

LCA in Business Decision Support Systems

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Life Cycle Assessment VIII

'Calculating Consequences Beyond the Box'
American Center for Life Cycle Assessment

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3:30 to 5:00 pm

Seattle, Washington

Overview

- LCA & Business Decisions
 - How can LCA be used in business decision making/planning to improve sustainability?
- Approaches to Integrating LCA & Business Decision Support Systems
- LCI Data Uncertainty

LCA & Business Decisions

The Business Imperative

- The financial bottom-line determines business survival and growth, though the “triple bottom-line” (people, planet, profit) arguably determines thriving.
- Financial (e.g., break-even, ROI) and market life cycles (e.g., product development, market introduction, market maturation, market withdrawal) is the focus of business planning
- Physical life cycles and environmental aspects/impacts is the focus of life cycle assessment (LCA).
- LCA literature sometimes addresses business issues (e.g., see Schenk 2000), but not in detail. Models/software often provide cost parameters, but not comprehensive financial metrics and not on firm/product line basis.

LCA vs. Business Attributes

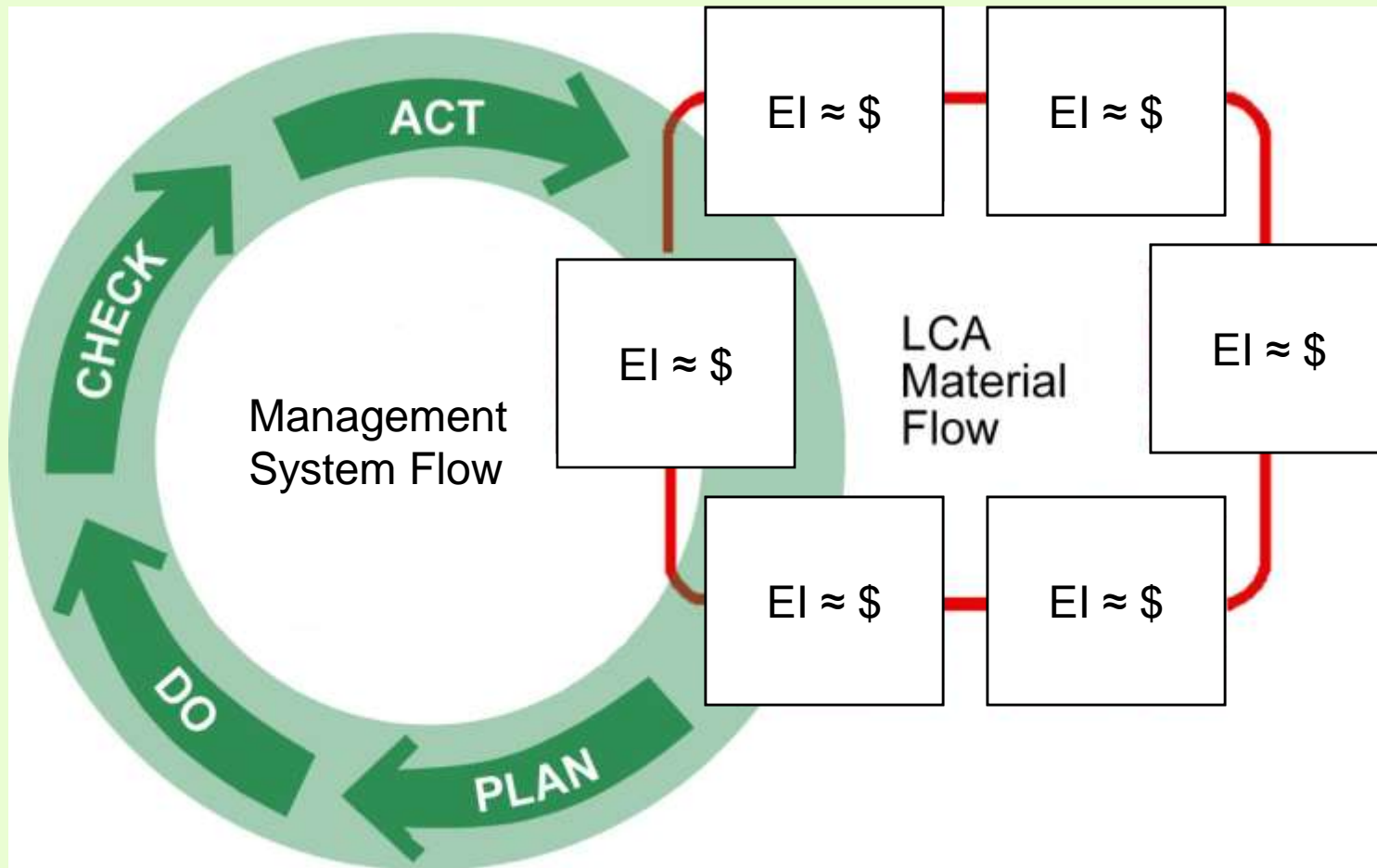
Example LCA Impact Attributes

- Global Climate Change
- Stratospheric Ozone Depletion
- Eutrophication
- Acidification
- Human Toxicity
- Ecotoxicity
- Resource Depletion

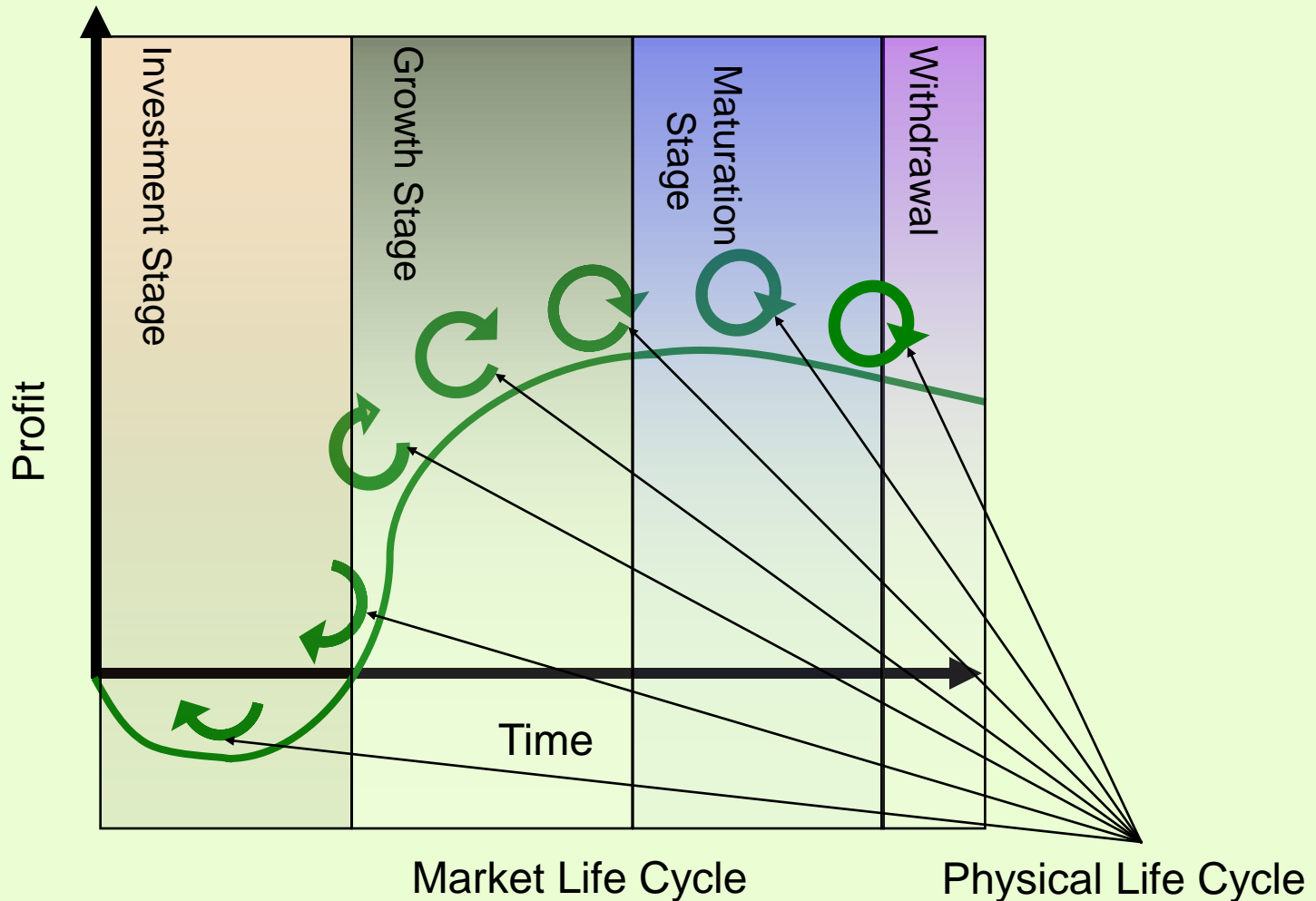
Example Business Impact Attributes

- Return on Investment
- Profit
- Costs
- Market penetration
- Market risk
- Liability risk
- Customer relations
- Brand

