MIT Auto Industry System Study
(2003.001 v1.0)

Integrating Social and Technical Systems
Overview

- Welcome and overview
- The “big picture”
- Social and technical framework
- Exercise: Focus on the Seven Wastes and the 5S’s
- Sample Socio-Tech Implementation
- Exercise: Cellular Design Socio-Tech Analysis
- Conclusion

Expected outcomes

- Awareness of shifts in social and technical systems over time
- Understanding of the interdependency between social and technical systems
- Identification of potential “guiding principles” for designing, implementing and sustaining change in social and technical aspects of new work systems
## The “Big Picture”

<table>
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<tr>
<th>Social Systems</th>
<th>Technical Systems</th>
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<td><strong>Craft Production</strong></td>
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<td>Decentralized Enterprises</td>
<td>Custom Manufacture</td>
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<td>Mastery of Craft</td>
<td>Specialized Tools</td>
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<td><strong>Mass Production</strong></td>
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<td>Vertical Hierarchies</td>
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<td>Scientific management</td>
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<td>Network Alliances</td>
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<td>Information Systems</td>
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Sample Social System Transformation Initiatives

- Socio-Technical Work Systems . . . . . . Semi-autonomous teams
  - 1950s-1980s

- Employee Involvement/QWL . . . . . . . EI/QWL groups (off-line)
  - Late 1970s-1990s

- Total Quality Management . . . . . . . Quality circles (off-line)
  - Early 1980s-1990s

- Re-engineering . . . . . . . . . . . . Work-out events (off-line)
  - 1990s

- Six Sigma . . . . . . . . . . . . Black belt let project teams (off-line)
  - 1990s-present

- Lean Production/Enterprise Systems . . Lean production teams/Integrated product & Process teams
  - 1950s-present
Sample Social and Technical Systems Framework

Fragile/Robust Interrelationships Producing, Over Time, Outcomes for Multiple Stakeholders

Customers . . . Workforce . . . Shareholders . . . Suppliers . . . Society

* Note: Context boundaries vary as appropriate with the systems under consideration.
Focus on Social / Organizational Systems

Structure & Sub-Systems

- Structure
  - Groups
  - Organizations
  - Institutions

- Sub-Systems
  - Communications
  - Information
  - Rewards & reinforcement
  - Selection & retention
  - Learning and feedback
  - Conflict resolution

Social Interaction Processes

- Leadership
- Negotiations
- Problem-solving
- Decision-making
- Partnership

Capability & Motivation

- Individual knowledge, skills & ability
- Group stages of development
- Fear, satisfaction and commitment
Focus on Technical Systems

Machines (Equipment & New Technology)
- Equipment and machinery
- Physical infrastructure
- Information technology
- Nano-technology, bio-technology, and other developments at the frontiers of science

Materials (Components & Supply Chain)
- Assembly – Interchangeable parts and mass production systems
- Logistics – Just-In-Time delivery (JIT) systems and Synchronous material flow systems
- e-commerce and supply chains

Methods (Processes)
- Job design/office design
- Work flow/process mapping methods
- Value stream mapping
- Constraint analysis
- Statistical Process Control (SPC)
- System optimization and decomposition methods
Focus on Contextual Systems

Economic Systems
- Markets
- Incentives
- Trade relations
- Public, private, and non-profit sectors
- Industry structures
- Product/firm/industry life-cycles
- Externalities and other “market failures”

Physical / Natural Systems
- Atmospheric systems
- Geo-thermal systems
- Aqueous systems
- Biological systems
- Chemical systems
- Bio-chemical systems
- Sub-atomic systems
- Laws of physics
- Extra-terrestrial systems

Political / Societal Systems
- Regulatory systems
- Standards and protocols
- Institutional arrangements
- History
- Cultures and sub-cultures
- Values and assumptions

* Note: Context boundaries vary as appropriate with the systems under consideration
Exercise: The Seven Wastes and the Five S’s

The Seven Wastes
- Over Production
- Waiting
- Transportation
- Inventory
- Processing
- Motion
- Defects

The Five S’s
- Simplify or Sort
- Straighten or Simplify
- Scrub or Shine
- Stabilize or Standardize
- Sustain or Self-Discipline

How are social and technical systems interdependent when it comes to addressing the Seven Waste?

How are they interdependent when it comes to the 5S’s?
Data on Technical Milestones

- Green
- Yellow
- Red

- Aug-98
- Sep-98
- Oct-98
- Nov-98
- Dec-98

Adapted from MIT Sloan Fellows thesis by Sean Hilburt
Data on Social Milestones

[Bar chart showing progress from Aug-98 to Dec-98 with percentages and categories: Green, Yellow, Red]
Exercise: Cellular Manufacturing Socio-Tech Analysis

Step 1: Group Formation and Stakeholder Analysis

Form small groups of 2-3 people (individuals at remote locations may link by phone), study the "current state" and "desired state" illustrations on a hypothetical cellular manufacturing intervention (next slide), and list stakeholders involved in your phase of this intervention.

*Note: Some groups will be assigned to “Preparing,” “Implementing,” and “Sustaining” phases of this intervention*

Step 2: Social Systems

Identify the most important social system changes in this work system that are relevant to your phase of the intervention.

Step 3: Technical Systems

Identify the most important technical changes in this work system that are relevant to your phase of the intervention.

Step 4: Integration and Guiding Principles

Discuss ways in which the social and technical changes are or are not interdependent. Derive 1-3 “Guiding Principles” for implementing a systems change of this type.
Exercise: Cellular Manufacturing

Current State

Desired State

Source: Lean Aerospace Initiative Fieldbook
Revisit the Social and Technical Systems Framework

Physical / Natural Systems

“Contextual” Systems *

Economic Systems

Political / Societal Systems

Methods (Processes)

Machines (Equipment & New Technology)

Materials (Components & Supply Chain)

Complexity

Uncertainty

Social / Organizational Systems

Social Interaction Processes

Capability & Motivation

Structure & Sub-Systems

Fragile/Robust Interrelationships Producing, Over Time, Outcomes for Multiple Stakeholders

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MIT Auto Industry Systems Study 2003.001 v1.0 Unit1: Integrating Social and Technical System
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Conclusion

- A unique historical moment
- The constant challenge and opportunity presented by social and technical interdependency
- A fragile foundation for a global transformation
Appendix: Japanese Model of Production System and “Humanware”

Growth

Profits

High Quality

Low Price

Low Inventory Cost

Low Labor Cost

Low Defects

J-I-T Production System

Small Lot

Even Flow

Low Buffer Stock

Continuous Adjustment of Labor Input

Human Control

Reduced Set-Up Time

Skill

Adaptability

Motivation

Corporate Goals

System Outcomes

Key Features of Production System

Key Areas of Human Resource Involvement

Human Resource Effectiveness

Source: Haruo Shimada and John Paul MacDuffie, Industrial Relations and “Humanware” (Sloan School of Management Work Paper, September, 1986)