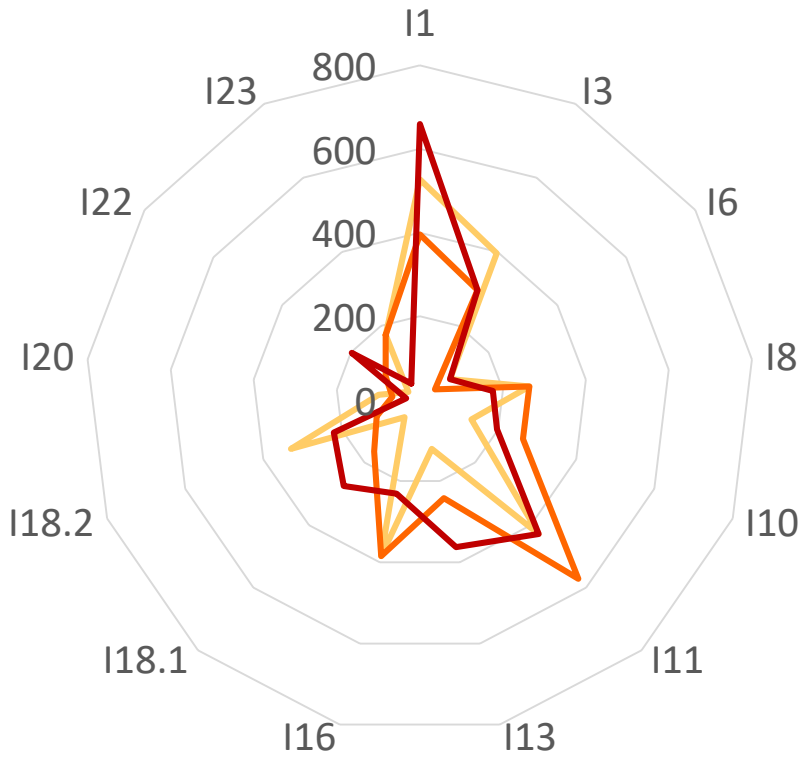
- Case Examples were analysed with three MCDAs

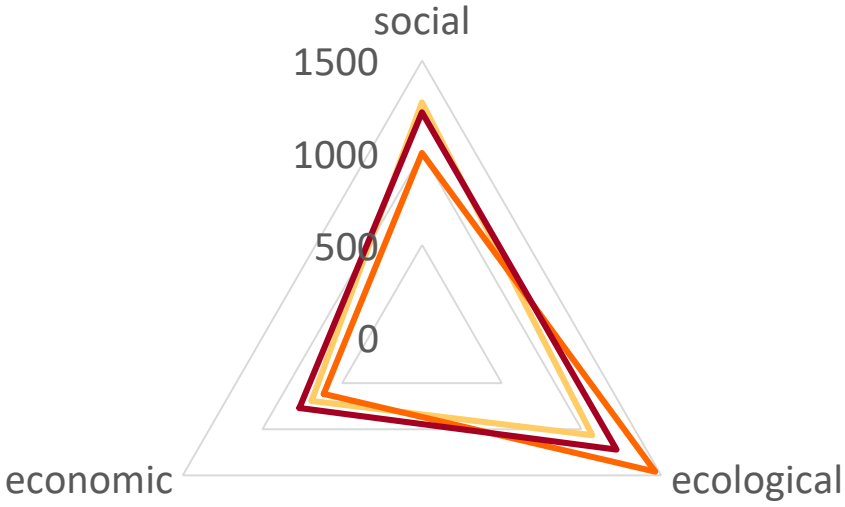
[8] Pankow 2018.

