Simple Ways to Improve Efficiency and Accuracy Using Lean Principles

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Objectives

- Upon completion of this workshop, participants will be able to:
  - understand the basic principles underlying Lean workflow planning
  - become familiar with the tools of Lean Manufacturing
  - be able to apply these principles to your laboratory to analyze the flow and recognize where it could be adjusted to improve efficiency, reduce costs, or reduce the chance of errors

The drive for efficiency

- Reductions in reimbursement
  - 88305 TC reduced by 52% in 2014
  - Reduction in IHC in 2014
  - Reduction in number of Prostate biopsies allowed
  - Shortage of technologists as baby boomers retire
- Increasing volume of tests
  - More people are insured (ACA)
  - Baby boomers are aging
  - New personalized medicine tests

The need for accuracy

The work done at Henry Ford revealed the following…

"**From 2,694 case accessions,** there were 4,413 individual specimen parts, 8,776 blocks, and 14,270 slides. **There were 45 individual identification defects** resulting from 45 cases, producing a **defective case rate of 1.67%.** Of the defects, 10 were found in the accessioning process, 5 in blocks, and 30 in slide identification. **Slide labeling alone accounted for 67% of defects (30/45), and blocks and slides together accounted for 78% of the defects (35/45)….** All misidentification defects would have been potentially addressed by use of an integrated identification system of bar-coded laboratory tags, blocks, and slides. **The correction of these misidentification defects required 159 hours of manual rework."**

(D'Angelo R, Zarbo R. The Henry Ford Production System Measures of Process Defects and Waste in Surgical Pathology as a basis for Quality Improvement Initiatives. American Journal of Clinical Pathology 2007;128;423-429)

Tragedies of inaccuracy

Lynn Yurosko was improperly diagnosed with breast cancer in 2006 due to a slide labeling error.

Reid J. Epstein, Woman treated for breast cancer-Mixup in lab shows no cancer, Newsday, September 26, 2006

Darrie Eason was improperly diagnosed with breast cancer in 2007 due to a slide labeling error.

Mike Celizic, 'I don't want this to happen to anyone else', Today Health, www.today.com, October 4, 2007

Scott Aprile was also improperly diagnosed with breast cancer in 2009 due to a slide labeling error.

Jane Lerner, Rockland man sues Nyack Hospital over cancer misdiagnosis, LoHud.com May 14, 2009

All three of these patients were treated for cancer when they never had it.

What is Lean?

Objective

- Lean is a **management philosophy** based on the Toyota Production System (TPS)
- Eliminate everything that does not add value (waste) in the **customers' eyes**

Focus and scope

- **Value stream** as primary work unit
- Focused on improving process performance
- Clear view of end state

Approach and tools

- Wide range of **Lean tools** are available
- **Learn-by-doing** approach to performance improvement and capability-building

What is Value?

- It's all about the customer
- Value is the **worth** of a product or service delivered to a customer
- It is the **degree** to which a customer need or desire is fulfilled and may include:
  - Quality
  - Usefulness
  - Functionality
  - Availability / Timeliness
  - and so on

What is Value-Added?

- Value-Added
  - Is any activity that increases the market, form, or function of the product/service
  - These are things the customer is willing to pay for
  - Example: grossing the specimen and loading into a cassette

What is Waste?

- Non-Value-Added = Waste
  - Any activity that adds cost or time but does not add value for the customer
  - These activities should be eliminated, combined, reduced or simplified
  - Example: reprocessing underprocessed tissue
  - Example: organizing blocks into numerical sequence for archiving

Traditional approaches to efficiency

- Large batch processing
- Large batches "push" work through the system
- Build inventories to capture low unit production costs
- Build in QC/check steps to detect errors and correct them

The Lean approach

- Minimize waste
- ***Prevent*** errors, not ***detect*** them
- "Pull" philosophy
  - "provide what the patient needs …"
  - "… when she needs it"
- Single piece flow/On-demand
- Standardized Work
- Involve the people who do the work
- PDCA (Plan, Do, Check, Act)

There are eight wastes to look for in our processes:

Over Processing

Motion

Waiting

Over Production

Transportation

Inventory

Defects

Intellect

Where are wastes in your processes?

Over-Processing

- Over-processing waste refers to operations and processing that may not be necessary
- Processes that do not add to customer value
- Examples:
  - Changing processor reagents before they are necessary
  - Fixing in formalin for longer than is required
  - Manually trimming a block to fit more sections on a slide

Motion Waste

- Motion waste relates to the discrete movements of operators performing their job.
- Often caused by poor workstation layout.
- Looking for hidden or obscured tools: having too many of the supplies they don't need obscuring the things they do need.

Waiting Time

- Waiting (Idle) time refers to both human and machine waiting
- The need to wait may be caused by many things, including transportation delays, machine failures, or some operators working too fast or too slow
- Example:
  - Tissue processor sitting idle all day
  - Accessioning personnel waiting for the next courier run

Overproduction

- Making something that is unnecessary
- Occurs when you process items when there are no orders
- Example:
  - Cutting slides for IHC at the same time as the H&Es
    - You don't know if the pathologist will ask for an immuno
    - You don't know how many he/she will need
    - If IHC is not requested, the slides, the tissue, and the time spent cutting will all be wasted
    - Creates an opportunity for error because the previously cut slides must be retrieved and matched to the right patient

Transportation

- Moving products, such as samples from accessioning to grossing and slides to staining
- Material handling is one key part of transportation
- Transportation can often be reduced by improving the lab's layout

Inventory

- Overproduction leads to inventory. So does large batch processing
- Inventory means any goods that are waiting for the next process step
- Inventory includes supplies, work-in-process and finished products
- Examples of where work or materials pile up?
  - 300 cassettes unloaded from the processor and waiting several hours for embedding
  - Grossed cassettes waiting for more to fill up a processor

Defects

- Waste includes
  - The defects themselves
  - The cost of inspecting for defects
  - Responding to customer complaints
  - Repeating the work
- In AP, this is the most dangerous waste because of the serious impact on patients
- Examples:
  - Mis-labeling a slide or a cassette
  - Underprocessed tissue
  - Ineffective antibody in IHC

Intellectual Waste

- Not involving the workers in solving problems or making the process more efficient

