Anticipatory LCA

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LCA Forum, Zurich

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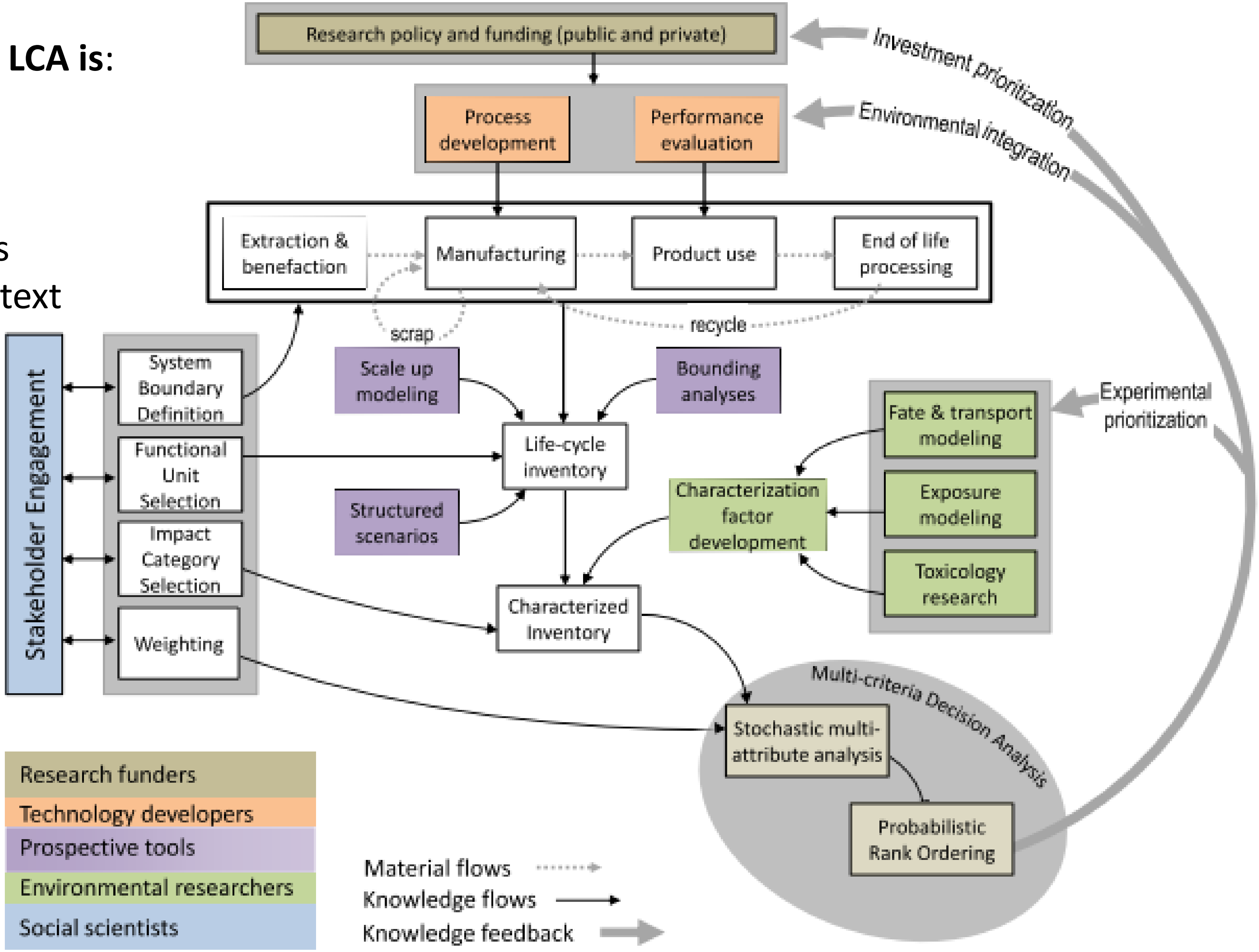
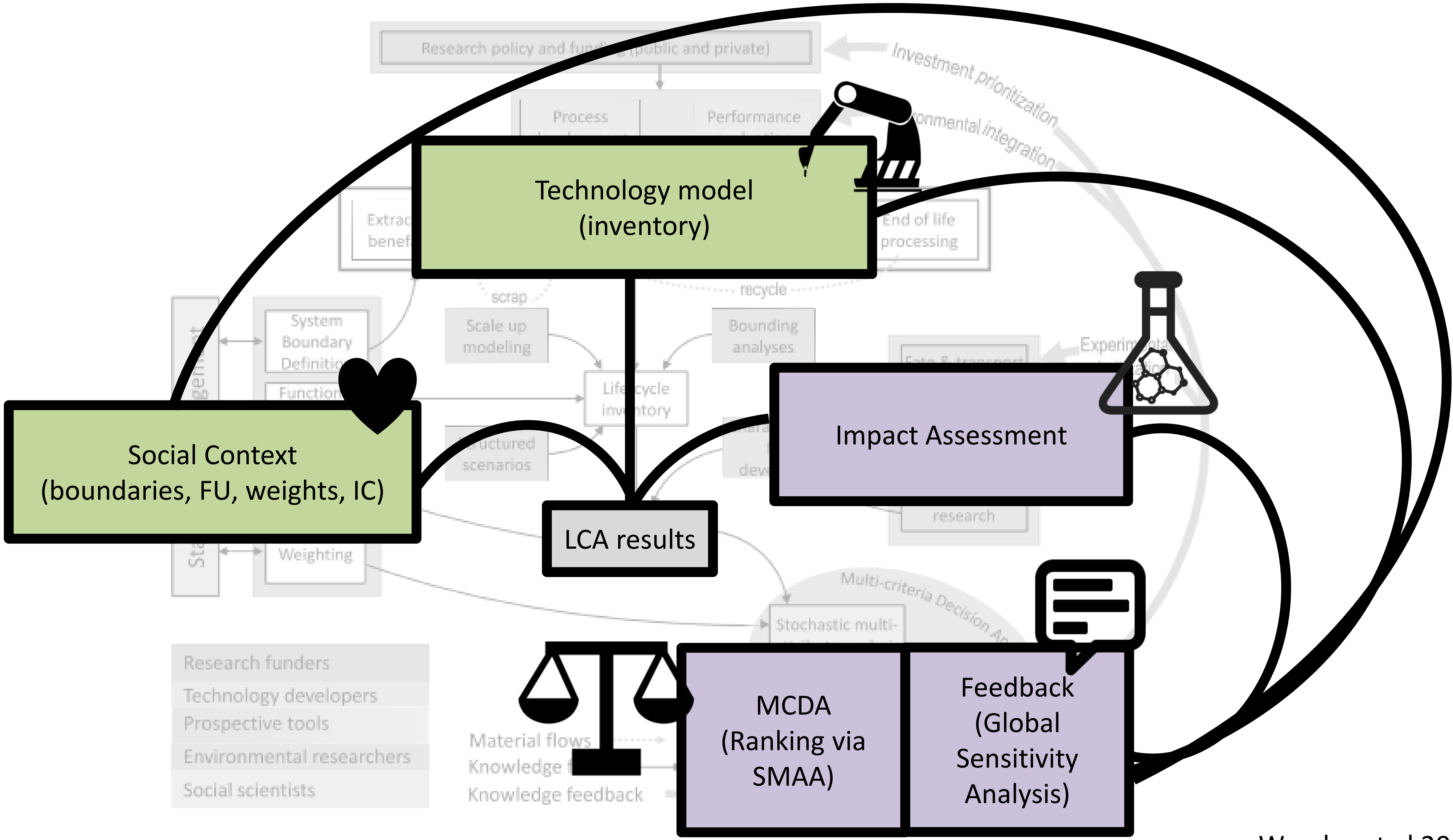
Anticipatory LCA is:
Explorative
Comparative
Design
Stoch. Values
Decision context



