Process Characterization

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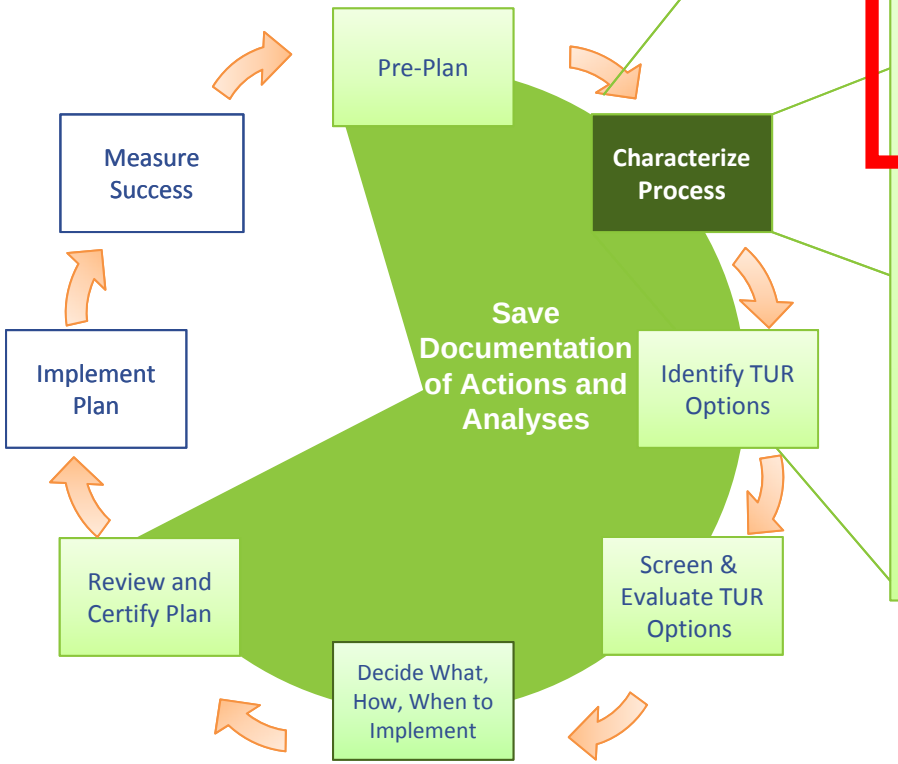
Agenda



- **Production Unit(s) Description**
  - Units of product
  - Process, inputs, and outputs of each stage
  - Purpose chemicals serve
- **Process Mapping**
  - Visual representation of production units
  - Show chemical movement into, through, and out of production unit including storage, treatment , recycling
- **Material Balance**
  - Determine amounts of toxic used
  - Amounts generated as byproduct, treated or recycled on-site, or released as emissions
- **Toxics Use Characterization**
  - How and why the toxic(s) are used
  - Chemical pathway analysis
  - Qualitative estimate of toxics costs: key cost components, relative importance

Process Characterization

The method by which a process or series of processes are broken down into smaller components

- Identification of inputs and outputs
- Degree of dissection dependent on the needs of the analysis
- "PROCESS FLOW DIAGRAM"

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Process Flow Diagrams

Technique to pictorially define steps of process

Visual outline of that which defines a procedure or process

The Process Flow Diagram provides:

- Clear concept of the process
- All the relevant pieces of the process
- All the input/output points
- Means of discussing the process with TUR Team