Lean Tools Introduction

Lean Introduction

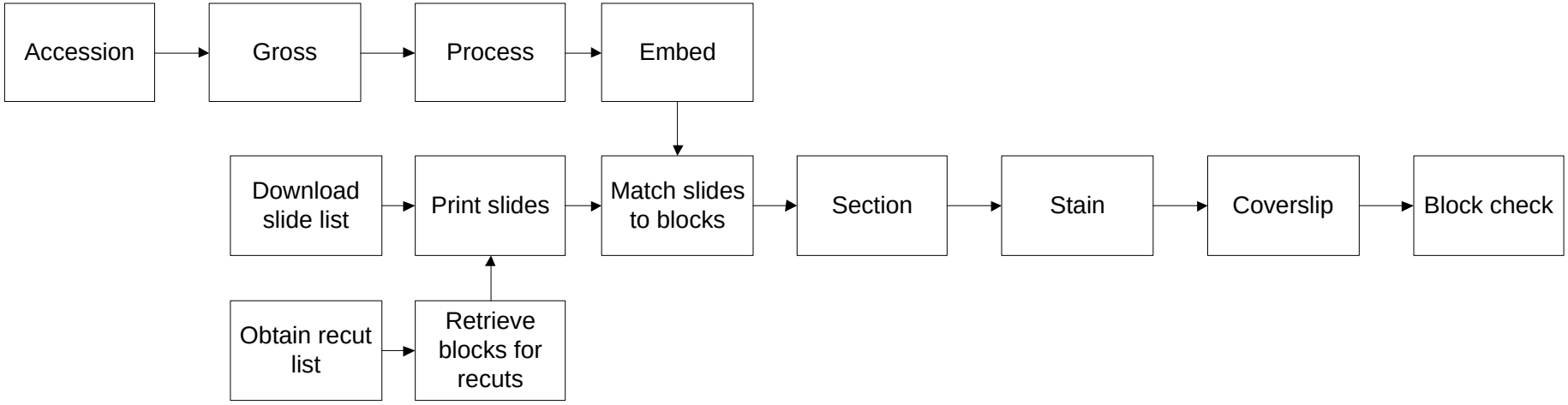
- Value stream map
- 5 S
- Flow
- Spaghetti diagram

Value Stream Mapping

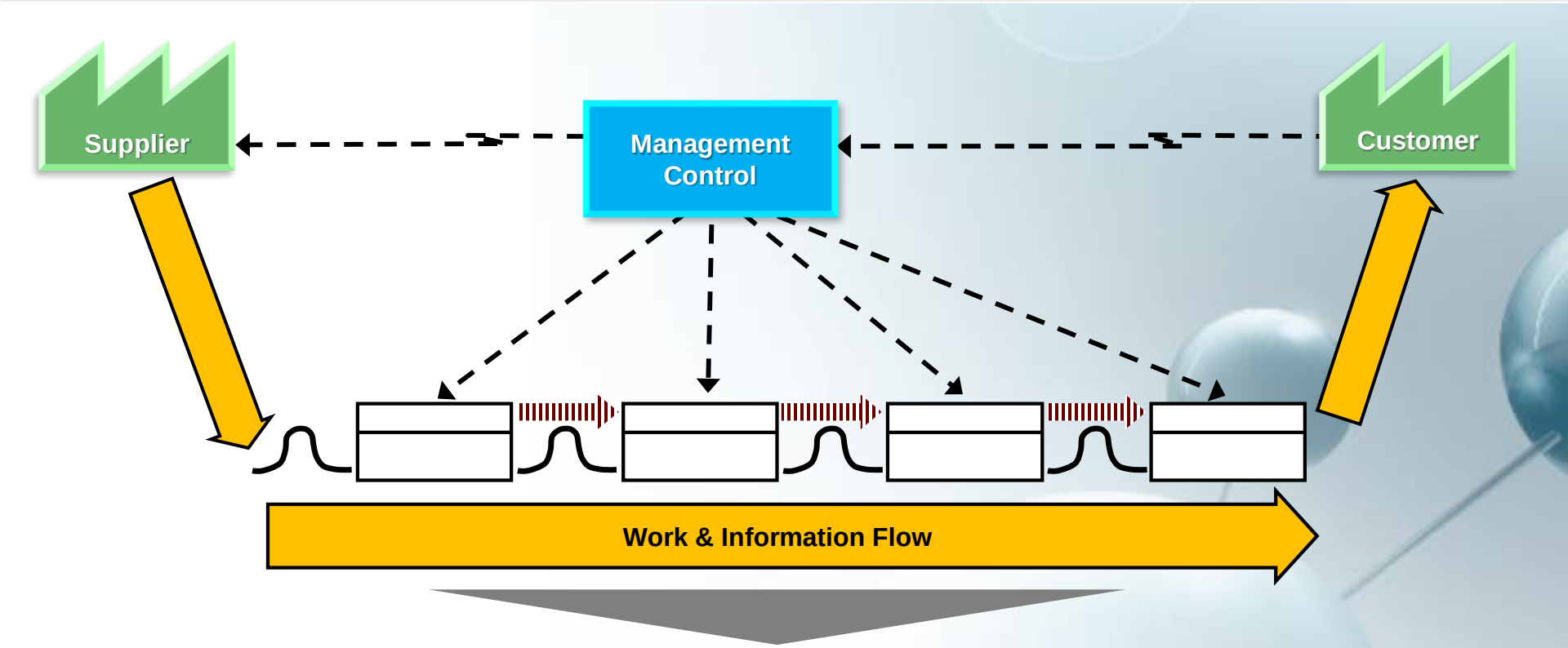
Mapping

- Understand the sequence of actions, process linkages, and dependencies
- Identify opportunities or processes where Lean tools can be applied
- Create the basis for Lean implementation plan
  - To free up resources or improve capacity
  - Eliminate process waste
  - Help reduce / eliminate inventory and waiting time
  - Reduce cycle and processing time