LCA & Business Focus



Market & Physical Life Cycles



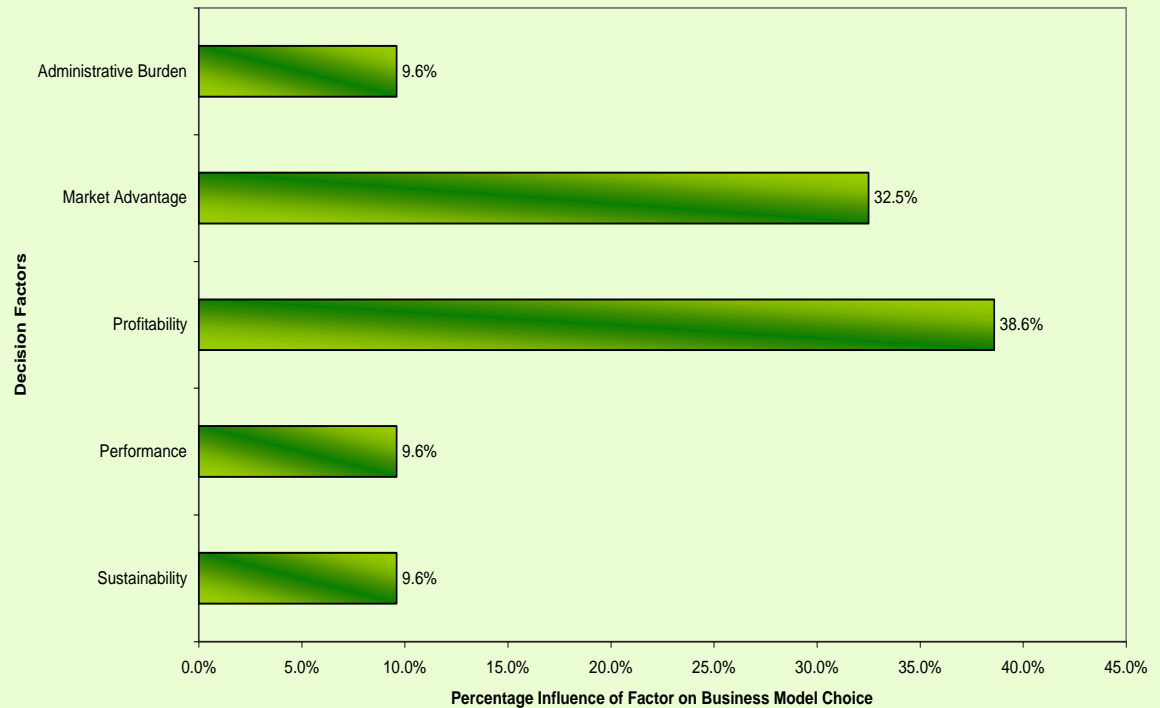
Analysis of Business Attributes

- tGT developed Analytical Hierarchy Processing (AHP) model using input from 5 building product industries (resilient flooring, wall protection, skylight control system, single ply membrane roofing, and solar power panels)
- Modeled decision is a selection between current and 2 potentially environmentally preferable business models involving product service systems (PSS)
- AHP model maximizes performance on five decision factors (sustainability, product performance, profitability, market advantage, and administrative burden).

