



# Biologically-Inspired Innovation and Sustainability

# The Many Roles of a Biologist

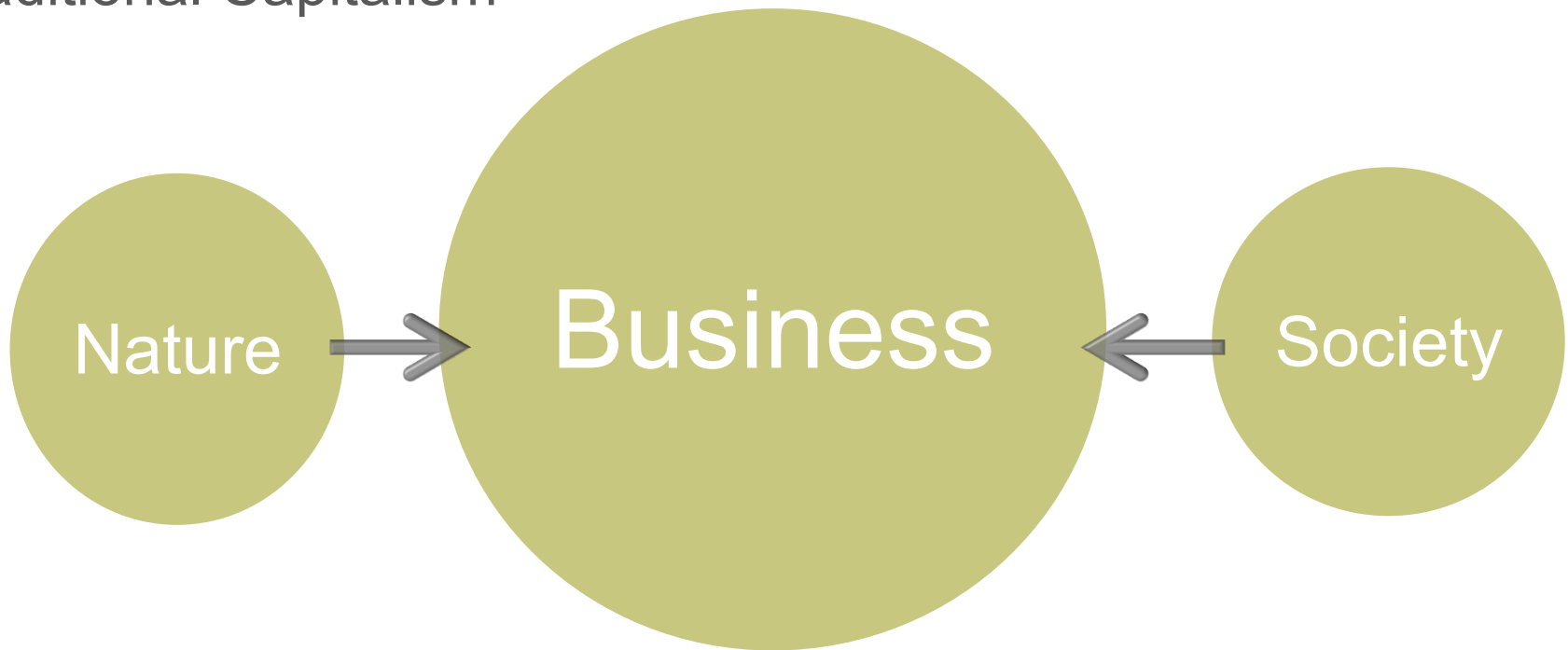
- ▣ Field Biologist
- ▣ “Biologist at the Design Table”
- ▣ Biologist in the Business School

# The State of Corporate Sustainability

- Sustainability “journeys” to nowhere
- Reaching the limits of eco-efficiency measures
- Bumping up against pressures of free and subsidized markets
- Difficulty with circular economy efforts
- Management strategies and research absent of biophysical foundations

# Changing Models of Sustainability

## Traditional Capitalism



-Classical capitalist economists A. Smith, etc.

