Handling future uncertainties in urban drainage planning using flexible systems

The COFAS method

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SWITCH Scientiffic Meeting Lodz

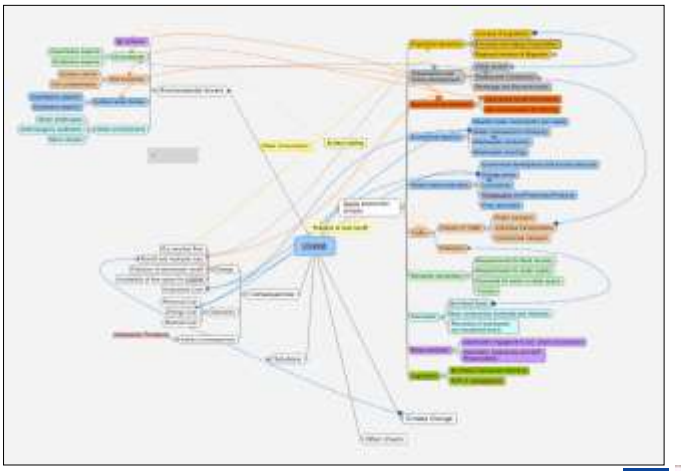
Introduction

- Urban Stormwater Management (USWM) systems are often long-lasting investments

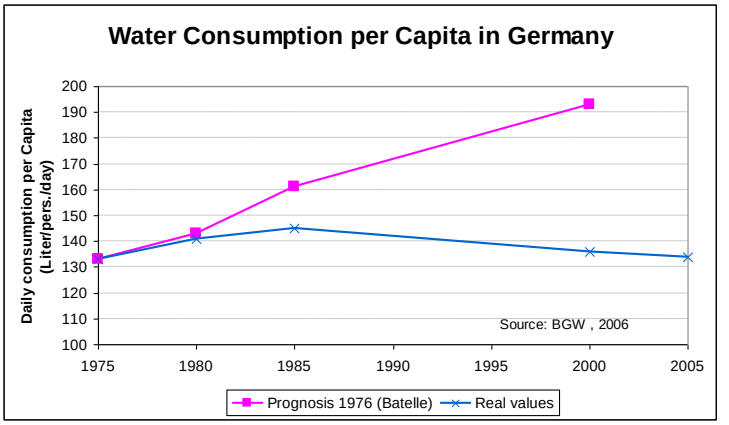
Type of installation	Average life in years
Sewers (new construction)	50 - 80 (100)
Pressure pipes and culverts	30 - 50
Tanks (CSO-tanks, clarifiers, construction part)	(40) 50 - 70
Pumping stations (construction part)	25 - 40
Gully (inlet)	40 - 80
Infiltration systems	20 - 40

According to LAWA (2005), Guideline for cost comparisons

Drivers for USWM



Problem of Prediction



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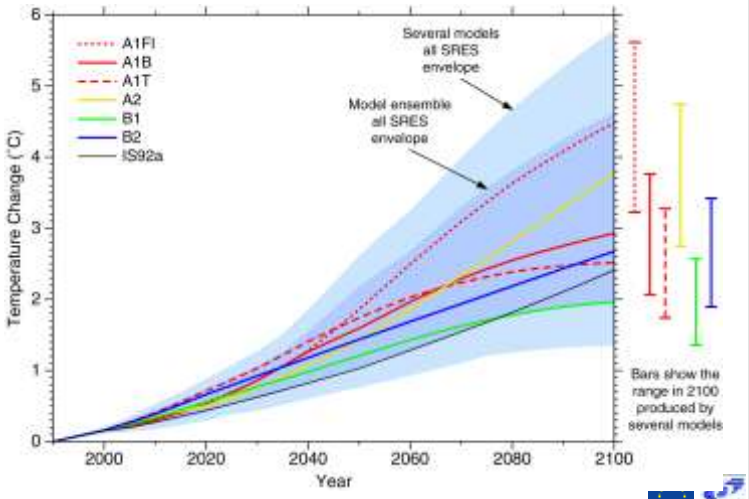