Start with a simple flowchart

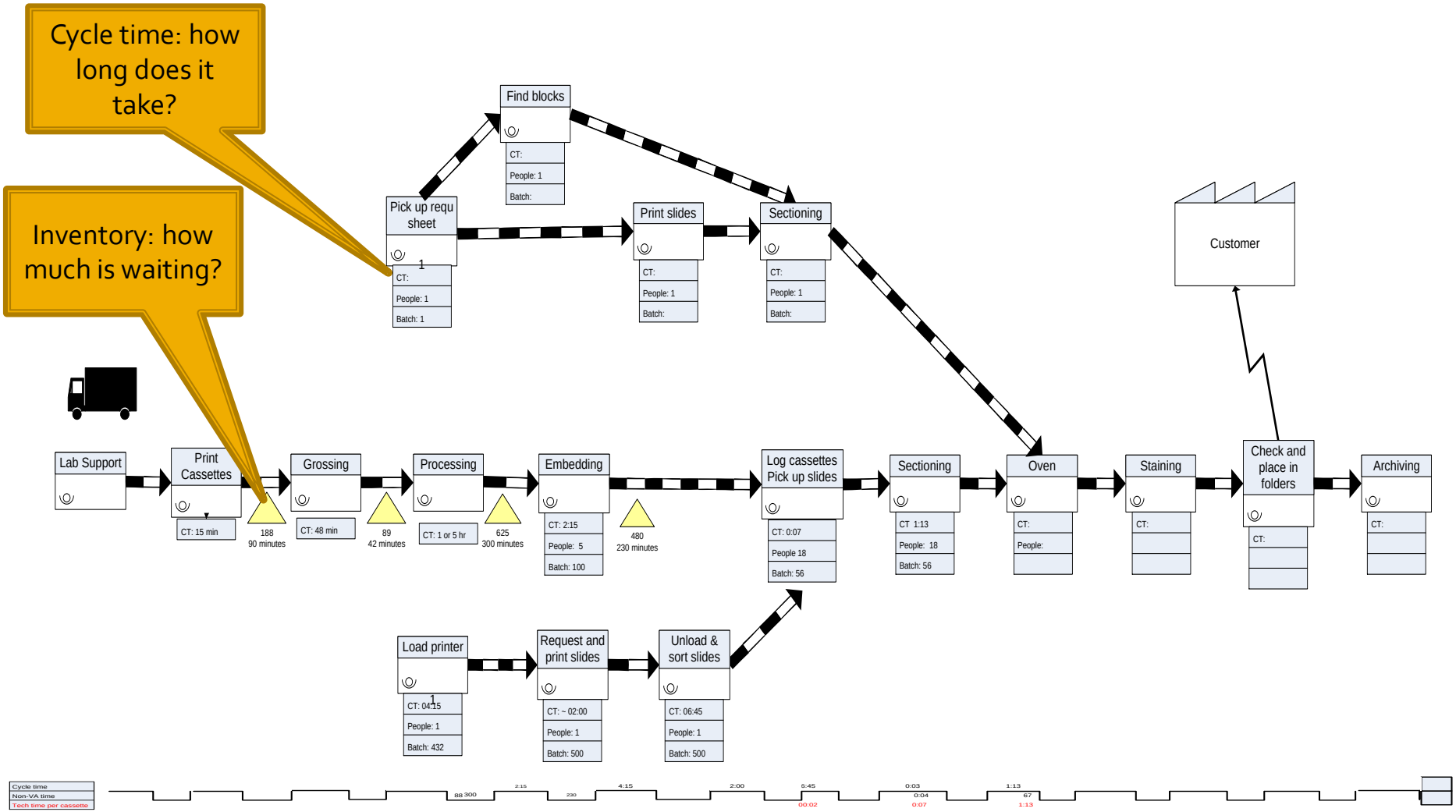


A Value Stream Map is an enhanced flowchart

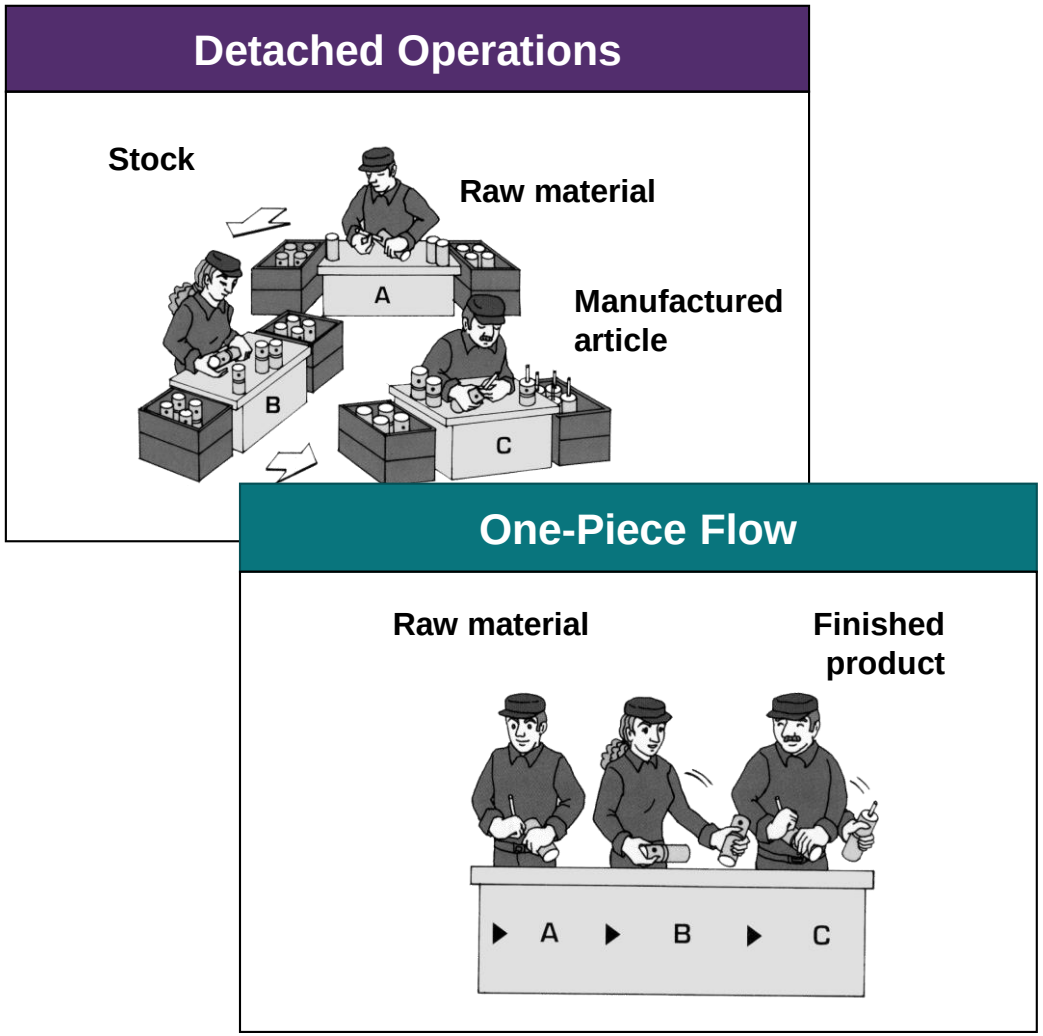


- Creates an end-to-end view of the system
- Demonstrates interaction between material/work and information flow
- Provides a common visual language for understanding a complex system

A Value Stream Map



Flow



Lean processes aim to achieve "one-piece flow"

- No work-in-progress inventory costs
- No quality defect
- Shortest cycle time
- Minimize waste
- Does not mean "One piece" at a time
- In histology it means small batches so that wait time between stations is reduced

Time Observation Worksheet

Time Observation Sheet

Area:
Date:
Prepared by:

(Data: top half watch reading, bottom half subtraction Low rep

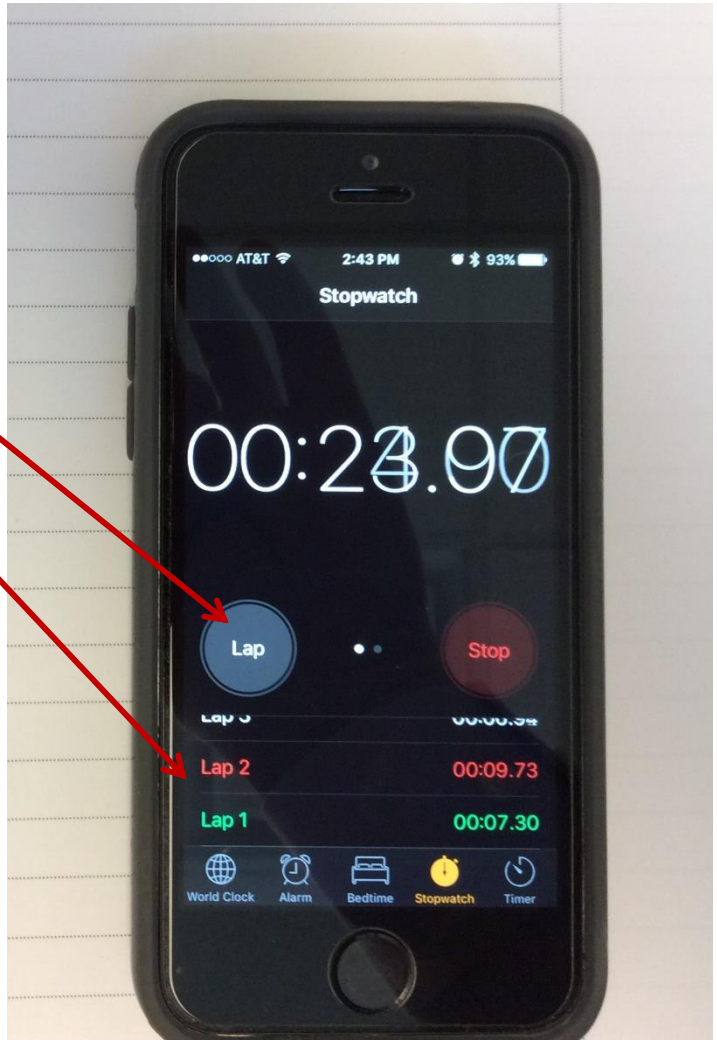
Seq.	Element	1	2	3	4	5	time	Fluc.	Comments/Notes
	Total Cycle Time								

Periodic Work Description	1	2	3	4	5	Freq.		Notes/Comments
Total Periodic Work								

Your phone has a lap timer

Simple to use your iPhone's stopwatch

- Press "Lap" for each repeat
- Records each lap in the table
- Write down each value at the end of measuring
- Record any unusual occurrences or situations



Take successive measurements

Time Observation Sheet

Area: SECTIONING
Date:
Prepared by:

(Data: top half watch reading, bottom half subtraction)

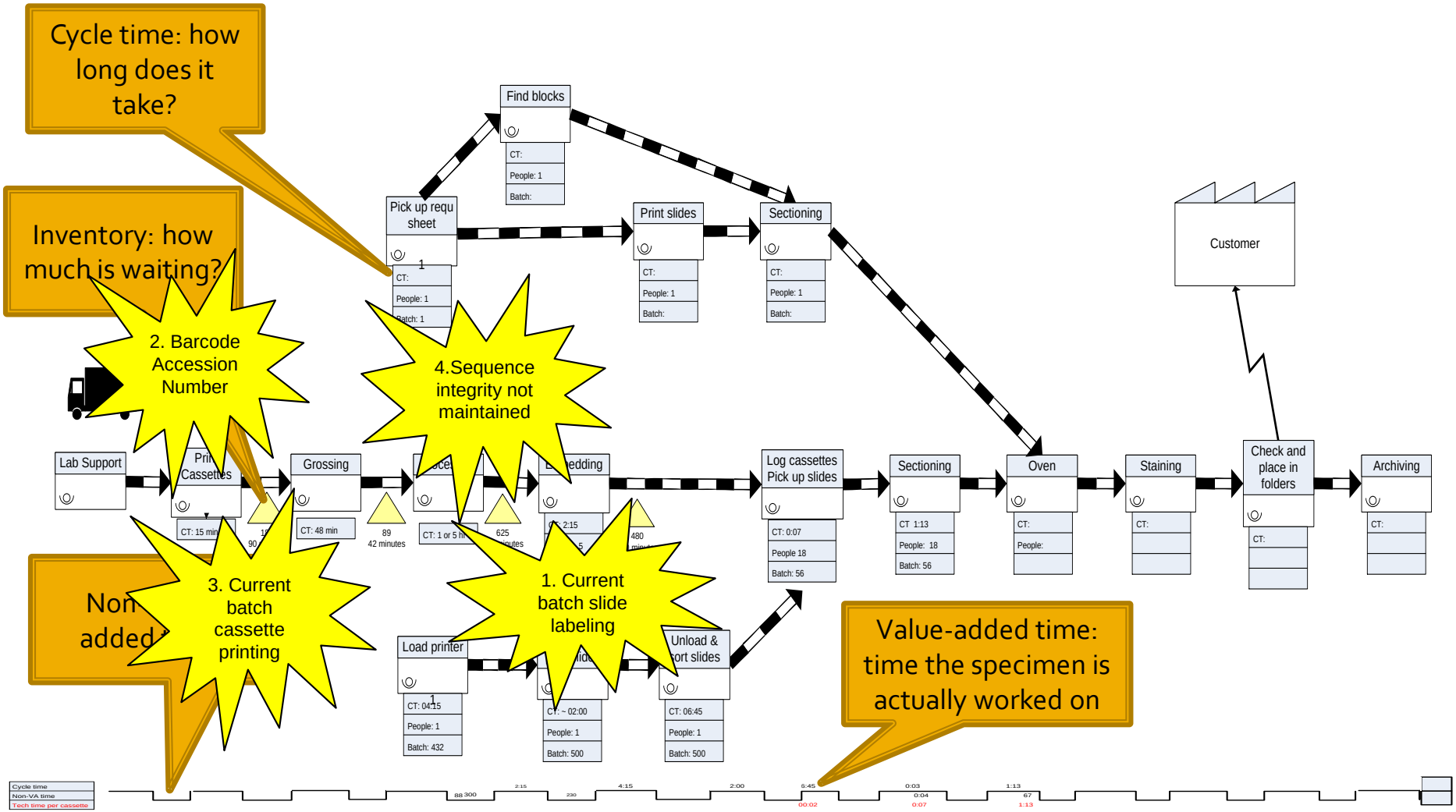
Seq.	Element	1	2	3	4	5	Low rep time	Fluc.	Comments/Notes
1.	FACING	0:14	0:27	0:38	0:49	1:00			
		0:14	0:13	0:11	0:11	0:11			
	CUTTING	1:03	3:05	5:30	6:51	7:53			4 SLIDES PER BLOCK
		1:03	2:02	2:25	1:21	1:02			INCL. PRINTING SLIDE
	Total Cycle Time								