Business Decision Attributes: AHP Results

Overall, results indicate traditional business metrics drive decision to adopt more sustainable business offering

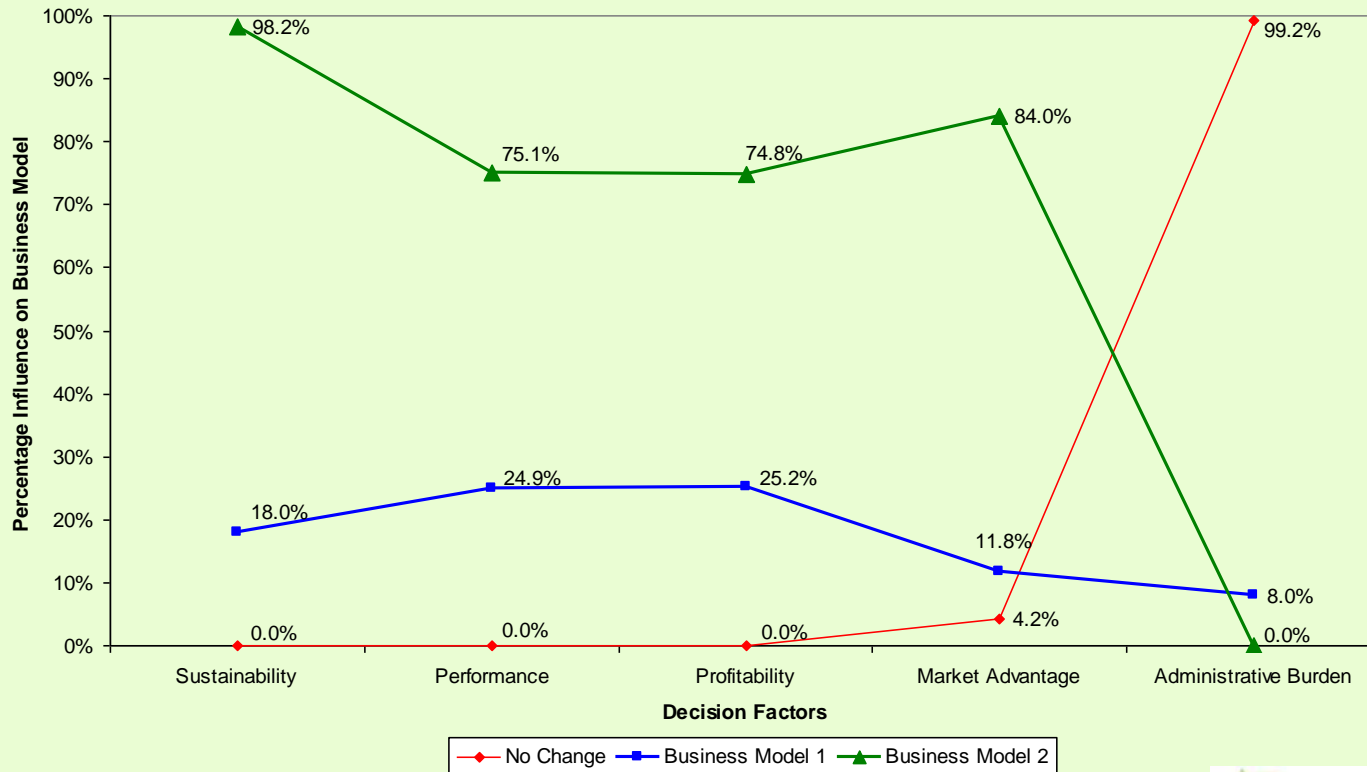
AHP Performance Sensitivity Results by Decision Factor



Prepared by David H. Reisdorph, July 29, 2008

AHP Results by Business Model

AHP Performance Sensitivity Factor Results by Business Model



Prepared by David H. Reisdorph, July 29, 2008



Approaches to Integrating LCA & Business Decision Support Systems

LCA and Business DSS

Support Integration Issues

- Decisions are difficult because of multiple business and environmental attributes.
- Business attributes will be primary.
- Business decisions are facilitated by comparing a manageable set of alternatives.
- Data uncertainty may result in decision gridlock and discourage meaningful analysis of potential environmental improvements.

Issue Implications

- Decision making will require evaluation models capable of processing multiple attributes.
- Decision support systems will need to balance environmental improvements with business objectives, and estimate how environmental improvements improve bottom line (e.g., operational savings or new competitive advantages).
- While integrated LCA and DSS may be capable of evaluating numerous alternatives across numerous iterations, managers are limited in the number of options that can be reviewed. Proposed alternatives need to bound upper and lower evaluation outcomes.
- Integrated LCA and DSS need to adequately address data uncertainty.
- **Overall, summary metrics that simultaneously convey environmental and business performance changes are preferable.**