Wender et al 2014



Technology model
(inventory)

Social Context
(boundaries, FU, weights, IC)

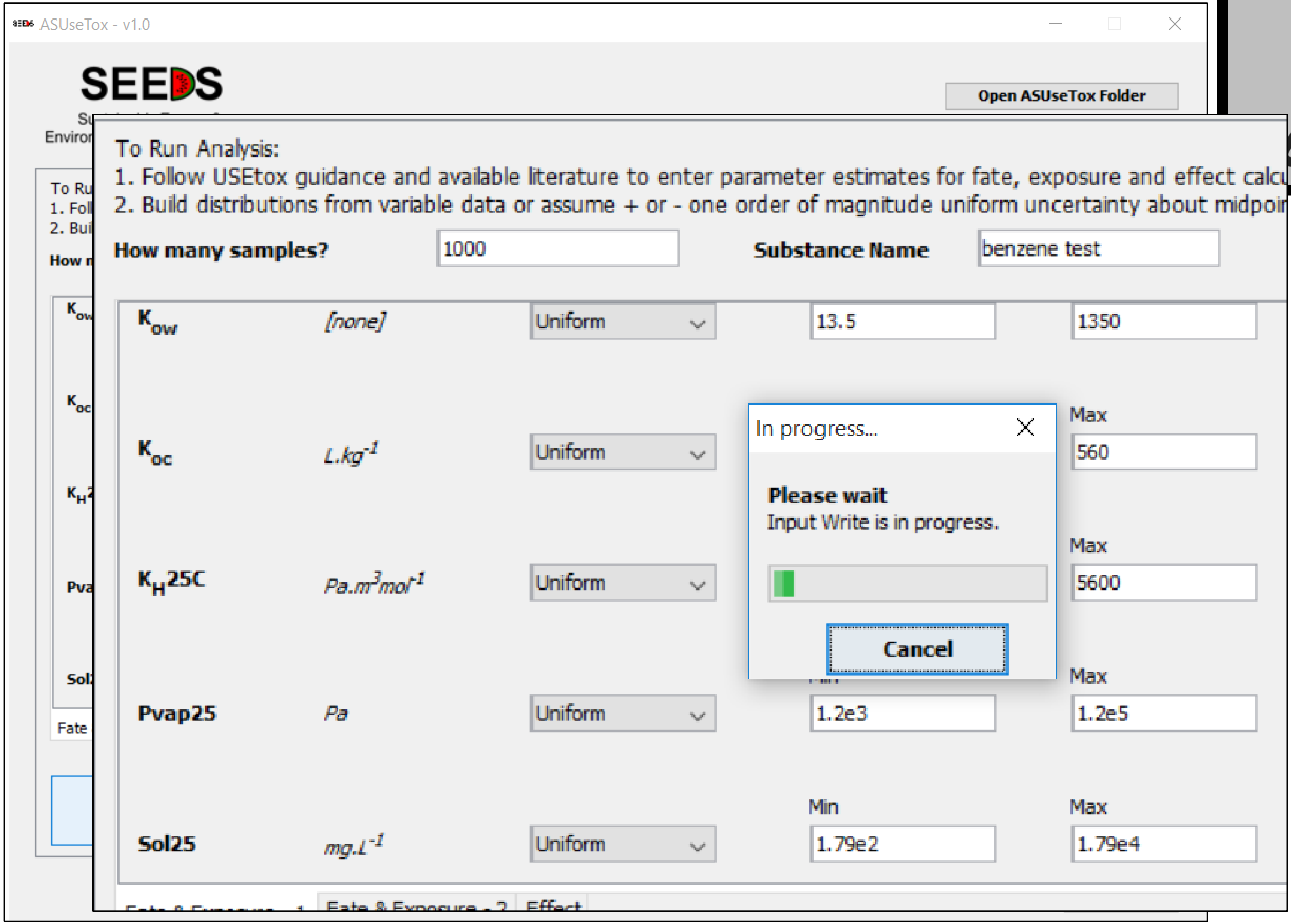
Impact Assessment

LCA results

MCDA
(Ranking via
SMAA)

