Socio-Technical Systems

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The "Big Picture"

	Social Systems	Technical Systems
Craft Production	Decentralized Enterprises Mastery of Craft	Custom Manufacture Specialized Tools
Mass Production	Vertical Hierarchies Scientific management	Assembly Line Interchangeable Parts
Knowledge-Driven Work *(Draft Defining Term)*	Network Alliances Team-Based Work Systems	Flexible Specialization Information Systems

Adapted from: "Knowledge-Driven Work: Unexpected Lessons from Japanese and United States Work Practices" (Oxford University Press, 1998)

Mass Production as an Emergent System

- 150 car makers in Indiana since the turn of the century -- only a handful doing final assembly of cars in Indiana today (GM, Honda, Subaru, Toyota)
- Leading manufacturer -- Auburn Motors -- established an assembly line, but it was fixed for chassis -- moving manually from one set of saw horses to another -- and they resisted abandoning wood for steel in body frames

The Social Systems to Accompany the Mass Production Technical System

"This paper has been written:

First. To point out, through a series of simple illustrations, the great loss which the whole country is suffering through inefficiency in almost all of our daily acts.

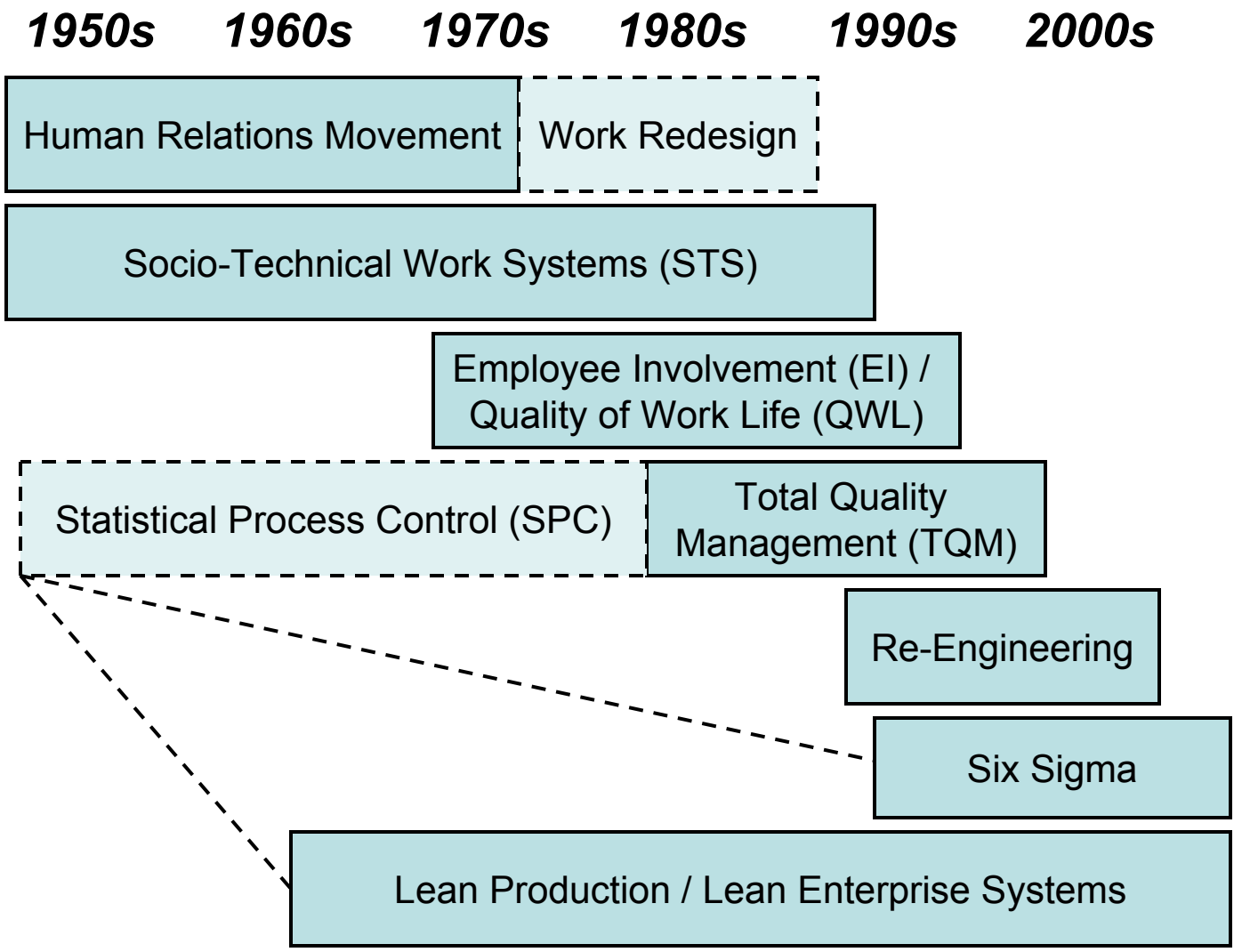
Second. To try to convince the reader that the remedy for this inefficiency lies in systematic management, rather than in searching for some unusual or extraordinary man.

