Taxonomy of Impact Categories and the Taxonomy Structure: Results from the UNEP/SETAC/EPA Hamburg Workshop

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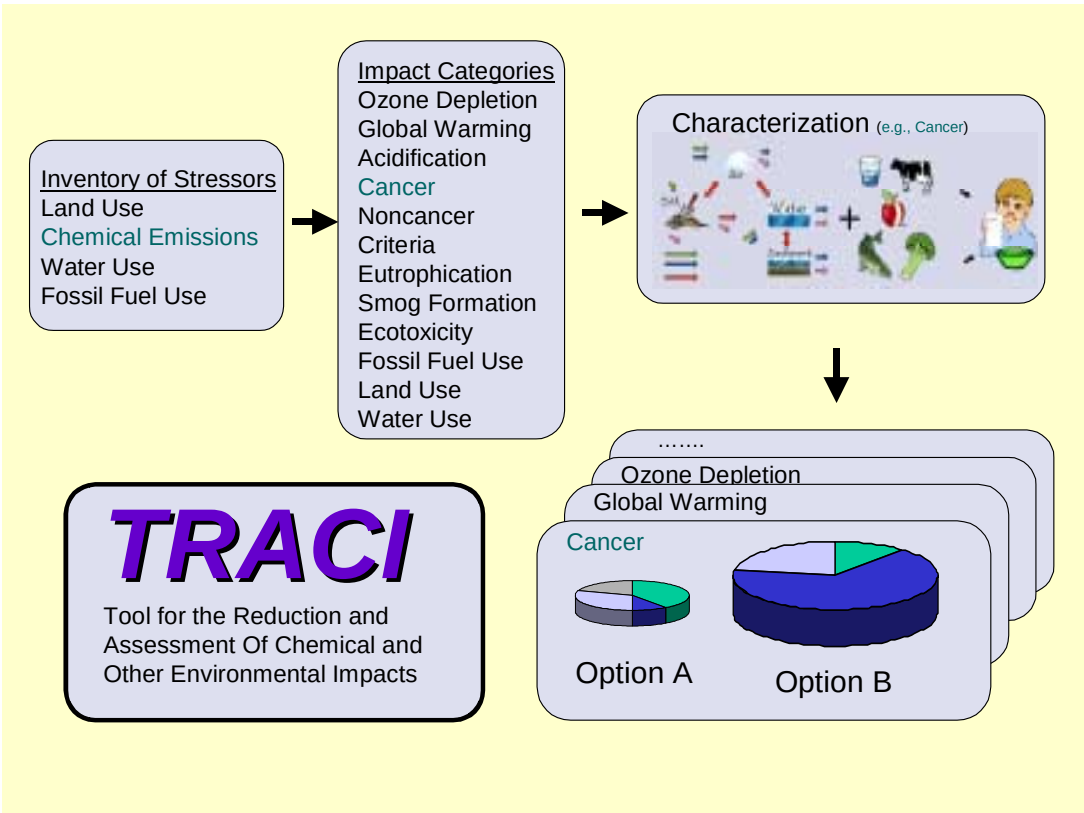
Goals of this Workshop

- To refine the meta model for LCA taxonomy focusing on the impact assessment.
- To challenge the inclusion of resource depletion
- To develop criteria for the selection of midpoint level categories, damage level categories, modes of contact, and areas of protection for any case study.
- To apply the meta model for taxonomy to the UNEP-SETAC LCIA Framework.
- To discuss the integration of social and economic dimensions.

History of this Work

- During EPA's development of TRACI, discussed internally what impact categories were "in" and "out." (http://epa.gov/ORD/NRMRL/std/sab/iam_traci.htm)



UNEP message on LCIA

1. Be less academic; the midpoint-endpoint framework is fine, but the first tasks should focus on recommended midpoint factors;
2. Link your work to the applications;
3. Include the social and economic aspects of sustainability;
4. Consider the impacts in all parts of the world;
5. Focus on a reduced number of practical key indicators;
6. Establish a multi-stakeholder dialogue with the users.