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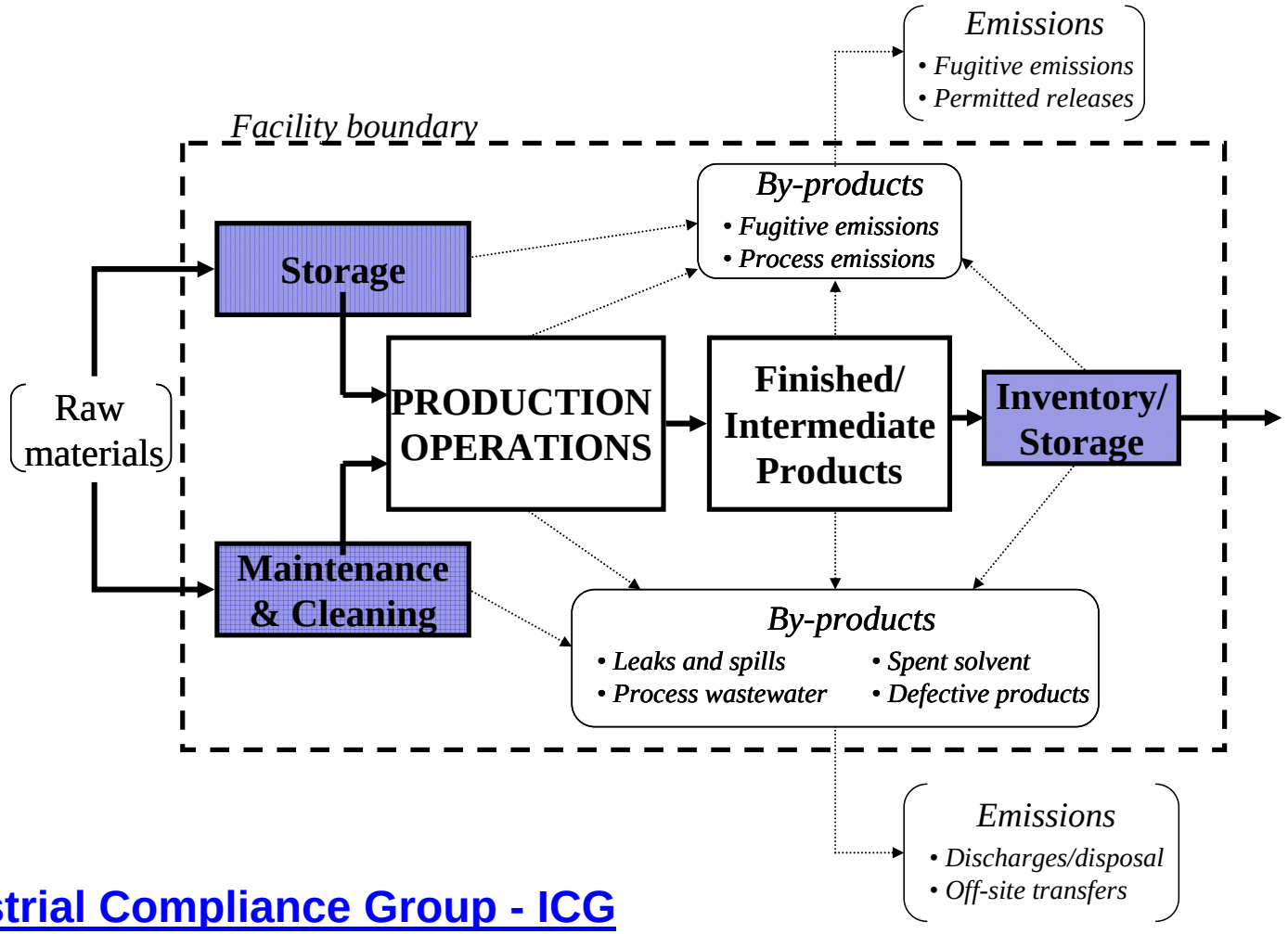
Example TUR Process Flow Diagram