Feedback
(Global
Sensitivity
Analysis)

Wender et al 2014



To Run Analysis:

1. Follow USEtox guidance and available literature to enter parameter estimates for fate, exposure and effect calcu
2. Build distributions from variable data or assume + or - one order of magnitude uniform uncertainty about midpoi

How many samples? 1000

Substance Name benzene test

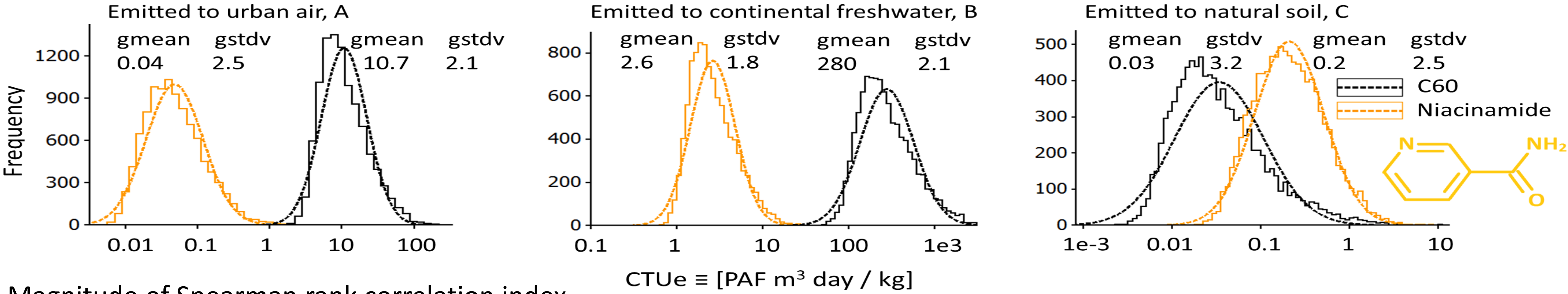
			Min	Max
K_{ow}	*[none]*	Uniform	13.5	1350
K_{oc}	$L.kg^{-1}$	Uniform		560
K_H25C	$Pa.m^3mol^{-1}$	Uniform		5600
Pvap25	*Pa*	Uniform	1.2e3	1.2e5
Sol25	$mg.L^{-1}$	Uniform	1.79e2	1.79e4

In progress...

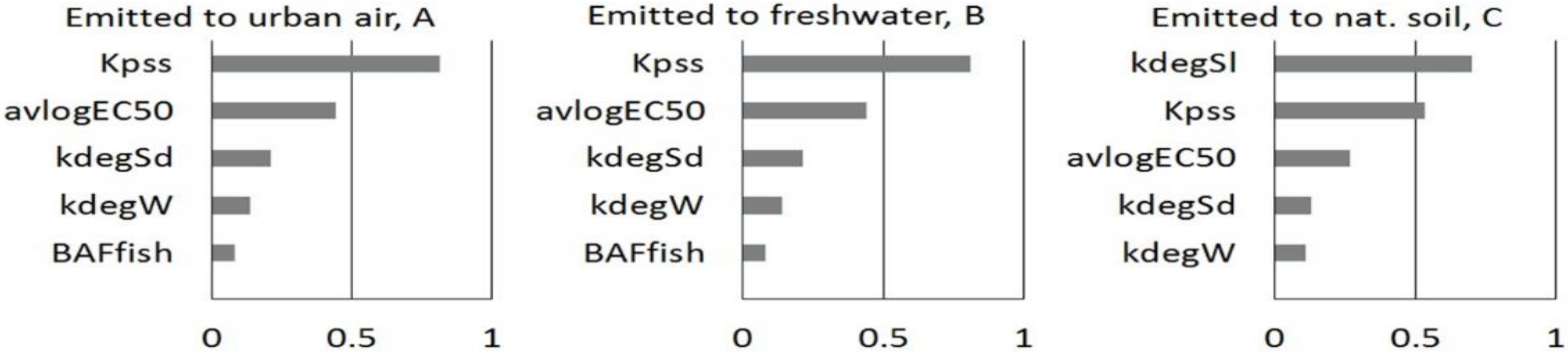
Please wait
Input Write is in progress.

Illustration of Stochastic Characterization factors and sensitivity of parameters

Characterization factors



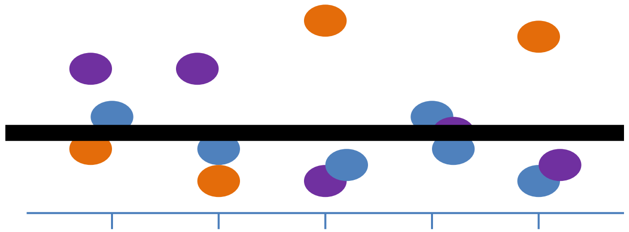
Magnitude of Spearman rank correlation index



Wender et al 2017 (accepted)

