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Sociotechnical Systems Design for Consent-Based Siting of Nuclear Waste Facilities

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SOCIOTECHNICAL SYSTEMS

- A theory of work systems design

- Recognizes the interaction and dependencies between people and technology

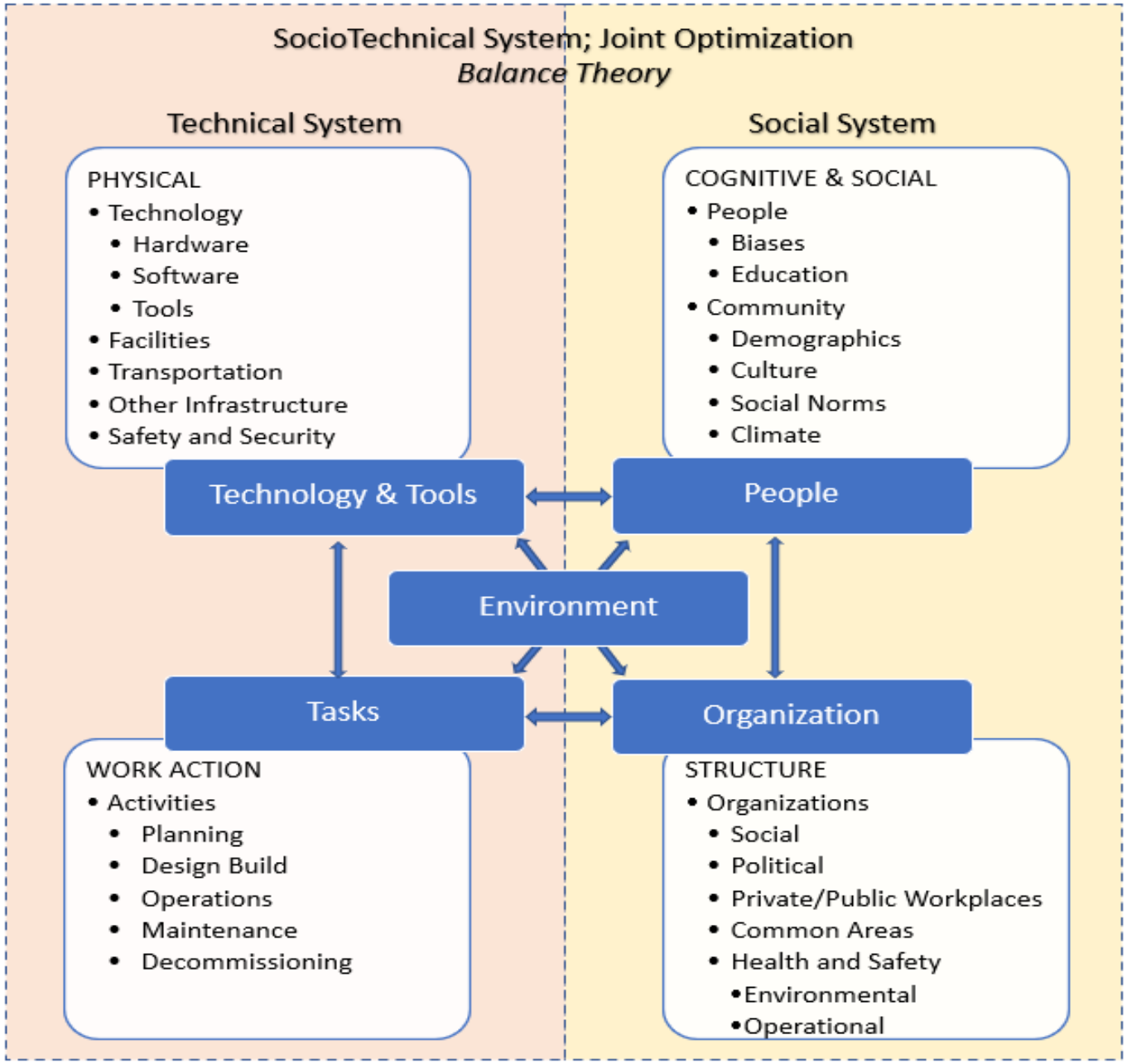
- Aims for joint optimization
  - of the social and technical aspects of the system
  - within the environment in which the system performs.

- Supports the design process from both the technology and the community standpoint
  - Enables communication channels
  - Integrate community and technical needs into the decision-making process

5 CORE ELEMENTS OF THE BALANCE THEORY

- **Tools and technologies** that define the technical subsystem
- **Tasks and activities (work)** generated in the technical subsystem
- **People** that act and interact with the system
- **Organization** and norms that define and control the social subsystem and its interactions with the technical subsystem
- Complex **environment** within which the system operates

JOINT OPTIMIZATION



CONCURENT ENGINEERING

- A non-linear, systematic approach to product and process design
  - requires the input of representatives from stakeholders throughout the lifecycle
  - early in the requirements gathering stages
  - and through the design process

CONCURRENT ENGINEERING GUIDELINES APPLIED TO NUCLEAR WASTE MANAGEMENT

1. Assemble a Concurrent Engineering Team that includes the social, technical and political subsystems of nuclear waste management

2. Define need in technical and community terms, and then translate into engineering requirements (Design with the end in mind)

3. Define process and performance parameters

4. Concurrent development of designs to meet all specifications across system elements, including manufacturing, transport, assembly, regulatory policies, safety, licensing, education, quality, operations, and maintenance.

