TECH 50800
QUALITY and PRODUCTIVITY in
INDUSTRY and TECHNOLOGY

Before we begin:

- Turn on the sound on your computer. There is audio to accompany this presentation.

- Audio will accompany most of the online presentation materials through-out the semester.

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TECH 50800
QUALITY and PRODUCTIVITY in
INDUSTRY and TECHNOLOGY

Week 8
Lean Thinking and Lean Tools

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LEAN SIX SIGMA PROCESS…

Lean 101

Identify Waste

Quick Hit Improve-ments

Lean 101

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Lean Six Sigma: Lean 101

Lean 101
Identify Waste
Quick Hit Improvements

Lean 101 Goals

- Identify and eliminate waste.
- Use PDSA's to make small, quick improvements to existing systems.

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LEAN SIX SIGMA TOOLS...

| Lean 101 |
| Process Observation Worksheet |
| Spaghetti Diagram |
| 5S |
| Visual Controls |

Lean 101

Lean 101
Introduction to Lean - Review

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INTRODUCTION to LEAN - Review

❑ The Toyota Production System or Lean Production was developed in the early 1950's in Toyota Motor Corporation.

❑ Japan was recovering from WWII

❑ Taiichi Ohno was Toyota's chief of production and tasked with growing the company in the tough economic environment

❑ Lean includes several fundamental improvement tools that can be applied to a process

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WHY DO YOU BUY WHAT YOU BUY?

✓ Price?
✓ Availability?
✓ Quality?
✓ Safety?
✓ Features?
✓ Brand name?

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WHAT is VALUE-ADDED (VA)?

$$Value = \frac{Benefits}{Cost} = \frac{Function}{Cost}$$ As perceived by each customer

$$Value = \frac{(Performance + Capability)}{Cost}$$

Performance includes:
• Quality
• Responsiveness
• Innovation

• Value-Added Activities: An activity that changes the work to meet customer requirements or a specific request for which they are willing to pay.

• *All other steps are Non-Value Added (NVA).*

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Lean Thinking
Identifying Waste

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WHAT is WASTE?

❑ Any activity that consumes resources but creates no value for the customer.

❑ Waste often appears as valueless

  ❑ Time

  ❑ Activities

  ❑ Variability

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WHAT is WASTE?

▪ Non-value adding, resource consuming activities

▪ "It is the little things that are hard to see – the awkward little methods of doing things that have grown up and which no one notices". (Henry Ford)
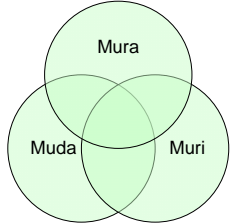
▪ "Friction" (Levinson & Rerick)

If it's frustrating, a chronic annoyance, or a chronic inefficiency, it's friction.

(Levinson & Tumbelty)

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WHAT is WASTE?

Non-value adding, resource consuming activities

Mura

Muda   Muri

- Mura – unbalanced workflow
- Muri – overburdening people or equipment
- Muda – process steps that do not add value

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IDENTIFYING WASTE

Observe the process to identify waste:

- ❑ Become familiar with the '8 kinds of waste'.
- ❑ Waste identification tools include:
  - o Process Observation Worksheet
  - o Checksheets
  - o Spaghetti Diagram
  - o Process Flow Maps
  - o Other tools …

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IDENTIFYING WASTE

Eight kinds of waste:

1. Inventory
2. Motion
3. Over Production
4. Over Processing
5. Transportation
6. Rework/Defects/Scrap
7. Waiting/Delays
8. Underutilized Talent

Waiting

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IDENTIFYING WASTE

1. Inventory
   - Ordering more than required to fill an the order.
   - Reason: Quality problems in the process
   - Reason: Belief it's less expensive to order larger quantities. True cost of excess inventory levels should be considered.
   - Service Examples:
     - Supplies, forms and equipment
     - Product for sale
   - Manufacturing Examples:
     - Raw materials, components and packaging.
     - Supplies and spare maintenance parts

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IDENTIFYING WASTE

2. Motion/Flow:
   - Any movement of people, materials or machines in excess of what is necessary to provide required services
   - Healthcare Examples:
     - Looking for supplies/equipment
     - Back-tracking
   - Manufacturing Examples:
     - Erratic product flow through manufacturing e.g. returning to a department multiple times

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IDENTIFYING WASTE

3. Overproduction
   - Producing more than needed or producing faster than needed.
   - Healthcare Examples:
     - Excess IV production/distribution
   - Service Examples:
     - Cooking food that is later discarded
     - Printing too many magazines
     - Production of any product with a shelf-life
     - Over staffing resulting in short work weeks.