Third. To prove that the best management is a true science, resting upon clearly defined laws, rules, and principles, as a foundation. And further to show that the fundamental principles of scientific management are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations, which call for the most elaborate cooperation. And, briefly, through a series of illustrations, to convince the reader that whenever these principles are correctly applied, results must follow which are truly astounding.

This paper was originally prepared for presentation to The American Society of Mechanical Engineers. The illustrations chosen are such as, it is believed, will especially appeal to engineers and to managers of industrial and manufacturing establishments, and also quite as much to all of the men who are working in these establishments. It is hoped, however, that it will be clear to other readers that the same principles can be applied with equal force to all social activities: to the management of our homes; the management of our farms; the management of the business of our tradesmen, large and small; of our churches, our philanthropic institutions, our universities, and our governmental departments."

Source: Frederick W. Taylor, *The Principles of Scientific Management* (New York: Harper Bros., 1911)

Key Social System Transformation Initiatives



Associated Team Structure

Human group (on line/off line)

Semi-autonomous teams (on-Line)

EI/QWL groups (off-line)

Quality circles (off-line)

Work-out events (off-line)

Black belt led project teams (off-line)

Lean production teams / Integrated Product & Process teams (on-line)

Roots of the Socio-Technical Systems Approach

"The socio-technical concept arose in conjunction with . . . several projects undertaken by the Tavistock Institute in the British Coal Mining Industry. The time (1949) was that of the postwar reconstruction of industry. . . The second project . . . Include(d) the technical as well as the social system in the factors to be considered and to postulate that the relations between them should constitute *a new field of inquiry."*

Source: Eric Trist, *The Evolution of Socio-Technical Systems: A Conceptual Framework and an Action Research Program,* (Toronto, Ontario: Ontario Quality of Working Life Centre, 1981) (original italics)

"The Concept of a production system as a socio-technical system designates a general field of study concerned with the interrelations of the technical and socio-psychological organization of industrial production systems. . . The concept of a socio-technical system arose from the consideration that any production system requires both a technological organization – equipment and process layout – and a work organization relating to each other those who carry out the necessary tasks. The technological demands place limits on the type of work organization possible, but a work organization has social and psychological properties of its own that are independent of technology . . . A socio-technical system must also satisfy the financial conditions of the industry of which it is a part. It much have economic validity. It has in fact social, technological and economic dimensions, all of which are interdependent but which have independent values of their own."

Source: A.K. Rice. *Productivity and Social Organization: The Ahmedabad Experiment (*London: Tavistock Publications, 1958) – cited in E.L. Trist, G.W. Higgin, H. Murray, and A.B. Pollock, *Organizational Choice: Capabilities of Groups at the Coal Face Under Changing Technologies – The Loss, Re-Discovery and Transformation of a Work Tradition. (*London: Tavistock Publications, 1963)