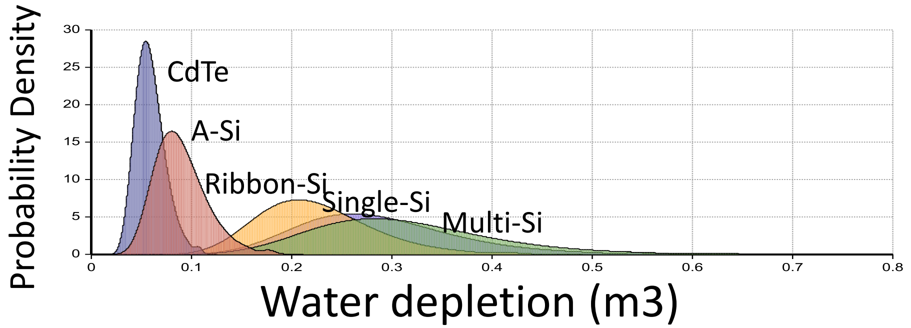
Impact Category	Unit	a-Si		CdTe		Multi- Si		Ribbon-Si			
		Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Agricultural land	m2a	4.9E-4	1.9E-4	6.9E-4	2.0E-4	1.2E-3	3.6E-4	1.0E-3	3.0E-4	1	
Climate change	kg CO2 eq	1.6E-2	4.1E-3	1.3E-2	2.5E-3	1.9E-2	4.0E-3	1.7E-2	3.6E-3	2.2E-2	4.8E-3
Fossil dep	kg oil eq	4.1E-3	1.1E-3	3.3E-3	6.8E-4	5.0E-3	1.1E-3	4.4E-3	9.1E-4	5.8E-3	1.3E-3
Freshwater ecotox	kg 1,4-DB eq	7.3E-6	2.4E-6	7.7E-6	2.3E-6	9.4E-6	2.8E-6	9.6E-6	2.7E-6	9.5E-6	2.7E-6
Freshwater eutroph	kg P eq	1.7E-5	1.0E-5	2.0E-5	2.1E-5	1.8E-5	1.0E-5	1.7E-5	1.1E-5	1.9E-5	1.2E-5
Human toxicity	k										
Ionising radiation	k										
Marine ecotox	k										
Marine eutroph											
Metal Dep											
Natural land trans											
Ozone Dep	k										
Particulate matter											
Photochem											
Terrestrial acid	kg SO2 eq	1.2E-4	3.1E-5	1.1E-4	2.3E-5	1.4E-4	2.9E-5	1.3E-4	2.7E-5	1.6E-4	3.4E-5
Terrestrial ecotoxicity	kg 1,4-DB eq	2.4E-6	9.8E-7	3.0E-6	1.3E-6	3.5E-5	3.4E-5	3.9E-5	3.0E-5	3.4E-5	2.8E-5
Urban land occup	m2a	1.9E-4	5.7E-5	1.8E-4	4.6E-5	2.1E-4	5.3E-5	1.9E-4	5.1E-5	2.3E-4	6.5E-5
Water Dep	m3	8.9E-2	2.6E-2	5.9E-2	1.4E-2	3.1E-1	8.8E-2	2.3E-1	5.7E-2	2.9E-1	7.7E-2

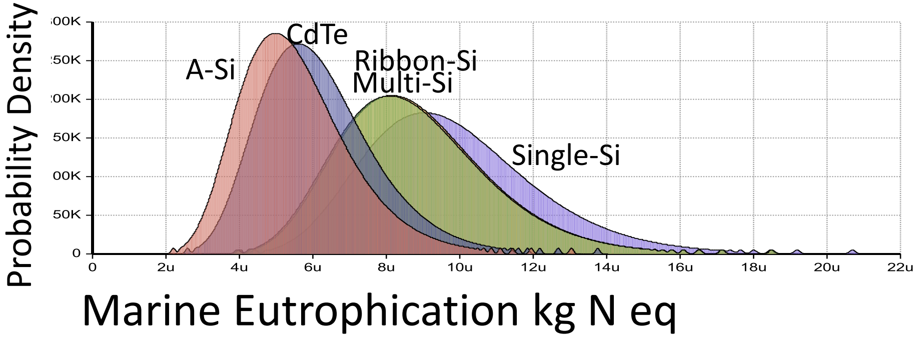
- Multiple indicators (& units)
- Uncertainty
- Decision Makers
- Not single optimization
- Best compromise

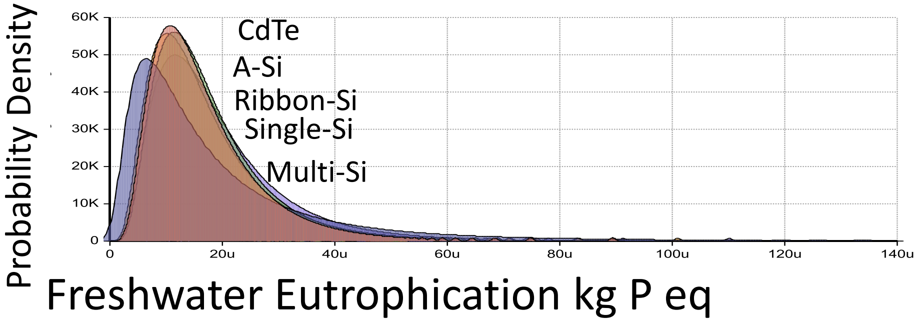


Tradeoff significance

	Impact Category	Avg area Eq. 9	Top 2
1	Water depletion	0.26	CdTe / A-Si
2	Terrestrial ecotoxicity	0.37	A-Si / CdTe
3	Marine eutrophication	0.40	A-Si / CdTe
4	Ozone depletion	0.48	A-Si / CdTe
5	Agricultural land occupation	0.51	A-Si / CdTe
6	Photochemical oxidant	0.54	CdTe / A-Si
7	Climate change	0.56	CdTe / A-Si
8	Fossil depletion	0.57	CdTe / A-Si
9	Particulate matter formation	0.67	CdTe / A-Si
10	Terrestrial acidification	0.73	CdTe / A-Si
11	Marine ecotoxicity	0.75	A-Si / CdTe
12	Metal depletion	0.78	Ribbon-Si / Single-Si
13	Freshwater ecotoxicity	0.79	A-Si / CdTe
14	Urban land occupation	0.83	CdTe / A-Si
15	Human toxicity	0.84	A-Si / CdTe
16	Natural land transformation	0.84	CdTe / A-Si
17	Ionising radiation	0.85	CdTe / A-Si
18	Freshwater eutrophication	0.88	A-Si / Ribbon-Si