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IDENTIFYING WASTE

4. Over Processing
   - Putting more into a product or service than is valued by the customer.
   - Goal is to match the level of process to what is useful and necessary as determined by the customer.
   - Manufacturing Examples:
     - Painting unseen areas
     - Unnecessarily tight tolerances
     - Cleaning and polish beyond level required

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IDENTIFYING WASTE

5. Transportation
   - Any material or information movement in excess of what is required.
   - Healthcare Examples:
     - Long travel distances to ancillary services
   - Manufacturing Examples:
     - Warehouse/storage areas in separate buildings
     - Random arrangement of production areas
     - Tool rooms located in remote areas
     - Supplies located multiple locations

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IDENTIFYING WASTE

6. Rework/Defects/Scrap
   - Rework - Inspection and/or correction of information, products or materials.
   - Healthcare Examples:
     - Double/triple checking
     - Returned IVs
   - Service Examples:
     - Incomplete documents
     - Incorrect information or data entry
     - Insufficient equipment repair

QUALITY CONTROL
FAILED
INSPECTION
REWORK

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IDENTIFYING WASTE

6. Rework/Defects/Scrap (continued)
   - Defects - Work that contains errors or mistakes
   - Healthcare Examples:
     - Medication errors
     - Procedure errors
   - Service Examples:
     - Incorrect data entry
     - Procedure errors
     - Incorrect billing
     - Failure to bill

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IDENTIFYING WASTE

6. Rework/Defects/Scrap (continued)
   - Scrap - Product or supplies that are discarded without being used.
   - Healthcare Examples:
     - Expired Medications
     - Returned IVs
     - Linens from an isolation room
   - Manufacturing Examples:
     - Defective product
     - Unusable by-products

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IDENTIFYING WASTE

7. Waiting/Delays
   - Idle time when people wait for people, people wait for machines, or machines wait for people.
   - Healthcare Examples:
     - Waiting for supplies
     - Waiting for patients
   - Manufacturing Examples:
     - Waiting on materials or supplies
     - Equipment breakdown
     - Processing delays
   - Computer network not available

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IDENTIFYING WASTE

8. Underutilizing Employee Talent
   - Not using people's mental, creative, and physical abilities
   - Examples:
     - Using staff as operational labor rather than as creative, talented individuals.
     - Not involving front line staff in systems improvement projects.
     - Workarounds

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IDENTIFYING WASTE

Secondary indications that a process is wasteful:

- Employees and Customers often complain about the process and process outputs.
- Employees spend a significant amount of time searching for items needed for the process.
- The outcome from the process is often not what was expected and/or the output must often be reworked.
- Everyone does 'IT' differently.
- The response to critical process breakdown is to increase the amount of double/triple checking, often including supervisors in this loop.

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IDENTIFYING WASTE

For each step in the process ask:

- Is this step adding value to the process?
- Does each employee complete this step in the same manner EVERY time?
- Are the equipment and supplies needed for step available EVERY time within 30 seconds?
- Is the information necessary for this step readily available and correct EVERY time?
- For hand-offs of materials and/or information: Is the hand-off linked with clear Yes/No signals?
- Does this step of the process travel as a single, simple and direct flow path to the next step?

