UPMC
LIFE CHANGING MEDICINE

Lean & Six Sigma

Presented by
Wolff Learning Academy

Sign the Wolff Learning Academy Guest Book... Enter your name, business unit or hospital you represent, and share a fun fact about yourself!

Waiting for responses ...

Objectives

1. Identify the fundamental principles of Lean Production.
2. Determine how Lean changes impact productivity, efficiency and satisfaction.
3. Compare Lean and Six Sigma
4. Discuss the Lean Six Sigma Framework (DMAIC)

What words come to mind when you think about the concept of Lean?

Waiting for responses ...

Workflow Improvement Theories

1. Six Sigma: aims to eliminate errors in final products.
2. Total Quality Management: aims to improve product quality as well as the work environment.
3. Lean Systems: zeroes in on eliminating excess overhead and waste, creating a “lean” organization in order to stay competitive to market changes

Insert Venn Diagram

What is Lean?

Lean is a methodology that evaluates processes with a focus on reducing waste and continuous improvement.

Consider whether each step of the process is value added for your customer or non-value added.

Define Value: What customers what, how they want it delivered and price they can afford.

Map the Value Stream: Identify all activities that contribute to these values. Remove non-value-added steps and waste.

Pursue Perfections: Lean thinking and continuous improvement is part of the culture. Highly specified and exact processes become standard, and everyone works to update processes.

Create Flow: After removing the wastes from the value stream the flow should be smooth and without interruptions.

Establish Pull: Limit inventory and work in process items while making sure necessary items are available.

What is Lean production?

- Lean creates value for customers by minimizing waste
- A Lean process..
  - Is faster
  - Is more efficient
  - Delivers satisfactory quality to customers
  - Continuously improving the process

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Customer Value

- Value Added –
  - Something the customer is willing to pay for
- Non-Value Added
  - Activity or process that does not add value from the customer perspective
- Necessary Non-Value Added
  - Still considered non-value added from customer perspective but is deemed a necessary stop by a specific entity (i.e. regulatory agency like the Joint Commission)

Who are some of your customers? And list something that your customer would consider value-added and something non-value added.

Waiting for responses ...

What do our Customers want?

Quality

- Does the product or service have all the functions and deliver everything you need?

Delivery

- A satisfied customer is one that gets their product or service when they want it.

Cost

- No one wants to pay more than they need for anything.

FUNDAMENTALS OF EFFICIENT WORKFLOW

Rule #1 Activities

Guides the design and performance of all individual activities

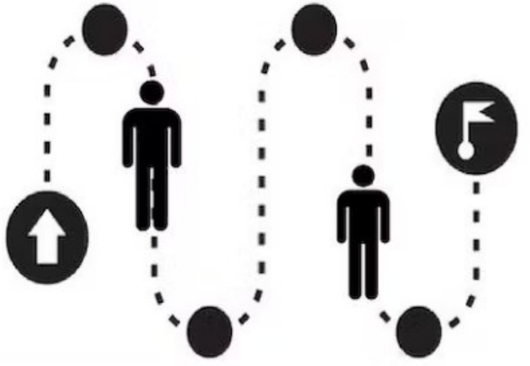
HIGHLY SPECIFIED
- Content
- Sequence
- Timing
- Location
- Expected outcome

Rule #2 Connections

Every customer supplier relationship must be direct and there is an unambiguous yes or no way to send requests and receive responses. Guides the design and operation of connections between activities

HIGHLY SPECIFIED
- Direct
- Binary (request/response)
- Unambiguous

Rule #3 Pathways



Guides the design and operation of pathways or systems of connected activities

HIGHLY SPECIFIED
- Predefined
- Simple and Direct
- No forks or loops

Spear, Steven & Bowen, Kent. "Decoding the DNA of the Toyota Production System" HBR 1999

Late 1800's
Frederick Taylor
(standard Work)

Early 1900's
Frank & Lillian Gilbreth
(Time & Motion Study/
Process Mapping)

1930's
Kiichiro Toyoda
(Just in Time)

1950's
W. Edwards Deming
(PDCA)

1950's
Taiichi Ohno
(Toyota Production
System)

1986
Bill Smith
(Six Sigma)

Late 1800's **Early 1900's** **1930's** **1950's** **1980's** **2009**

Early 1900's
Henry Ford
(Flow Production)

1950's
Joseph Juran
(TQM)

1950's
Shigeo Shingo
(SMED, ZQC)

