Building Better Organizations –
The Lean Way

Lean Systems
Overview

Institute for Lean Systems

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Agenda

- Introduction/historical overview
  - ILS Card simulation Round 1
- Lean Basics
  - ILS Card simulation Round 2
- Critical Lean Tools
  - 5S & Motion Economy
  - Standardized work
  - ILS Card Simulation Rounds 3, 4, and 5
- Wrap up

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Course Objectives

- Become a lean organization
  - Understand the philosophy behind the success of great companies, and how you can use it to take yours to higher levels of success
  - See the value and the waste in your processes and systematically enhance the value while eliminating waste, increasing your capacity and profitability
  - Create work flow to improve delivery to your customers and ensure perfect quality
- Become a lean team member
  - Describe how everyone in the lean organization contributes to success
  - Apply basic tools of 5S/Visual control (using motion economy principles) and Standardized work

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Desired Outcomes

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Historical Overview

from craft manufacturing

to mass manufacturing

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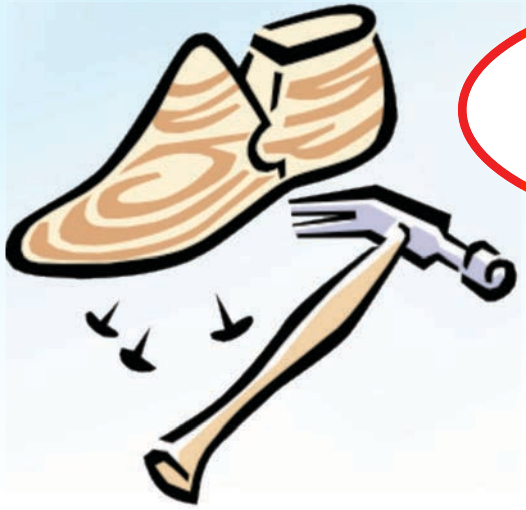
History

- **The Master Craftsman**
- The Inventor
  - Eli Whitney
- The Entrepreneur
  - Henry Ford



Mastery

Deep and broad knowledge

Nature of employment

Apprentice

Master

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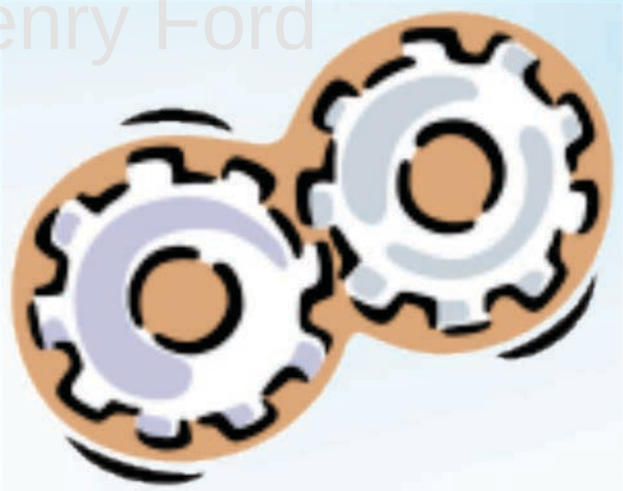
History

- The Master Craftsman
- **The Inventor**
  - **Eli Whitney**
- The Entrepreneur
  - Henry Ford



Invented the Milling Machine

Interchangeable parts

American System of Manufacturing

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History

- The Cobbler
- The Inventor
  - Eli Whitney
- **The Entrepreneur**
  - **Henry Ford**

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Atomization & Automation

Standardization

Detached Management

“Check Your Brain at the Door”

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ILS Card Simulation

Baseline Round,

Conventional thinking…

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Conventional systems

- Structure
  - Functional (requires sharing)
  - Defined by routing
  - Economies of scale - batching
  - Control systems
    - Scheduling
    - Tracking
    - Financial controls
  - Management
- Performance?
  - Production lead time
  - Work in process
  - Transportation & handling
  - Labor utilization
  - Control
  - Space
  - Responsiveness to customer
  - Performance measurement

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Lean is…

- … a people-oriented philosophy where organizations succeed by delivering the greatest value to their customers

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Focus

Conventional Focus

cost + profit = price

Lean Focus

price - cost = profit

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Value

$$\text{Value} = \frac{\text{What it's worth}}{\text{What it costs}}$$

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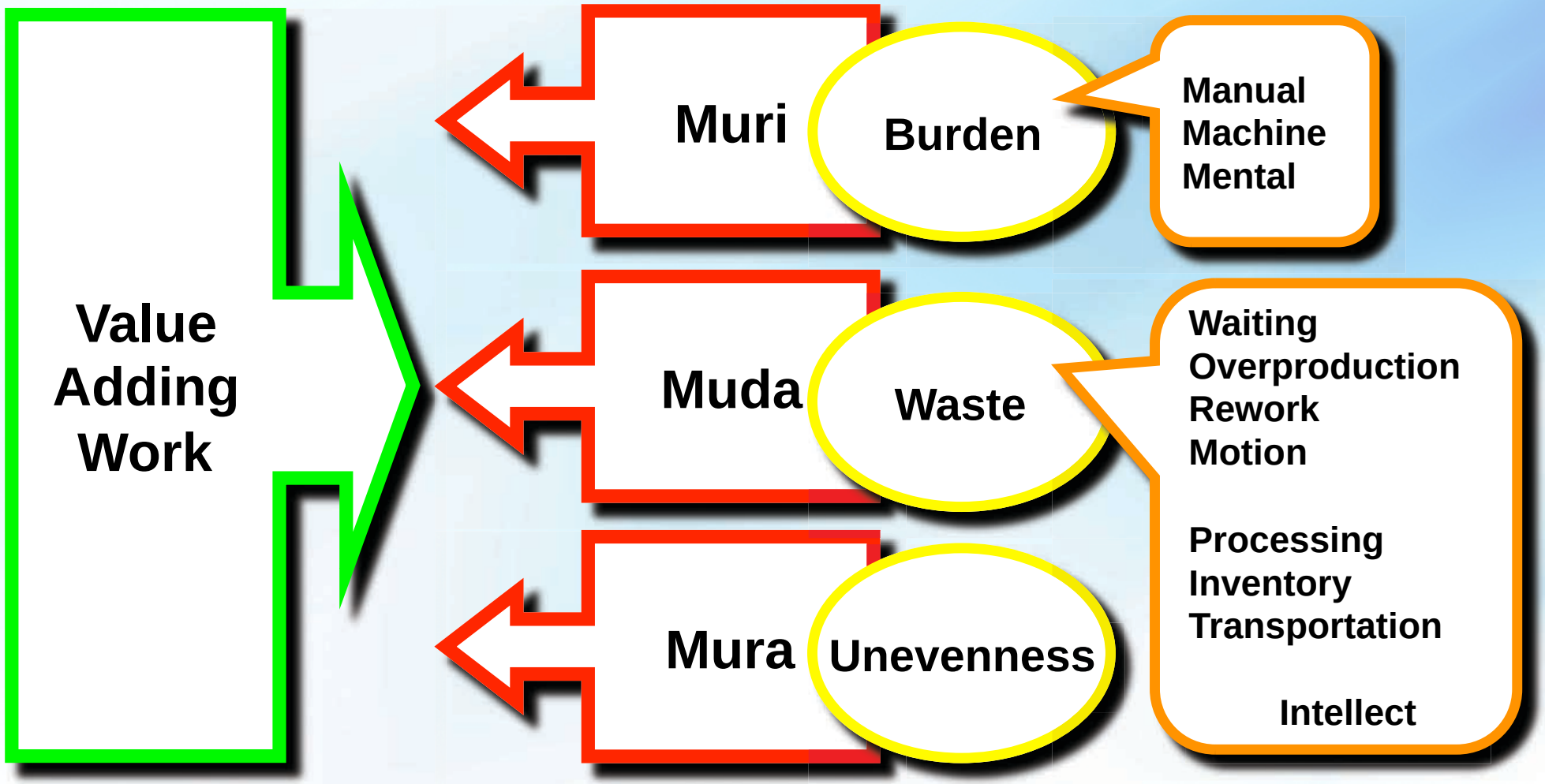
Value v. Waste



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8 Forms of Waste - the WORMPIT

- Waiting
  - Idle time due to lack of materials, equipment cycling time or lack of information.
- Over-production
  - Making more product than the customer wants.
- Rework/Rejects
  - Products not meeting the quality standards of our company and our customers.
- Motion
  - Any movement of people that does not add value to the product.

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8 Forms of Waste - the WORMPIT

- Processing
  - Performing any process that is not required to make or assemble a product.
- Inventory
  - Excess finished products, in-process products, raw materials, or information. All of these hide other problems.
- Transportation
  - Any movement of materials, work in process, or finished goods
- Intellect
  - Failure to make best use of peoples' ideas, thoughts, and suggestions that lead to improvements. The ONLY way OUT of the WORMPIT!