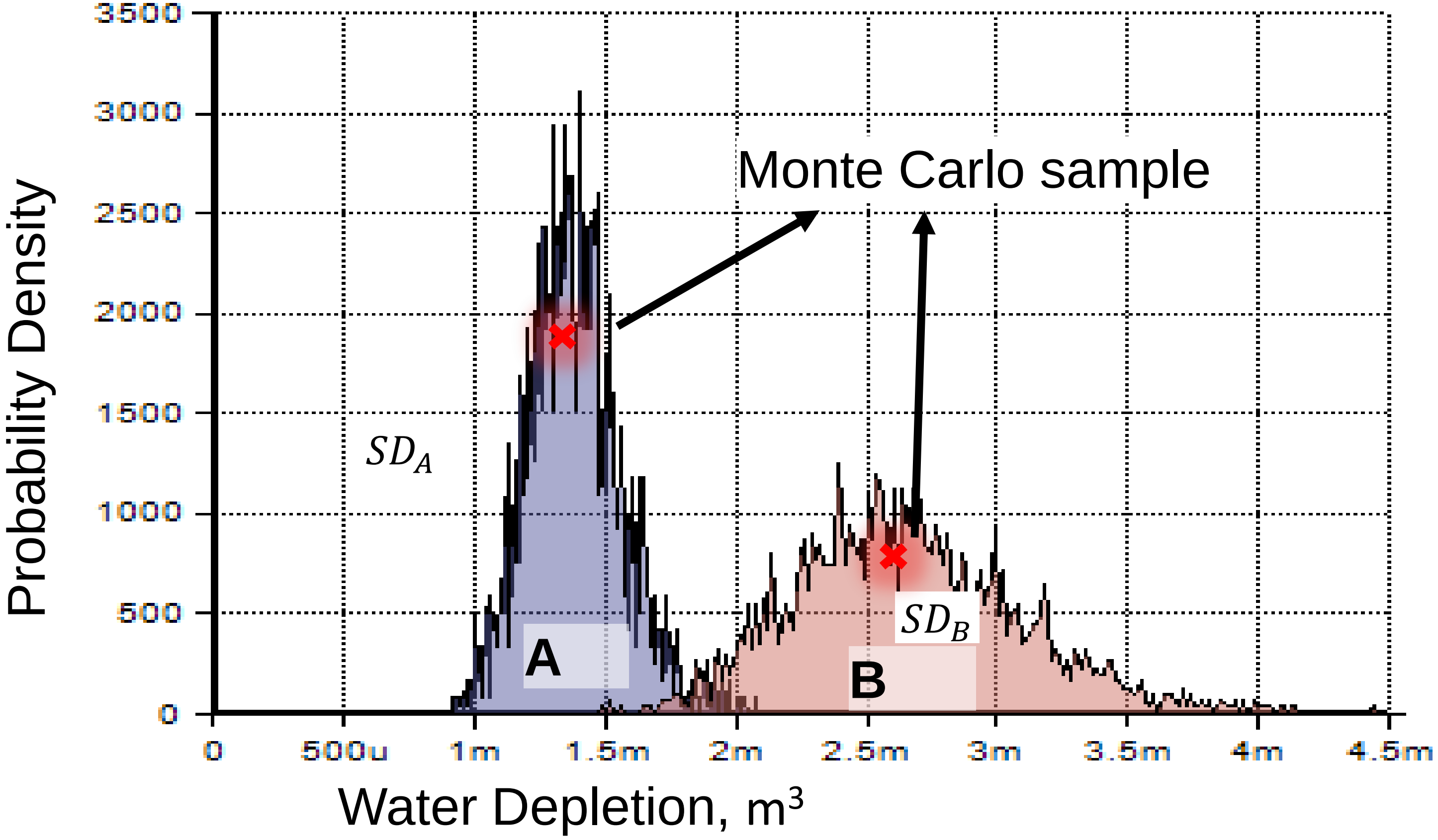


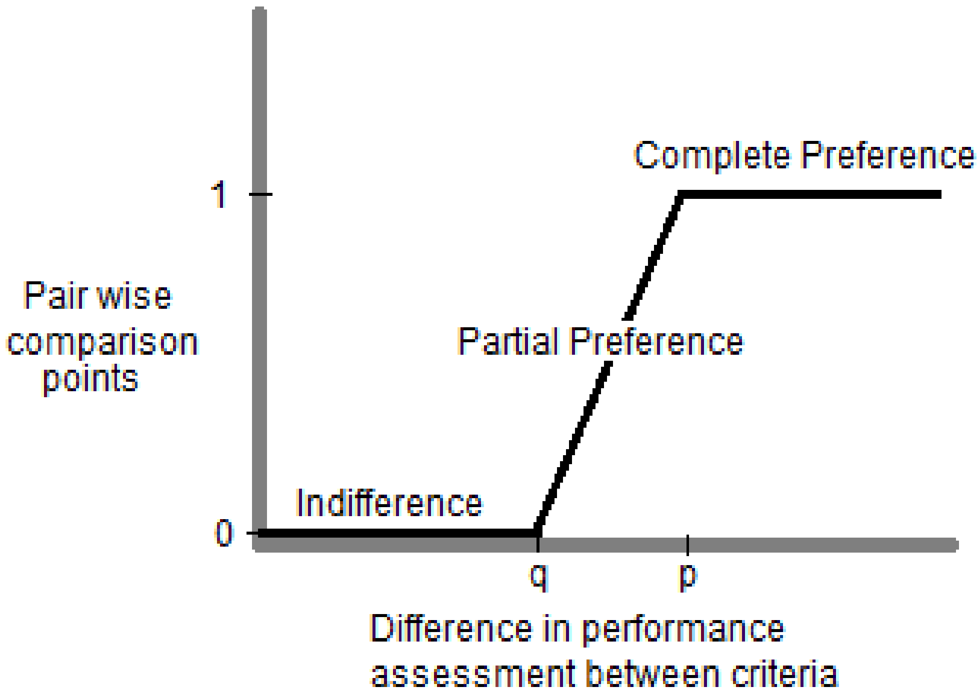




Prado-Lopez et al 2015

