MSID

National Institute of Standards and Technology
U.S. Department of Commerce

NIST Workshop on Sustainable Manufacturing: Metrics, Standards, and Infrastructure

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MEL/MSID/NIST

Sustainability: Different Viewpoints

Ecological Approach

- Central notion is that the economic and social systems are sub-systems of the global environment.
  - sustainability in the economic and social dimensions is subsidiary to environmental sustainability.
  - The key characteristic to be sustained is the capacity of ecosystems to respond with resilience to external perturbations and changes. That is the health of ecosystems should be protected.
  - Health of ecosystem is measured by
    - —*pressures* placed on ecosystems by human activities
    - —*responses* of ecosystems to these human pressures

Capital Approach

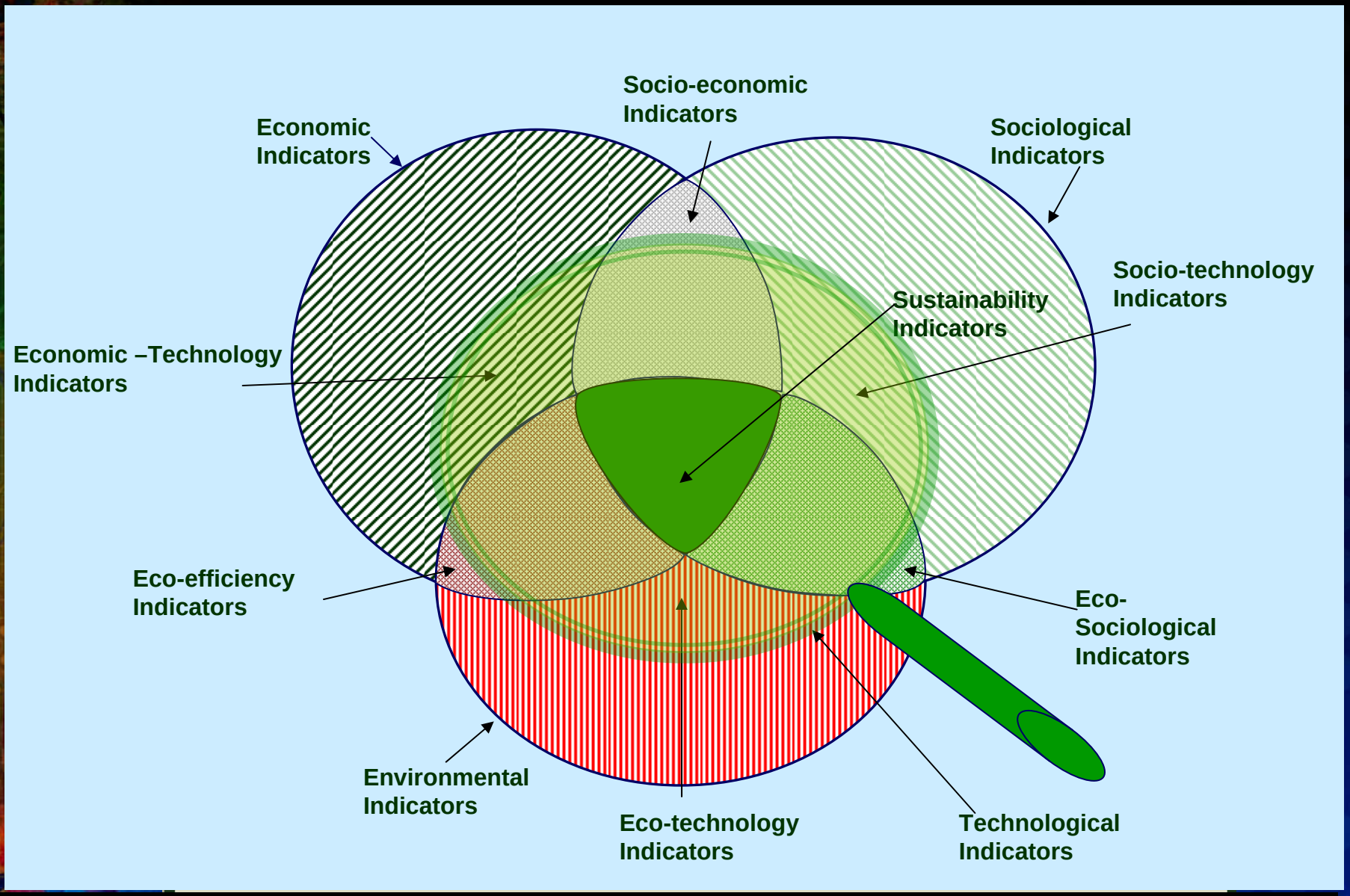
- Broadens the concept of *capital* from economics to incorporate sustainability of human development.
- *"Sustainable development is development that ensures non-declining per capita national wealth by replacing or conserving the sources of that wealth; that is, stocks of produced, human, social and natural capital."*
  - United Nations H*andbook of National Accounting - Integrated Environmental and Economic Accounting (commonly referred to as SEEA)*
- The long-term sustainability of development depend upon the maintenance of natural capital (in addition to the other forms of capital).
- The controversy over the degree of substitutability for natural capital has translated into concepts of weak and strong sustainability
  - For both forms of sustainability: development must be compatible with long-term maintenance of capital stocks.