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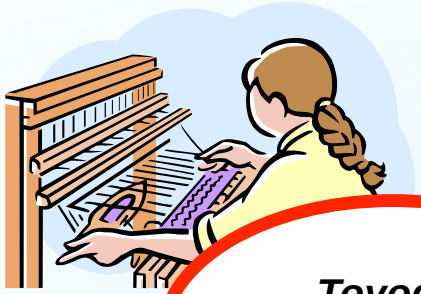
From Mass to Lean



Toyoda Automatic Loom Works

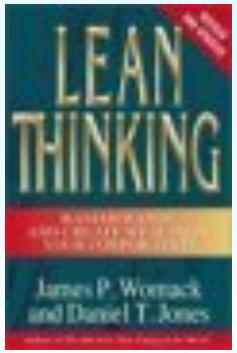
The Loom that Changed the World

World War II

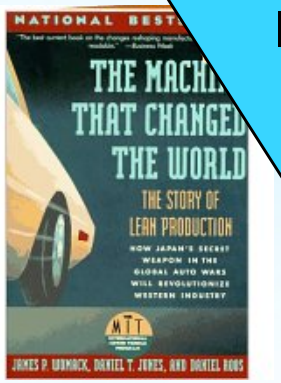
Kiichiro's recovery plan

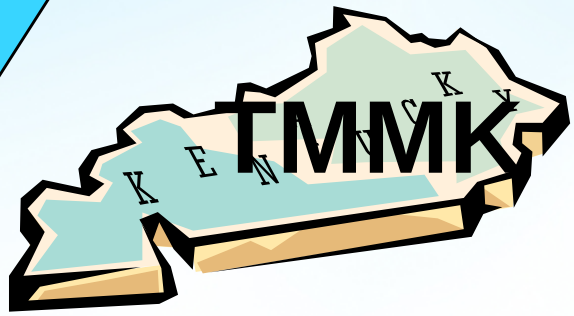
Labor Unrest

Ed and Joe go to Japan



IMVP





The Oil Crisis

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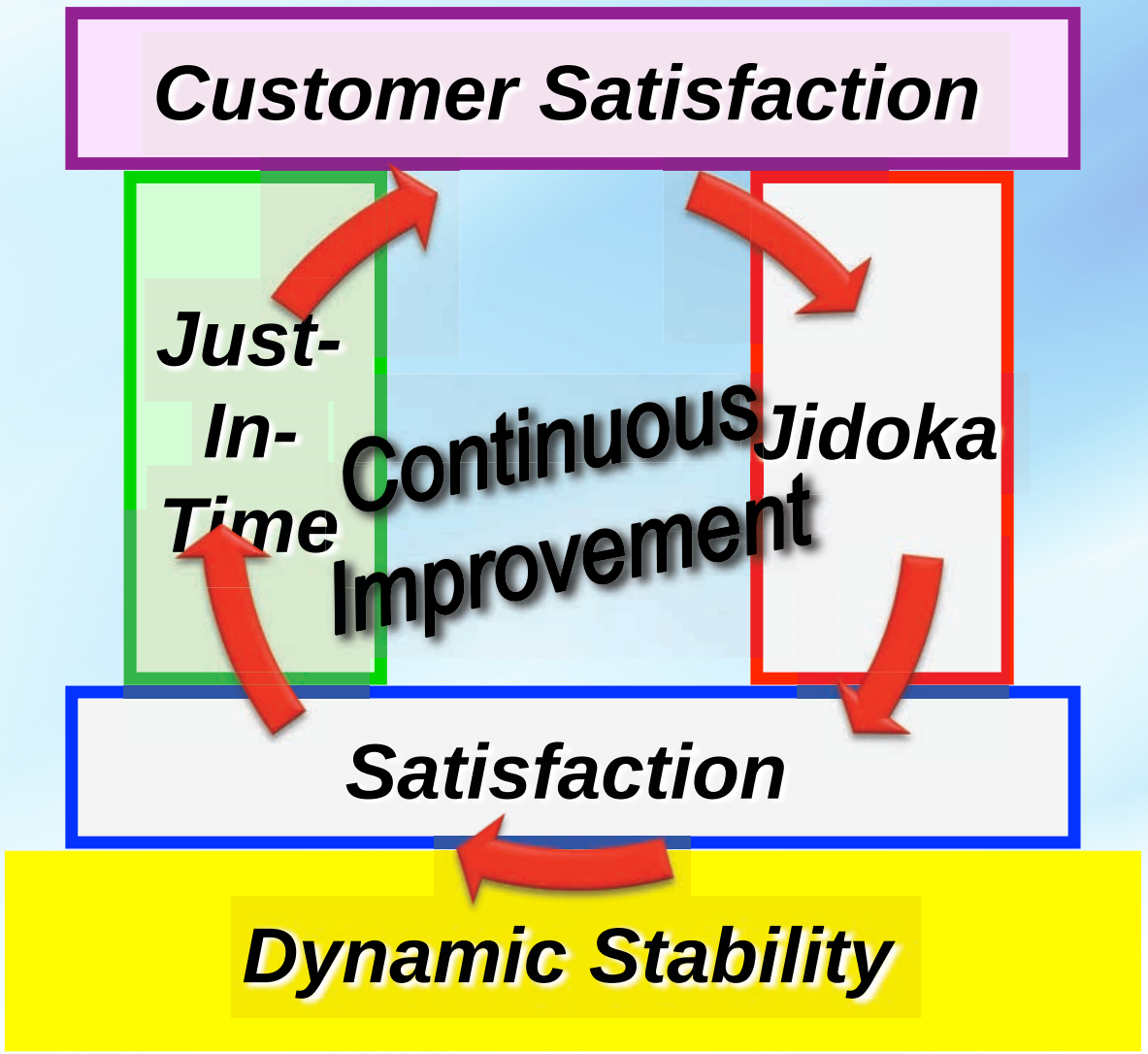
The Lean Way

- Continuous Improvement
- Respect for People, Community, and

The Integral Lean System - The Lean Way



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The Lean Way

Creates value

Pursues a common vision

Challenges the team to lead change

Solves problems at their source

Learns and Improves

Respects and serves people

Gets results

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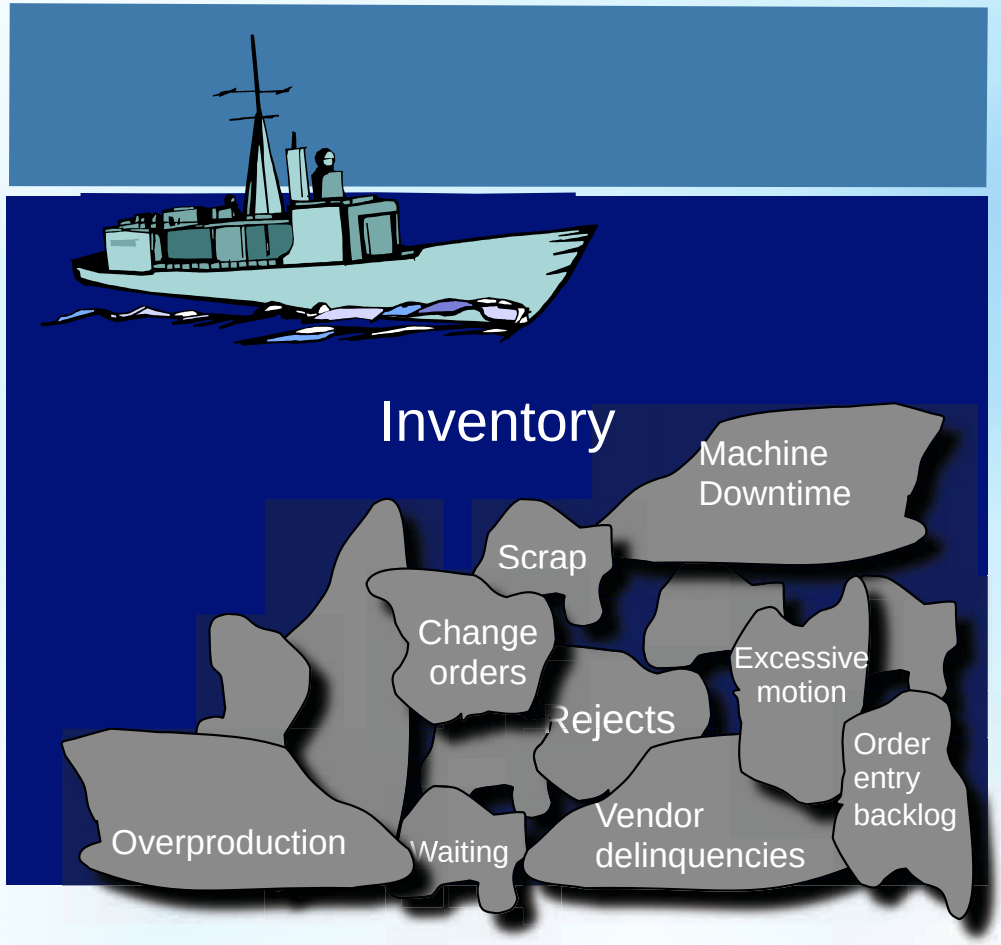
Challenge



Productivity Problems

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Transformation

Becoming a Lean Organization

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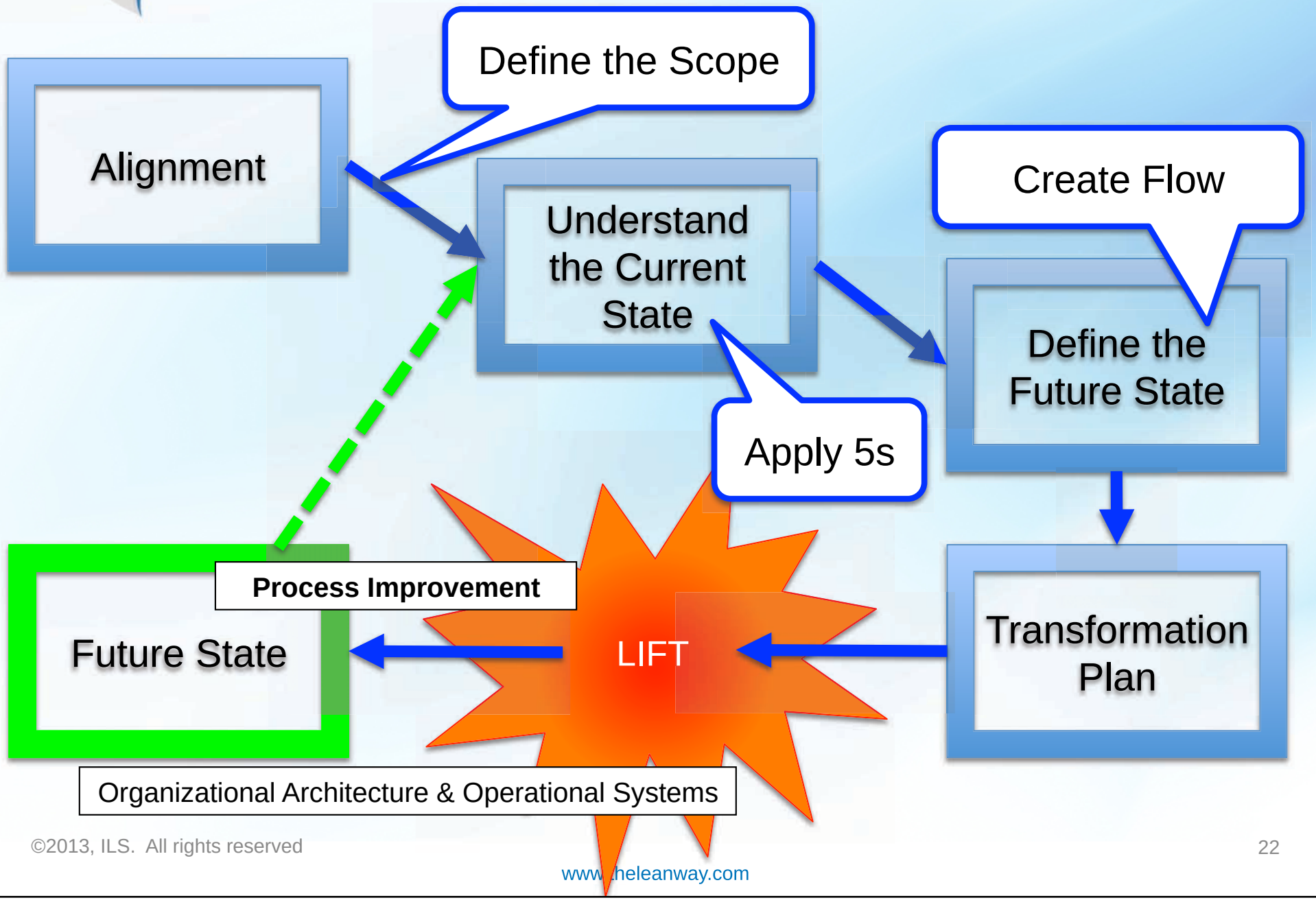
Transforming an Organization