Sample Socio-Technical Design Principles

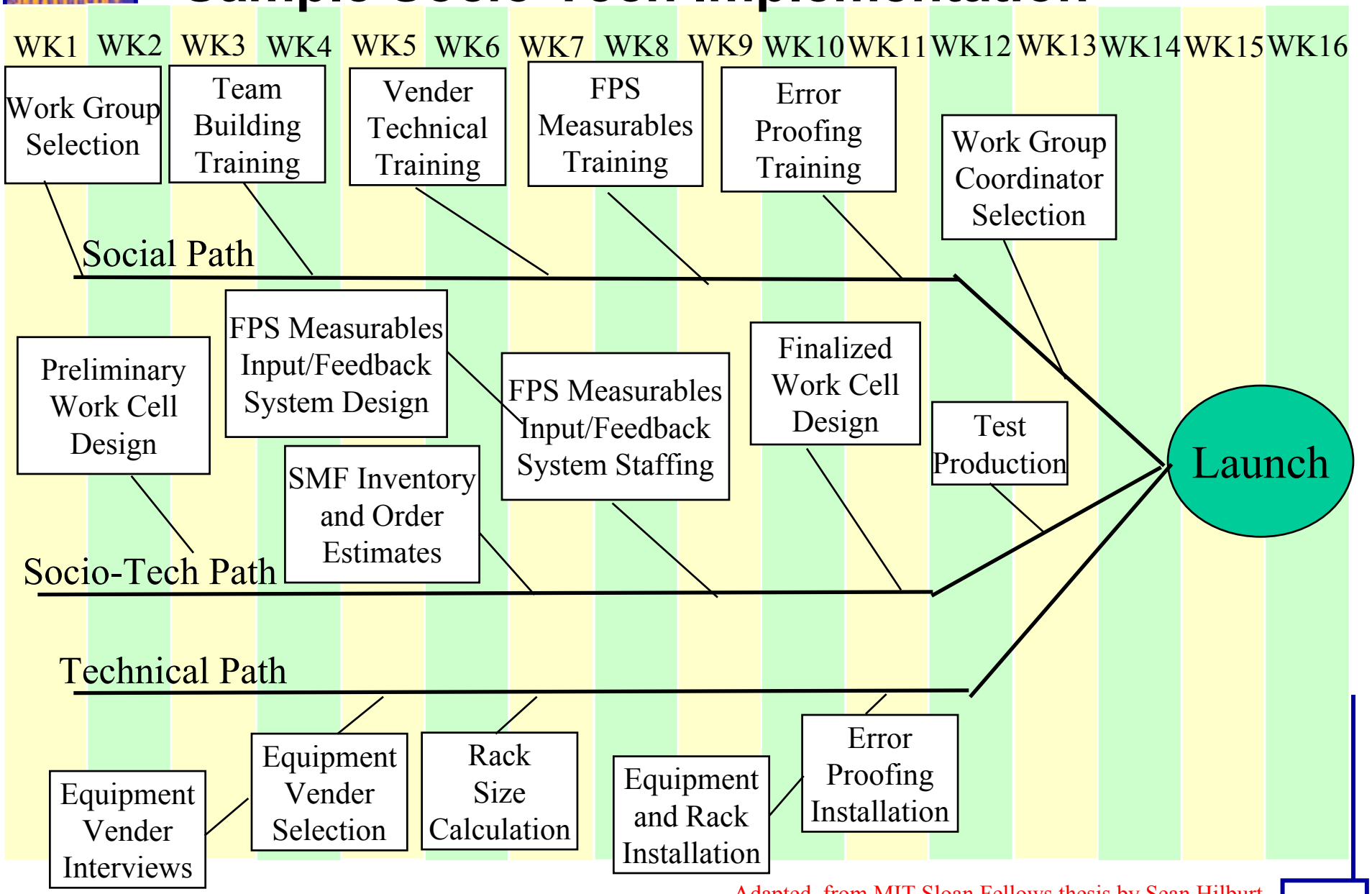
- Self-Design
- Minimum Critical Specifications
- Open-Ended Design Process

- Technical Subsystem – Locate capability to control variances where they occur
  - Tools and techniques
  - Variances
    - Transmitted variances
    - Boundary variances

- Social Subsystem – Division of Labor and Methods of Coordination
  - Autonomy and discretion
  - Opportunity to learn
  - Optimal variety
  - Opportunity to exchange help and respect
  - Sense of a meaningful contribution
  - Prospect of a meaningful future