PROBLEM DEFINITION

- The problem definition stage outlines the need for a nuclear waste management facility with **pre-defined technical characteristics**
  - Include description of need and **minimum criteria for success**, where host community, state, and federal **consent and support being part of such criteria**
  - Include overview of **external influences** which may interface/moderate potential solutions
  - Outlines **siting alternatives** and **stakeholder definition** for each site

CONCURRENT ENGINEERING AND SOCIOTECHNICAL FRAMEWORK

Problem Definition

Identify Problem
- Define Need
- Identify Criteria for Success
- Identify External Influences

Siting Alternatives
- Identify Communities
- Identify Stakeholders
- Identify Concurrent Team
- Develop Communication Plan

Identify High Level Goals
- Identify Community Goals
- Establish Priorities

Assemble a Concurrent Engineering Team that includes the social, technical and political subsystems of nuclear waste management

Socio Technical System Definition

Define System
- System
- Sub-Systems
- Boundaries
- Interfaces
- Lifecycle

Define Requirements
- Social
- Technical
- External Influences
- Re-evaluate Stakeholder Priorities

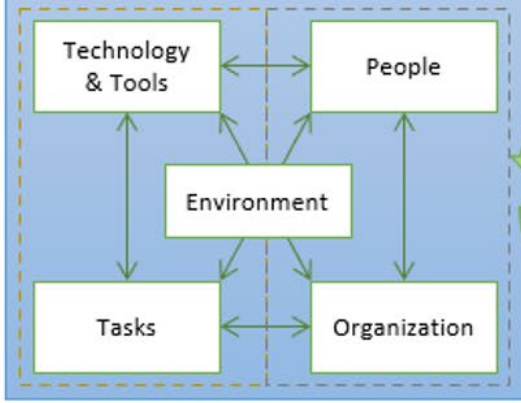
Establish Success Metrics
- Identify Potential Metrics
- Identify Go No-Go Decision Criteria
- Validate with end-user & Stakeholders

Define need in technical and community terms, and then translate into engineering requirements

Define process and performance parameters

CE STS Design

Balance Analysis of Requirements



Joint Optimization from Design to Execution

Joint optimization between the social and technical aspects of the system, and within the environment in which the system performs

- Recognize interfaces across system elements
- Understand and affect policy
- Design with the end in mind (both social and technical)
  - Develop technical solutions that address technical requirements in full
  - Address social specifications by design across system elements
- Acknowledge inevitable interfaces. Use change response to create a balanced system
- Ensure compatibility with the host community goals, capabilities, and expectations
- Plan community systems to meet purpose, motivations, interest, and characteristics of host
- Improve human interactions, evolution, law, and planning to support self-regulation and control of community resources

Concurrent development of designs to meet all specifications across system elements, including manufacturing, transport, assembly, regulatory policies, safety, licensing, education, quality, operations, and maintenance

SOCIOTECHNICAL SYSTEM DEFINITION

The STS definition stage defines the system and sub-systems, both technical and social, including the boundaries and interfaces between them.

- **Social** – to be identified and defined by stakeholders, weighted, and discussed within the CE team

- **Technical** - expected lifecycle of the facility, description of the waste, logistics and operations (such as transportation, storage, and disposal) and decommissioning at the end of the facility life-term

- **External influences** - In a consent-based siting process, policy is a critical subsystem moderating the social and technical subsystems

KEY QUESTIONS TO GUIDE SUBSYSTEM DEFINITION FOR A NUCLEAR WASTE MANAGEMENT STS

- What is the technology
- What are the tasks
- What are the technical requirements/specifications
- What are the non-technical requirements (quality, records mgmt)
- What are the risks
- What are the benefits
- What are the alternatives
- How does new technology interface with existing technology
- What is the required skill set for technology
- Technology Logistics
- Technology Operations and Maintenance

- What is the law
- What is the policy
- What is the practice
- What contracts are in place, missing
- What is the timeframe of change
- What is the funding source(s)
- Environmental protection requirements
- Safety requirements
- Technology Licensing

- Who are the stakeholders
- Who are the representatives
- What are the socio-economic goals
- What are the concerns
- What are the limitations
- What are the social norms for nuclear waste
- What is the culture for nuclear waste
- What is the community awareness level

CE & STS DESIGN PRINCIPLES FOR JOINT OPTIMIZATION

- Recognize interfaces across system elements
- Understand policy and build-in time for change (if needed)
- Design with the end in mind (both social and technical)
  - Technical solutions that address technical requirements
  - Address social specifications by design
- Acknowledge inevitable interfaces. Use change response to create a balanced system
- Ensure compatibility with the host community goals, capabilities, and expectations
- Plan community systems to meet purpose, motivations, interest, and characteristics of host
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Thank you

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