Conclusion for USWM-Drivers

- Large number of drivers for USWM
- There are certainly future drivers we don't know about today
- For the known drivers, a prediction with a time horizon of 30-50 years is difficult or even impossible
- Drivers are often linked, what makes the development of scenarios even more difficult

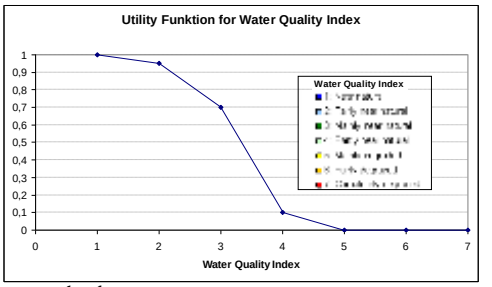
- But, we have to design the USWM today!
- => Felxible Systems

One way out of the Dilemma

1. Work with Scenarios
   - Future scenarios
   - Multiple scenarios: worst case, best case, most likely, etc.
2. Define indicators to measure the performance of different measures for each scenario
   - Indicators should reflect the drivers
   - Use models to predict the performance
   - Setup decision matrices
3. Take flexibility into account when assessing measures
   - COFAS "Comparing the Flexibility of Alternative Solutions"
   - Base: Utility Value Analysis

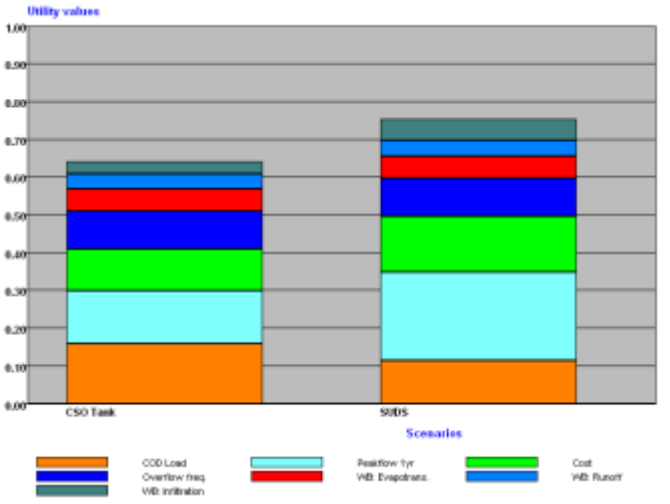
Utility Value Analysis (UVA)

- Classical method in Multi-Criteria Assessment (MCA)
- Transformation of indicators => standardized values
- Definition of utility value functions
- Example

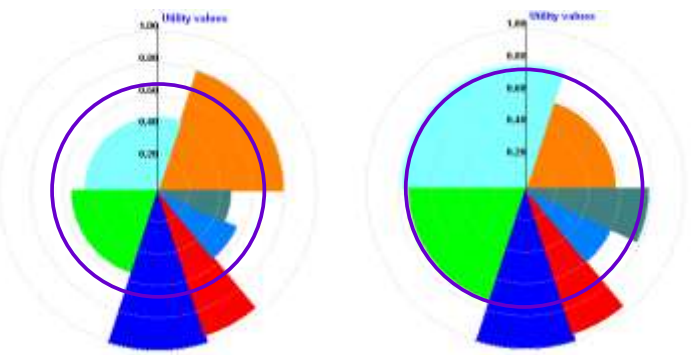


- Utility values are weighted...
- ...and added to the total utility value

Utility Value Analysis (UVA)