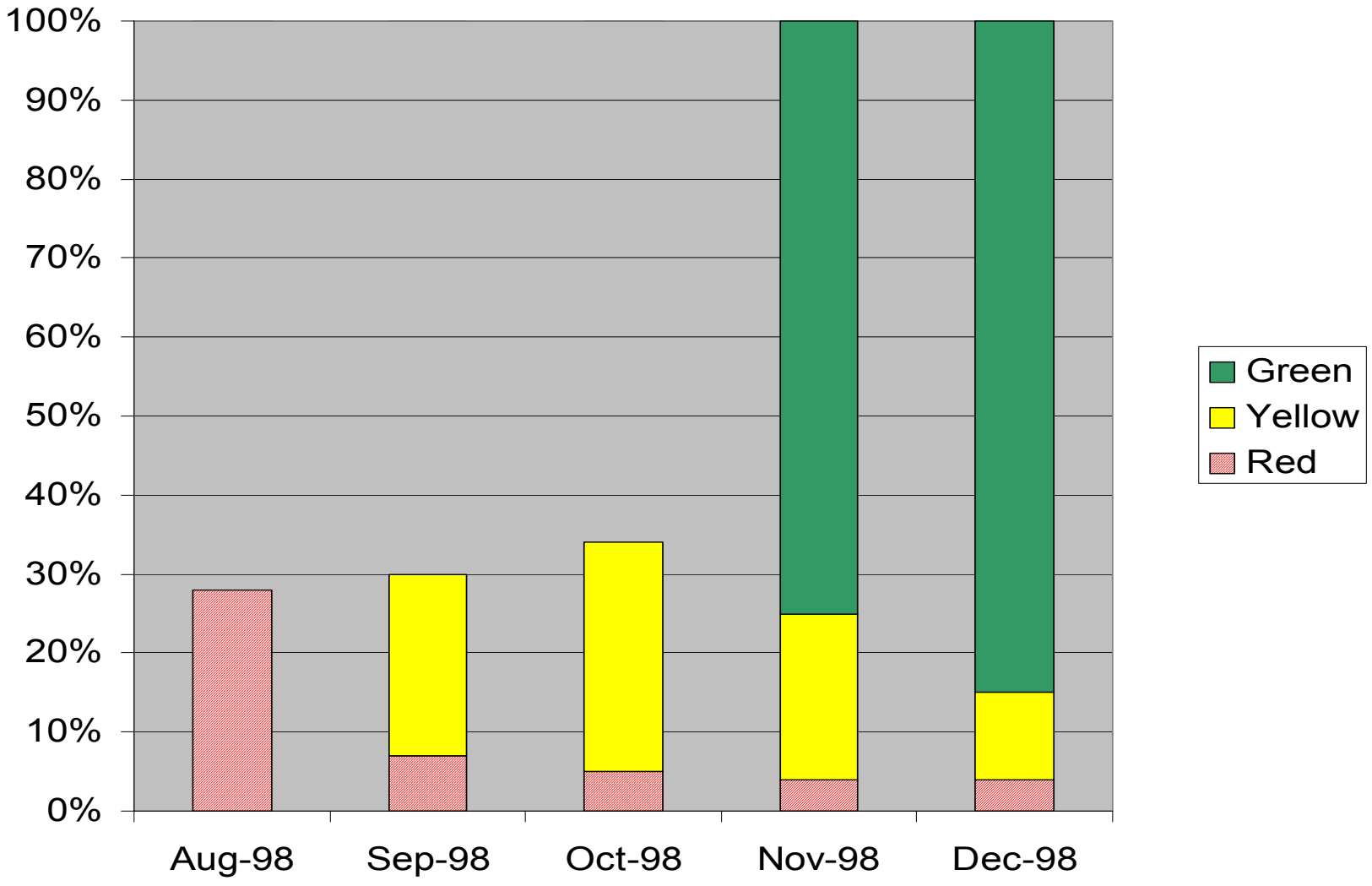
Source: Calvin Pava. *Managing New Office Technology: An Organizational Strategy (*New York: The Free Press, 1983)

Sample Socio-Tech Implementation



Adapted from MIT Sloan Fellows thesis by Sean Hilburt

Data on Technical Milestones



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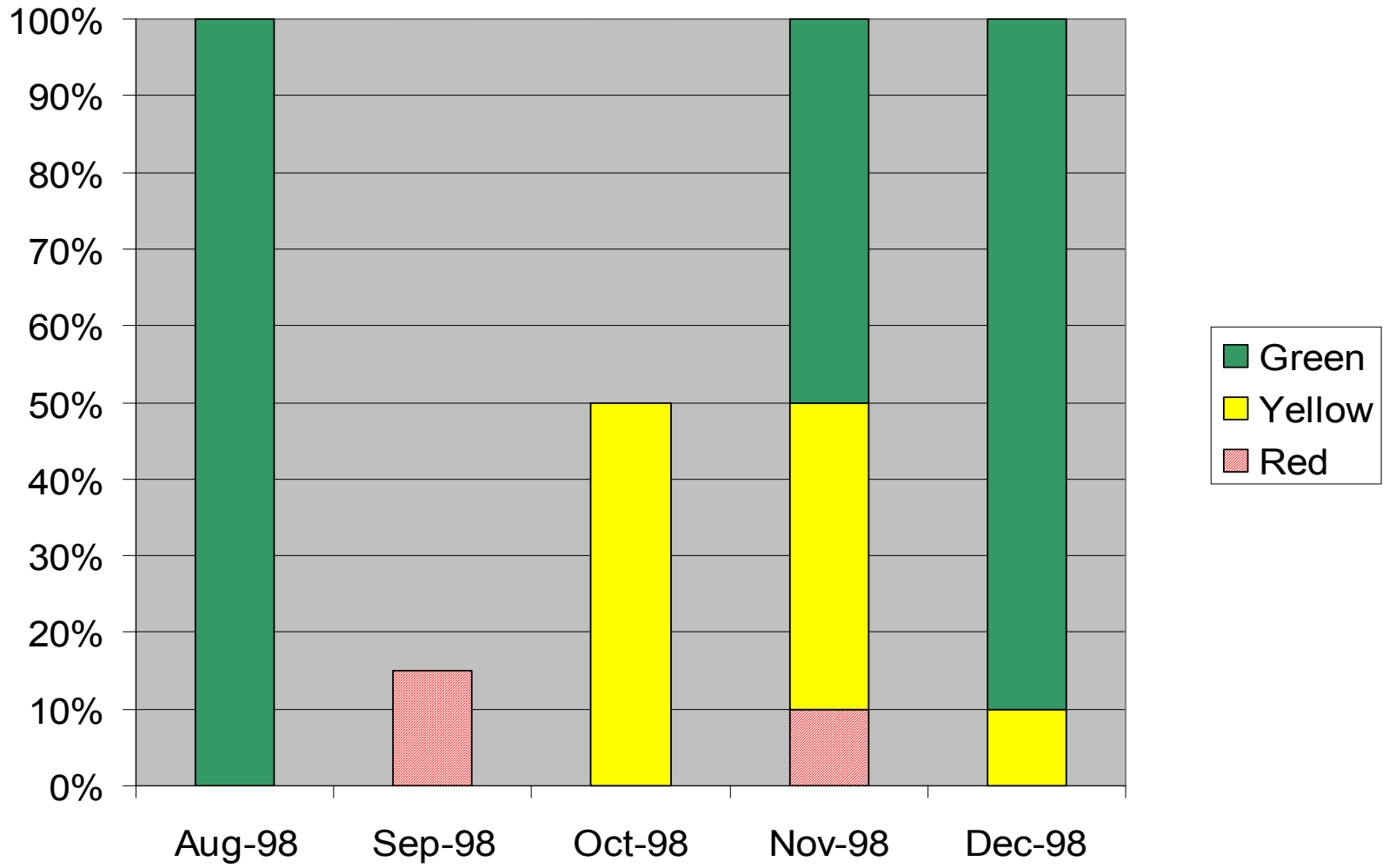