Challenges for LCIA

1. Further research on damage assessment or establishment of widely acceptable midpoint factors?
2. Which applications to focus on?
3. How to combine reliability and user-friendliness?
4. What are the key indicators?
5. Focus on environmental impacts that are relevant in different parts of the world or broadening the scope by inclusion of social and economic impacts?
6. Who are the stakeholders to talk to?

Workshop Sought to Investigate Following Questions:

- **Question # 1:** Looking at the Taxonomy Meta Model, are there inconsistencies, missing elements, redundant elements, or elements which are presented at too finely differentiated or too coarsely differentiated levels?
- **Question # 2:** Is the meta model appropriately designed to handle resource depletion issues? Or how should it be changed?
- **Question # 3:** What are the criteria for inclusion and exclusion of midpoint level, damage level, mode of contact, and areas of protection, making use of the Taxonomy Meta Model?
- **Question # 4:** Applying the Taxonomy Meta Model and the above criteria -- what is a consistent and consensus-based list of elements which should be included at the midpoint level, damage level, mode of contact, and areas of protection for the UNEP-SETAC LCIA Framework?
- **Question # 5:** How should social and economical dimensions be integrated into the LCIA framework?

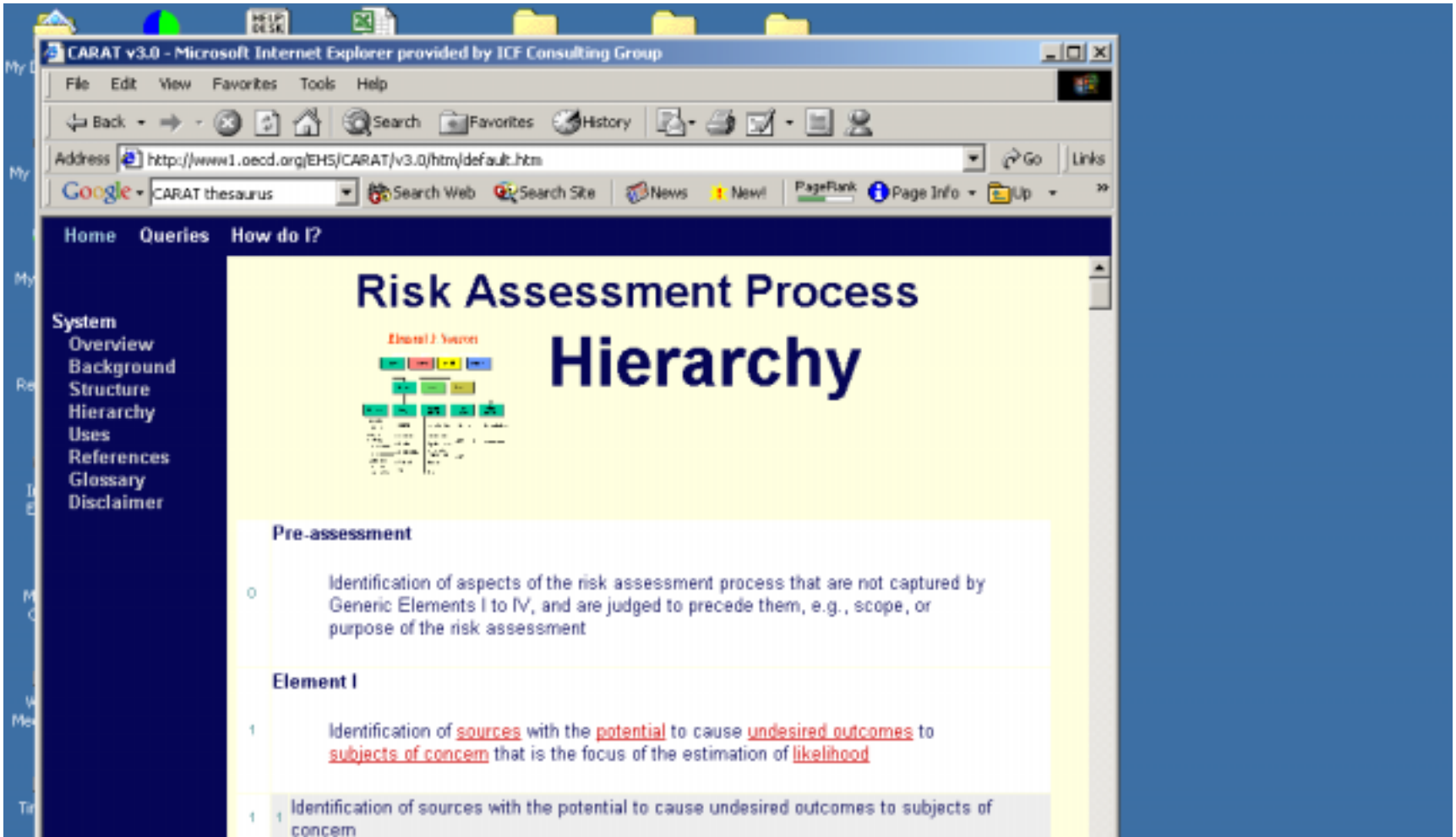
Meta Model for LCA Taxonomy

- Value of meta model is its use in LCA study design.
- Developed with focus on LCIA common categories (e.g., midpoint categories consistent with UNEP-SETAC, TRACI, and others.)
- Focused on environmental aspects independent of social and economic impacts.

Based on CARAT system

(Chemical Accident Risk Assessment Thesaurus)

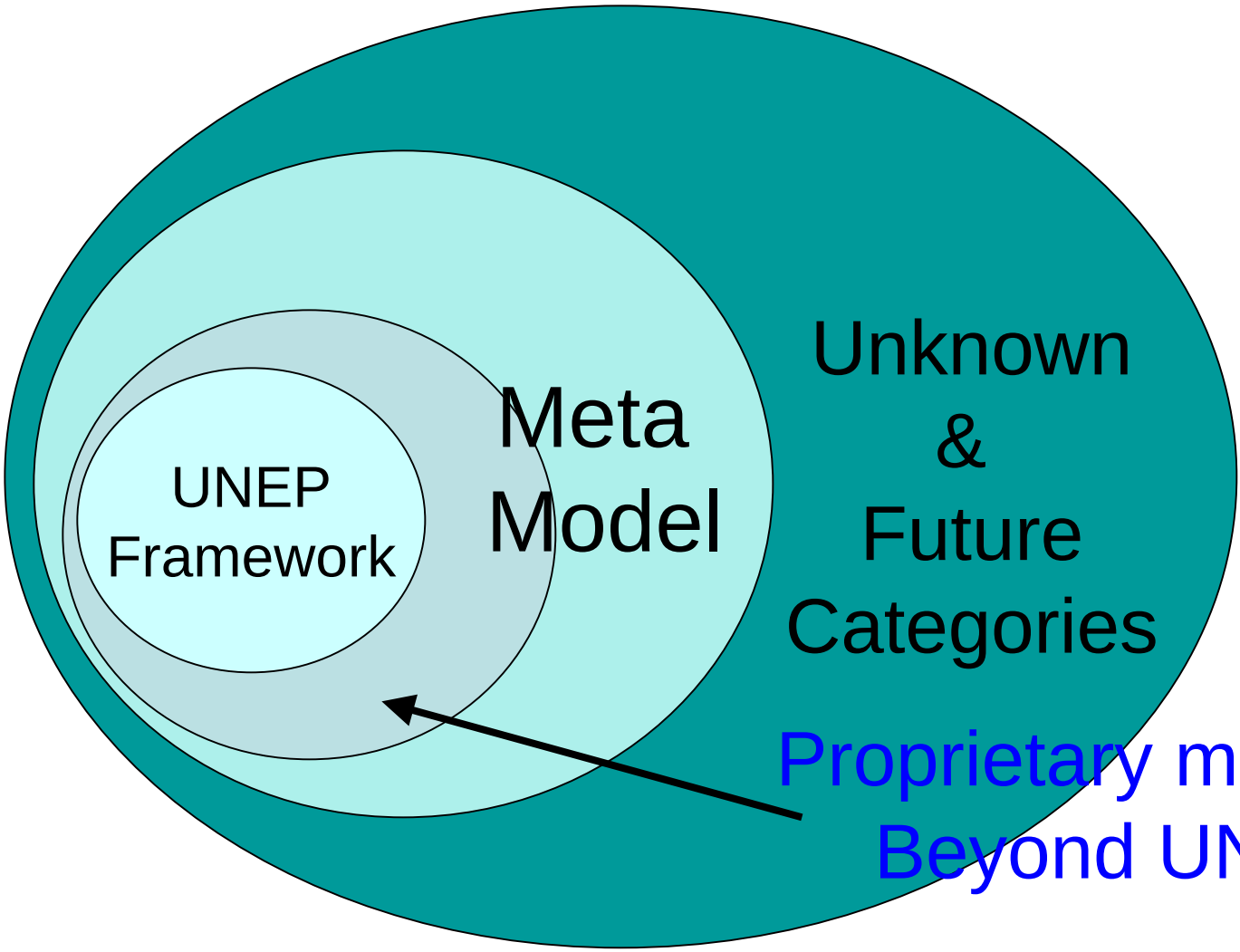
- Developed by OECD in conjunction with U.S. EPA CEPPO. (www.oecd.org/ehs/carat)