2009
Mark Graban
Shingo Research Award
Lean Hospitals

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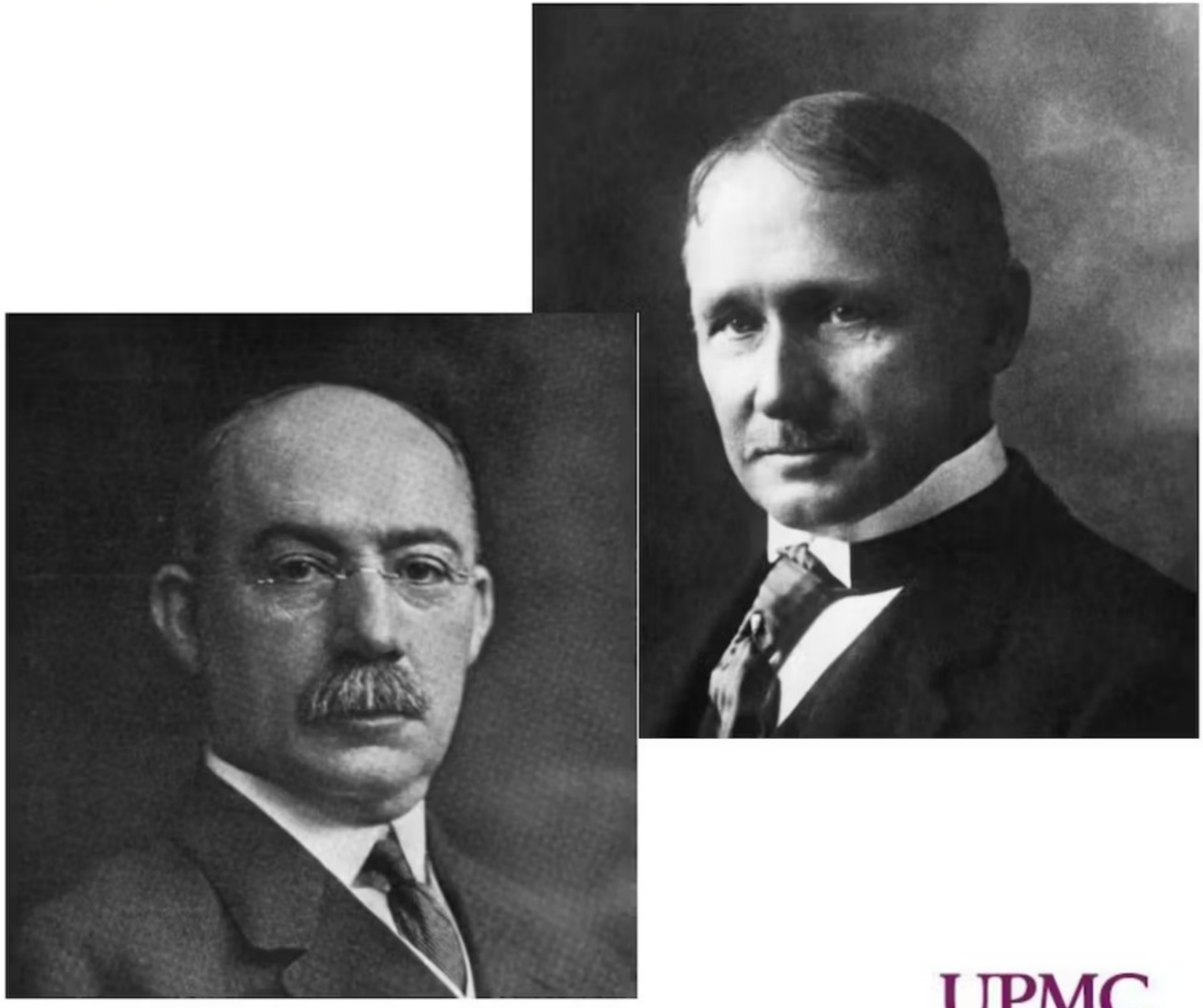
Historical Perspective of Flow Mapping

- Developed in 1880s.
- Founding fathers Frederick Winslow Taylor and Henry Gantt.
- Term workflow was presented in a railway engineering journal.



1. The exact jobs being done.
2. Who is responsible for what.
3. The time each task takes.

https://www.process.st/what-is-a-workflow/

What is a Workflow Mapping Diagram?

Workflow mapping: a method to diagram an entire process using different standard symbols to document the process steps and actions.

- Visually breaks down complex processes into easy-to-understand pictorial diagrams.
- Shows who is responsible for work in the process.