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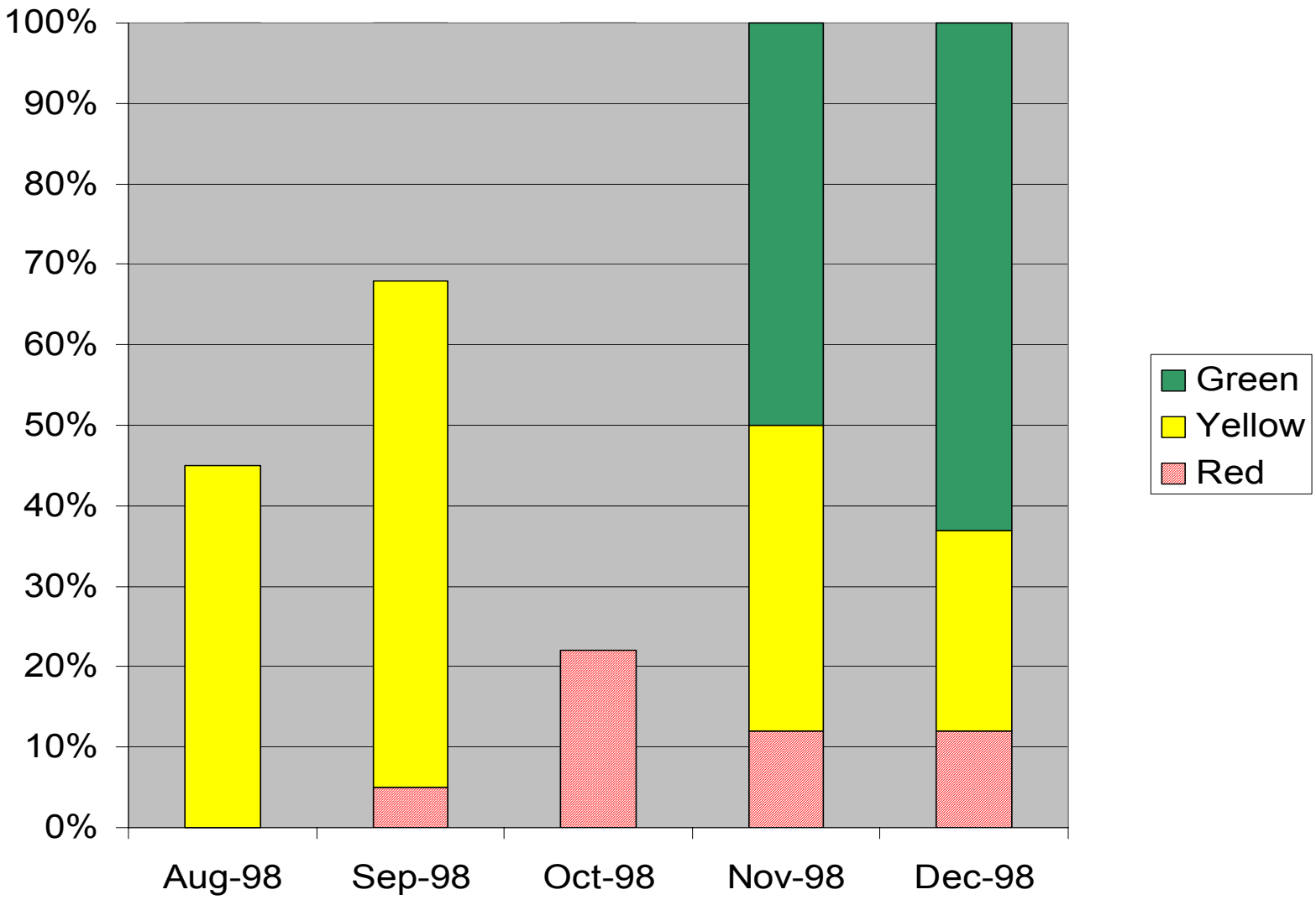
Socio-Tech Data