5 Results

Vaule benefit Analysis

Exhaust Air Treatment in a WWTP



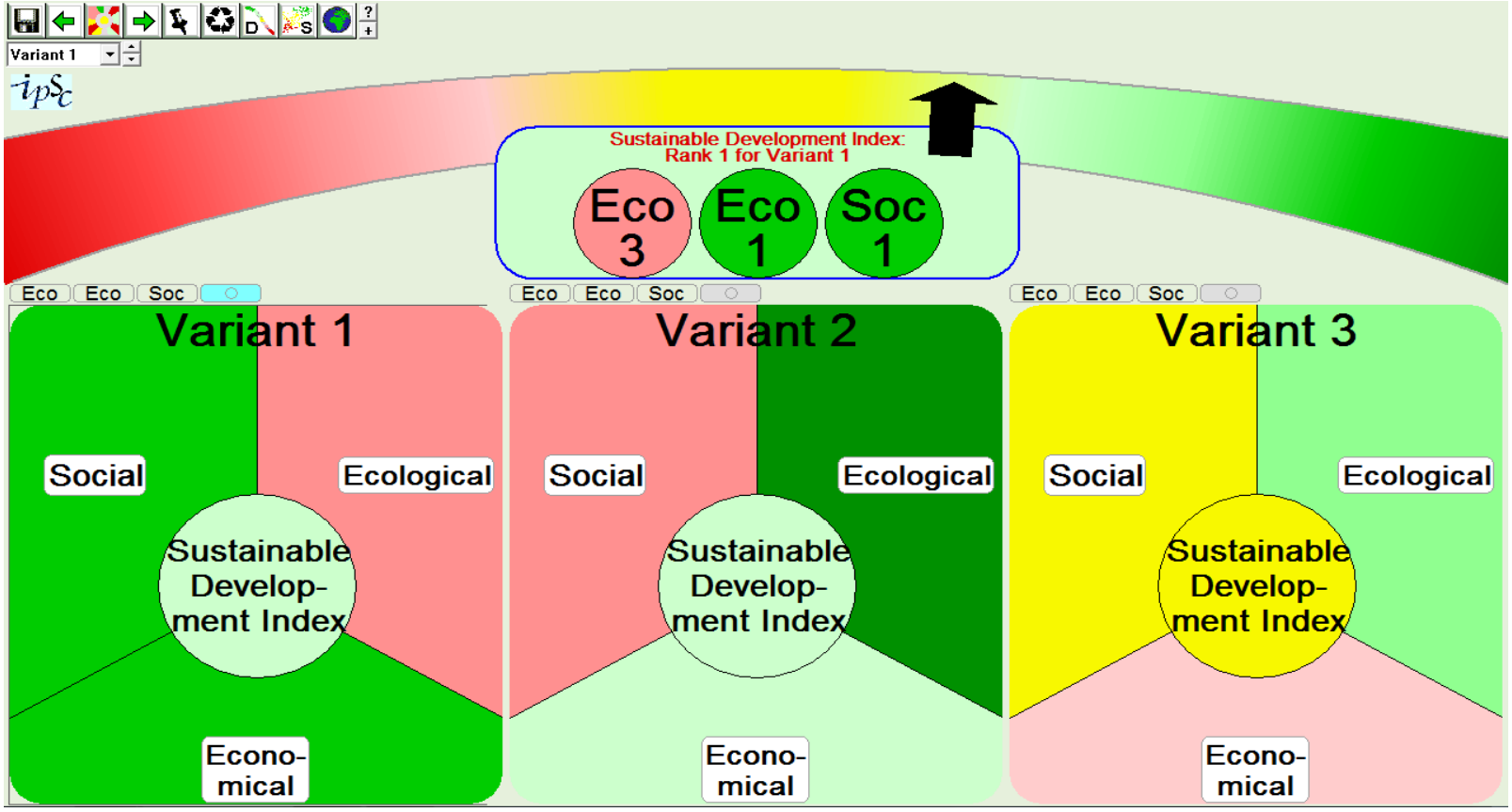


Variant 1 (TV 3033) Variant 2 (TV 3072) Variant 3 (TV 3209)