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Lean Systems
Flow Ideals

One Place; One Piece; One Pace; One Resource

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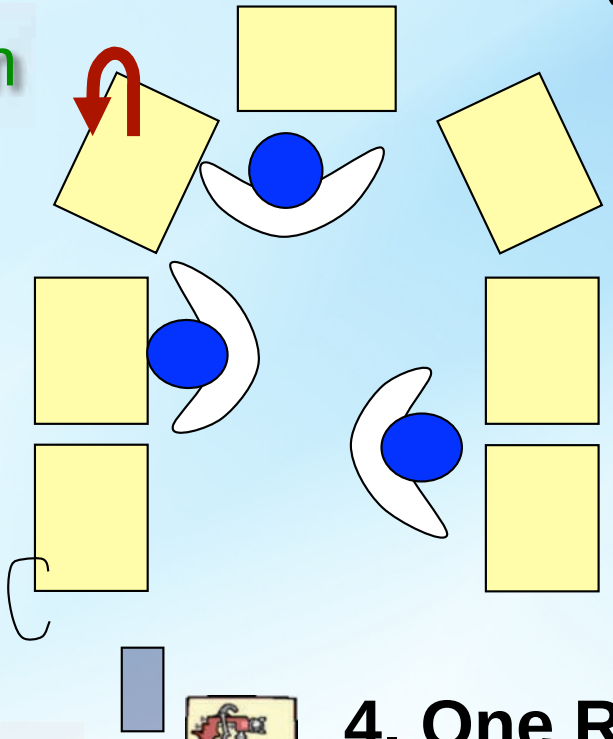
Structural Ideals for Flow

1. One Place
(Work aggregation)

- Lean work system

2. One Piece
(Make one, move one)



3. One Pace
(Takt pacing and level loading)

- Jidoka management (Visual)

4. One Resource
(Selective resource dedication)

- Value stream management

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Ideal 1 – One Place

Round 2 - Creating work cells

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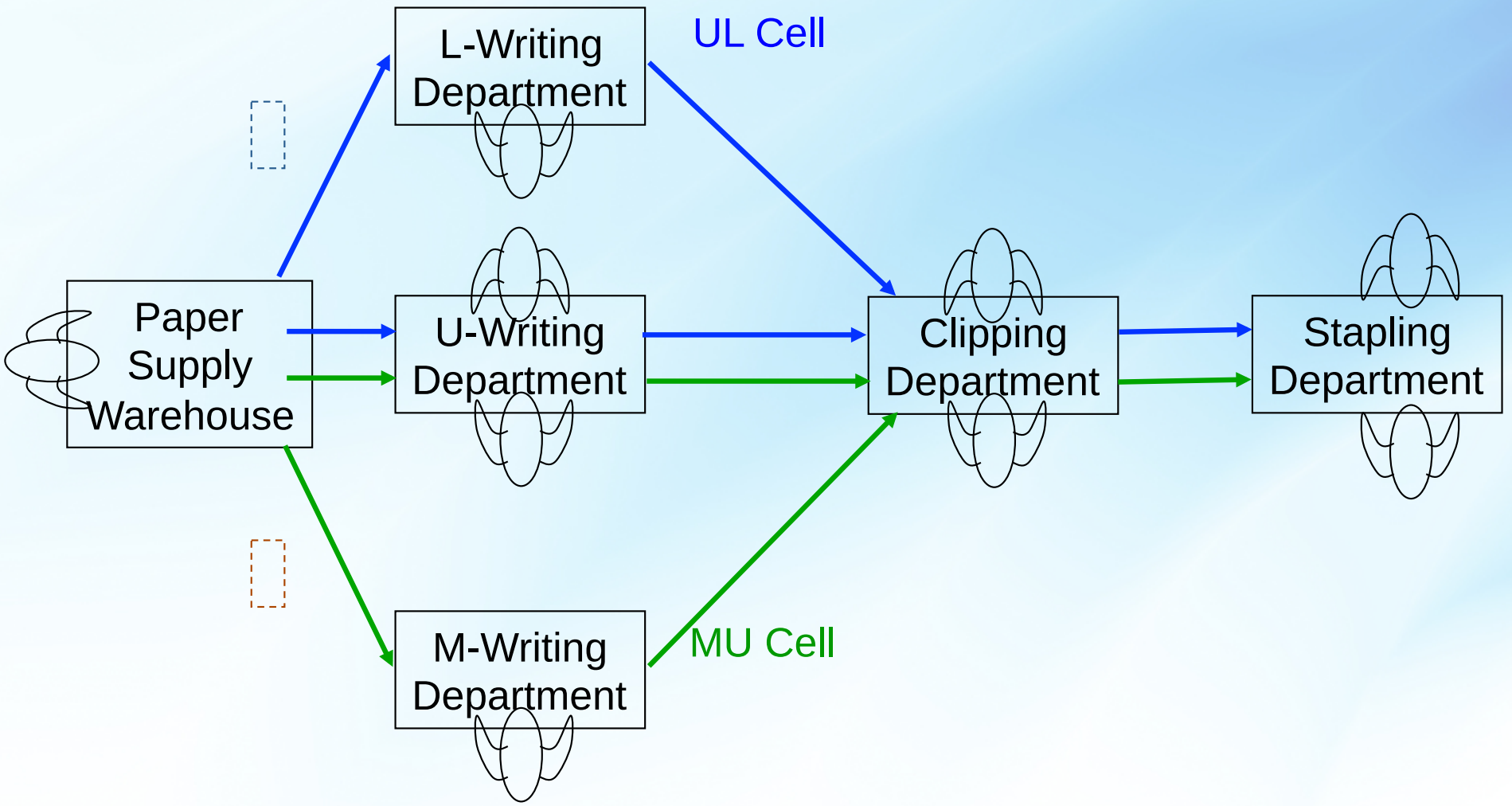
Product Flow, Round 1



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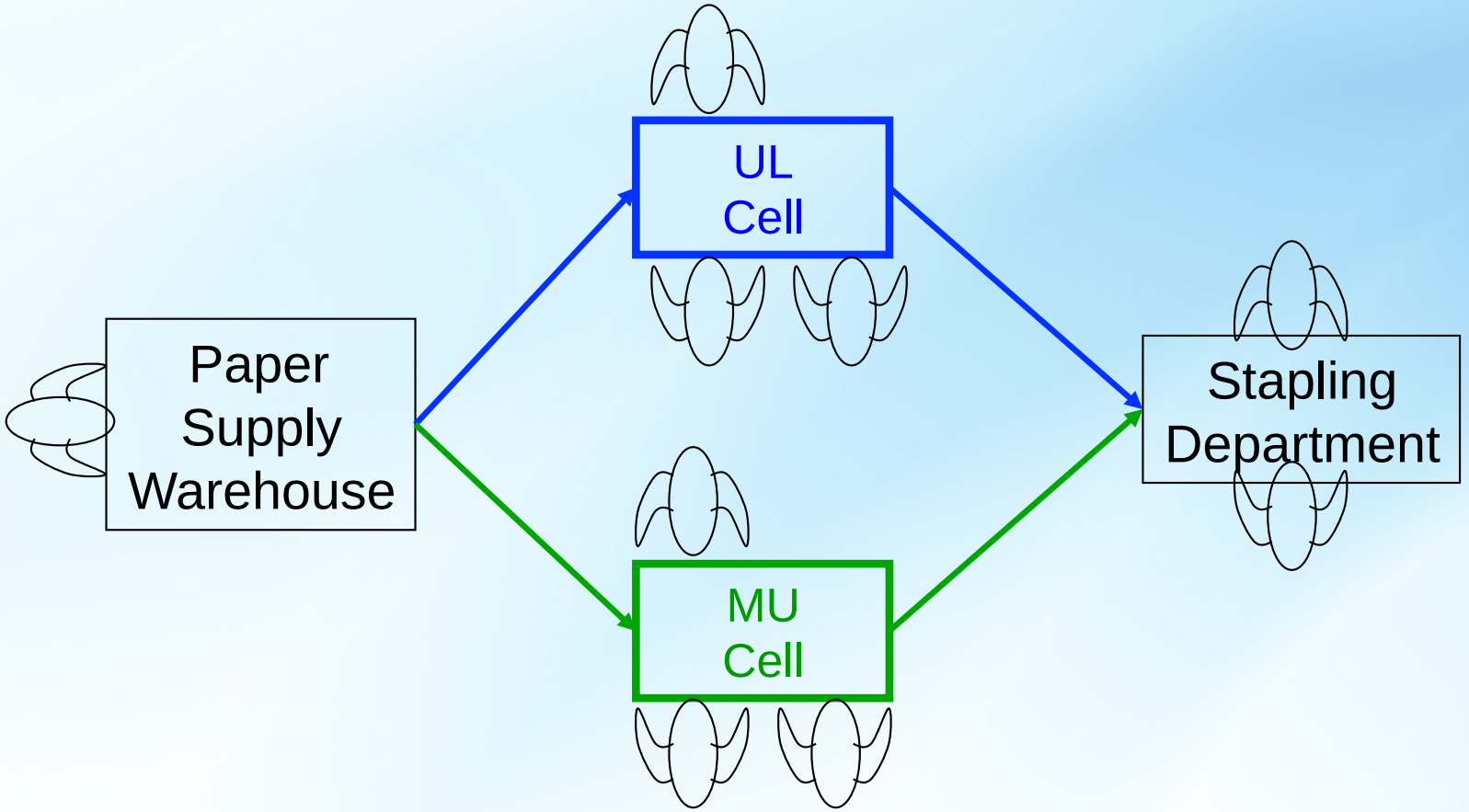
Cell Formation, Round 2