Adapted from MIT Sloan Fellows thesis by Sean Hilburt

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.

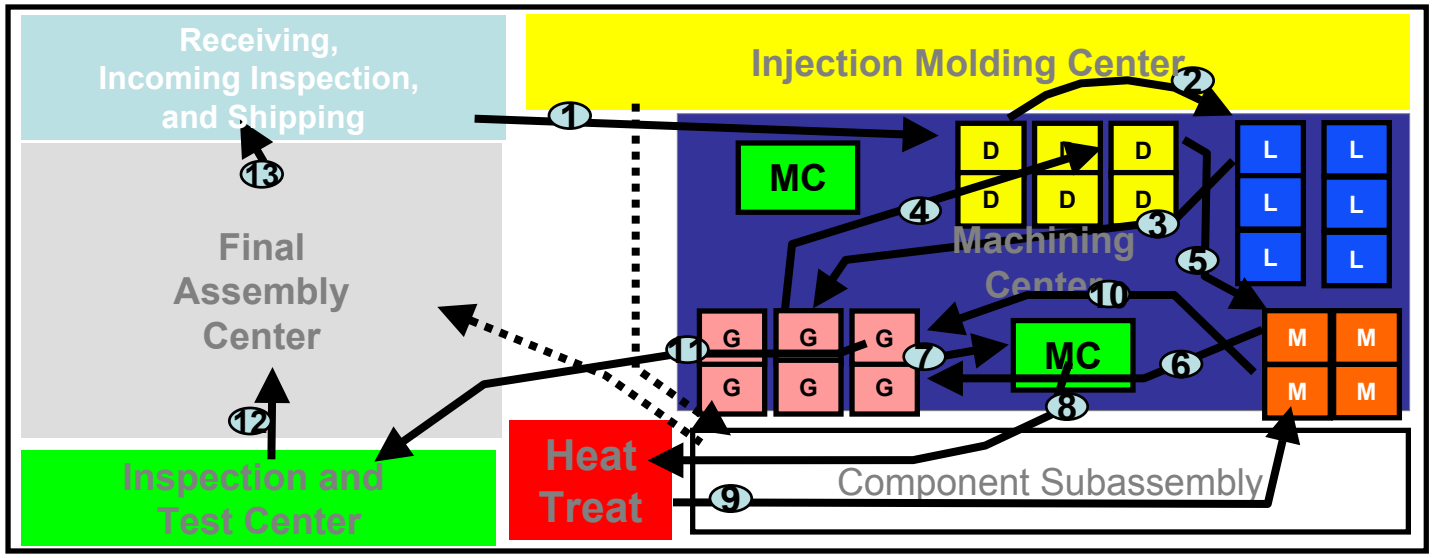
Step 3: Technical Systems

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

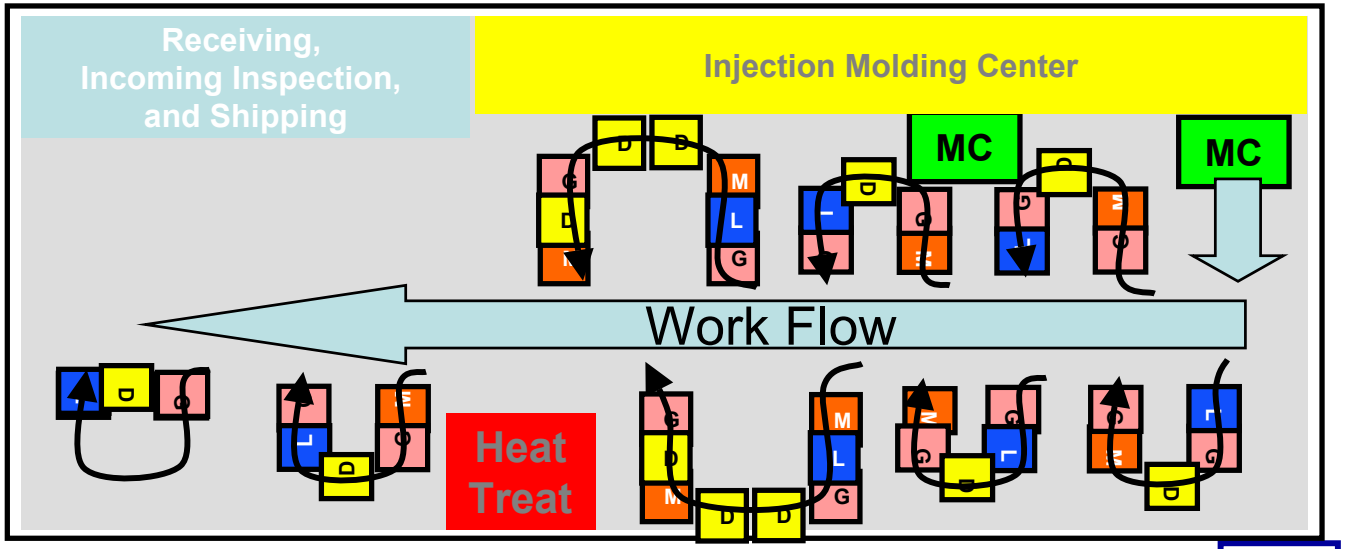
Discuss ways in which the social and technical changes are or are not interdependent. Derive 1-3 "Guiding Principles" for implementing a systems change of this type.

Exercise: Cellular Manufacturing



Current State