Lap times

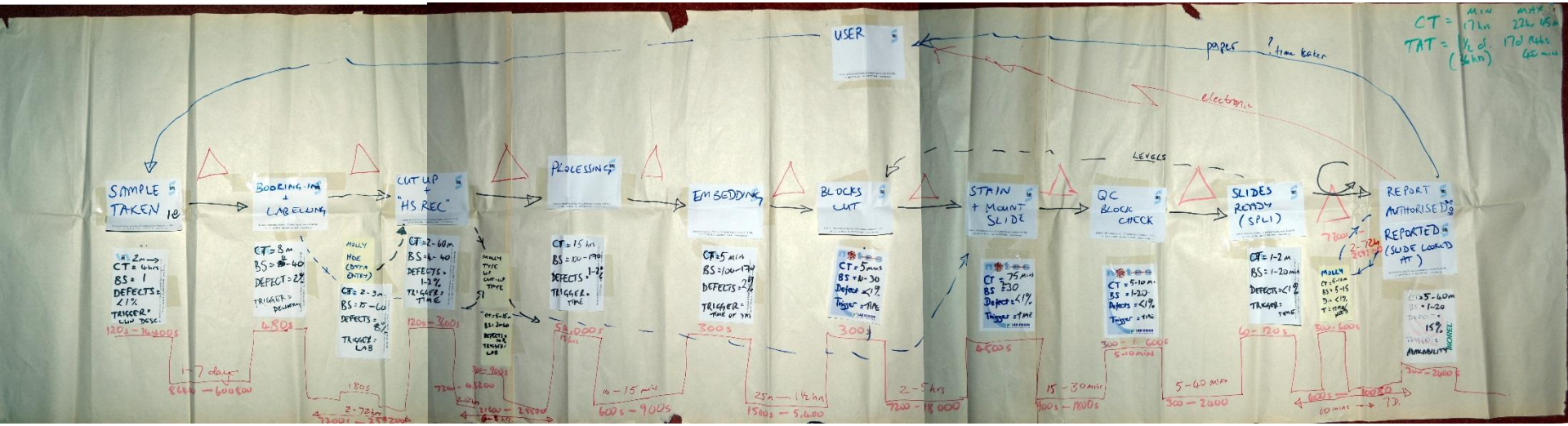
Differences = Cycle times

Periodic Work Description	1	2	3	4	5	Freq.		Notes/Comments
COLLECT ICE	0:42							ONCE @ START OF SHIFT
SETUP STATION	0:14							
CLEAN STATION	0:48	2:30	0:38					AFTER FACING/CUTTING BATCH
Total Periodic Work								

Interpreting a Value Stream Map



The VSM doesn't need to be beautiful to be useful!