Multiple Attribute Processing Solutions

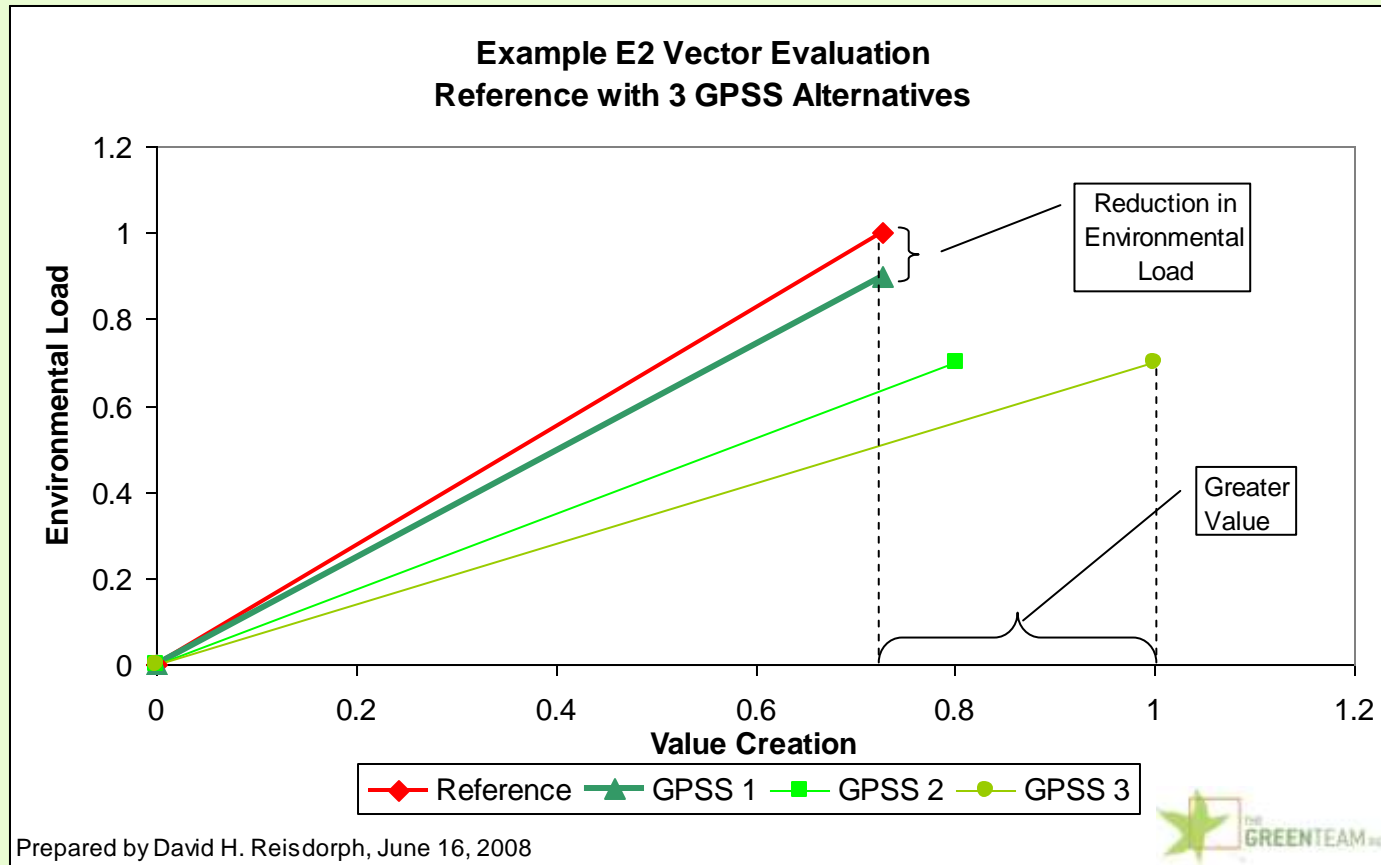
Data mining methods

- Traditional statistical analyses
- Decision trees
- Bayesian classifiers
- Artificial Neural Networks
- Genetic Algorithms

Data mining advantages

- Ability to evaluate several attributes
- Not just applicable to large data sets
- Iterative, learning algorithms may produce more optimal solutions
- Identifies patterns that can lead to further improvements

Summary Solution—E² Vector



See Goedkoop et al 1999 for E² Vector application information.