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Lean Tools

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LEAN TOOLS

Lean Tools to reduce or eliminate waste include:

- Checksheets
- Process Observation Worksheets
- Spaghetti Diagram
- 5S
- Visual Controls
- Visual Workplace Rules
- Workstation Design
- Setup Reduction

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GATHERING INFORMATION

- Use teams of 3-4 people
  - Include "Fresh Eyes"
  - Determine who is going to collect what data
  - Data gathering tools: clipboards, forms, stop watches, pedometers, cameras.
  - Include star and flower shaped Post-its™
- Assign teams to gather data in as many areas as feasible
- Review "Data Gathering Rules of Conduct"

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GATHERING RULES of CONDUCT

- ❑ Inform staff they are being observed – no hidden cameras.
  - o Participation may need to be voluntary
- ❑ Explain the purpose of the observation
  - o Ask staff to go about their activities in the usual manner – we need to see what works and what does not work.
- ❑ Respect privacy
  - o Reassure staff that data collection is anonymous – focus is on the process, not the people
  - o Avoid taking pictures of people without permission

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CHECKSHEETS - Review

- Initially discussed in week 5 material
- A worksheet used to collect qualitative process output data, such as compliance and adherence data
- Standardizing forms ensures that data is collected in a reliable, repeatable way.

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CHECKSHEETS - Review

Steps to creating/using a checksheet

1. Select the output variable(s) to be measured.
2. Add columns to collect additional information, such a dates, times and shifts.
3. Add columns that may be used to indicate categories or reasons for non-compliance/ adherence.
4. Pilot test the form design and make changes as required.

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CHECKSHEET EXAMPLE...

Project Name:	MRSA				
Output Metric:	Handwashing				
Date / Time	Unit	Room #	Followed handwashing protocol	Reason for Non-compliance	Comment
5/18/2007	5E	124	Yes		
5/18/2007	5E	126	No	Non-cleanser in dispenser	
5/18/2007	5S	148	No	Nurse carrying items; no place to put down	

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PROCESS OBSERVATION - Review

- Initially discussed in week 5 material

- A data collection tool used during process observation to collect times and durations for individual process steps.

- Using a standardization process observation worksheet allows for reliable, repeatable data collection.

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PROCESS OBSERVATION - Review

Steps to creating/using a process observation worksheet:

1. List the steps from the process map in sequential order.

2. Observe the process and collect information on process step durations, wait times, and travel distances.

3. Multiple observations should be done in order to determine range of variation in processing steps/times.

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PROCESS OBSERVATION WORKSHEET

Step #	Description	Distance	Clock Time	Task Time	Wait Time	Observations
1	Customer Drives to Speaker					
2	Customer Questions?					
3	- If Yes					
4	Customer Places Order					
5	Customer Drives to Pay Window					
6	Customer Pays					
7	Customer Drives to Food Window					
8	Customer Order Ready?					
9	- If No, customer drives to side					
10	Food Delivered to Customer					
11						

EXAMPLE: Drive-Thru Current State Process Map

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PROCESS OBSERVATION WORKSHEET

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PROCESS OBSERVATION WORKSHEET

Additional process observation worksheets include (available from Oncourse):

- Waste Worksheet and Waste Recording Worksheet
- Process Study Form
- Standard Work Layout
- Standard Work Combination
- Process Recording and Process Summary
- Process Capability
- Interruption Log
- Office Process Observation Worksheet

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SPAGHETTI DIAGRAM - Review

Spaghetti Diagrams

- Discussed in week 5 material.

- Also known as a transportation or workforce diagram

- Is used to visually represent the physical flow of work for a process
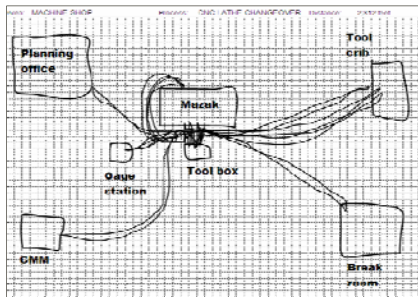
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SPAGHETTI DIAGRAM - Review