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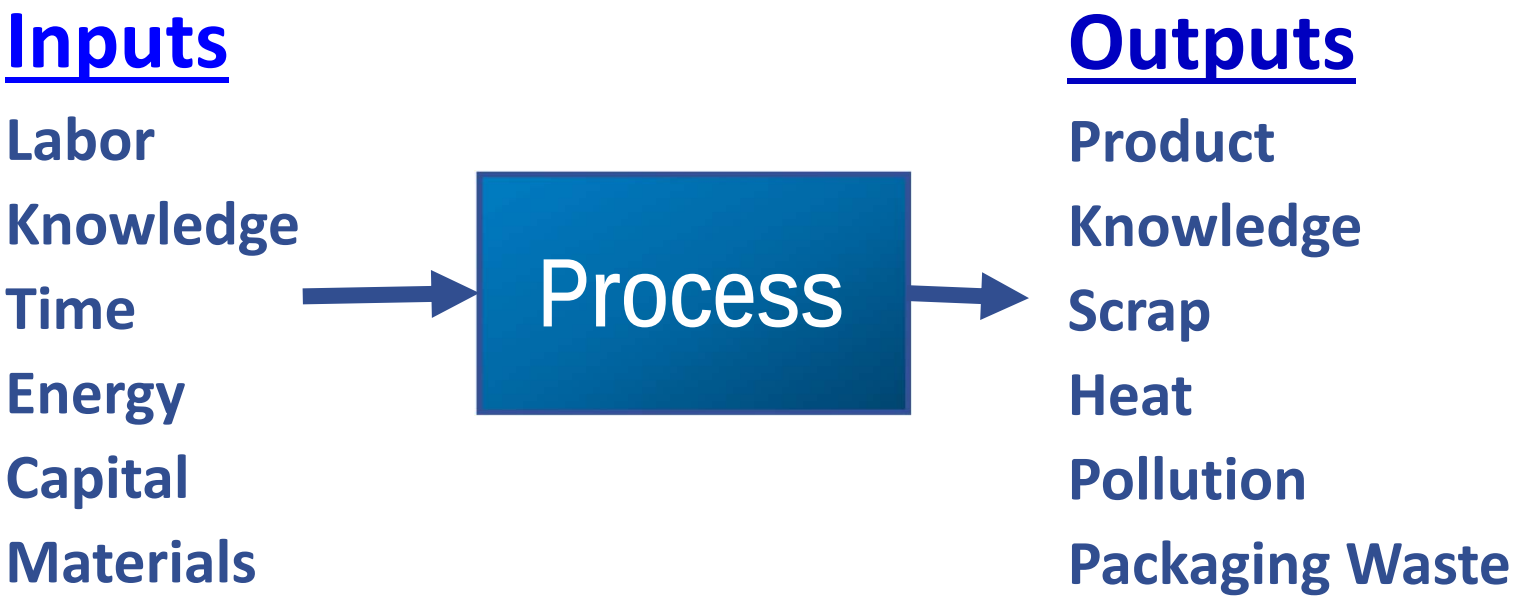
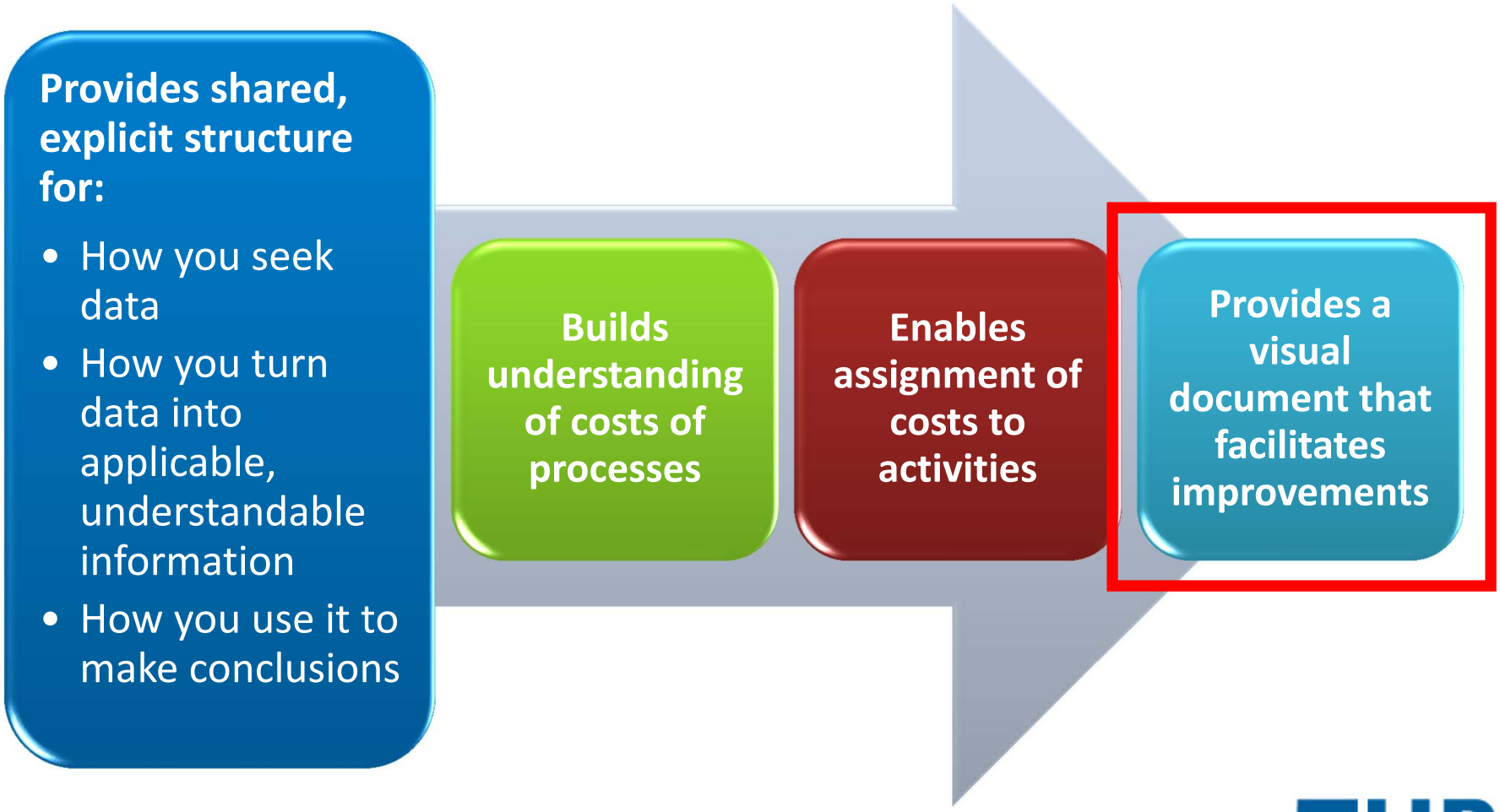
Manufacturing Model

Facility Level Process Flow Diagram



Why Use Process Flow Diagrams?