Desired State



Source: Lean Aerospace Initiative Fieldbook

Lean Thinking

- **Specify Value**
- **Identify the Value Stream**
- **Make Value Flow Continuously**
- **Let Customers Pull Value**
- **Pursue Perfection**

Source: J.P. Womack and D.T. Jones. *Lean Thinking* (New York: Simon & Schuster, 1996)

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

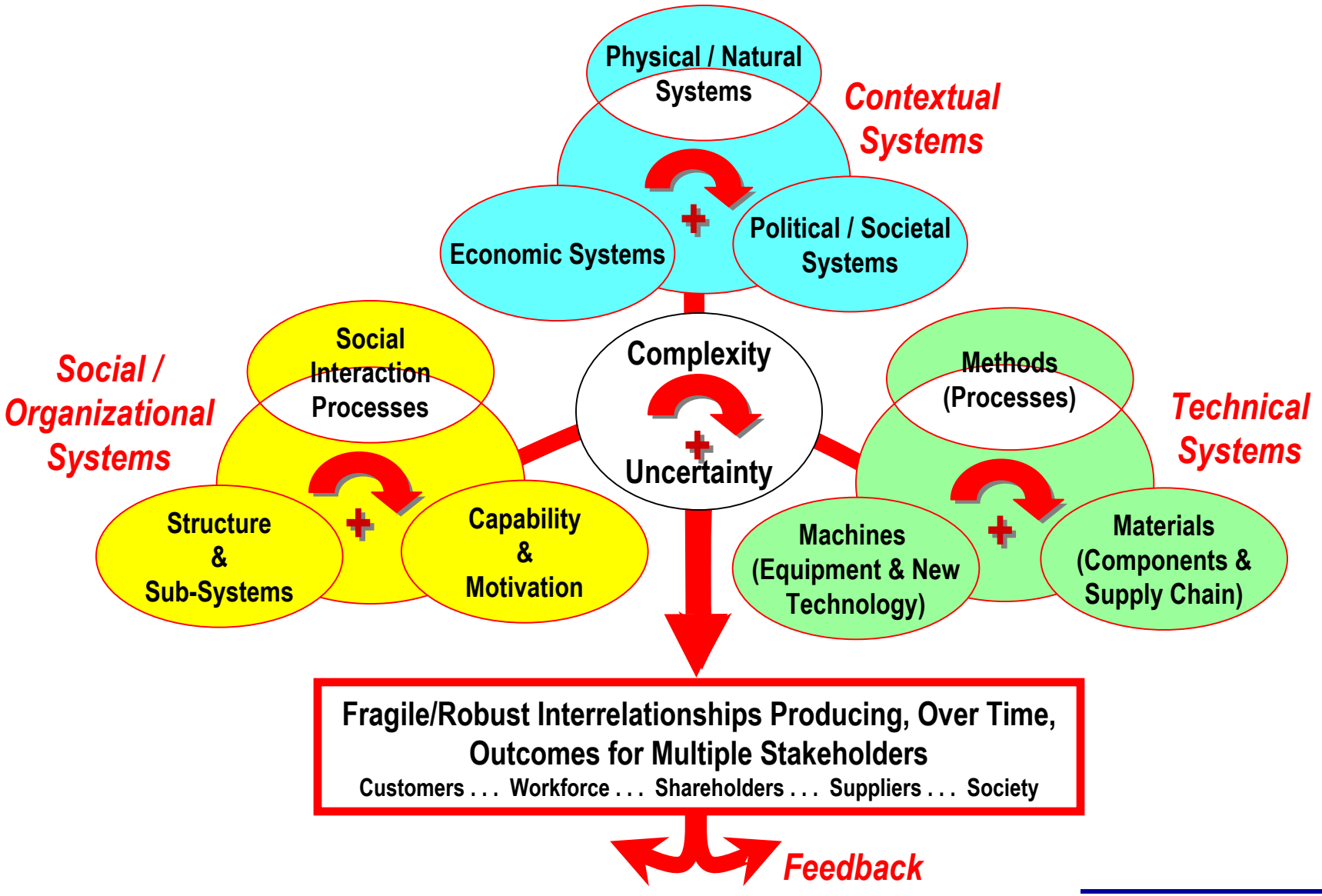
How are social and technical systems interdependent when it comes to addressing the Seven Waste?