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Benefits of One Place

Ownership

Communication

Visibility

Teamwork

Transportation

Simplified Production Control

Motion

Labor Utilization

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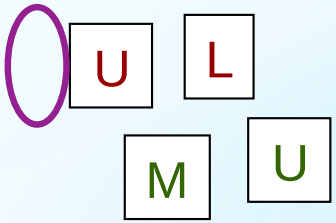
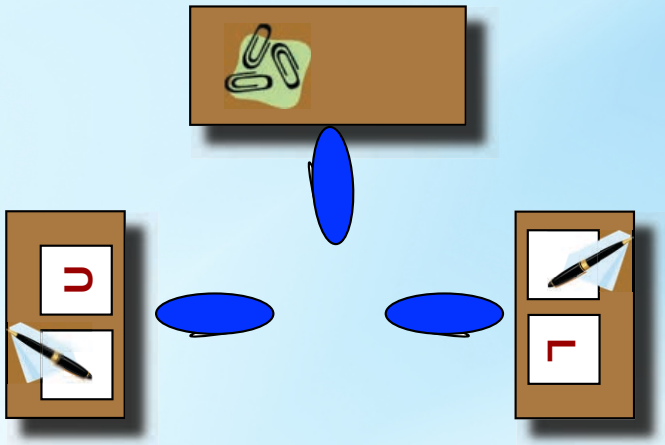
Components of One Place

FOCUS





DEDICATION and CO-LOCATION

CHARTERED OWNERSHIP OF WORK PACKAGE

CROSS FUNCTIONAL TEAM

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Why teams?

Involve and Empower

Satisfy needs

Maximize Learning

Expand Capabilities

Encourage Responsibility

Supporting Network

Develop Ownership

Promote initiative

"Combining individual talents is important in team play."

Adolph Rupp, Hall of Fame Basketball Coach

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Embedded support roles

Knowledge worker

Evolutionary Standardized Work

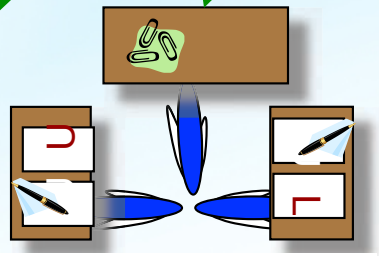
Beyond Skill

Lean Work System

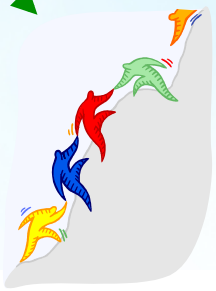
Focus principle

Learn by doing
… Simplify
… Automate

Method over process



Cross-Training



Teaming Contributions

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Standardized Work

The key tool in building and sustaining the right culture

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Standardized work

- Reliable work methods or procedures and sequences developed to achieve the most effective combination of people, materials and parts, and machinery and tools.
  - Focuses on the work itself
  - Teach team members consistently
- Team members/Operators must contribute to the preparation of the standardized work with documentation by team leaders and/or supporting staff (engineers, maintenance, etc.)
  - Only with specific planning will the team members be able to handle the documentation piece

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Goals of standardized work

- Understand the work
  - Use to organize the workplace and create a learning environment
  - Identify improvement opportunities
- Define the current best method
  - Use that method to train others
- Build in quality, ensure safety, cap inventory levels, and measure productivity
- Make problems visible
- Build team member confidence
  - Builds mastery-level skills
  - Gives them control over their environment

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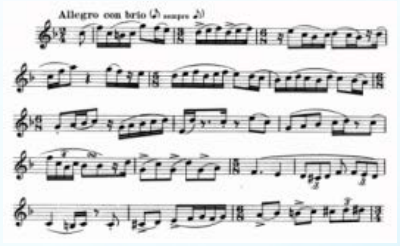
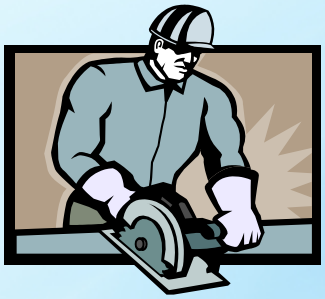
Standardized Work

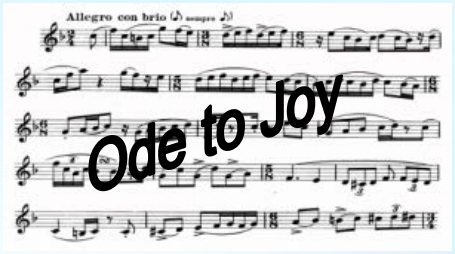


The work process is scripted



Everyone follows the script with discipline

A problem in highly mature systems.



The script quickly evolves to a higher level

The team owns the script and is charged to learn and improve it.

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Enforcing standardized work

- Performance metrics related to quality (first time through, scrap rate, etc.) and tracked by the hour should provide immediate out-of-compliance feedback.
- Audit systems may be necessary in the early months, but soon become troublesome to keep up-to-date as the standardized work begins to change more and more frequently
  - Direct observation by someone familiar with the standardized work is required…usually the team leader

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Building Better Organizations –
The Lean Way

5S

The Transformation Starting Point

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5S

Sort

Set in Order

Shine

Standardize

Sustain

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5S – Why?

- Sets a foundation for other transformation activities
  - Builds in control, flexibility, lean work system, continuous improvement culture
- Sets ownership of processes
  - Everyone needs to do it!
- Contributes to value creation
  - Low cost – high benefit
  - Don’t think of 5S as “housekeeping”

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Positive impact of 5S

- Visibility & awareness of problems
- Supports team member ownership
- Eliminates safety hazards (slipping, tripping, pinching, body stress) for team members and visitors
- Easy way to get team member engagement
- Improves quality
  - Promotes repeatability, reduces errors
  - Supports maintenance (less abrasive wear, more cleaning)
  - Ensures proper disposition of materials
- Improves cost
  - Saves floor space
  - Labor efficiency improves (less walking around & searching)

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5S

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Shine

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Sustain

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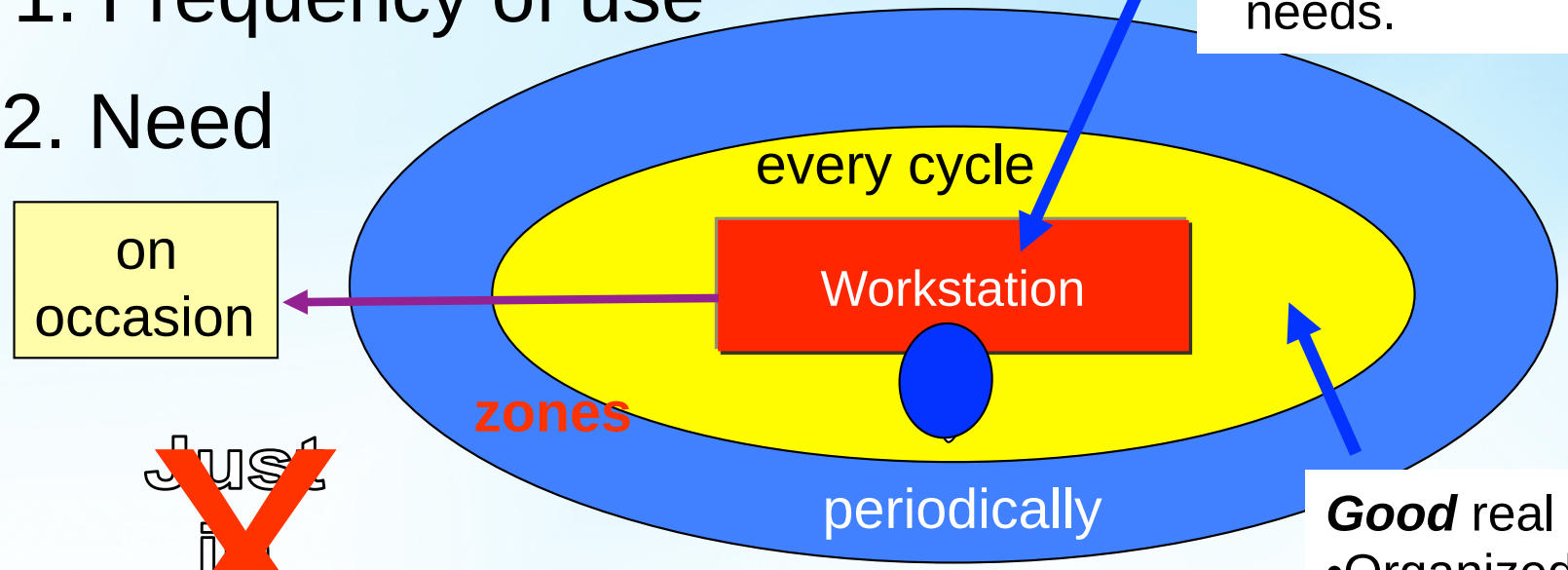
Sort

- Separate the necessary from the unnecessary
  - 2 Key Factors

1. Frequency of use
2. Need



Premium real estate.
•Organized by *motion economy* principles and direct work support needs.