LCI Data Uncertainty

Types of Uncertainty

Low Information Environment

- Data unavailable
- Low quality data
 - Methods
 - Abstraction
- Data allocation
- Variation

Broad LCA scopes means error can propagate through the analysis (system).

Table 2.1: Categories of Current Limitations to Environmental Life Cycle Analysis

LCA Phase	Problem
Goal and Scope	Functional Unit Definition
	Boundary Selection
	Social and Economic Impacts
	Alternative Scenario Considerations
Inventory	Allocation
	Local Technical Uniqueness
Impact Assessment	Impact Category & Methodology Selection
	Spatial Variation
	Local Environmental Uniqueness
	Dynamics of the Environment
	Time Horizons
Interpretation	Weighting and Valuation
	Uncertainty in the Decision Process
All	Data Availability and Quality

From Duncan 2008, p 23

Uncertainty Models

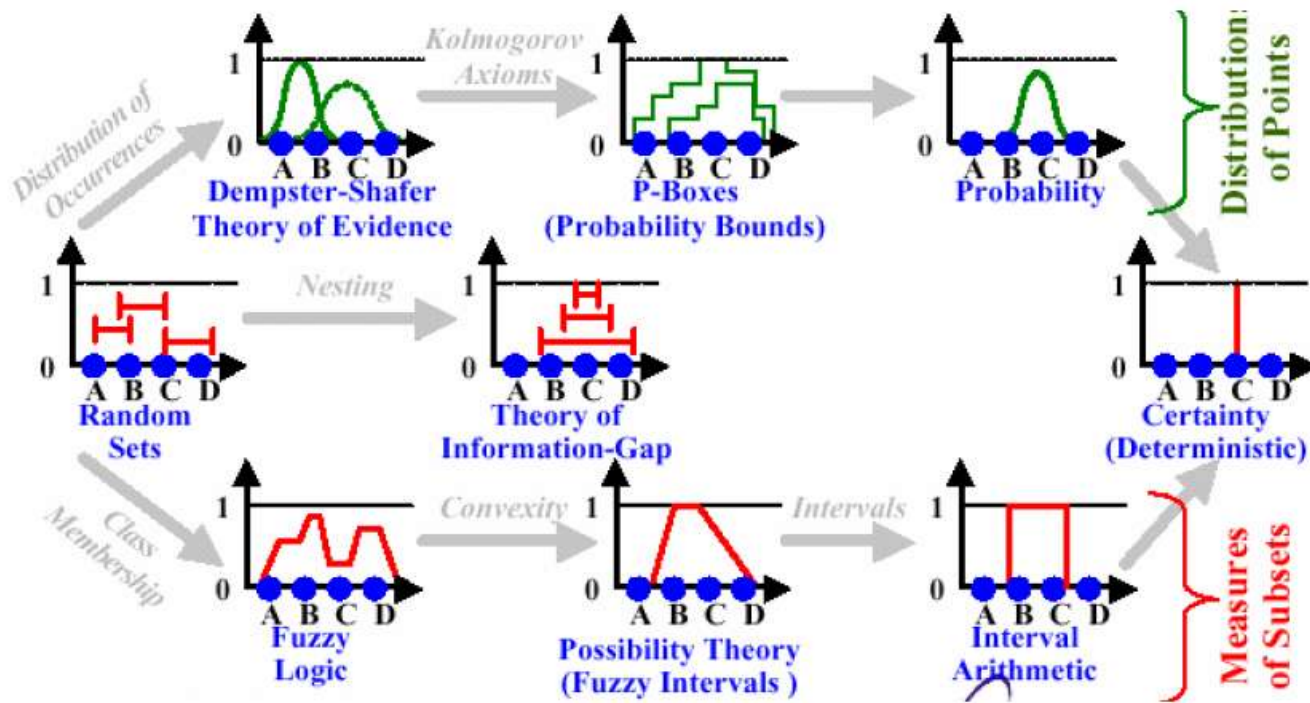


Figure 3.1: Different models of uncertainty and their relationships, from (Hemez 2002)

Cited in Duncan 2008, p 45

Assessing Uncertainty

- Expert judgment (grading assessment quality)
- What-if analysis
- Sensitivity analysis
- Interval (bounds) analysis
- Monte Carlo analysis
- Fuzzy math
- Probability bounds analysis
- Information Gap Theory

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