Robustness



CSO Tank SUDS

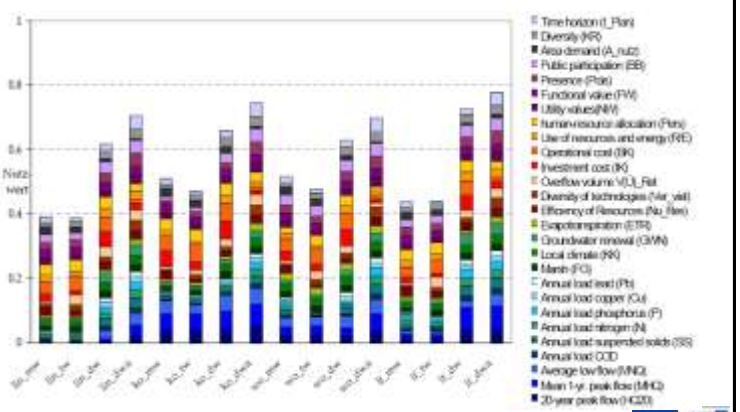
Robustness: Ability of a system to cope with changes of boundary conditions

Flexibility

- **Flexibility** (or Adaptability/Adaptiveness):
  Ability of a system to be adapted to future changes
- Example: Stormwater master plan for Kupferzell,
  a small City in southern Germany
- Futures scenarios have been developed

Name of scenario	*Description*
Linear scenario (lin)	Extrapolation of the actual development based on statistical information.
Loading case scenario (lf)	Combination of the results of a sensitivity analysis with plausible extremes for the boundary conditions. Maximum load for the system.
Growth-oriented scenario	Boundary conditions for a individualistic and consumer-oriented
Combined sewer system (mw)	New areas will be drained with a combined sewer system
Separate sewer system (tw)	New areas will be drained with a separated sewer system
Decentralised system (dw)	Stormwater runoff from new areas will be managed with a decentralised infiltration system
Extended decentralised system (dwa)	Stormwater runoff from new areas will be managed with a decentralised infiltration system. In addition 20% of the existing impervious area will be disconnected, for another 20% green roofs will be implemented and 20% of the water supply will be covered by rainwater utilisation.

Results of COFAS



Results of COFAS

all numbers in [%]	Combined sewer system	Separate sewer system	Decentralised system	Ext. decentr. system
Utility values				
Conservational scenario	51.4	47.4	66.4	74.1
Growth-oriented scenario	51.9	47.7	63.2	69.4
Linear scenario	39.3	38.8	61.9	70.1
Loading case scenario	44.1	44.1	72.9	77.5
Mean value	46.7	44.5	66.1	72.8
Internal homogeneity				
Conservational scenario	42.1	45.4	59.6	66.7
Growth-oriented scenario	61.6	40.0	65.6	64.2
Linear scenario	33.7	33.7	61.1	68.6
Loading case scenario	50.4	50.7	69.9	74.1
Mean value	46.9	42.4	64.1	68.4
External homogeneity				
	83.8	88.0	92.3	95.0
multi-dimensional, multi-variant Degree of Target Achievement (dvDTA				
	56.4	55.0	73.3	78.0

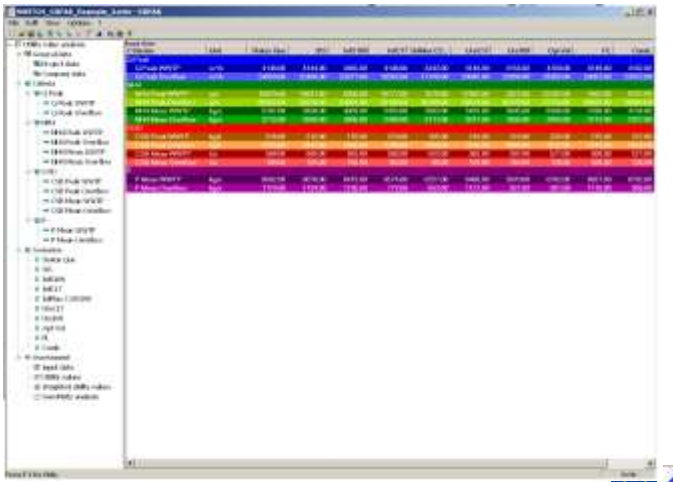
Conclusion

- For many USWM drivers future changes are unpredictable
- Robustness and Flexibility are important decision making criteria
- With COFAS, flexibility of different solutions can be measured and compared
- Decentralized systems (SUDS, source control) tend to be more flexible then conventional end of pipe systems