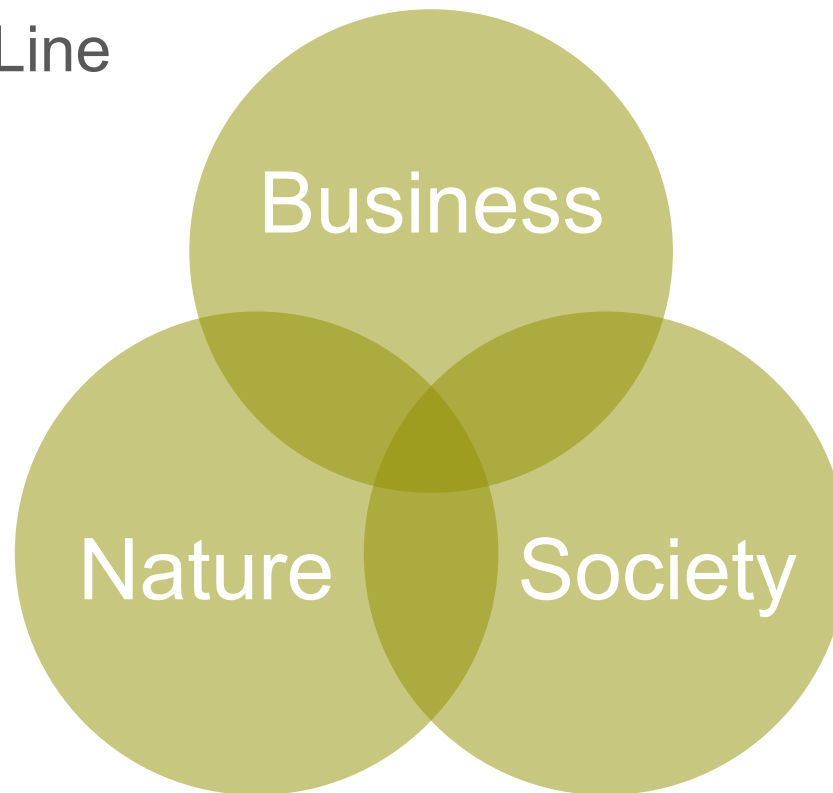
-Marcus, J. Kurucz, E. C. and Colbert, B. 2010. *Conceptions of the Business-Society-Nature Interface: Implications for Management Scholarship*. *Business & Society*. 49(3) 402-438.

Taryn Mead, Jan 2014



# Changing Models of Sustainability

Triple Bottom Line  
(1998)



-Elkington, J. 1998. *Cannibals with Forks: The triple bottom line of 21<sup>st</sup> century business*. Capstone Publishing Ltd. Oxford.

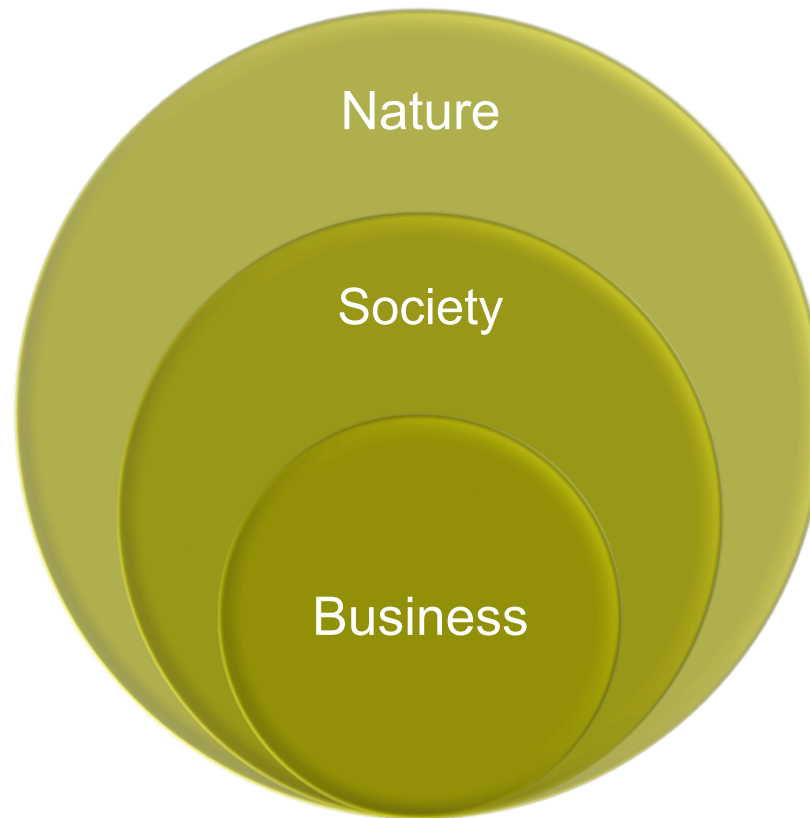
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# Changing Models of Sustainability