Good real estate.
•Organized to support work flow and logically organized to avoid searching

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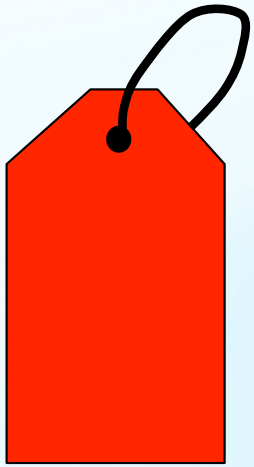
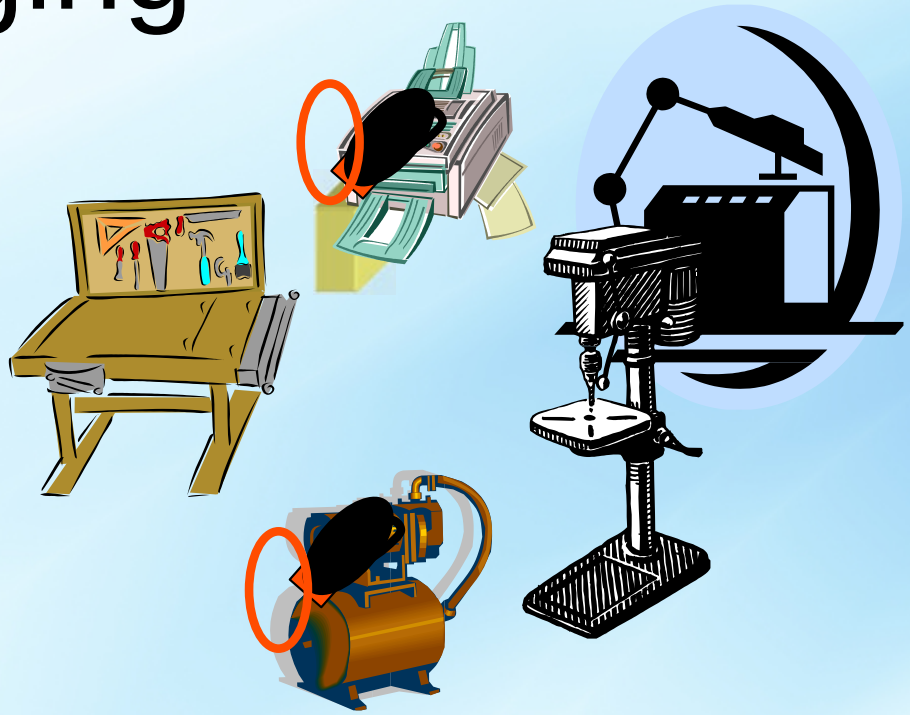
Red tagging



Tag major items to be removed, then remove them to the Red Tag Area



- Promotes effective removal and disposal
- Communicates status of sort process
- Motivates completion and continuation

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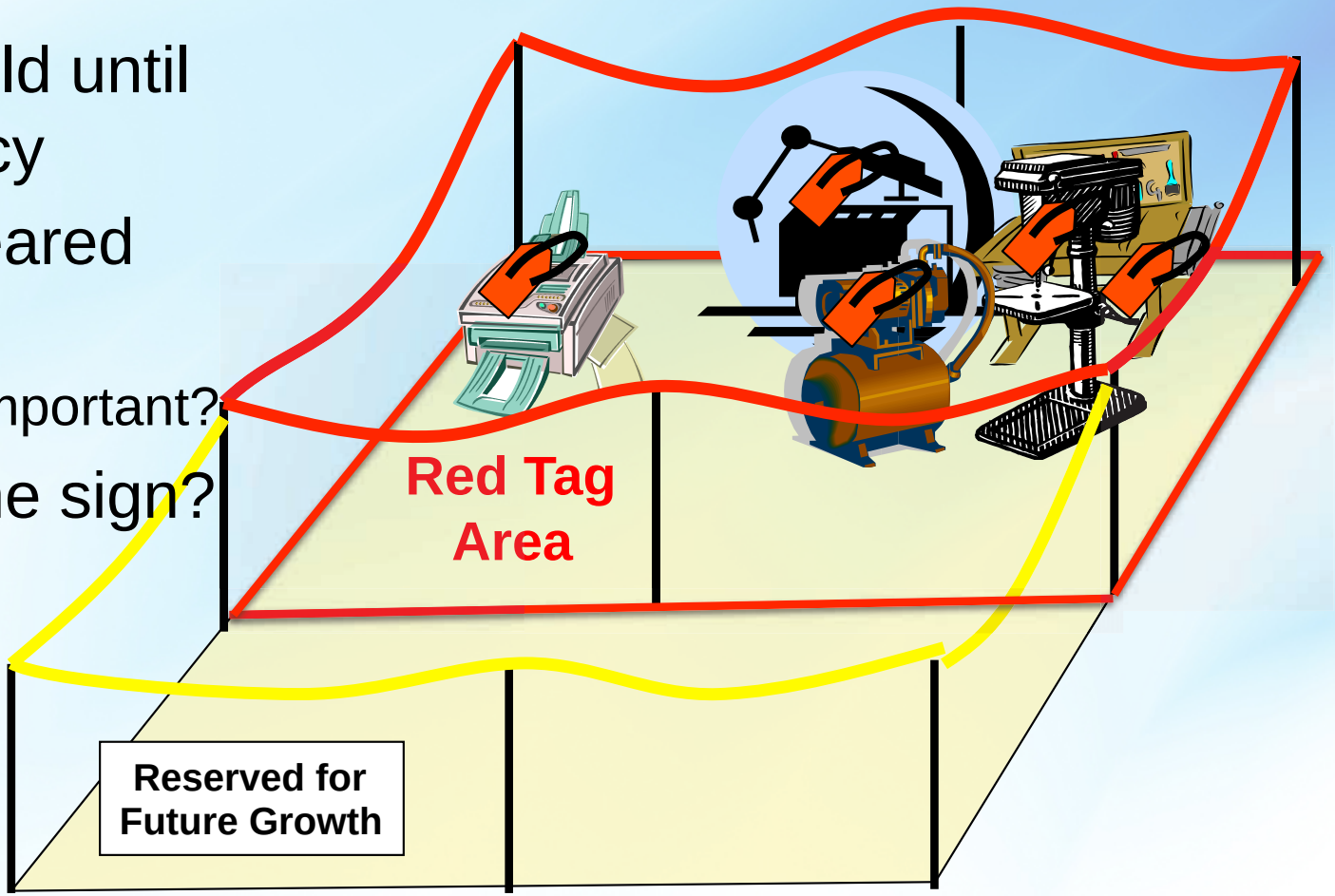
Red Tag Area

- Supports “sort” as an ongoing process
- Enables a “hold until time xxx” policy
- Cordon off cleared space
  - Why is this important?
- What about the sign?



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Classifying red-tagged items

- Classify based on the disposal action
  - Inventory categories
    - Dead stock
    - Excess
    - Defects/rework
  - Special disposal requirements
    - Chemicals and hazardous materials
  - Scrap value
  - Potential for use in other locations
  - Privacy issues (especially for office 5S)

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5S

Sort

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Set in Order

- A place for everything, and everything in its place
- What are some of the major goals of organization?
  - Eliminate wasted time spent searching
  - Compactness, saving space and time
  - Simplify by eliminating decisions and insuring the natural way is the correct way
  - Making readiness and status visible
  - Supporting standardized work and quality

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Workstation Layout

- Consider the work layout and sequence
  - Layout so that one motion naturally follows next without unnecessary motion
  - Distribute parts around the work area
    - Avoid two workers having to use the same part source. Replicate the part source.
  - When you transfer to the next station…
    - Position for ease of reach of next worker
    - Grasp your next part with the other hand while dropping part off

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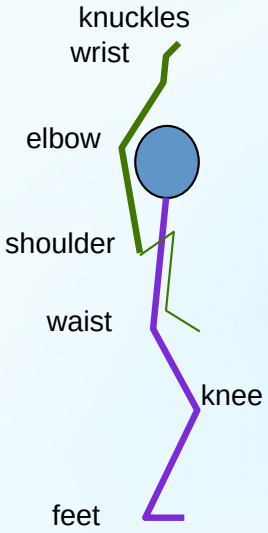
Motion Economy

- Body Segment Class Definitions



Class	Joint Involved	Body Segment
1	Knuckles	Fingers
2	Wrist	Hand + Fingers
3	Elbow	Forearm+Hand+Fingers
4	Shoulder	Upper arm+Forearm+Hand+Fingers

- Seek lower class movements first
  - Key strategy: compact workstation layout
- Example:
  - What class is the motion required to operate your car?

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Motion Economy

- A place for everything and everything in its place
  - Outlined storage areas.
    - Avoids searching, Faster visual perception
- Most frequently tools close, less frequently used tools far away
- Position tools in sequence of use
- Seek blindfold tool retrieval and release
  - Spring cord mounted, mesh bags
- Combine multiple tools in one if possible
- Design levers/hand wheels for maximum mechanical advantage and easy reach
  - Should not have to reposition body to work lever or wheel

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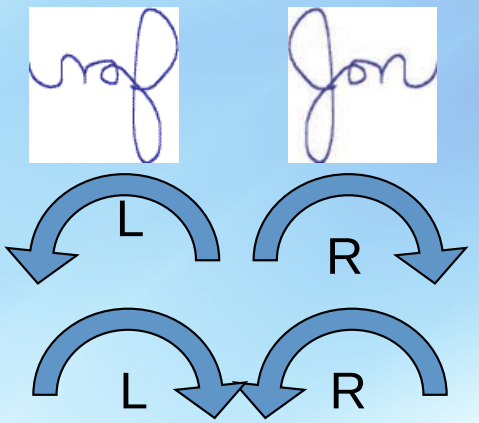
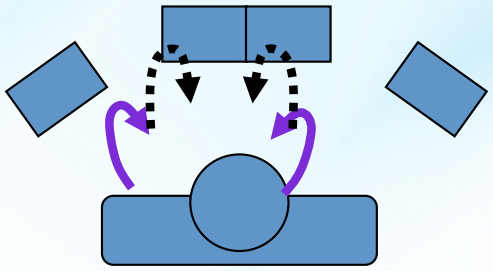
Hands and Arms

- Key idea: work with both hands, not one
  - Seek mirror-image motion
    - Start and stop hands concurrently
    - Move arms and hands symmetrically to and from center of body
    - Lay out parts/tools symmetrically
    - Simple strategy to increase symmetry: make things in twos
  - Both hands should never be idle concurrently
  - Let fixtures hold parts, not hands
    - Hand is world's most expensive fixture
    - Holding parts is also fatiguing



Think of swimming



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Hands and Arms

- Try to avoid movement of parts by hands. Use other means:
  - Gravity
    - Drop scrap into hole; don't pitch into distant container
    - Tilted parts container minimizes reach since parts slide down
    - Use gravity to present parts and to remove work piece
  - Mechanical movement
  - Slide (small/light) parts across the work surface; do not lift and carry them.
    - Design work surface to permit and facilitate this.