Weak Sustainability

- Natural resource stocks may be depleted, and environmental systems degraded, but only if this depletion/degradation is offset by equivalent or greater increases in other forms of capital.
  - so long as there is no reduction in total capital, development is assumed to be sustainable.
- Since it is the total capital stock that is to be maintained, all forms of capital must be measured using the same yardstick.
  - this implies measurement of natural capital in monetary terms.

Strong Sustainability

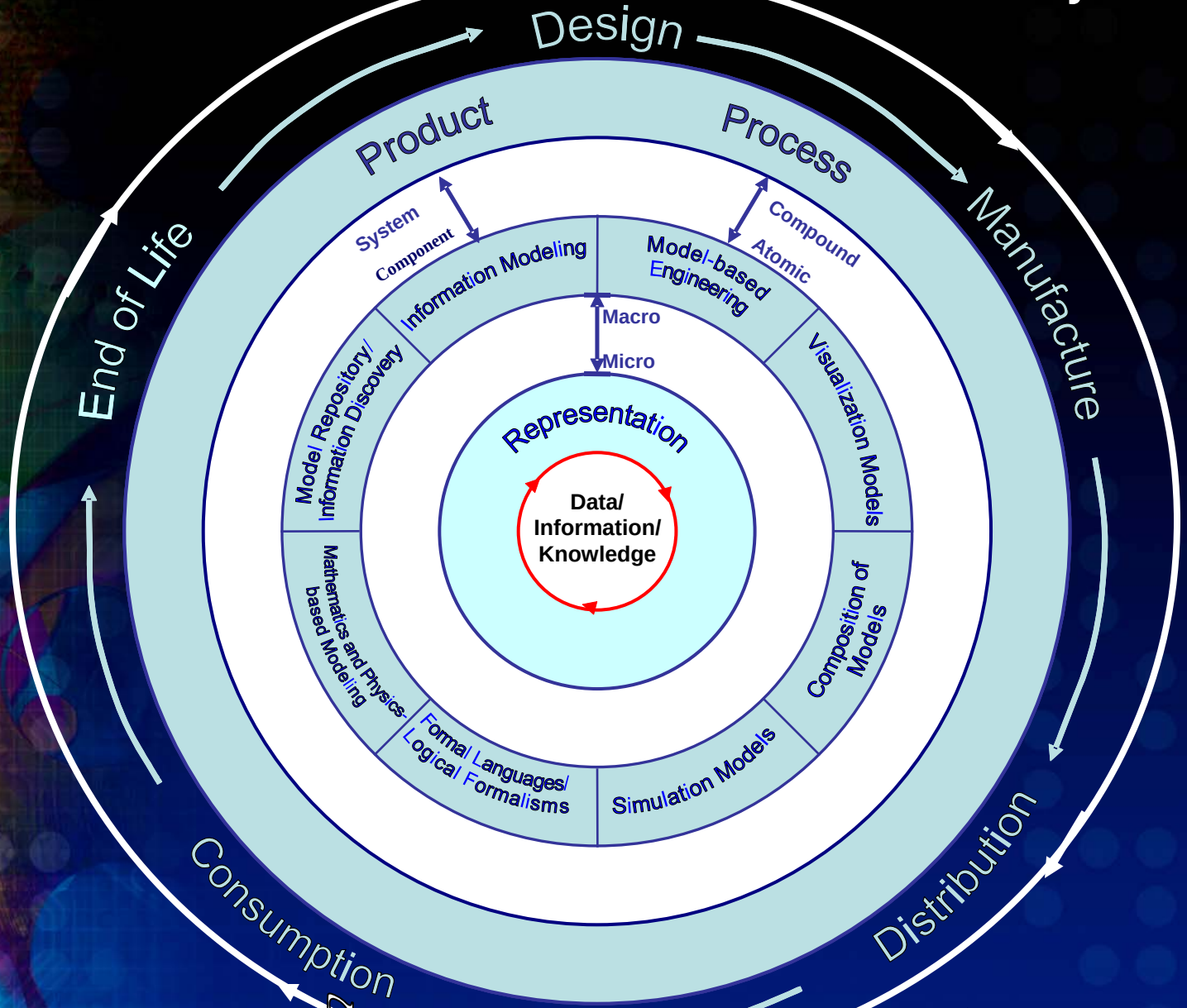
- Strong sustainability is often expressed in terms of the "precautionary principles":
  - Renewable resources should not be used in excess of their natural regeneration;
  - Non-renewable resources should be used prudently and efficiently with care that the same function is available to future generations, say by technological development or shift to use of renewable resources;
  - Sink functions should not be used beyond their assimilative capacities;
  - Activities which cause deterioration in service functions should be avoided or at least minimized.