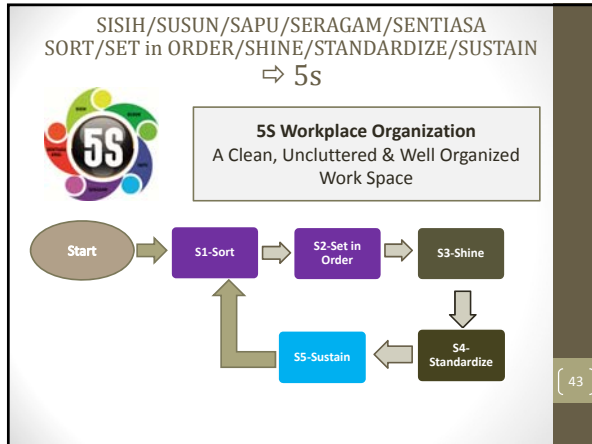Steps for creating a spaghetti diagram:

1. Find or create a diagram of the workspace.
2. Observe the process:
   - Note the physical location of the worker at the beginning of the process.
3. Draw lines that follow the path that the worker takes as they complete the process.
   - Lines may be numbered to reflect the steps on the process map.
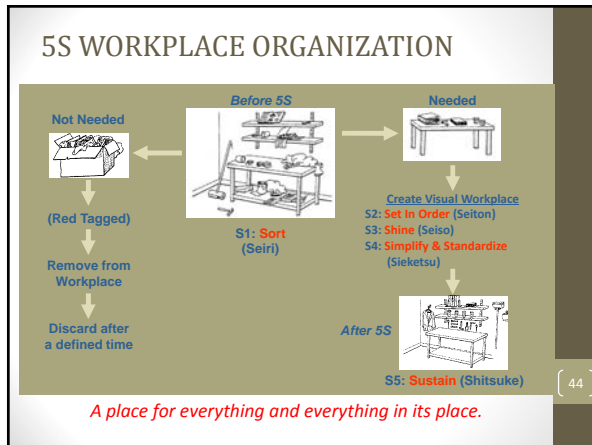
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SPAGHETTI DIAGRAM EXAMPLE...

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SISIH/SUSUN/SAPU/SERAGAM/SENTIASA
SORT/SET in ORDER/SHINE/STANDARDIZE/SUSTAIN
⇨ 5s

5S Workplace Organization
A Clean, Uncluttered & Well Organized Work Space

Start → S1-Sort → S2-Set in Order → S3-Shine → S4-Standardize → S5-Sustain → (back to S1-Sort)

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5S WORKPLACE ORGANIZATION

Not Needed

(Red Tagged)

Remove from Workplace

Discard after a defined time

Before 5S

S1: Sort (Seiri)

Needed

Create Visual Workplace
S2: **Set In Order** (Seiton)
S3: **Shine** (Seiso)
S4: **Simplify & Standardize** (Sieketsu)

After 5S

S5: **Sustain** (Shitsuke)

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A place for everything and everything in its place.

S1: SORT

- ✓ Take "Before" pictures
- ✓ Touch everything
- ✓ Separate necessary from unnecessary
- ✓ Remove clutter
- ✓ Red tag items
- ✓ Free up floor space
- ✓ Eliminate obsolete items
- ✓ Do not keep "just in case"
- ✓ Take "After" pictures

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S1: SORT

Remove and Red Tag items not used

Group and Organize remaining supplies

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S2: SET in ORDER

- ✓ Organize items by frequency of use
- ✓ Assign items to locations
- ✓ Mark "home" locations for movable objects
  - ✓ Outline if possible
- ✓ White boards for tracking shared items
- ✓ Create a well-ordered, visually instructive office space

Goal: A space that is visually instructive and is the source of minimal waste and human errors

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S2: SET in ORDER

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S3: SHINE

- ✓ Take Pride in your work area
- ✓ Establish "shine" schedules and accountability
- ✓ Define "clean"
- ✓ Get cleaning supplies. Clean the work area
- ✓ Fix small imperfections
- ✓ Identify contamination sources

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S4: STANDARDIZE / SIMPLIFY

- ✓ Work with all stakeholders
- ✓ Develop policies and procedures to maintain 5S improvements
- ✓ Establish written documentation for all processes and procedures
- ✓ Use pictures to document desired state
- ✓ Monitor adherence to standards