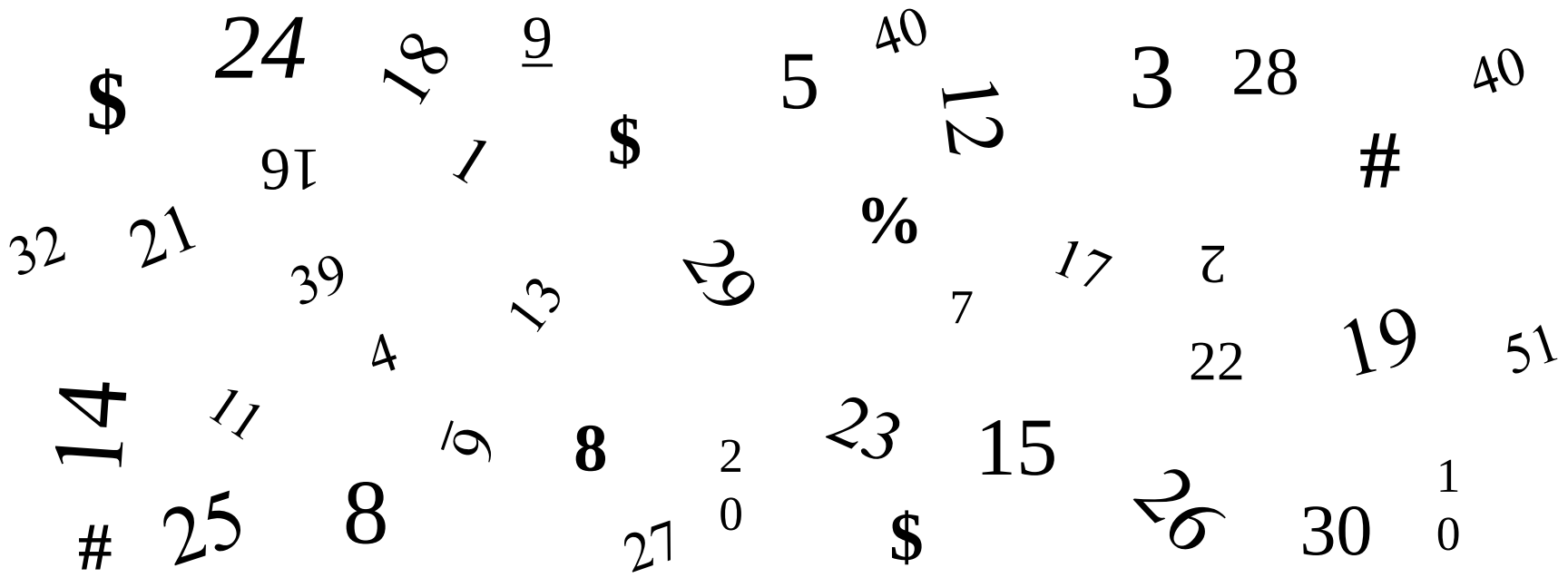


Organization

5 S

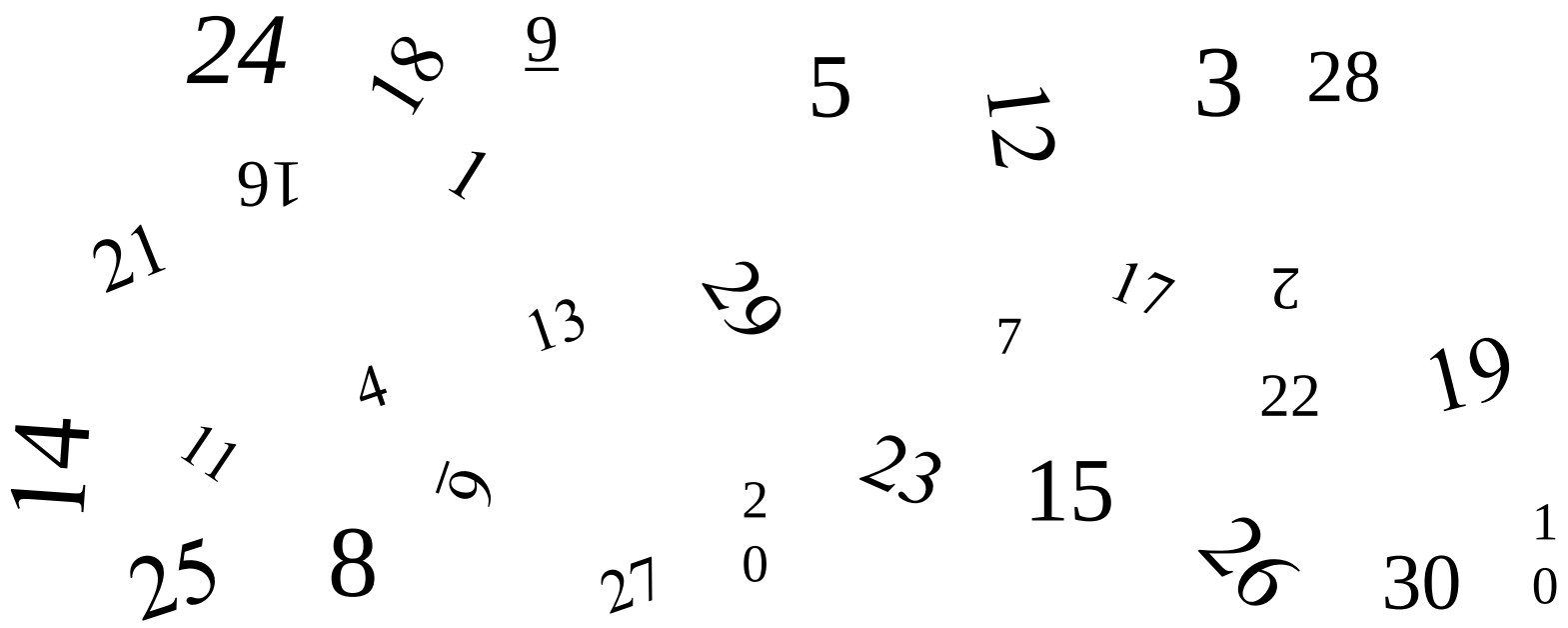
- Sort
- Straighten
- Sweep
- Standardize
- Sustain

Number Challenge



My workstation uses numbers from **1** to **30**. Starting from **1,** see how high you can count the numbers from **1** to **30** in 15 seconds.

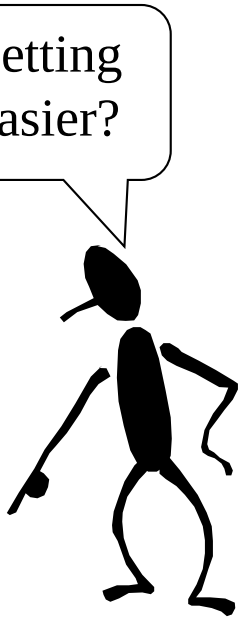
SORT



Now I have **SORTED** my workstation (removed what is not needed). **Now,** see how high you can count the numbers from **1** to **30** in 15 seconds.

STRAIGHTEN

24	18	9	5	12	3	28		
21	16	1	13	29	7	17	2	
14	11	4	20	23	15	22	19	
25	8	6	27			26	30	10



Now I have **Straightened** my workstation. **Now,** see how high you can count the numbers from **1** to **30** in 15 seconds.

STANDARDIZE

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29 30

Now my workstation is **Standardized** (in sequence **and** same size). See how easy it is to count the numbers from **1** to **30**.

Number Challenge

1	2	3	4	5	6	7	8	9	10
11	12		14	15	16	17	18	19	20
21	22	23	24	25	26	27	28		30

Now that my workstation is fully **5S'ed**. What numbers are missing? See how easy it is to recognize abnormalities when your workstation is **5S'ed**.

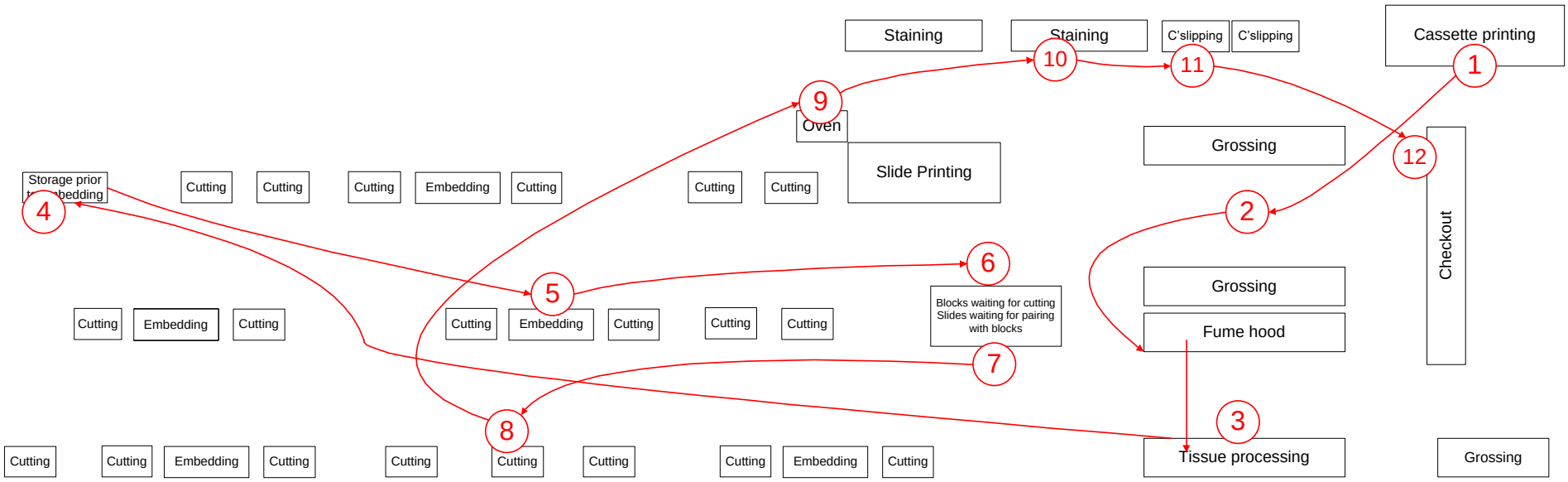
The Five S's

Sort	• Eliminate the clutter, "When in doubt, Throw it out"
Straighten	• Organize and label, "A place for everything and everything in its place"
Sweep	• Clean everything, inside and out. "Inspection through cleaning"
Standardize	• Everything in a state of readiness
Sustain	• Maintain discipline through systems and supportive culture