Triple bottom line of sustainability being viewed from a lens of influence of technology

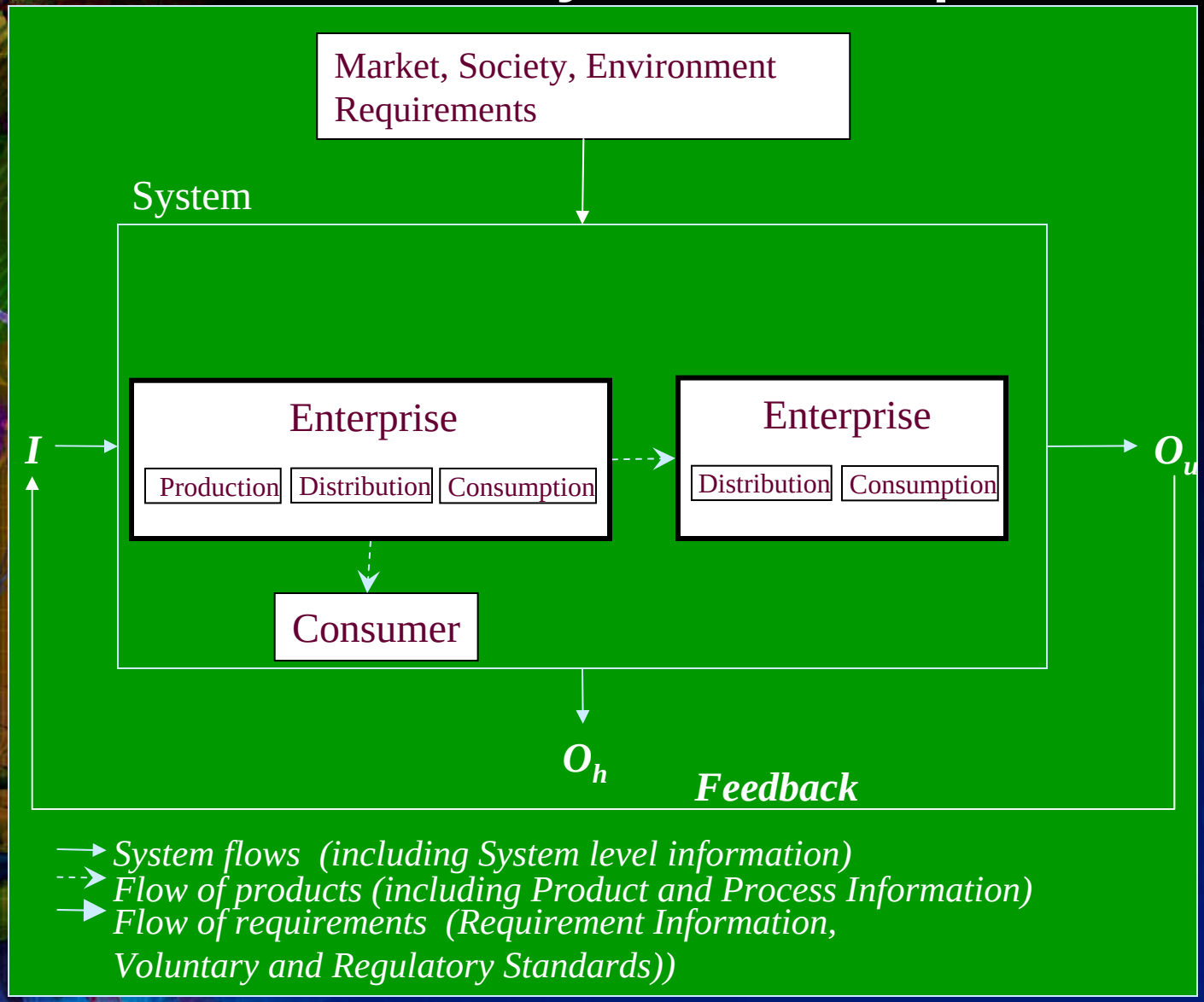
Sustainability and PLM

Information representation and Product Life Cycle



Sustainable Systems

A Systems Perspective



The whole system works under various control parameters (***C***) such as availability of scarce resources, energy efficiency, government and environmental regulations. The system gets resources from the planet as input (***I***) and generates useful and harmful outputs (***Ou*** and ***Oh***). There is also a feedback to this system from ***Ou*** in terms of reuse, recycle, and remanufacturing.

The information infrastructure and the system view should allow us to extend the notion of "quality" – physical, informational, and sustainable

- *The primary objective of this workshop is to bring together experts from India and the US to discuss the social, economic, environmental, and technological aspects of designing sustainable systems, especially manufacturing systems. This workshop will deliver a knowledge base supporting further research and enhanced interaction among Indian and US experts actively involved in the area of sustainability research.*

- **Outcomes:**
- The workshop was well attended and the main message from industry is that they implementing sustainability manufacturing by extending already exisiting lean manufacturing program.
- Workshop proceedings synthesizing the technical sessions, recommendations from panels, and breakout sessions is under preparation.
- Among other things the main recommendations from this workshop is to submit a proposal for a Joint Centre for Excellence for collaborative research in sustainable design and manufacturing between IISc, NIST and other relevant partners.

Workshop Introduction

AGENDA