5 Results

Dashboard of Sustainability

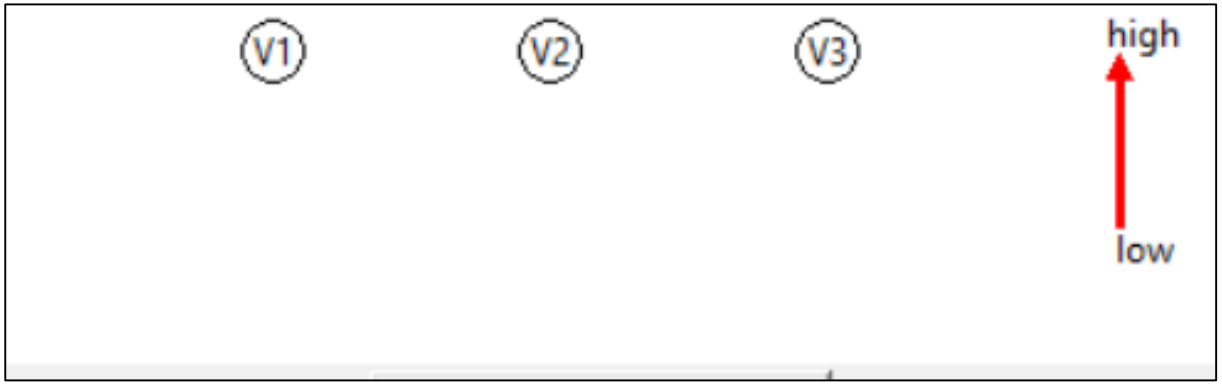
Exhaust Air Treatment in a WWTP



5 Results

Partial Order

Exhaust Air Treatment in a WWTP



→Variants couldn´t be compared

→ In HD visualized by antichains

5 Results

Indicator Assessment

Exhaust Air Treatment in a WWTP

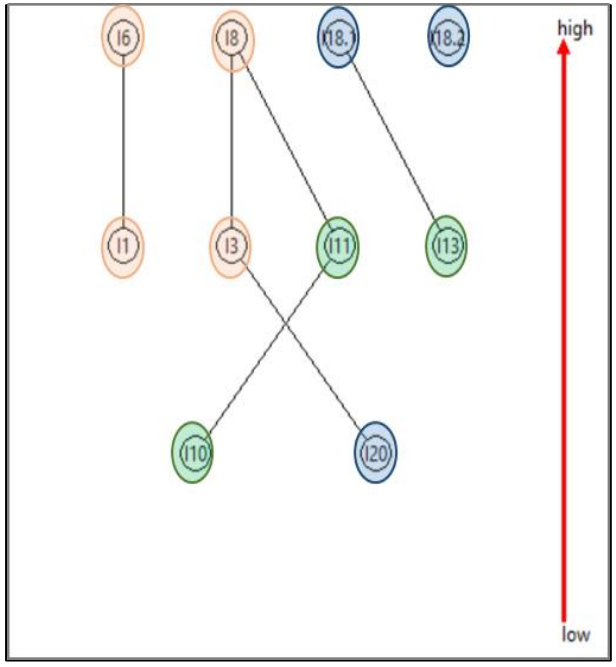


Fig. 10 HD of indicators with the appointed sustainable dimensions of the Exhaust Air Treatment

Seperation of components

→*high degree of seperation*

Dominance of dimensions

→*low degree of dominance*

6 Conclusion

1. How can sutainable Indicators be implemented?

- In addition of various Indicator Sets led to a high number of indicators
- participation of employees significantly reduced the indicators from over 150 to 24 indicators
- Evaluation methods showed practicability and easy to interpret graphics
- Due to the weighting, the value benefit analysis has a subjective value attitude. The Dashboard of Sustainability simplifies the results of the colour representation more strongly, thus losing the statement of transparency.