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Chemical Pathway Analysis

Identifies flow of specific chemicals (toxics), byproducts, or emissions, through processes

Traces flow of toxics through process flow diagram

Helps identify potential environmental emission points or safety problems

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Product

The outcome of a production process

Can be a byproduct used as a raw material without treatment

Under TURA, a product can be:

- A Product
- A Family of Products
- An Intermediate Product
- A Family of Intermediate Products
- A desired Result or Family of Results
- Byproduct as Product

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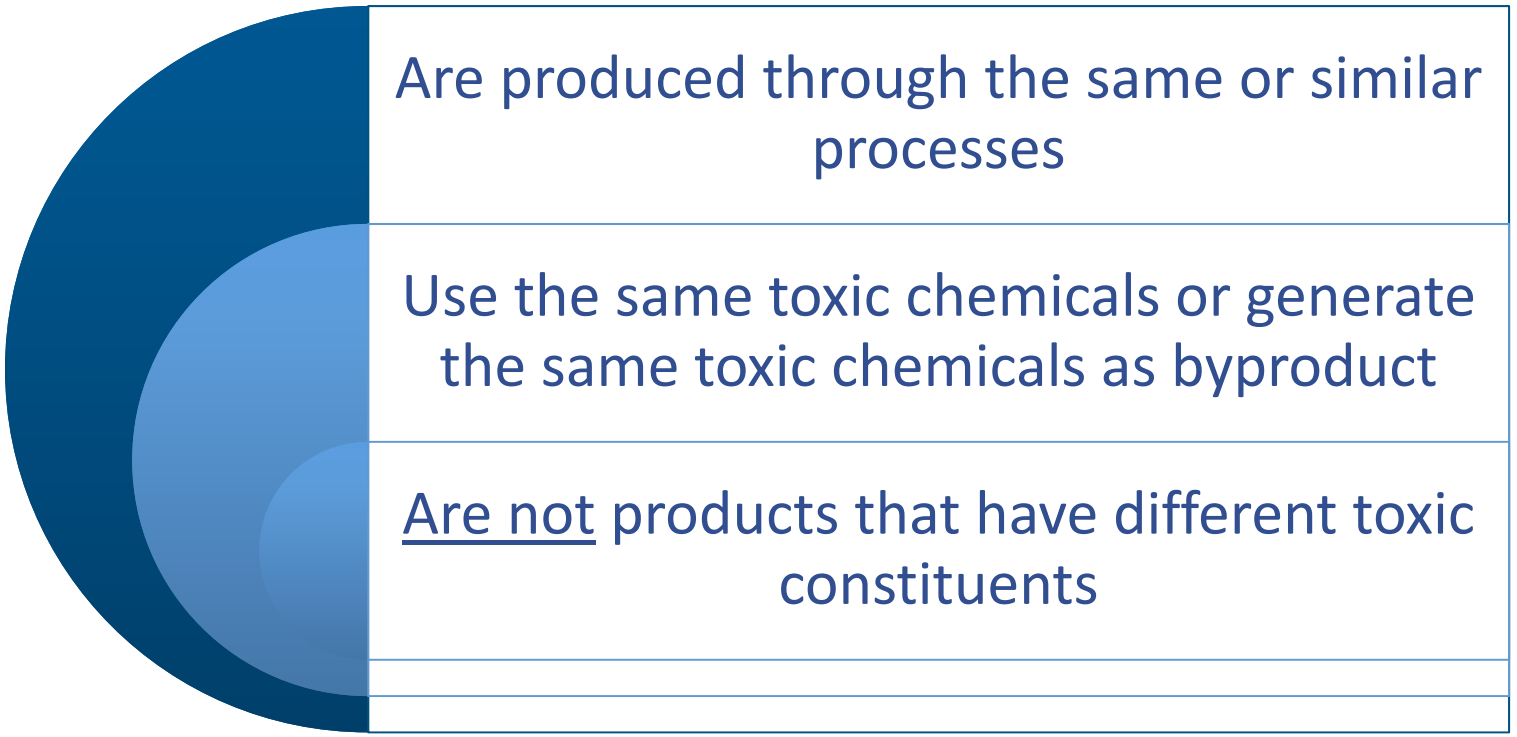
Family of Products

Products that:



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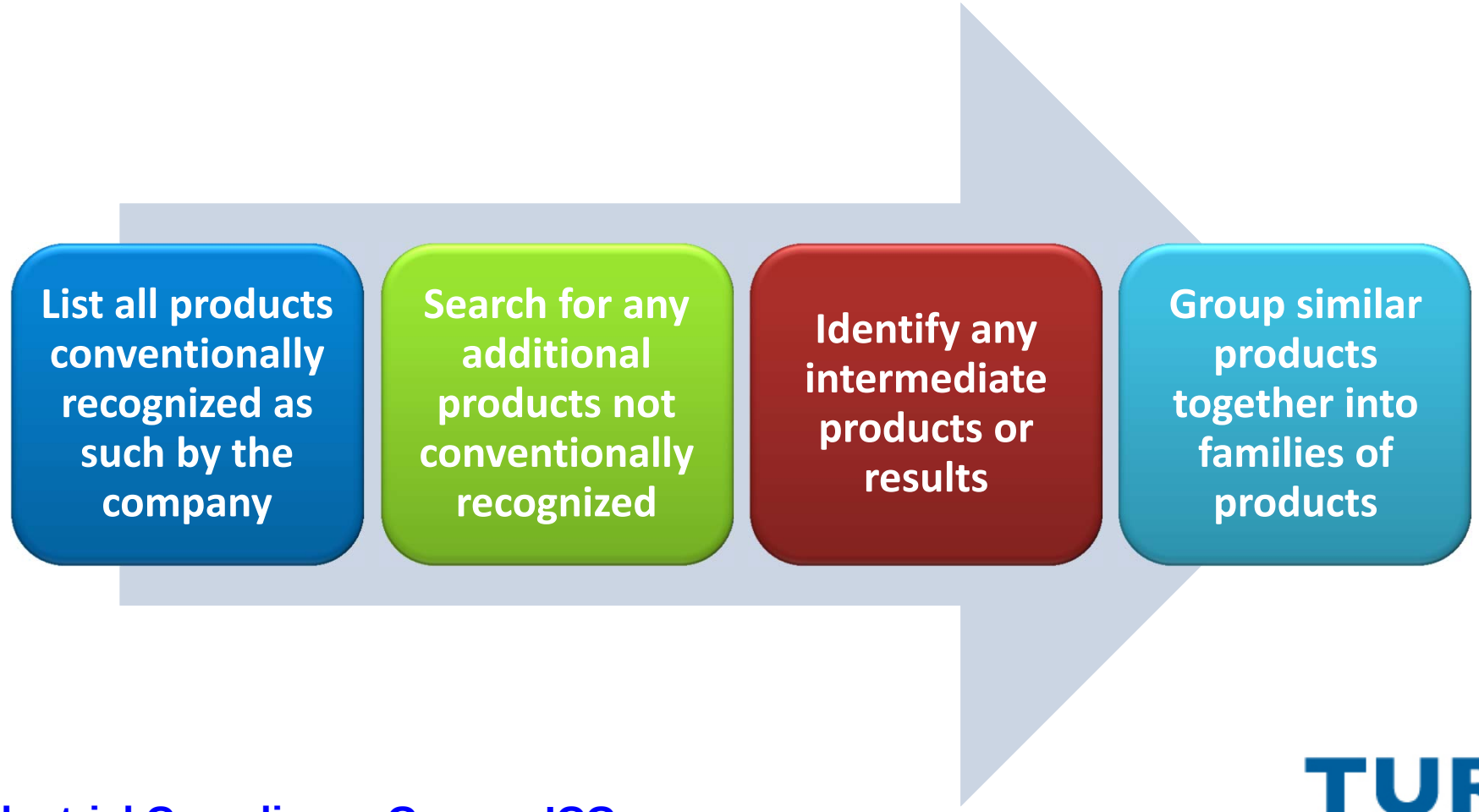
Protocol for Identifying Products



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Production Unit

"A process, line, method, activity, or technique or a combination or series thereof, used to make a product“

Process or group of processes regarded as a distinct entity for the purpose of TUR planning

Production Unit = Toxic + Process + Product

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Production Unit examples

	Production Unit =	Listed Toxic +	Process +	Product
1	Fountain Pen Assembly	Trichlor-ethylene	Assembly	Fountain Pens
2	Cleaning Work Uniforms	Perchlor-ethylene	Cleaning	Clean Uniforms
3	Plating Sports Trophies	Hexavalent Chromium	Plating	Sports Trophies