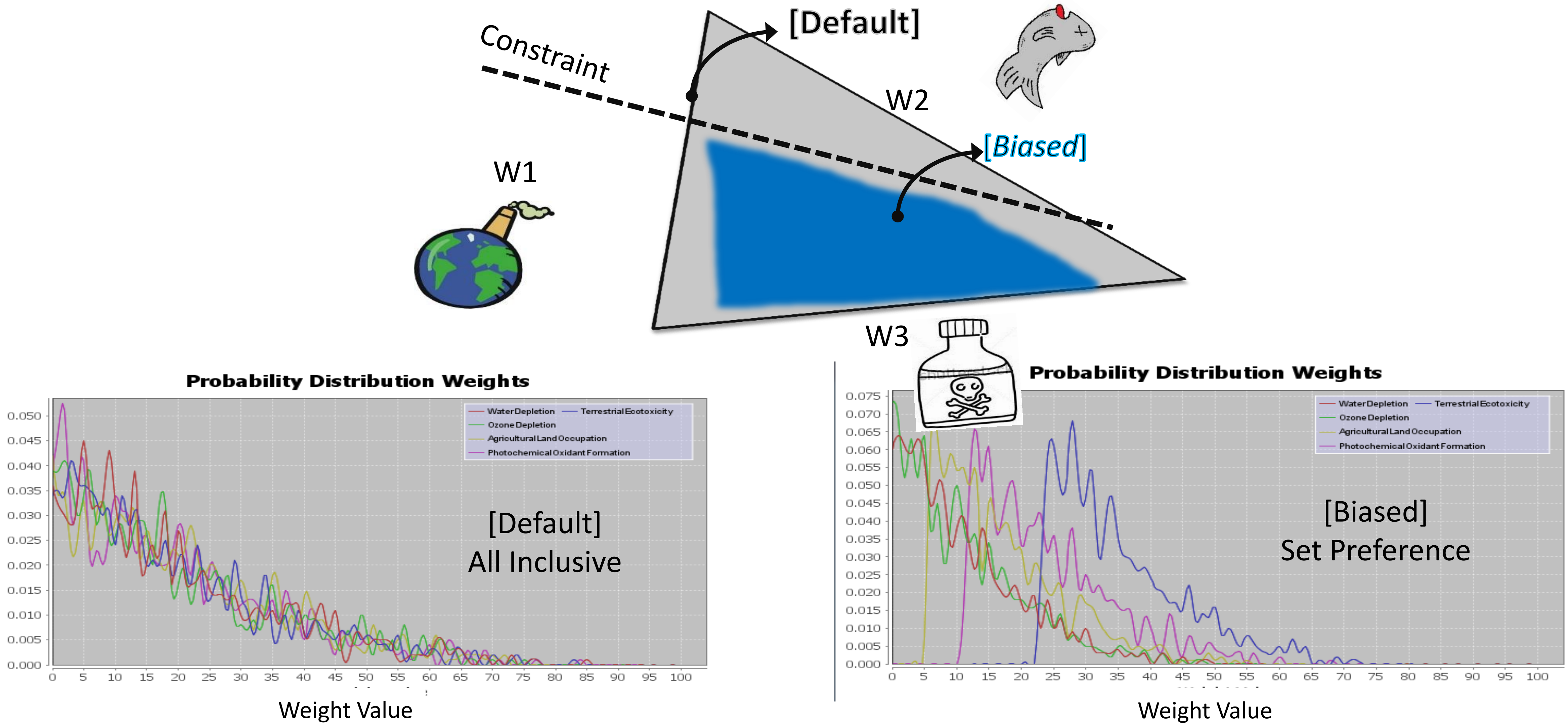
Stochastic multi attribute analysis (SMAA): Outranking