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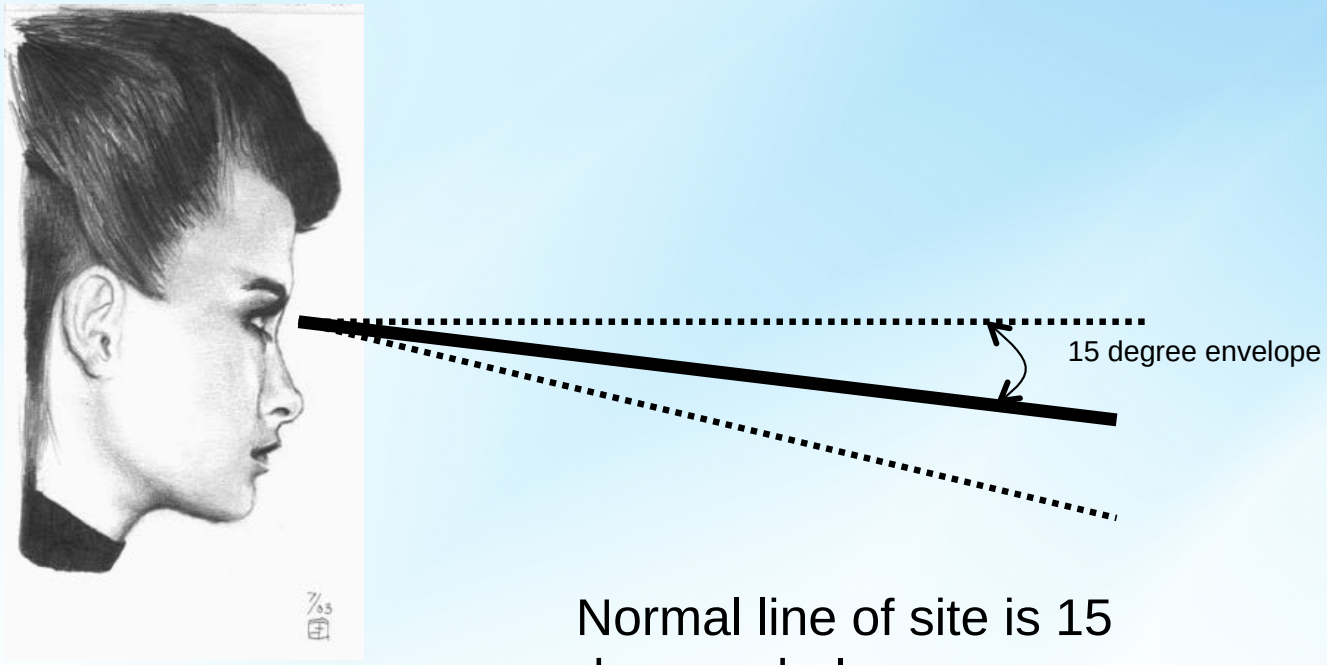
Eyes

- Avoid need for eye movements if practical



Normal line of site is 15 degrees below horizontal

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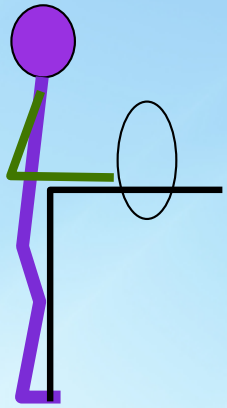
Additional Principles

- Ergonomic work surface is positioned elbow height
  - Forearm parallel to ground
- Put your feet to work too
  - Especially switches
  - Work hands and feet concurrently. (E.g., driving a car)
- Workers should generally be standing
  - Facilitates multi-process work design and high utilization
  - Facilitates teamwork and response to the abnormal
  - Ergonomically designed sit/stand chairs are acceptable
- 4 - 5’ distance across U-cell is ideal
  - Adequate to avoid worker interference
  - Minimum number of steps to cross



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Video Example

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Video Example

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5S

Sort

Set in Order

Shine

Standardize

Sustain

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Shine

- Clean up
- Paint
- Illuminate
  - Impact on morale
  - Visibility

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Visibility

- Support vision and rapid perception:
  - Good illumination is essential to fast perception and reduction of time
  - Enhance contrast between work object and background for rapid perception
  - Avoid glare through reflection or light sources near line of sight
  - Increase size of object to be seen if possible
    - E.g., key visual controls, handles, etc.
  - Avoid need to perceive object while worker is moving
  - Apply standard uses of color (red, yellow, green) to indicate status

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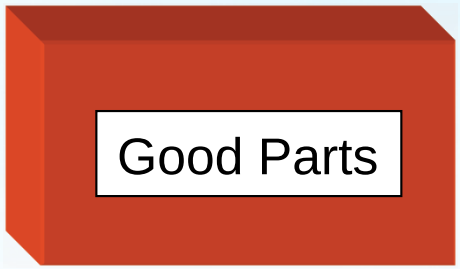
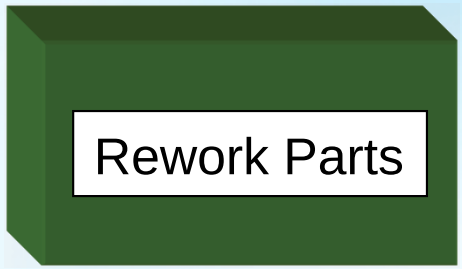
Use color

- Do not violate common assumptions
- Use color to convey meaning





General Trash

Yard Waste

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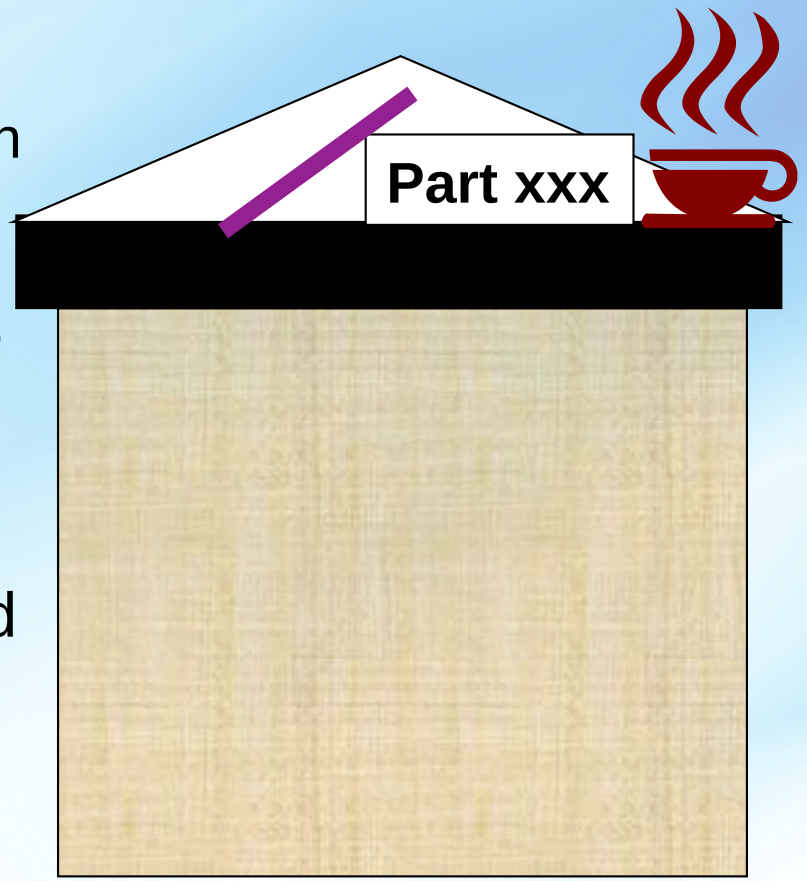
Make Clean up Easy

- Eliminate sources of dust, dirt, and clutter
  - Use skirts, shields, and covers to prevent accumulations in hard to clean places
  - Schedule regular clean ups
- Contain waste as close as possible to the source
- Organize the work for easy cleaning
  - Tape backing disposal
- Keep cleaning supplies organized and handy
- Integrate cleaning up with machine inspections



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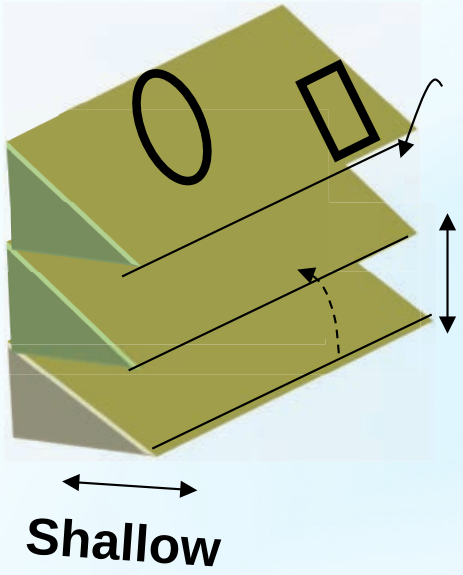
Organizing principles

Shelves: generally used for low frequency items.

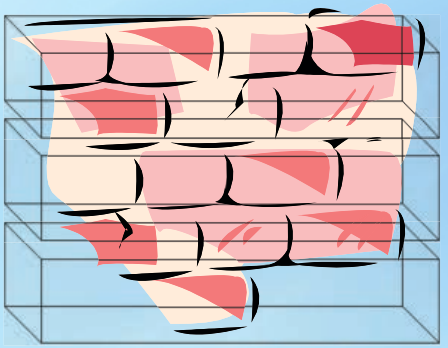


Shallow

Tilted surface preferred

Wide access

Avoid stacking items if possible



Location along walls preferred

Post maps identifying locations

	1	2	3	4	5	6
A						
B						
C						
D						

Addressing

Labels

Min/max

Hoses & forms

Boxes

Dedicate aisles organized functionally or by kits

Position items by frequency

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Outlining and Shadowboxes

- Uses
  - Faster visual perception
  - Verification
- Good method for flat items
  - Photocopy and laminate

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5S

Sort

Set in Order

Shine

Standardize

Sustain

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Standardize

- Standardize the system and the practices to support it
- When possible and appropriate, standardize across the organization

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Green Team

Red Team

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5S

Sort

Set in Order

Shine

Standardize

Sustain

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Sustain

- Previously mentioned components of sustain
  - Periodic red-tag campaigns
  - Leadership of the 5S process.
    - Publicity
      - » Before/after photos
    - Modeling by top leaders
  - Make cleanup easy
- Many of these make the 5S system self-sustaining
- Auditing
  - May be required early to build good 5S habits

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Flow Ideals

- One place
  - Bring together all required work into a co-located cell
  - Enables the Lean Work System
- One piece
  - Make one, move one
  - Enables velocity
- One pace
  - Everything moves through the work system at the same rate
  - Enables visibility and stresses the system
- One resource
  - Selective dedication of available resources
  - Enables all the other ideals