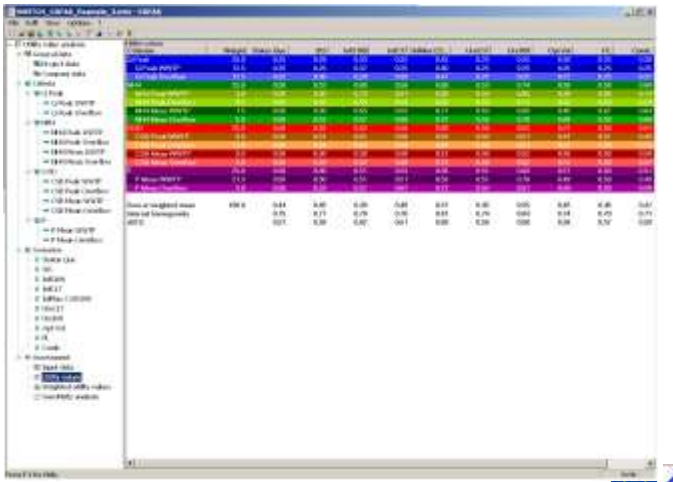
COFAS Software

- Flexibility assessment
- „Normal“ Scenario comparison
- Multi Criteria Analysis
- Mediating tool in learning alliances