Workflows are also very useful to help employees understand how their work interconnects with upstream and downstream process stakeholders

WHAT IS A PROCESS FLOW MAP?

- A process map **provides a mechanism for analyzing and studying any process**
  - Step toward process management and process improvement
  - They are used to map existing processes, to design new processes, and to map the future state of how things should be after implementing continuous improvement initiatives

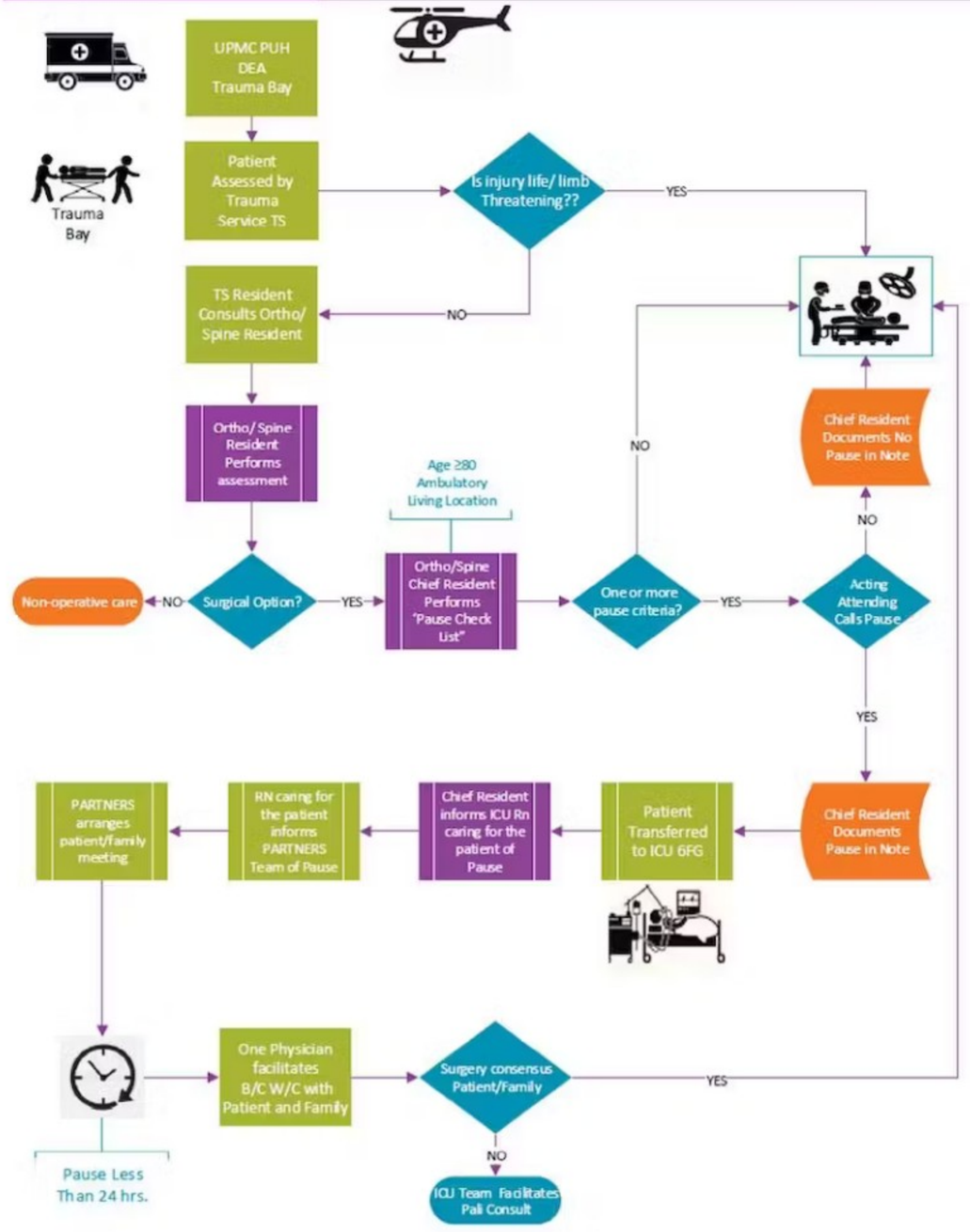
Process Maps

- Show complex workflows through visual communication
- Show an entire process from start to finish
- Refine and improve specific processes
- Planning and decision-making
- Scenario testing and what-if assessments
- Prove your processes are reliable.