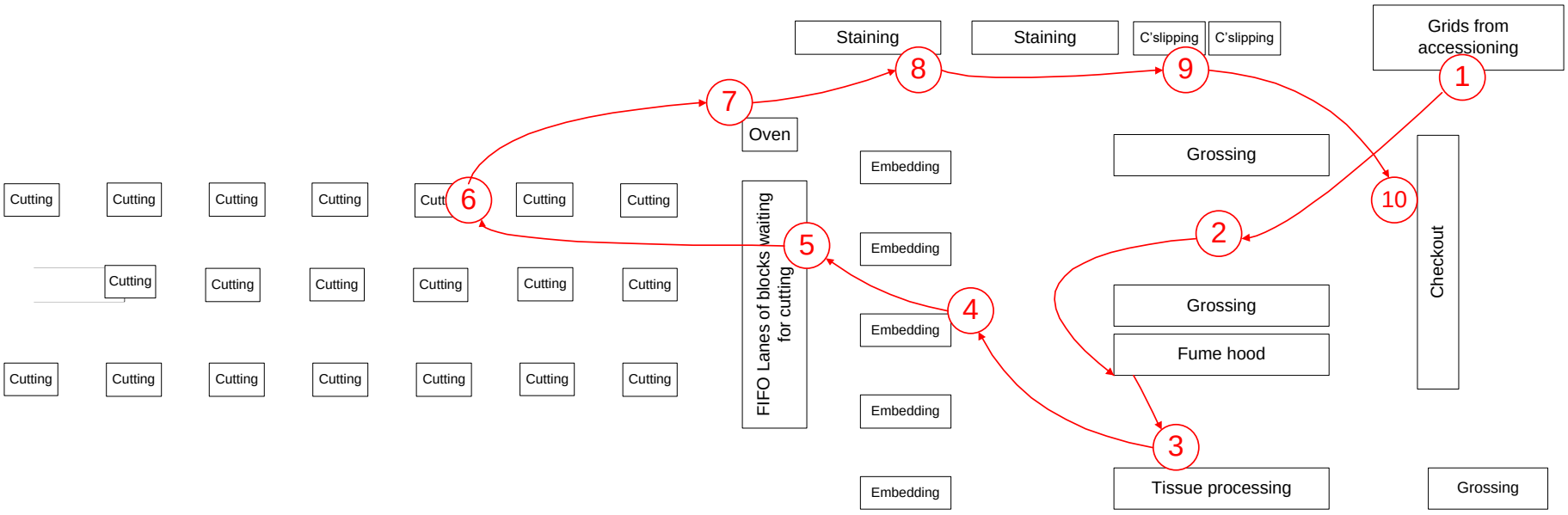
Spaghetti Diagram

- Draw the lab layout and draw lines showing the movement of people and materials
- Draw the actual flow, not what it should be or is perceived to be
- Include:
  - *Product Flow*
  - *Paper Flow*
  - *People Flow*
- How would you change this to reduce the amount of motion needed?

Current state spaghetti diagram



Future state spaghetti diagram



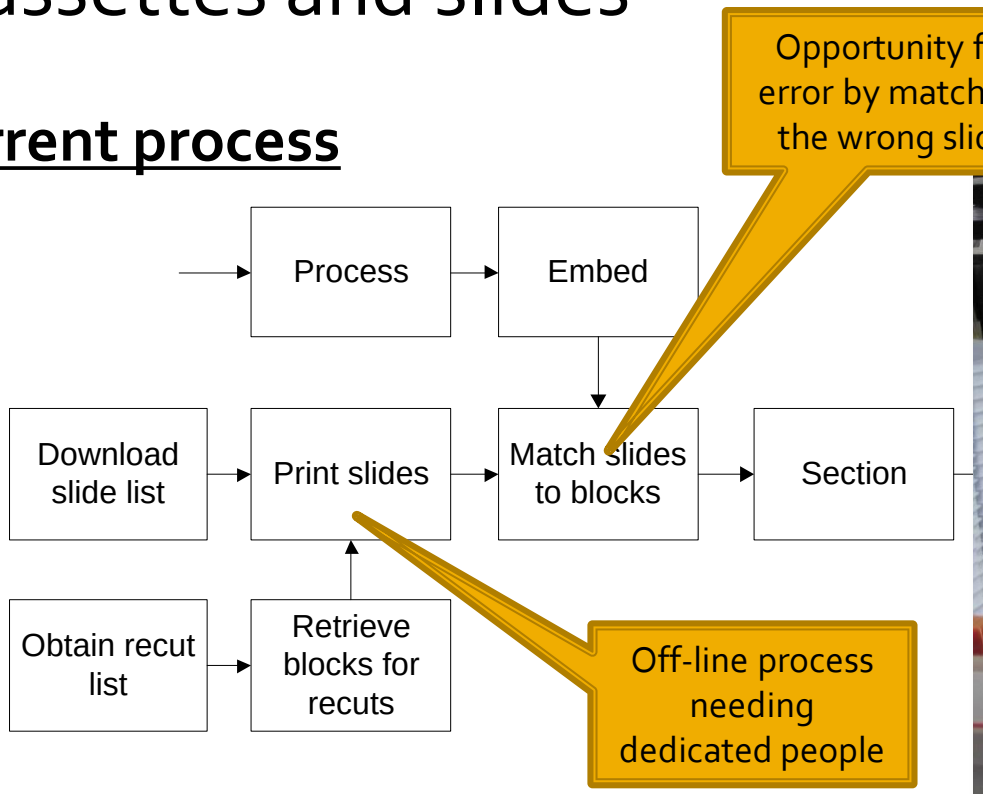
What to look for

- How can we reduce the amount of work waiting between operations?
- Does everything that we do contribute to something that the pathologist or clinician wants? If not, how can we eliminate it?
- Can we reduce the amount of motion or transport?
- Where are errors made, and can we change the process to make them impossible?