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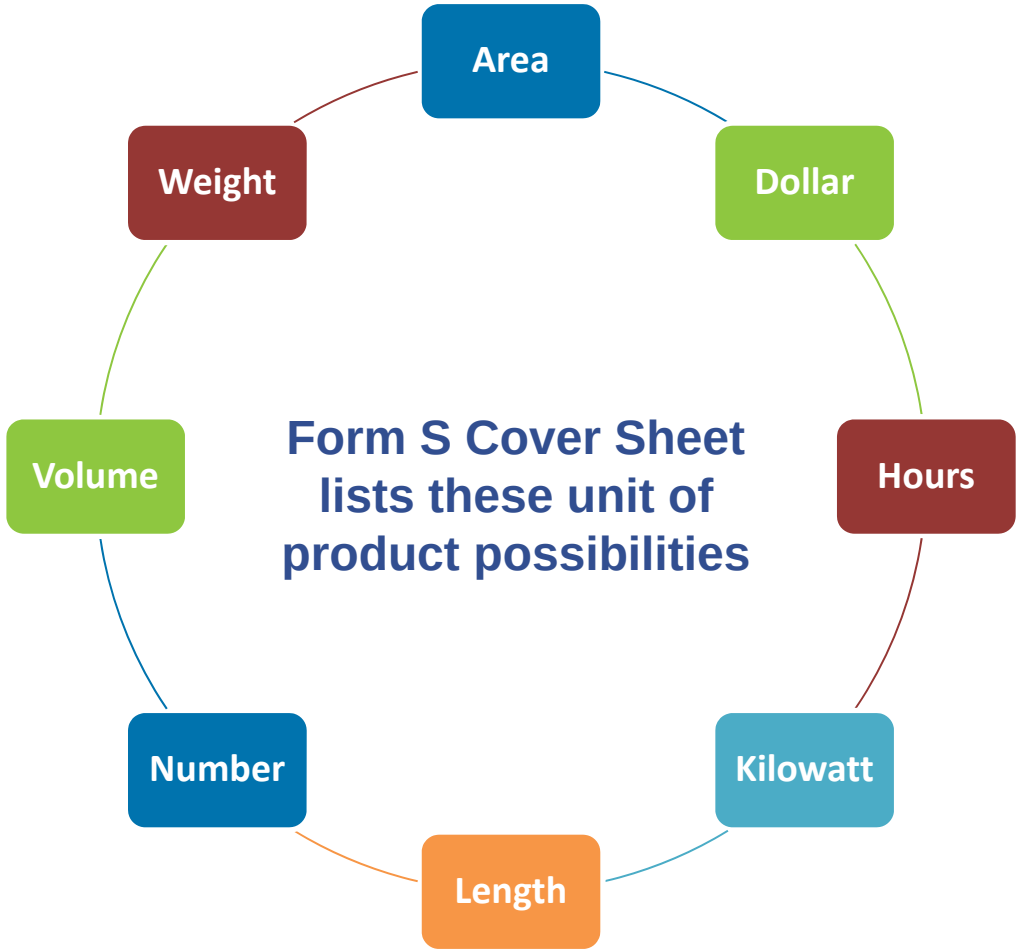
Protocol for Identifying Production Units

Only 1 product?	• Whole production process = production unit
Multiple products?	• Consider each one-at-a-time • ID processes necessary for each product • Each process cluster = 1 production unit
Several products require same process elements?	• Lump them together as product family or families • ID processes necessary for each family • Each process cluster = 1 production unit

Different TUR Planners will make different choices – ALL ARE VALID!

Unit of Product



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Doing It in Real Life

Walk-Arounds:
Identify points where chemicals are entering or leaving process

- Fugitive, Point, and Area emissions to all medias
- Byproduct flows to pollution control units
  - fume scrubbers
  - wastewater treatment
  - on-site recycling
  - etc.
- Leaks, spills, evaporative losses, maintenance activities

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Doing It in Real Life

Process Flow Diagrams: Use Existing Data

- Operational Data
- Piping diagrams
- Operating manuals
- Work flow diagrams
- Architect's plans

Do Not Re-Invent The Wheel !

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Use of Data in Planning

Compile data for current materials use, toxics use, production processes

- Serves as base-line for all future TUR possibilities
- Provides comprehensive view of current work practices
- Indicates areas of high toxics use, or inefficiency

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IMPORTANT!

DEP Notes from Multi-Media Audits

- **Process Flow Diagram must include:**
  - Each Step including treatment and recycling
  - Movement of each reportable chemical through the process including all points of entry and **exit** as product, byproduct or emission