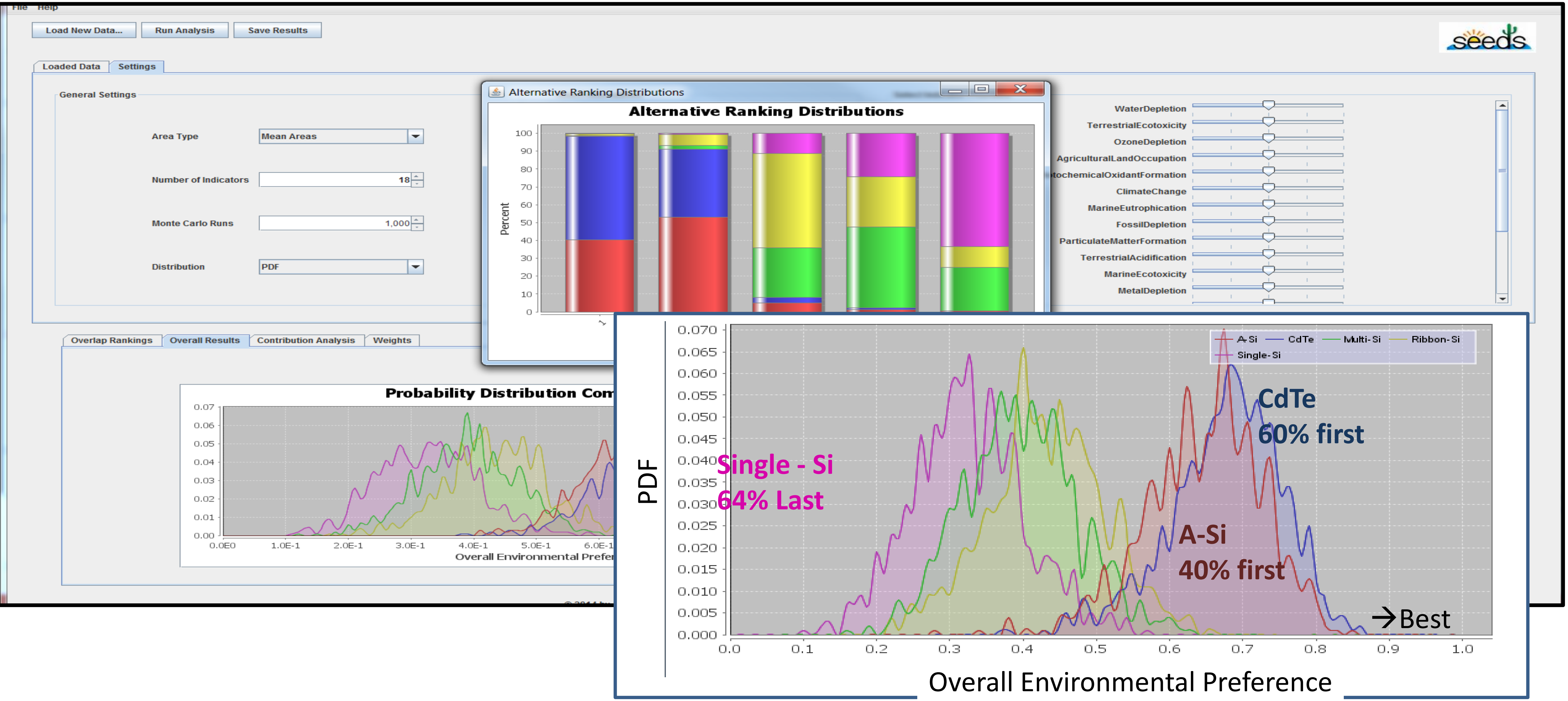


Prado-Lopez et al 2014

Stochastic multi attribute analysis (SMAA): Weights



SMAA-LCA



General Settings

Area Type: Mean Areas

Number of Indicators: 18

Monte Carlo Runs: 1,000

Distribution: PDF

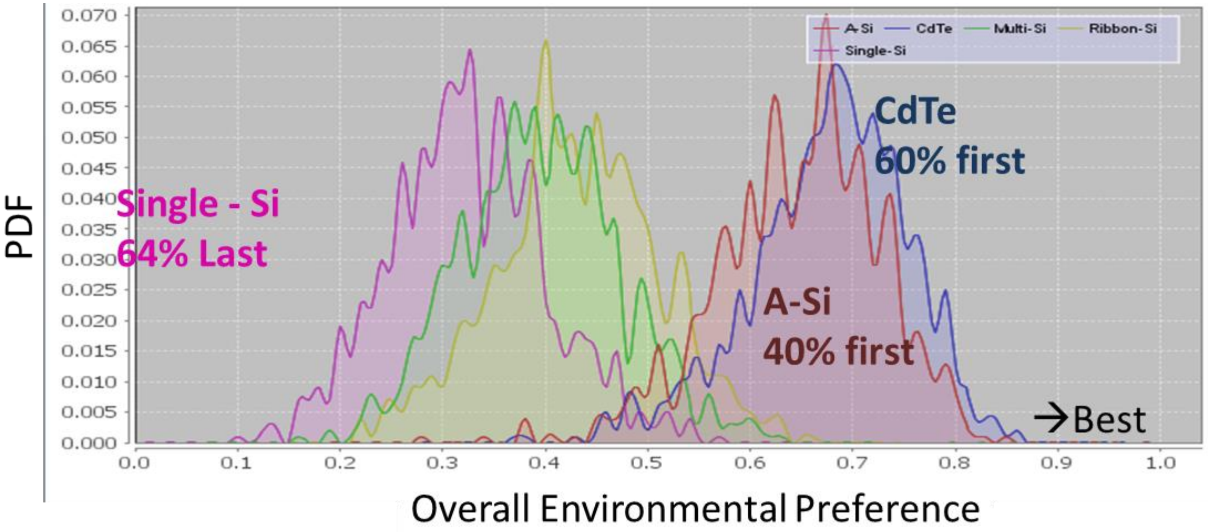
Overall Environmental Preference

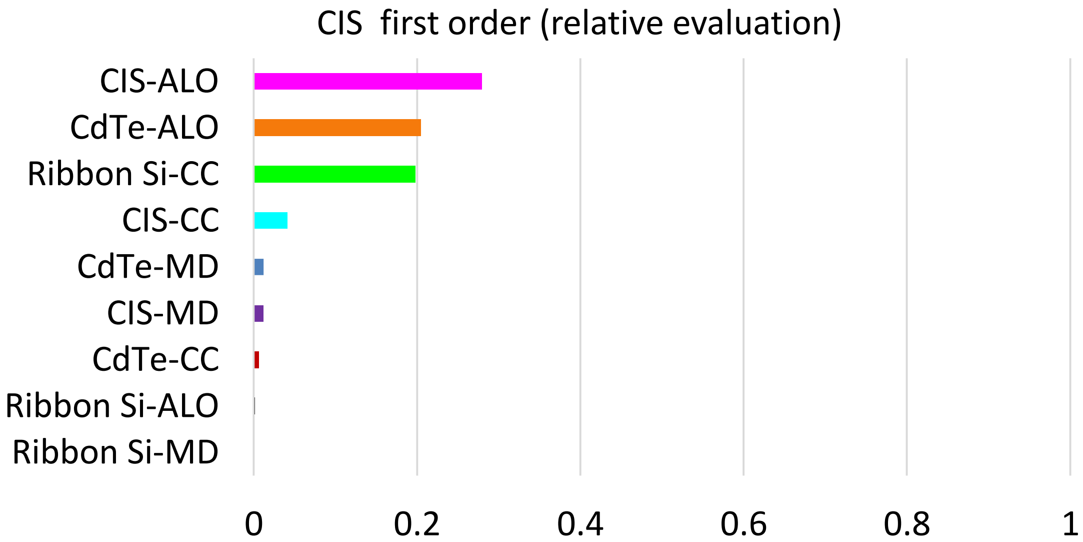
Single - Si 64% Last

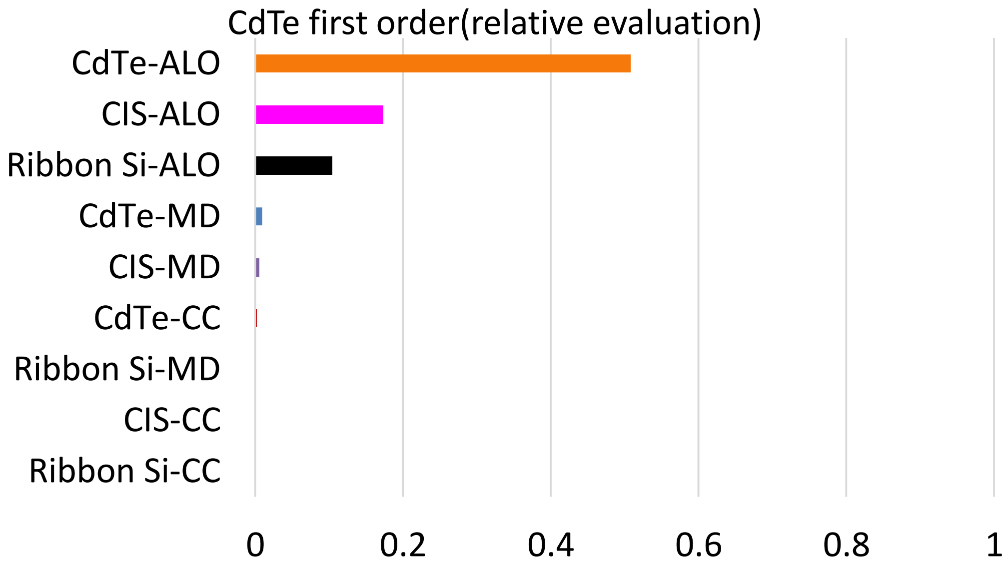