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Ideal 2- One Piece

Increasing the Velocity of the System

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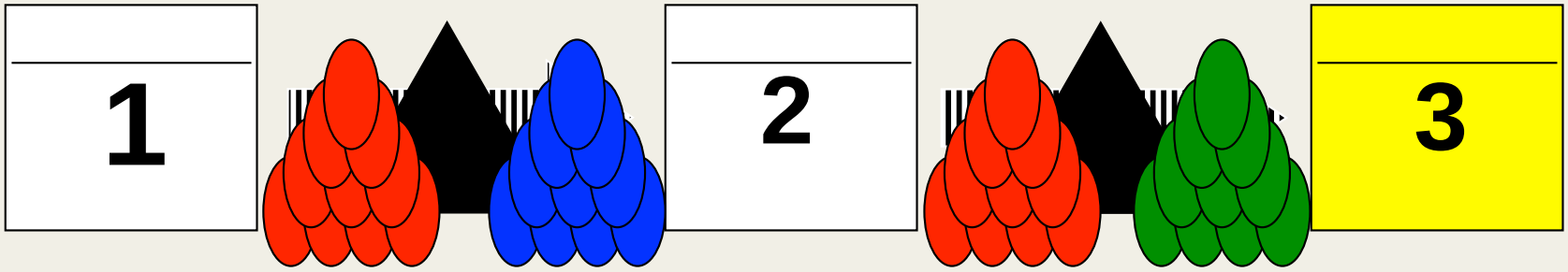
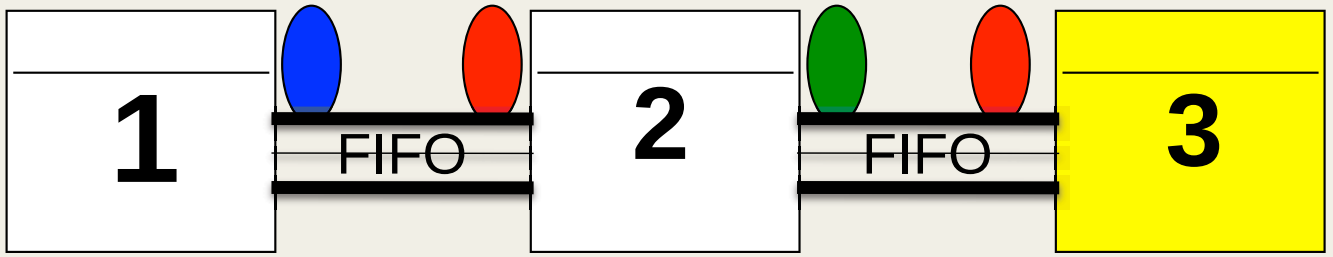
One Piece



4 Batches of WIP



4 *Pieces* of WIP

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Organizing for One Piece

- Insure First In First Out (FIFO)
  - Auto-advance
  - Forklift access
  - Visual WIP cap
  - Sequence discipline
- Why is this important?
  - Traceability
  - Schedule adherence
  - Obsolescence
  - Simplified information systems

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One Piece

- Make one, move one
- Rapid set up and Changeover (SMED)
- Co-location
- Multi-skilled team members
- Kitted work packages
- Milk-run replenishment
- Total Equipment Maintenance (Total Productive Maintenance – TPM)

Round 3 – Make one, move one

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Ideal 3 – One Pace

Responding to customer demand

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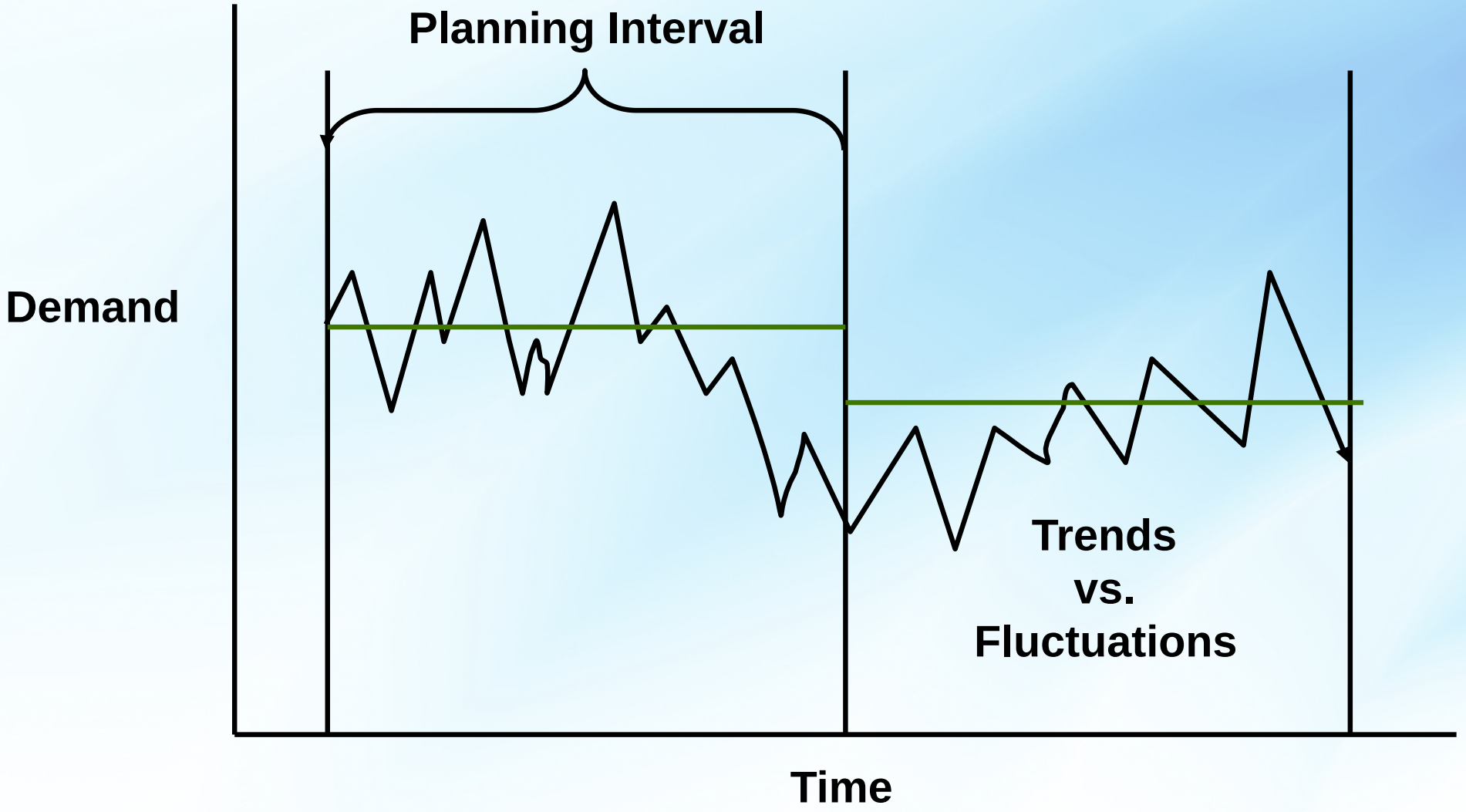
Smoothing and Takt Pacing



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One Pace

- Cycle Time = average interval between work exiting a process
  - Cycle time is the actual work time required to do a task or a series of tasks
- Takt Time is the time allowed to take to complete the required work

$$\text{Takt Time} = \frac{\text{Scheduled Work Time}}{\text{(Shift Time – Lunch / Breaks – Planned downtime)}}{\text{Leveled Demand}}$$

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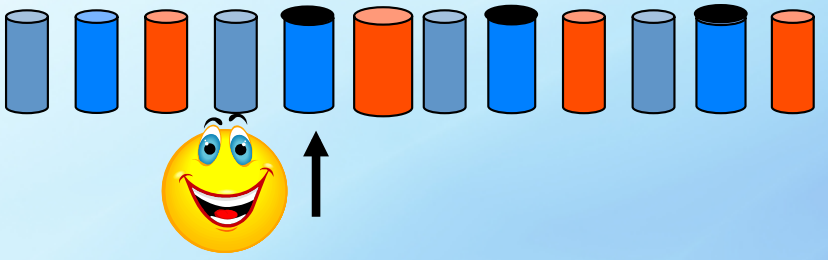
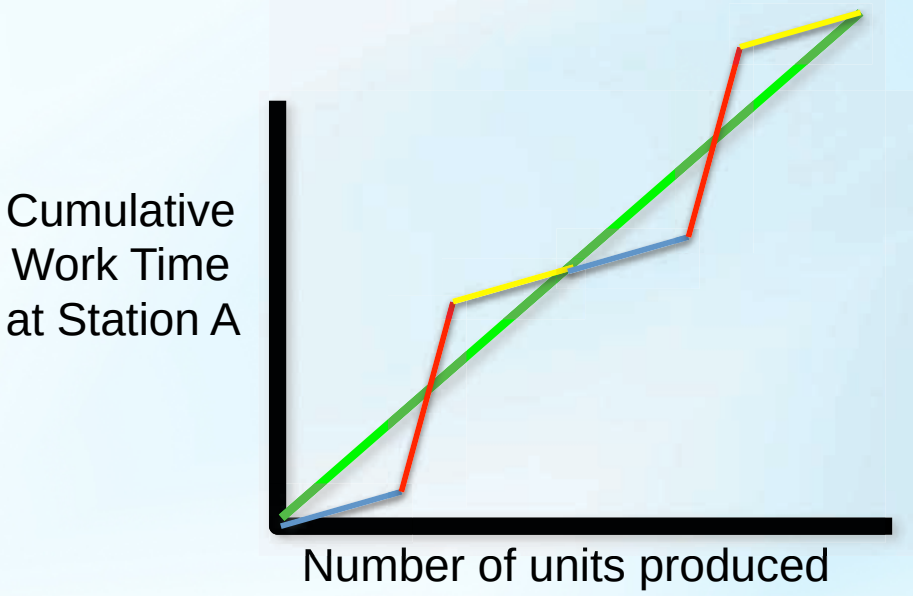
Leveling