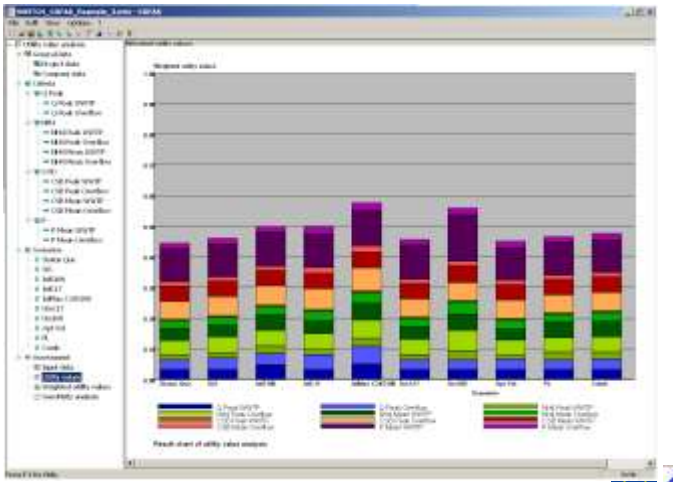
COFAS Tool, Input data



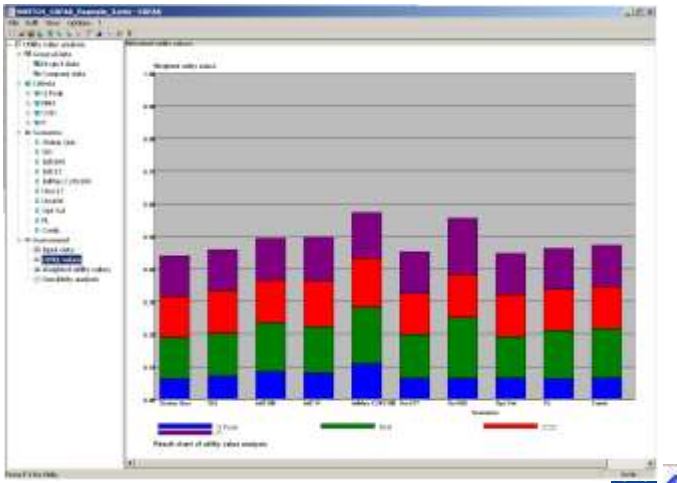
Output Table



COFAS, Output Chart



COFAS, Output Chart



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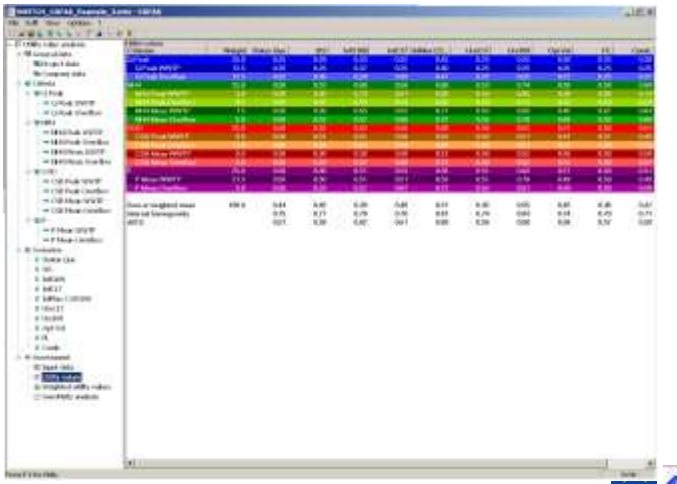

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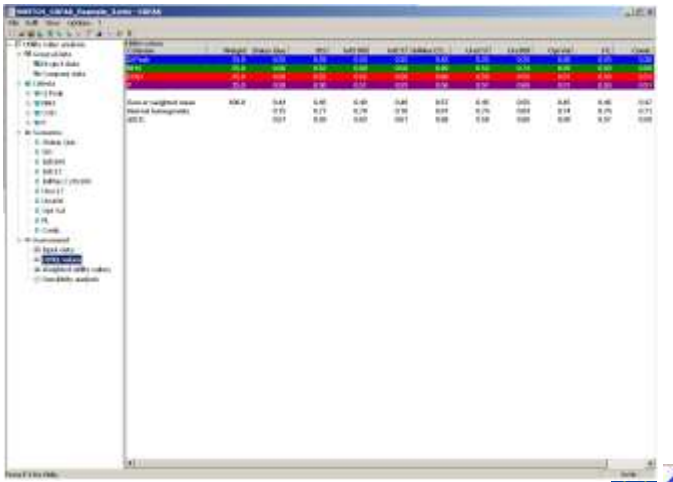

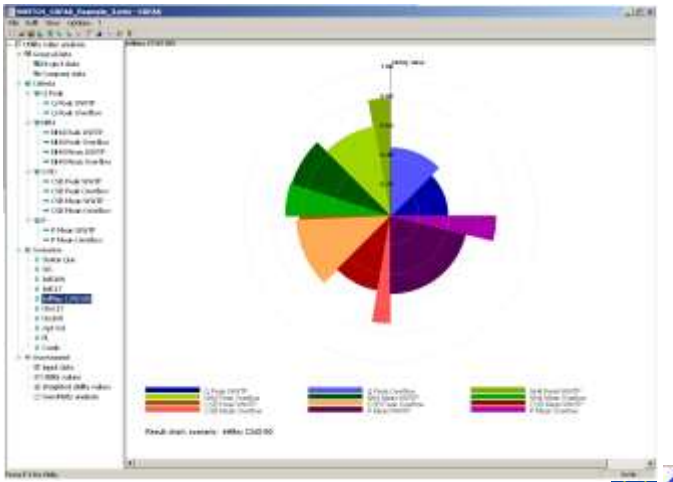

COFAS Download

- Download on the SWITCH Intranet (D 2.1.4)
  - http://www.switch.watsan.net/page/4748
  - Software
  - Example datasets
  - Documentation including introduction, tutorial and scientific background

Thank you for your attention

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