Process Flow Diagram Examples

2 Different Manufacturing Sectors

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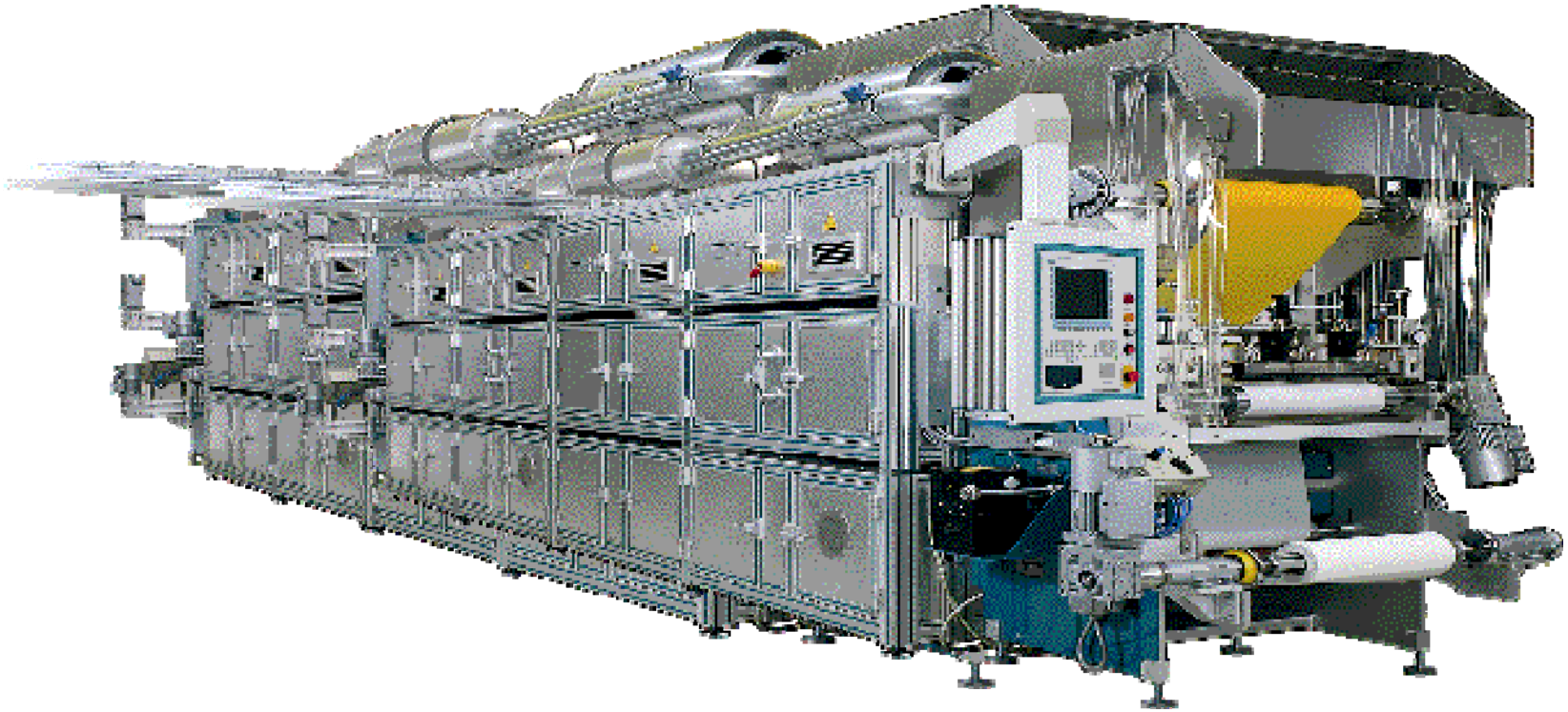
Coating Facility Example



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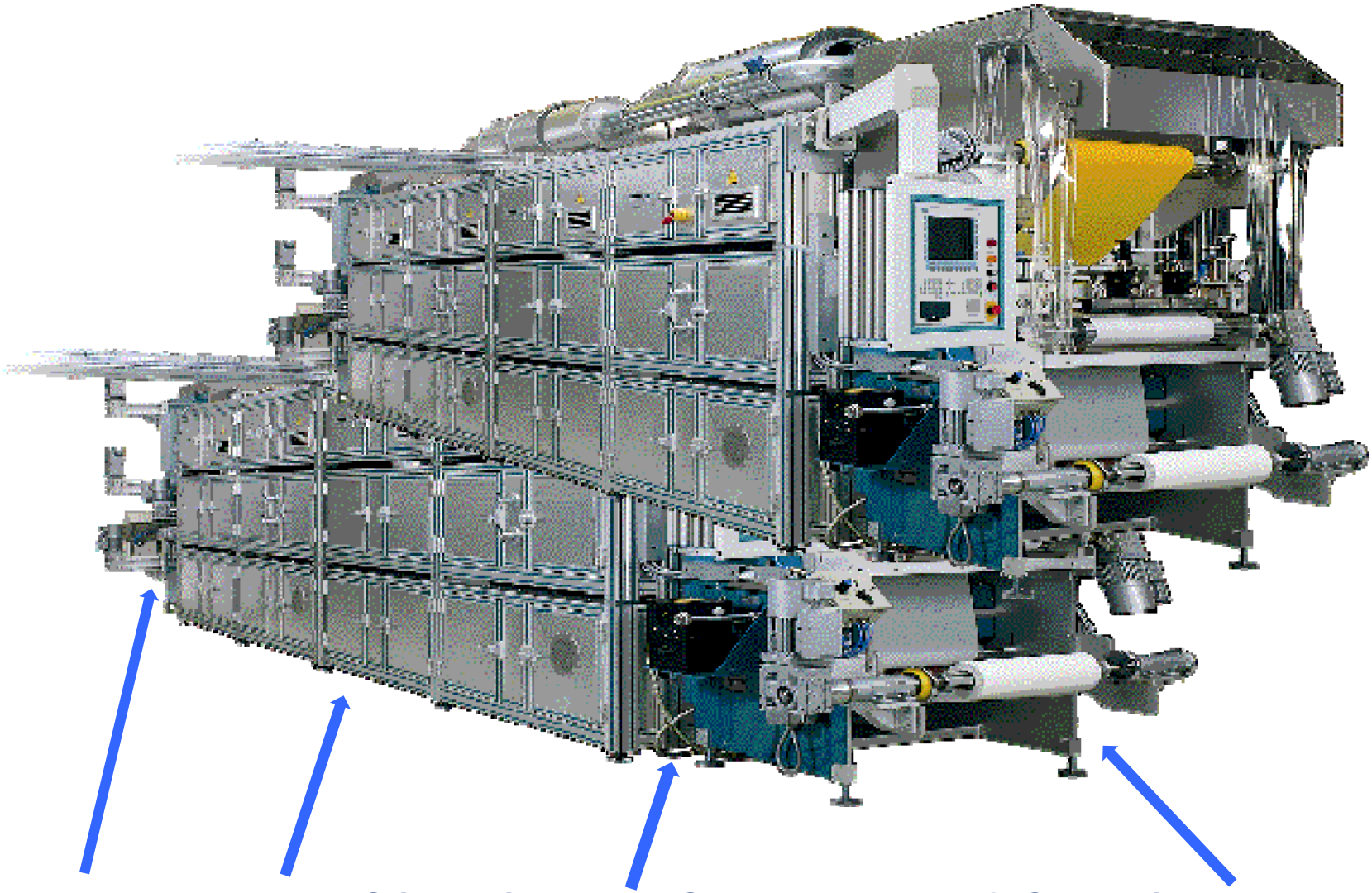
- **Process Characterization – discovery process – initial discussions**:
  - How many products are made?
  - What chemicals are used in production?
  - Do you have purchasing records with total pounds or gallons of each chemical?
  - How many production lines and what chemicals and products are associated with EACH production line?
  - Ask to see any existing Process Flow Diagrams, if available. Note: This facility had identified over 100 Production Units!