Purpose of Meta Model

- To capture the general procedural structure, state-of-the-science, and terminology.
- To provide a comprehensive, transparent structure from which one can discuss what is included and excluded within a particular study.
- To promote communications about impact assessment methodologies, including the commonalities and differences among the various approaches.

Relationship to Other Frameworks



2	**Impact Assessment** Classification of inputs (resources used) and outputs (emissions) and Characterization of the potential to cause impacts to areas of protection (endpoints)			
2	1	Midpoint Classification of inputs (resources used) and outputs (emissions) with the potential to cause impacts (undesired outcomes) to areas of protection		
2	1	1	Midpoint Category - Emission Related	
2	1	1	1	**Human Health Effects (Human Toxicity)**
2	1	1	2	**Accidents**
2	1	1	3	**Noise Related Effects**
2	1	1	4	**Oxidant creation (Smog Formation)**
2	1	1	5	**Ozone depletion**
2	1	1	6	**Global Warming (Climate Change)**
2	1	1	7	**Acidification**
2	1	1	8	**Nutrification (Eutrophication)**
2	1	1	9	**Ecotoxicity**
2	1	1	10	**Species & organism dispersal (inc. GMO, invasive)**
2	1	1	11	**Waste**
2	1	1	12	**Radiation Effects**
2	1	1	13	**Pathogenic Effects**
2	1	1	U	**Undefined midpoint category source**
2	1	2	Midpoint Category - Resource Related	
2	1	2	1	**Minerals**
2	1	2	2	**Energy**
2	1	2	3	**Water (use – surface, ground, ocean)**
2	1	2	4	**Land Use & Habitat Losses**
				Physical Modification to Land (forest cutting, paving, landscaping, hunting)

Meta Model Discussion: *Question 1*

- The US EPA taxonomy project was presented as a communication tool for assistance in the selection of impact categories
- Group Discussion Points:
  - Definitions are essential to the meta model
  - Difficult to separate inventory and IA
  - Clear representation of relationships important to be expressed in the model
    - midpoint ⇔damage assessment integration
  - Indicators for both midpoint impacts and DA in Taxonomy
  - To fill in the model, work from the ends and meet in the middle

Resource Depletion: *Question 2*

- Issues of Resource Depletion were presented in the context of metals mining:
  - Increased demand for metals and recycling limitations suggest that resource depletion should be considered in LCIA.
  - Should be considered as midpoint indicator for its long term environmental impacts
    - ***Example: depletion of high grade ores will produce higher impacts and higher energy consumption for each unit of metal produced in the future.***
  - Midpoint indicators should not only reflect the degree of scarcity of the particular metal but also the potential actual misuse of the resource due to the low recovery of the current mining and metallurgical processes in use.