Goal: Develop procedures, checklists, and other mechanisms established to maintain a work environment that is visually instructive, has minimal waste and human error, is clean, uncluttered and organized

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S4: STANDARDIZE / SIMPLIFY

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S5: SUSTAIN

- ✓ Create communication board
- ✓ Use communication board
- ✓ Conduct periodic audits
- ✓ Conduct failure mode analysis and take corrective action when problems found during audits

   Goal: A space that automatically restores order, regulates activity, and continuously improves

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BEFORE 5s

4 minutes to find 20 items

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AFTER 5s

1 minute to find 20 items

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5s OFFICE

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5S – WASTE REDUCTION

Physical and Electronic Workplaces

Lack of Standards and Discipline for organization and configuration results:
- ✓ *loss or damage to documents/files*
- ✓ *use of wrong versions*
- ✓ *equipment not maintained*
- ✓ *searching*

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5S EXAMPLE

Prior to a 5S event, supplies were stored on the floor and countertops, as shown

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5S EXAMPLE

Afterwards, countertops are clear; drawers and cabinets are labeled with their contents, as shown in the two bottom photos. Over-stocking and stock-outs were virtually eliminated.

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5S EXAMPLES

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VISUAL CONTROLS

Key Principle: Make It Visible

- Everyone, including outsiders, can see and understand the status of the process at all times
- See:
  - Flow
  - Performance
  - Problems
  - Opportunities for improvement

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VISUAL WORKPLACE RULES

- Tools, supplies, and equipment must be:
  - Easy to see
  - Easy to use
  - Easy to return
- 30-second rule:
  - Items accessed at least once a month should be located within 30-seconds
    - Supplies
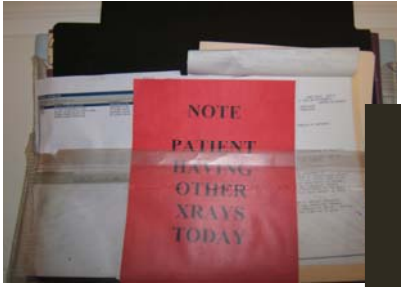   - Tools, equipment
    - Information

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VISUAL CONTROLS + 5S

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VISUAL CONTROL EXAMPLES...
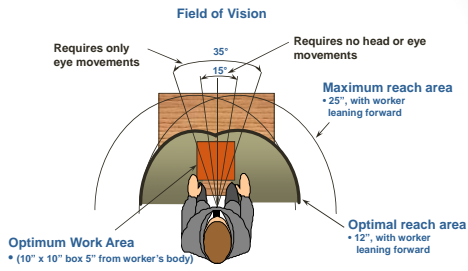
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MORE VISUAL CONTROL EXAMPLES...

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WORKSTATION DESIGN RULES

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WORKSTATION DESIGN RULES

Good workstation design incorporates design rules:

- ❑ Field of Vision:
  - ■ Goal: Minimize eye and head movements required.
  - ■ Reason: It takes ~3 seconds for head and eyes to rotate and refocus.
- ❑ Grab Area:
  - ■ Locate the most used parts as close as possible to worker.
  - ■ Locate heavy parts close to the work surface.
  - ■ Position all containers in the optimum reach area.

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WORKSTATION DESIGN RULES

Ensure information and knowledge flow is:

1. Correct
2. Timely
3. Complete
4. Waste free
5. In your face (exception based)

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WORKSTATION DESIGN RULES

Error-Proofing (Poka-Yoke or Mistake-Proofing)

- "Any task that requires human intervention and judgment to prevent mistakes is a mistake waiting to happen"
- Assembly keys, gages
- Built-in data entry checks
- Other Examples?

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SETUP REDUCTION

Setup Reduction

- a.k.a. Change-over reduction or SMED
- Reduction and elimination of setup time associated each process
- Strive for performance of as much setup work as possible prior to processing step
- Examples??

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END OF WEEK 8 MATERIAL

Reference Material:
- Excel Templates

Assignment: Homework #3

Due Date: October 21st