- **Facility walk-through:**
  - Create a quick sketch of materials flow through the various manufacturing/materials handling operations.
  - Create a quick “sub-set” sketch of operations that makeup an individual Production Unit
  - Try to identify any common elements/chemicals in Production Units. How many can be combined?
  - Are there any Key-Operations for which all other operations depend (i.e., pure water production/Semiconductor Industry; similar/identical chemicals used to make products in Production Units/Solvent Based Coatings, etc.)

- **Complete the Process flow diagrams:**
  - First, create a Facility Wide Process Flow Diagram to provide an overview of operations.
  - Next, create Process Flow Diagrams based on chemicals used and products produced:
    - Sometimes different chemicals are used to make different products, which requires different Production Units.
    - Sometimes all operations and chemicals can be combined into one Production Unit.
  - Review DRAFT Process Flow Diagrams with facility personnel for accuracy

- **Identification of opportunities for Toxics Use Reduction:**
  - Chemical Storage/Handling
  - Cleaning operations
  - Chemical Formulations
  - Product yield
  - Are there any opportunities for TUR [low-hanging-fruit] that do not require capital investments or excessive consumption of man-hours, such as operational changes? Provides measurable TUR with cost savings [This helps to establish a positive view of TUR with process managers and senior management]

- **Initial evaluation for TUR in each area listed above:**
  - Product yield - quickly learned this area was "taboo" – at least initially.
  - Chemical Formulations – leave our magic "pixie-dust" alone! It works great!
  - Chemical Storage/Handling – good practices in place for chemical transfers to USTs (very little emissions)
  - Cleaning Operations – accounted for 36% of all MEK solvent use. There were many steps in cleaning. A good place to start!



Locations of buckets of MEK used for cleaning

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Roller and MEK Cleaning Tray

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- **TUR Options Identified via Process Flow Diagrams - that were implemented:**
  - 5 gallon pails of MEK used for cleaning:
    - Improved Operation and Maintenance: Increased the number of pails to reduce the distance from liquid to area of application. Reduced the amount of drag-out.
    - Improved Operation and Maintenance: Keep pails covered when not in use. Reduced evaporation.
  - Rubber Roller Solvent Cleaning Tray:
    - Production Unit Redesign: Decreased dimensions [depth] of MEK solvent tray without creating quality issues. Resulted in MEK reduction > 40%

- 5 gallon pails of MEK - additional TUR Options, after two TUR Planning Cycles:
  - Input Substitution: 5 gallon pails of MEK were replaced with Ethyl Acetate – a less toxic chemical.
  - Improved Operation and Maintenance: Tools were developed to reduce the amount of skin contact with solvents.
- Chemical Formulation Changes, after two TUR Planning Cycles:
  - Input Substitution: Heightened awareness of health hazards associated with other toxic chemicals used below reporting thresholds, resulted in Input Substitutions in some cases.

Questions?

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