Sustainable Manufacturing Metrics & Standards: Guiding Theory

David Ervin

Professor of Economics and Env. Mgmt.

Fellow, Center for Sustainable Processes & Practices

Portland State University

NIST Sustainable Manufacturing Workshop

October13-15, 2009

Outline

- Problems with current metrics
- Guiding sustainability theory
- Genuine savings
- Critical elements for manufacturing

Problems with Current Metrics and Standards

- Eclectic set of measures based on individual firm's interests and data, e.g., toxics
- Often measure input or waste flow with no reference point to sustainability, e.g., water
- Partial environmental coverage, e.g., omit non-regulated effects such as solid waste

Problems with Current Metrics and Standards (cont'd)

- Incomplete economic and social metrics
- Difficulty of 'adding up' different metrics to assess firm's total sustainability impact
- End result: Partial and perhaps erroneous view of manufacturing firm's contribution to system sustainability

Sustainability Theory

- General concept – Maintain sufficient resources (capital) such that future generations can enjoy at least as high a standard of living as the present does.
- Total capital stock comprises manufactured, natural/environmental, human, social and other assets.

Translating Theory to Practice

- Maintain the SUM of all forms of capital over time to enable non-declining per capita welfare levels (weak sustainability)
  - Allows substitution between natural capital and other forms, e.g., manufactured, human
  - Do thresholds of irreversibility exist?
- Meet social equity objectives, e.g., provide access to basic health care by employees

Genuine Savings

- Annual net contribution to a nation's total stock of capital (World Bank)
- Includes investment and depreciation for key types of capital.
  - Manufactured (Km)
  - Natural/environmental (Kn)
  - Human (Kh)
  - Social (Ks) (currently not estimated)
  - Technology (Kt) (currently not estimated)

Firm Genuine Savings (GS)

- GS ($) = Km + Kn + Kh + Ks + Kt
- Km, Kn, Kh, Ks, and Kt >, <, = 0
- Therefore GS can be >, <, or = 0
- Forces consideration of all types of capital
- Avoids reporting increases in some that conceal losses in another form
- Provides a system of measures to analyze progress toward firm-level sustainability

GS Elements for Manufacturing

1. Net investment in plant and equipment
2. Net change in natural capital, e.g., wetlands restored, forestlands replanted
3. Net changes in environmental emissions, e.g., air pollution reductions
4. Net changes in human resources, e.g., educational programs
5. Net changes in social/community capital
6. Net future value of technology innovations

Take-Home Messages

- Base sustainable manufacturing metrics and standards on comprehensive theory
- Include NET effects on all forms of capital
- Monetize as many metrics as credible
- Include nonmonetary effects on thresholds for critical capital stocks as feasible
- Include quantitative social measures where possible

Sustainability Theory cont'd

- **Strong sustainability** – Meet weak sustainability conditions AND prevent 'critical' natural and other capital resources from falling below irreversible thresholds
- Forces recognition of imperfect substitution for some forms of irreplaceable capital, e.g., gene pools