Embedded View  
(2010)



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# Progressing BII for Sustainability – Oriented Innovation

- BII initiatives need to be aligned with larger corporate sustainability agendas
- A cohort of designers, engineers, architects, etc. who aim to understand biological systems
- Transition from inventions to innovations
- BII has matured enough as a discipline to transition to more robust analysis
- Target participation in biophysical systems, not just emulation of them

# A note on history of terms...

Term (Year) Oldest to most recent	Attributed To	Connection to “Sustainability”
Bionics (1958)	Jack E. Steele	No historically, but increasing
Biomimetics (1969)	Otto Schmidt	No
Biologically-Inspired Design (Early 1990s)	Unknown	Yes and No
Biomimicry (1997)	Janine Benyus	Yes
Ecomimicry (2007)	Alan Marshall	Yes
Nature-Inspired Design Strategies (2010)	Pauw, et al.	Yes
Biologically Informed Discipline (2014) <small>Pending Publication</small>	Alena louguina	Yes and No
Others? Clarifications?		

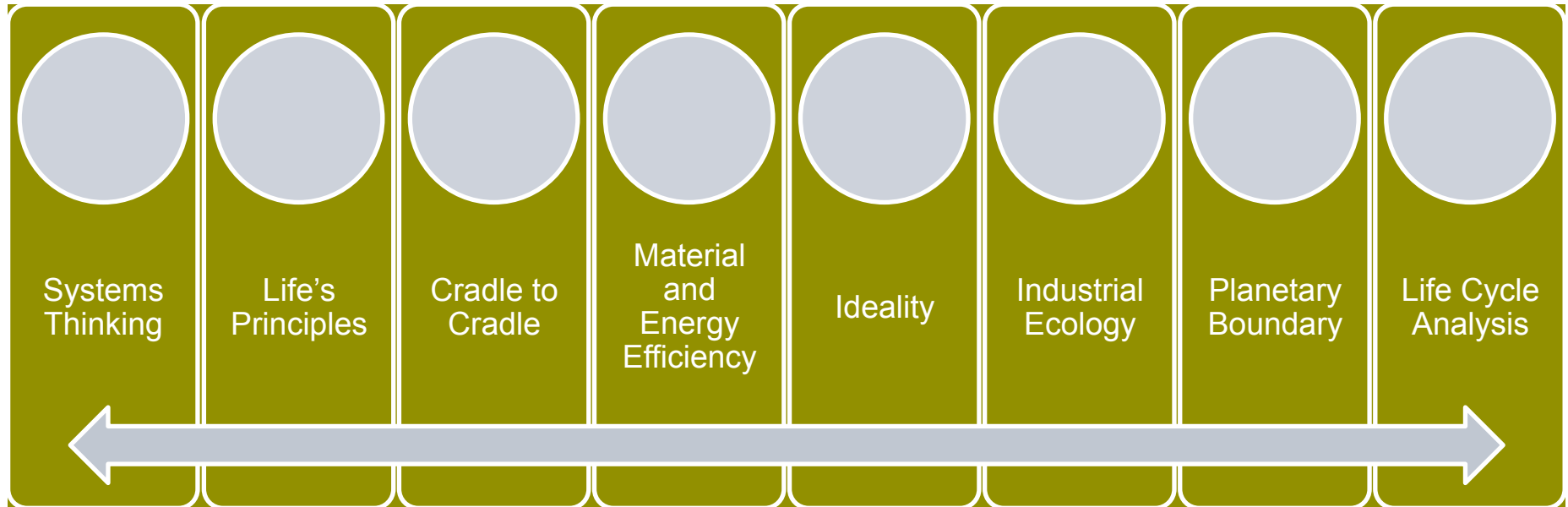


# Are BIs contributing to sustainable development? How do we know?

- Systems Thinking
- Life's Principles
- Material and Energy Efficiency
- Ideality (TRIZ)
- Life Cycle Analysis
- Industrial Ecology
- Planetary Boundaries
- Green Chemistry Principles
- Living Building Challenge



# Levels of Specificity of Tools



# Blended Scales of Analysis

- Systems thinking vs. Reductionism (?)
- Scientific method (reductionism) = dialogue of analysis + synthesis
- The role of systems thinking is to frame this dialogue