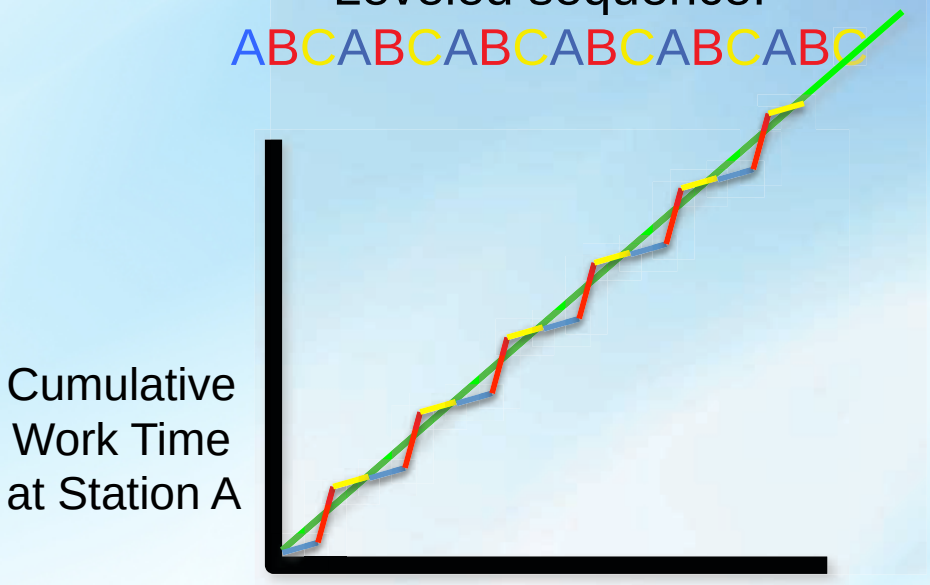
Poorly leveled sequence:

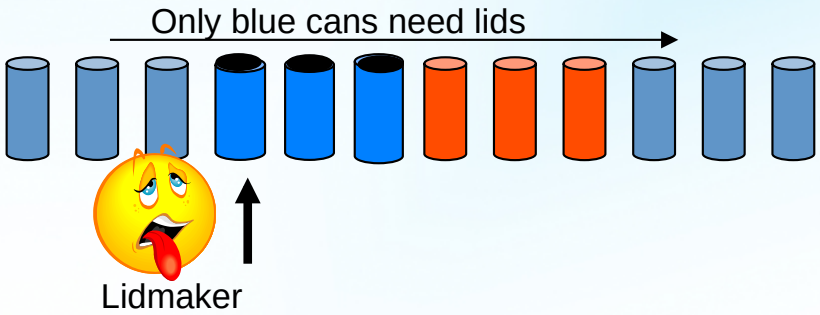
AAABBBCCCAAABBBCCC



Leveled sequence:

ABCABCABCABCABCABC





- Smaller buffers
- Easer to staff for average cycle time

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Random Arrival Process (Poisson)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15

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Smoothed and Paced Order Launch

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15

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Ideal 4 – One Resource

Selective dedication of resources

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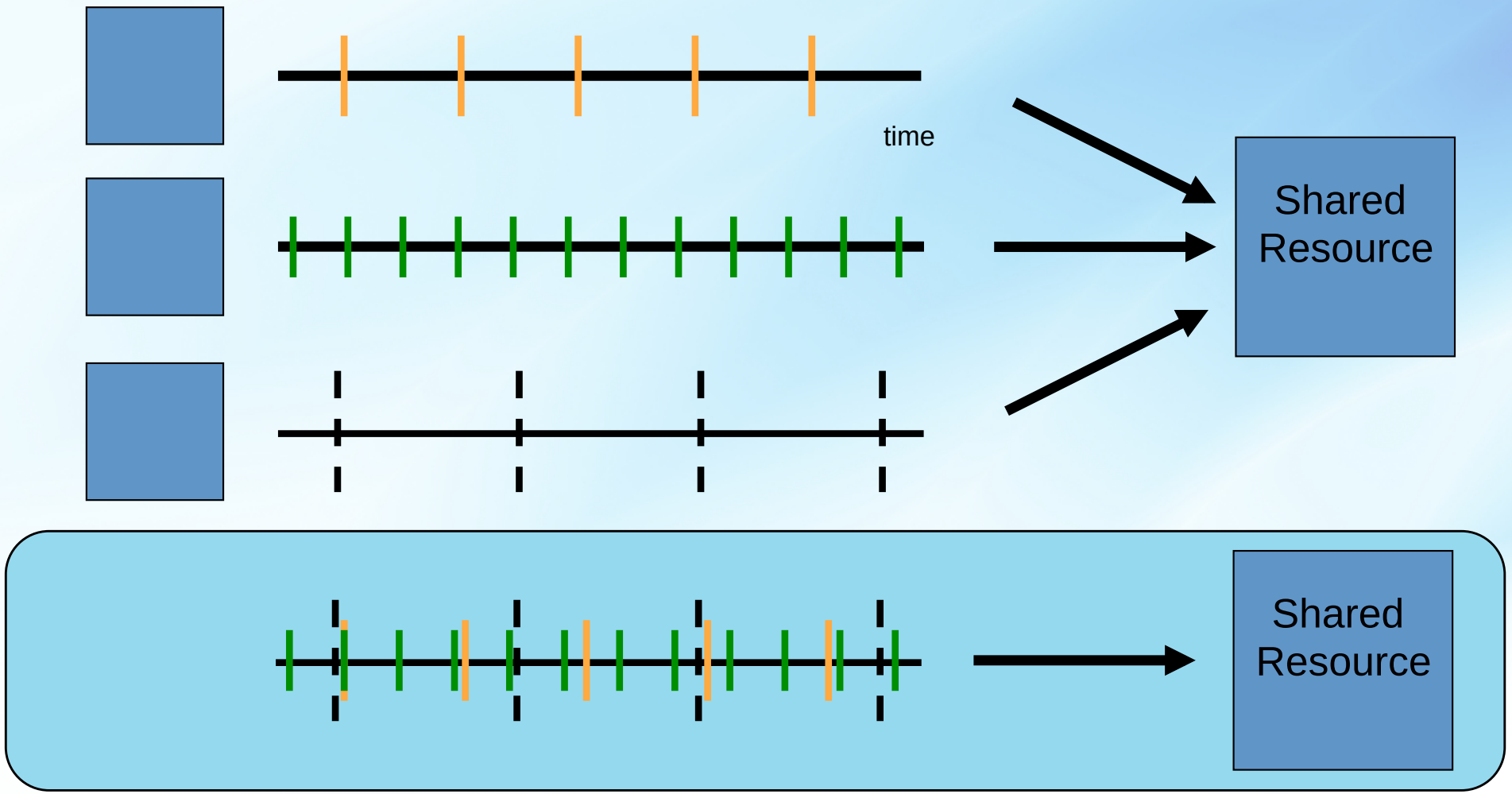
Ideal 4 – One Resource

Departure events for three products



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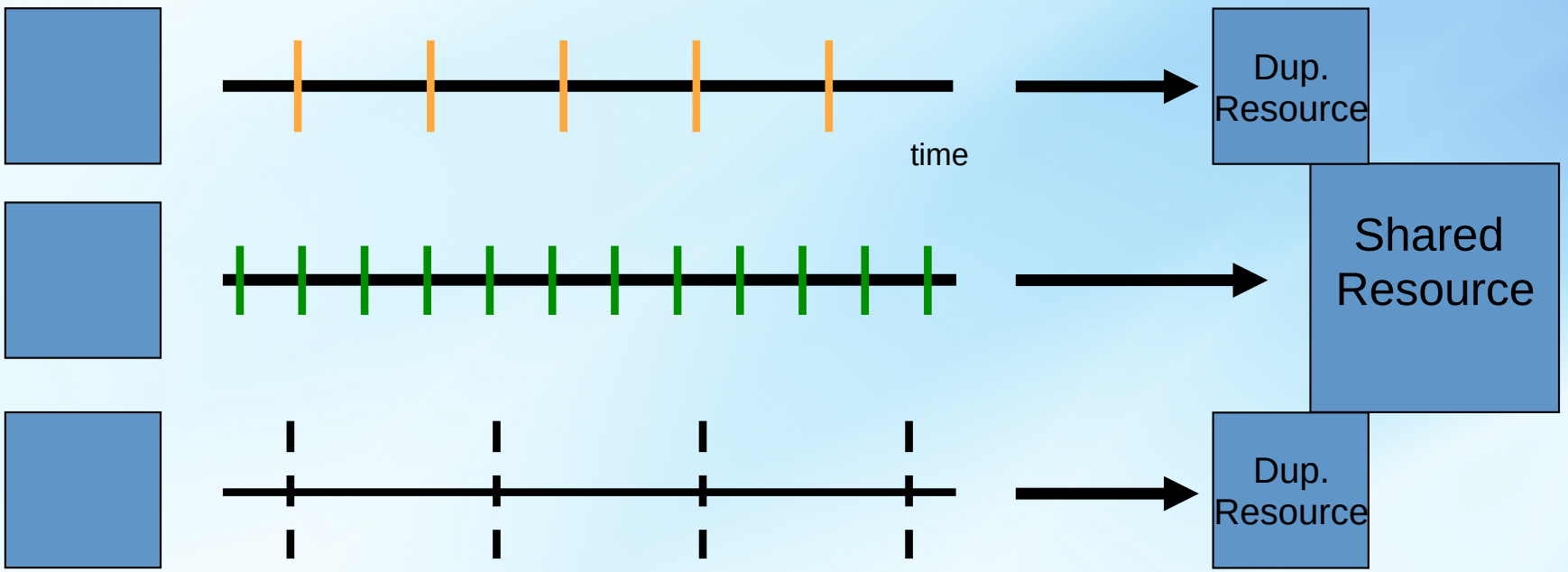
Ideal 4 – One Resource



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Round 4 – Dedication

Dedicate staplers to the cells

Rebalance the work in the cell

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Personal To-Do list

- Be the model
  - Set an example for others
  - Build trust
- Share your ideas
  - Write them down, talk them up
- Build relationships
  - Invite the leaders to your workstation
- Challenge each other
  - Can you do it faster, better, easier?
- Work as a team
  - Rely on each other; help each other
- Be a continuous learner
  - Understand the system
- Stay positive
  - Your attitude is contagious
- Start all over again

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Questions?












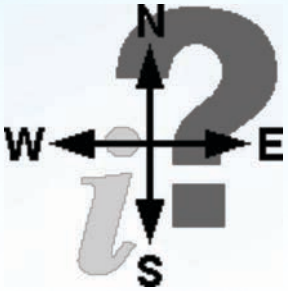


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