CdTe 60% first

A-Si 40% first

→Best



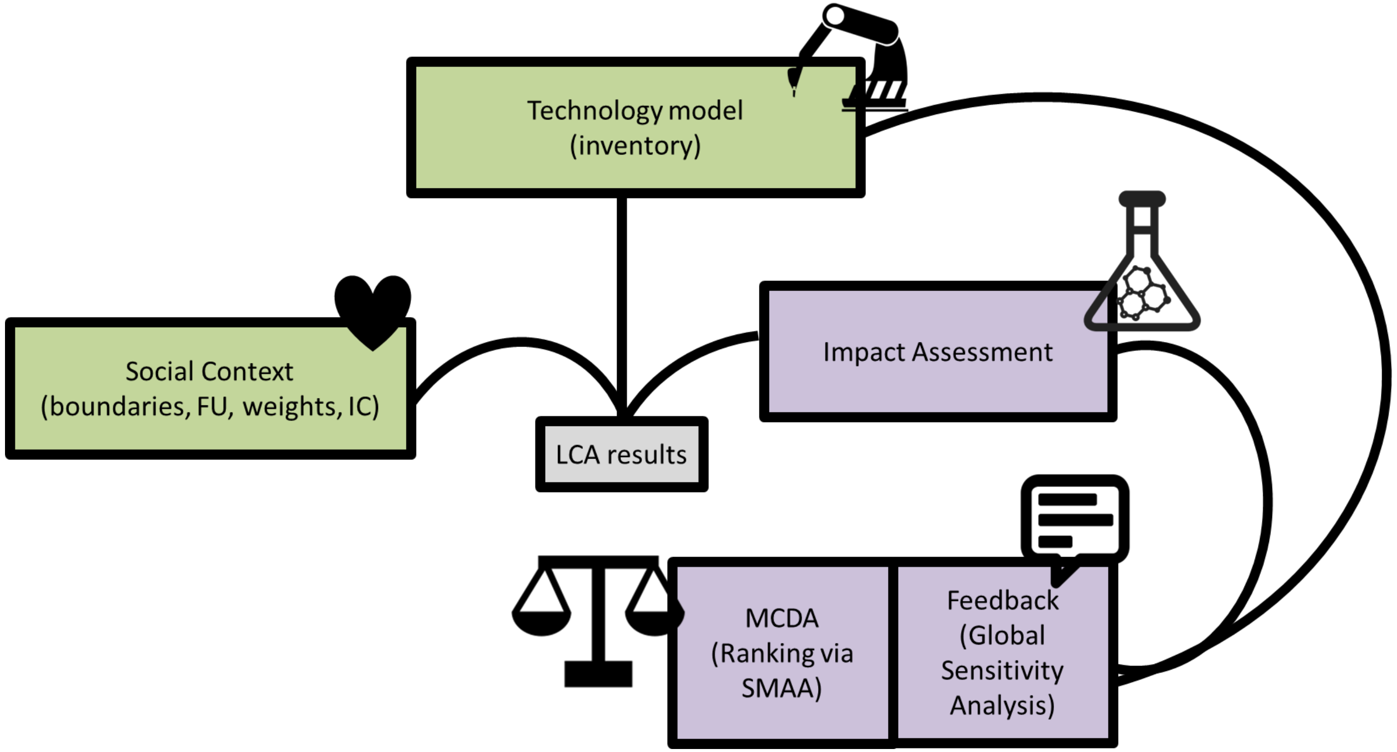

CIS first order (relative evaluation)


CdTe first order(relative evaluation)

Ravikumar et al 2017 (in prep)

Final remarks

- LCA for technology design
- Feedback: Data/experiment prioritization
- Inclusion of stakeholder values
- Incorporation of uncertainty in the decision



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