2. How can the Multi-Indicator System be assessed?

- PyHasse showed an option to asses the MIS without other criteria
- 4 Case Examples aren´t statistical stable
- However, the indicator rating used with PyHasse could be further developed

6 Conclusion

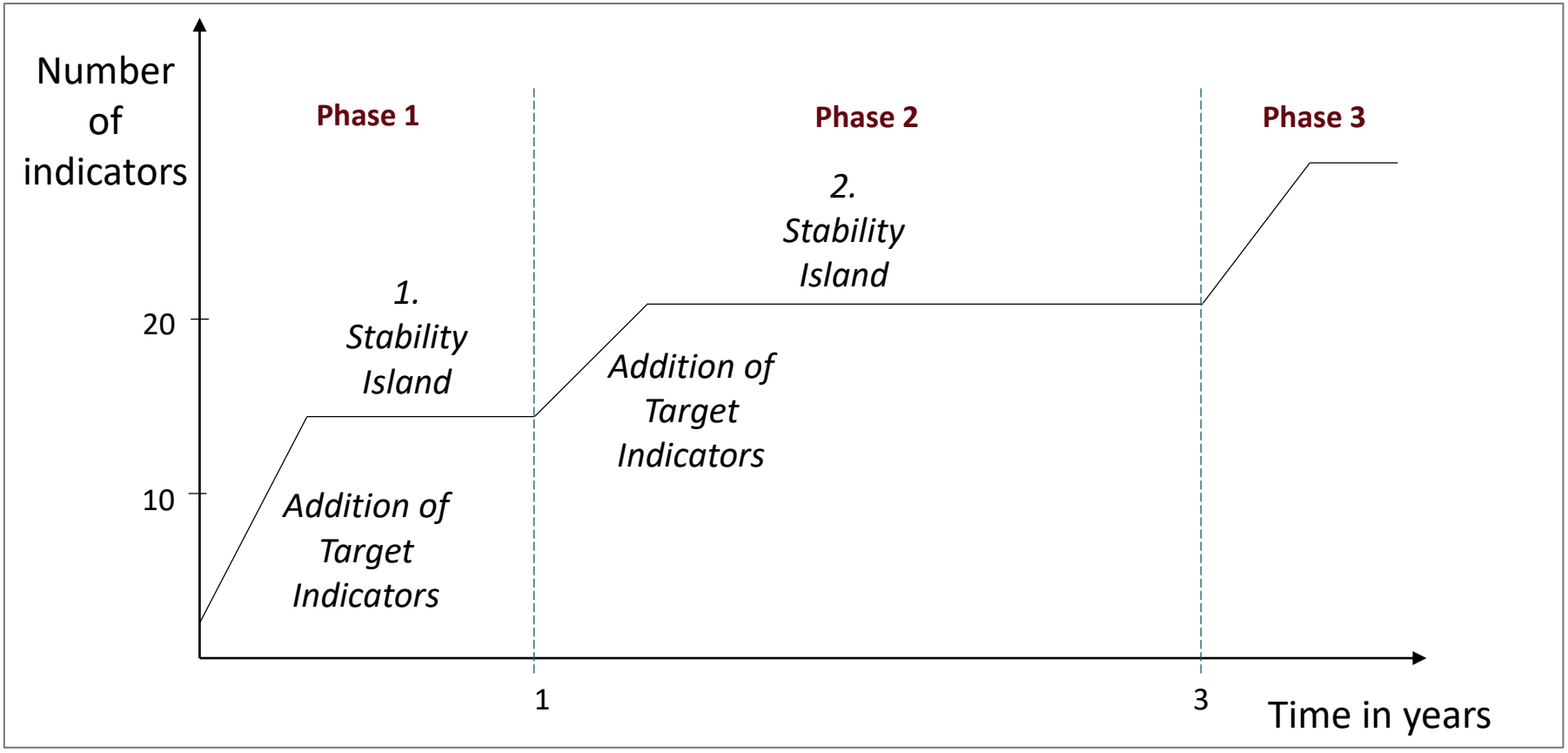


Fig.2 Implementation of Indicators over time

Thank you for your attention!

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Pictures

1.

WWTP Wassmansdorf

https://www.wassmannsdorf.bwb.de/

2.

http://www.bwb.de/content/language1/html/fuehrungen.php

3.

https://www.welt.de/newsticker/news3/article106244825/Die-heiligen-Hallen-am-Nikolassee.html