- Not mutually exclusive, rather dependent on one another

Barton, J. and Haslett, T. *Analysis , Synthesis , Systems Thinking and the Scientific Method : Rediscovering the Importance of Open Systems*. Systems Research and Behavioral Science. Dec 2006. Vol 155.

# Planetary Boundaries: Overview

Convergence of Three Bodies of Research:

1. Ecological economics – “The scale of human action in relation to the capacity of the earth to sustain it.”
2. Earth’s processes including human activities
3. Combined with resilience theory, complex dynamics and self-regulation of living systems

Rockstrom, J. 2009. *A Safe Operating Space for Humanity*. Nature Vol 461. 24 Sept 2009.

# Planetary Boundaries (PBs)

1. Climate change (Exceeded)
2. Rate of Biodiversity Loss (Exceeded)
3. Nitrogen Cycle (Exceeded)/Phosphorous Cycle
4. Stratospheric Ozone Depletion
5. Ocean Acidification
6. Global Freshwater Use
7. Change in Land Use
8. Atmospheric Aerosol Loading (not yet quantified)
9. Chemical Pollution (not yet quantified)

Rockstrom, J. 2009. *A Safe Operating Space for Humanity*. Nature Vol 461. 24 Sept 2009.

# Reflections on PB

- Not about going backwards in time
- Cycles within boundaries
- Humans as participants in biophysical cycles
- Like any good science, it is rigorously debated

# Applying PBs

- Framework for cross-firm, cross-sector and cross-country analysis
- Needs to be disaggregated and operationalized
- The same lenses of analysis for corporate sustainability and for BIIIs?

Whiteman, G. Walker, B. and P. Perego (2013) Planetary Boundaries: Ecological Foundations for Corporate Sustainability. *J. of Mgmt Studies*. 50(2) 307-336.