How are they interdependent when it comes to the 5S's?

A COMPARISON OF THREE TYPES OF TEAM SYSTEMS

Source: Knowledge-Driven Work: Unexpected Lessons from Japanese and United States Work Practices, Cutcher-Gershenfeld, et. al., 1998.

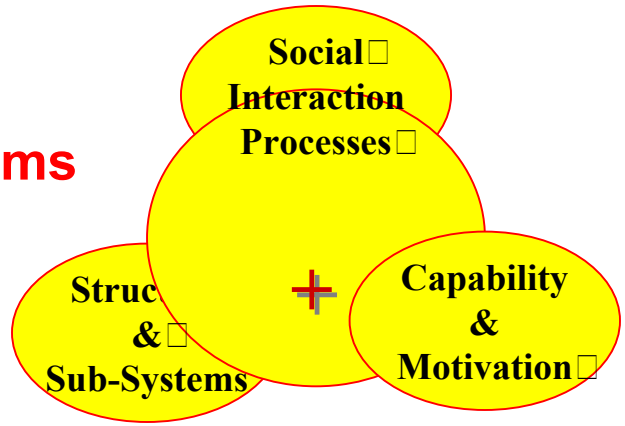
Sample Social and Technical Systems Framework



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

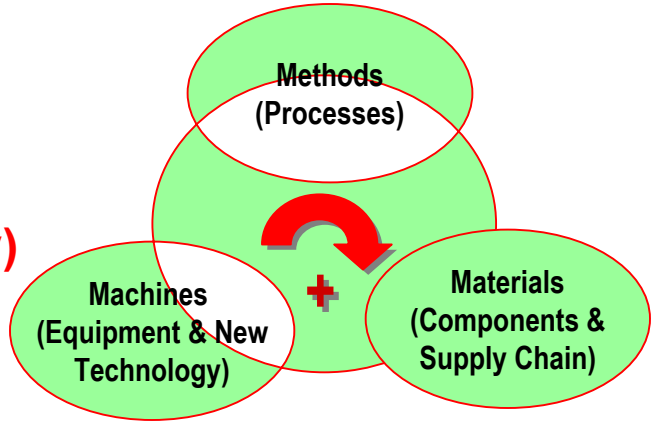
Capability & Motivation

- 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 frontiers of science



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

Materials (Components & Supply Chain)

- Interchangeable parts and mass production systems
- Just-In-Time delivery (JIT) systems
- Synchronous material flow systems
- e-commerce

Conclusion

- A deep historical legacy
- Challenge goes beyond just articulating useful principles about social and technical interdependency
- A fragile foundation for a global transformation

Appendix

- The Cross-Cultural Diffusion of New Work Systems

The Cross-Cultural Diffusion of New Work Systems

Structure

- Primary
- Secondary
- Reverse

Strategy

- Piecemeal
- Imposed
- Negotiated

Process

- Knowledge-Driven

Source: Knowledge-Driven Work: Unexpected Lessons from Japanese and United States Work Practices, Cutcher-Gershenfeld, et. al., 1998.