Easy Wins

- Move from batch to on-demand printing for cassettes and slides

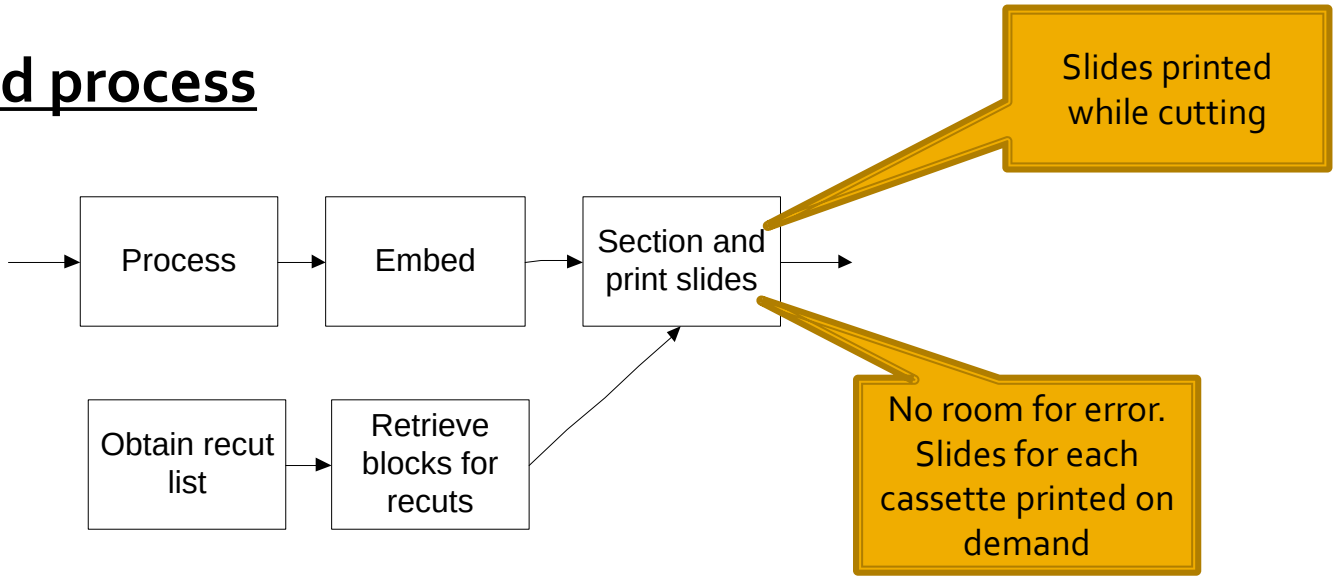
Current process



Easy Wins

- Move from batch to on-demand printing for cassettes and slides

Proposed process



In one workflow study, changing from batch printing of slides to on-demand saved 15% of total technologist time

Labor savings and error reduction

- In a large laboratory, on-demand cassette and slide printing saved $20,000 in labor
- Reduced labeling errors by 90%

TABLE 1
Time Savings With On-demand Printing

	Time Savings With On-demand Printing	Annual Volume	Annual Labor Savings (Hours)	Annual Labor Savings
Grossing: Cassette Labeling	5 seconds/piece	140,000	194	$3,889
Sectioning: Slide Labeling	7 seconds/piece	300,000	583	$11,667
Case Assembly: Slide Labeling	3 seconds/piece	300,000	250	$5,000
Total Savings			1,028	$20,556

TABLE 2
Average Labeling Error Reduction With On-demand Printing

Average Labeling Errors per Month	Cassettes	Slides
Prior to implementing on-demand printing	26.7	20.7
After implementing on-demand printing	3.3	2.0
Reduction in labeling errors due to new process	23.4	18.7
% reduction in labeling errors due to new process	88%	90%

Easy Wins

- Reduce batch sizes by processing more often

Easy Wins

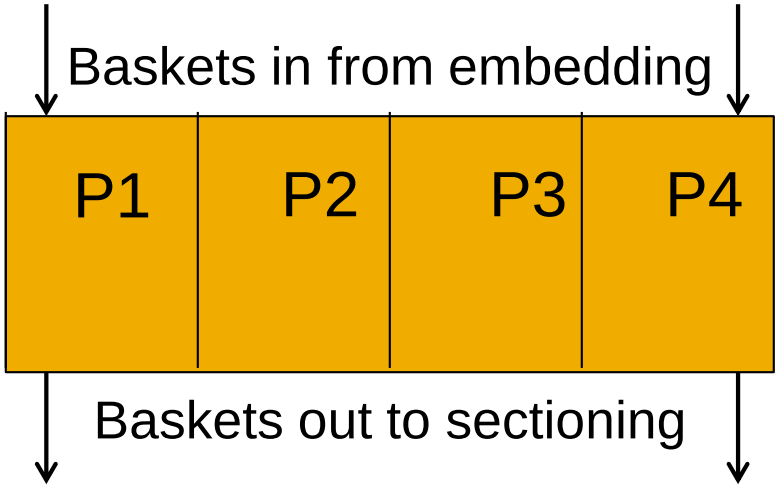
- Re-organize lab to reduce motion and transport

Easy Wins

- Cut slides for IHC and other reflex tests when requested, not when cutting H&Es

Easy Wins – larger labs

- Use a table with FIFO lanes for each type of specimen to provide visual cues to balance embedding and cutting for fastest throughput
- If the lane is full, transfer resources from embedding to cutting



Summary

- Our aging population requires that more tests are performed each year; we must change the way we do things to become more efficient
- Lean processes offer a way to think differently about workflow and focus on improvements
- Involve your team in every step – you need their hands-on knowledge as well as their commitment

Thank you!

References and further reading

- D'Angelo R, Zarbo R. The Henry Ford Production System Measures of Process Defects and Waste in Surgical Pathology as a basis for Quality Improvement Initiatives. American Journal of Clinical Pathology 2007;128;423-429
- Jennifer L. Condel, David T. Sharbaugh, Stephen S. Raab: Error-free pathology: applying lean production methods to anatomic pathology. Clin Lab Med 2004 Dec; 24(4):865-99
- Leo Serrano, Pamela Hegge, Brendon Sato, Barbara Richmond, Lennis Stahnke: Using lean principles to improve quality, patient safety, and workflow in histology and anatomic pathology. Adv Anat Pathol Volume 17, Number 3, May 2010
- NHS improvement, Leicester, UK: Learning how to achieve a seven day turnaround time in histopathology. www.improvement.nhs.uk. *(Don't worry about the 7-day TAT in the title – UK labs have a different set of criteria. This book is a very helpful compilation of Lean initiatives undertaken by 14 UK hospital laboratories, many of which are relevant to US situations)*