# Levels of BII



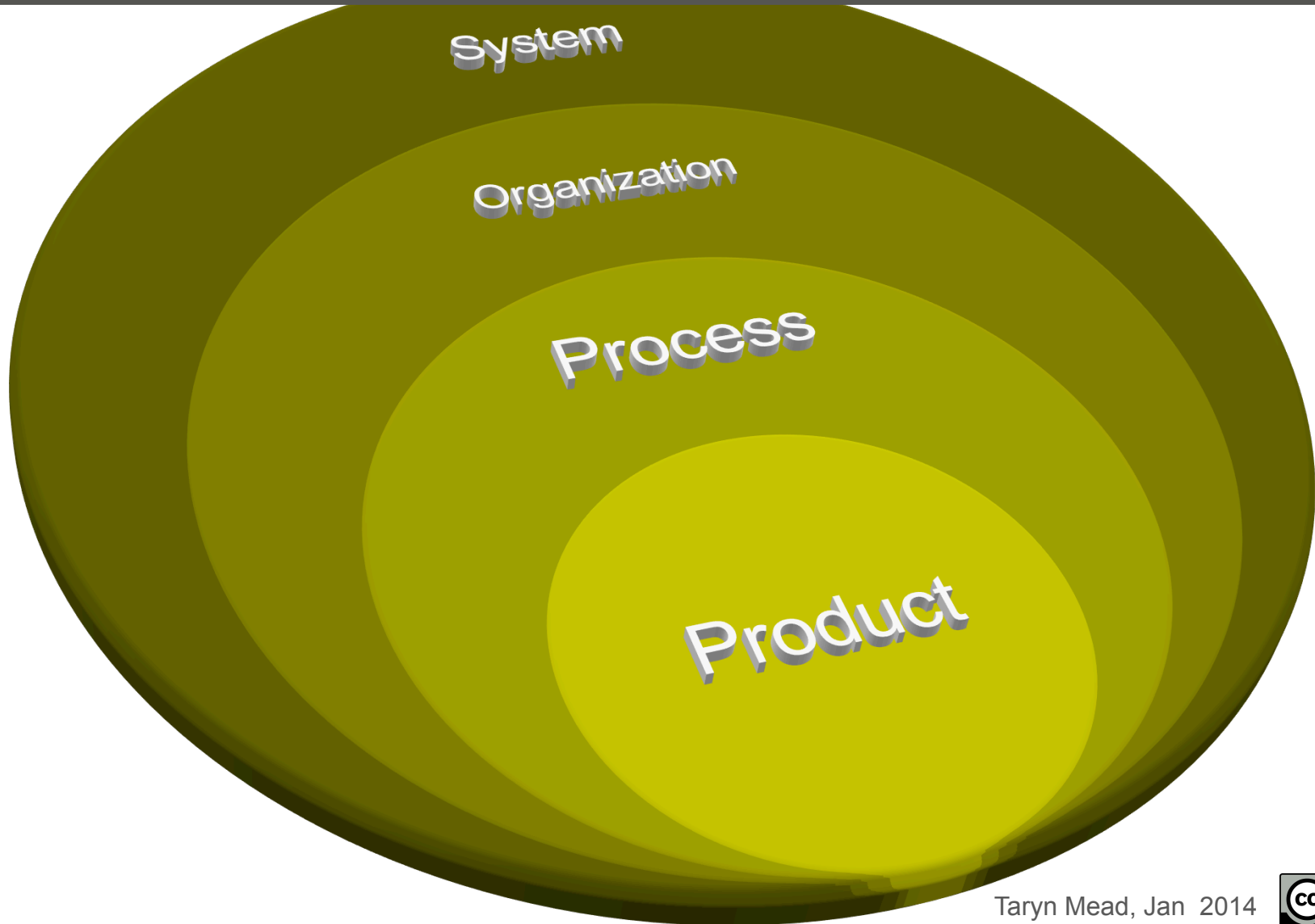
Benyus, J. 1997. *Biomimicry: Innovation Inspired by Nature*. Harper Publishing.

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# Embedding BII for Sustainability



# The Role of Analogues and Metaphors

- Each has a role at different scales and with different users
- Biological lenses = Function, Structures, Materials, Ecology, Principles, Big Theories
- Applications within natural, design and social sciences
- E.g., Organizational Ecology, Cybernetics, Ecosystem (My personal mission of disambiguation)

# Units of analysis of BII for Sustainability

When using BII as a tool for sustainability-oriented innovation, users need to consider multiple scales of analysis simultaneously.

# Sustainability defined:

*A firm, innovation, etc. contributes to sustainable development when it creates equitable economic opportunities for human development by dynamically and resiliently **participating in biophysical systems** at local, bioregional and global scales in such a way that it improves societal relationships to planetary boundaries.*

# Implications for Further Research

- Industry-specific measures of sustainability applied to development of new BII
- More research directed at “Market Pull” scenarios
- Innovation and other public policies that encourage BII at multiple levels
- Using BII to solve BIG problems

“One has to make up his mind whether he wants simple answers to his questions – or useful ones...you cannot have both.”

-J.A. Schumpeter

# Contact Info

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