Navigating the Production Maze: The Topic Mapped Enterprise

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Y-12 National Security Complex
Y-12 National Security Complex: Specialized Manufacturing for DOE

- Established as part of Manhattan Project
- Oak Ridge Centers for Manufacturing Technology
- National Prototype Center
- Major site for nuclear weapons production
The Manufacturing Enterprise

- The factory
  - Buildings and shops
  - Equipment
  - Material streams
  - Staff

- The products
  - Current products
  - Legacy products
Y-12 Facilities

- About a dozen major production facilities
- Multiple shops in some facilities
- About 140 numerically controlled tool centers
- Coordinate-measuring machines, X-ray systems, and other inspection tools
- Smelters, rolling mills, forming presses up to 7500 tons, heat treatment furnaces
- Chemical facilities
- Environmentally controlled facilities
Y-12 Products: Assembled Systems

- Start from raw or recycled materials
- Cast, pressed, or forged/rolled blanks or rough shapes
- Machining to final shapes
- Assembly of components
- Certification of parts and assemblies at almost every stage
Other Products: Dismantlement

- Retire obsolete systems
- Meet treaty requirements
- Recover materials
- Destroy classified shapes
Issues: Products

- DOE expects us to be able to refurbish systems in Enduring Stockpile with 36-month lead time.
- Some systems were last made over a decade ago, and staff have retired and equipment may be out of service.
- Decades-old systems are coming back for retirement/dismantlement.
- Health, safety, and environmental requirements may have changed since systems were produced.
Issues: Equipment and Facilities

- Site was designed for Manhattan Project, 60 years ago.
- Facilities are scattered over large campus.
- Machine tools were acquired for height of cold-war production.
- Even when old tools are still functional, computer support is obsolete (e.g., early ’90s technology).
Issues: New Techniques and Technologies

- Agile machines
- New computers
- Better chemical processes
- New processes (e.g., microwave smelting)
Why a Topic Map

- Need to deal with multithreaded information
- Need to have multiple views into information
- Need to harmonize diverse data sources and formats
- Need more flexibility than RDF allows
- Already have Topic Map projects under development
Mapping the Enterprise

- Analyze products
- Analyze material streams
- Trace products through processes
- Catalogue equipment and facilities
- Link processes to equipment
- Locate equipment in facilities
Looking for Destinations

- Determine requirements for production
  - Materials
  - Equipment and facilities
  - Processes
  - Staff

- Look for effects of change
  - Materials
  - Equipment and facilities
  - Processes
  - Staff
Charting the Map

- Develop ontologies of parts, materials, processes, equipment
- Collect and convert data
- Design interface: views of data
Ontology: Products

- Systems
- Assemblies/subassemblies
- Parts and characteristics
  - Generic manufacturing process
  - Generic shape
  - Material
  - Mass
  - Routing (sequence of production steps)
- Component identification
Ontology: Production

- Processes
  - People
  - Schedules
  - Planning

- Machines
  - Manufacturers and models
  - Capabilities
  - Inventory data
  - Schedules for maintenance and refurbishment
Process Structure

- Process
  - People
  - Modernization
- Duration
- Schedule
- System
- Machines
  - Machine
Using the Map

- Systems entrance
  - Systems
  - Parts
  - Materials

- Equipment entrance
  - Locations
  - Makers
  - Inventory
Destination: Part

- Identification numbers
- Parent
- Related parts (cousins from other versions of parent)
- Material (generic and named)
- Shape
- Routing
Destination: Tool

- Maker and model
- Controller
- Capabilities
  - Axes
  - Range and precision
- History
- Evaluation
- Inventory
Many Paths through the Map

- System → Parts → Materials
- System → Part → Machines
- Part → System
- Material → Parts → Machines
- Machine → Parts → Systems
- Shop → Machines
- Machine → Shops
Live Demonstration
It’s not the destination but the journey!

- Data is not new (available from other sources)
- TM allows integration
- Paths through data are as important as nodes