Metals Resource Depletion: *Question 2*

- Group Discussion Points:
  - Impacts due to mining are currently considered in Damage Assessment
  - It is difficult to estimate depletion of an ore
  - Dependencies should be considered (e.g. ores that are recovered simultaneously)
  - Important issue for LCI – concentration when it enters and leaves the technosphere
  - Time horizon – discounting should be left to valuation

Criteria to Include Impact Categories: *Question 3*

- Main question: what are criteria for selection of impact categories, using the taxonomy meta-model?
- In fact two questions:
  - criteria for inclusion in the taxonomy meta-model itself
    - Real progress and important contribution to LCIA Definition Study
    - Inconsistencies/questions were raised regarding LCI, midpoint, and endpoint
  - criteria for selection for ad hoc LCA study
    - All relevant categories
    - All categories at the same level
    - Surveyable number in relation to decision making

Criteria to Include Impact Categories: *Question 3*

- Group Discussion Points:
  - Relevance to damages on environment / urgency of problem
  - Relevance to policy context
  - Addresses / consistent with available inventory data
    - Fitness and appropriateness to inventory
  - Should include environment and human health characteristics
  - General acceptance:
    - Scientifically based and internationally recognized
    - Consensus and robustness
    - Acceptance in practice/developed a “tradition” (established)

Criteria to Include Impact Categories:*Question 3*

- Group Discussion Points:
  - Link to LCI Results that draws from basic tenets of epidemiology:
    - time order (exposure must precede the effect);
    - strength of association (relative risk);
    - specificity of a compound to an effect (does X lead to Y?);
    - consistency on replication (results are supported across studies, geographic areas, and over time);
    - coherence with theory (the relationship must be plausible); and
    - performance on prediction (does the test stand up to empirical evidence?).

UNEP Framework Priorities: *Question 4*

- Group Discussion Points:
  - Priority Damage Categories for the definition study:
    - Human health
    - Biotic natural environment
  - Also, include at midpoint:
    - Accidents and risks
    - Noise
    - Species dispersal

Discussion of Socio-Economic Aspects: *Question 5*

- Summary of Presentation:
  - LCAs should include social indicators with engaged stakeholders
  - Is an LCA without social indicators no use to developing countries?
    - Absolutely not!
    - But can give wrong signals
  - Are solutions to be found in LCM?
    - Yes, but not suitable to all applications and practitioners
    - high cost and too complex
  - Could create significantly more appealing and useful tool for developing country users if included simple social indicators.

Discussion of Socio-Economic Aspects: *Question 5*

- Group Discussion Points:
  - DALY calculations could be used as a metric to assess value of creating jobs in developing countries
  - Decisions are most apparent when there is a supply chain choice
    - However, could create possible perverse effect of social indicators by stimulating inefficient industries that out-compete cleaner industries in the long run.
  - Economic pathways may have positive impacts on HH which may override environmental impacts.
  - Careful not to funnel money without knowing where it is going

Discussion of Socio-Economic Aspects: *Question 5*

- Group Discussion Points:
  - Motivation is for LCA is to bring in externalities - careful not to bury process
  - LCIA is a good point to originate exploration
  - We only know our proximate consequences – LCA helps us to figure out the pathways beyond and their consequences
  - LCA adds information in addition to costs/price
  - HH and social attributes may dilute environmental assessment.

Discussion of Socio-Economic Aspects: *Question 5*

- Group Discussion Points:
  - Need to bring the method to engaged entities
  - Perspectives are a concern
    - state explicitly all aspects
    - Multi-attribute analysis methods to address this
  - Stuffing the LCA tool with out concern for meaning
    - need for a systematic approach
  - Measuring everything might not be in harmony with other groups

Discussion of Socio-Economic Aspects: *Question 5*

- Group Discussion Points:
  - Recognition to garner aid by toxicity folks to bring greater sophistication to LCA methods
  - LCA is not the only tool – getting as much as we can and then point to better tools
  - Large cultural differences with indicators and this is a concern, challenge and opportunity
  - Interest in creation of a Task Force in the UNEP LC Initiative - The LCA SD Task Force
  - LCIA is a good starting point to move towards creating a sustainable development decision making tool.

Next Steps

Outputs of workshop

- Proceedings with PowerPoint presentations to be located on website ***http://www.uneptie.org/sustain/lcinitiative***
- Paper with discussion points and conclusions
  - First draft prepared by J. Bare and T. Gloria
  - Review by workshop steering committee and contributors
  - Final draft by J. Bare, T. Gloria and others who contributed essentially to revision of paper
  - Publication in Int.J.LCA
- Option for contributors to publish paper in same Int. J. LCA issue