Process Maps

- **Activity Process Map:** This represents value-added and non-value-added activities in a process.
- **Detailed Process Map:** This gives you a detailed look at each step in the process.
- **Swimlane (or Cross-functional) Map:** This diagram separates two or more flows within the organization while retaining their sense of interconnectedness.
- **Value Stream Map:** This is a lean-management technique that analyzes the current state of your processes and designs an improved future state that takes the process from its beginning through to the finished product or customer.

Level 1 Trauma: Ortho Surgical ICU Pause



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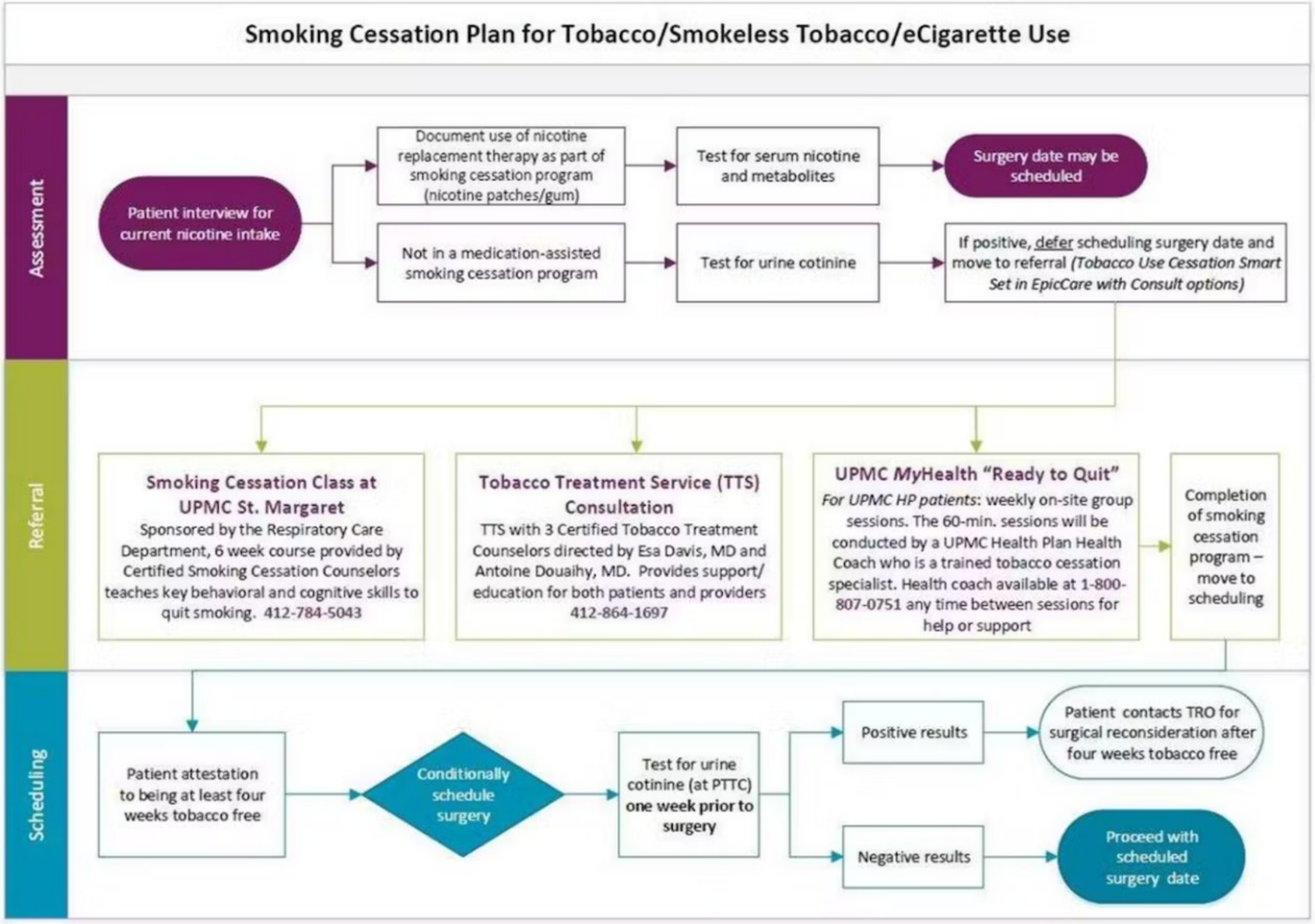
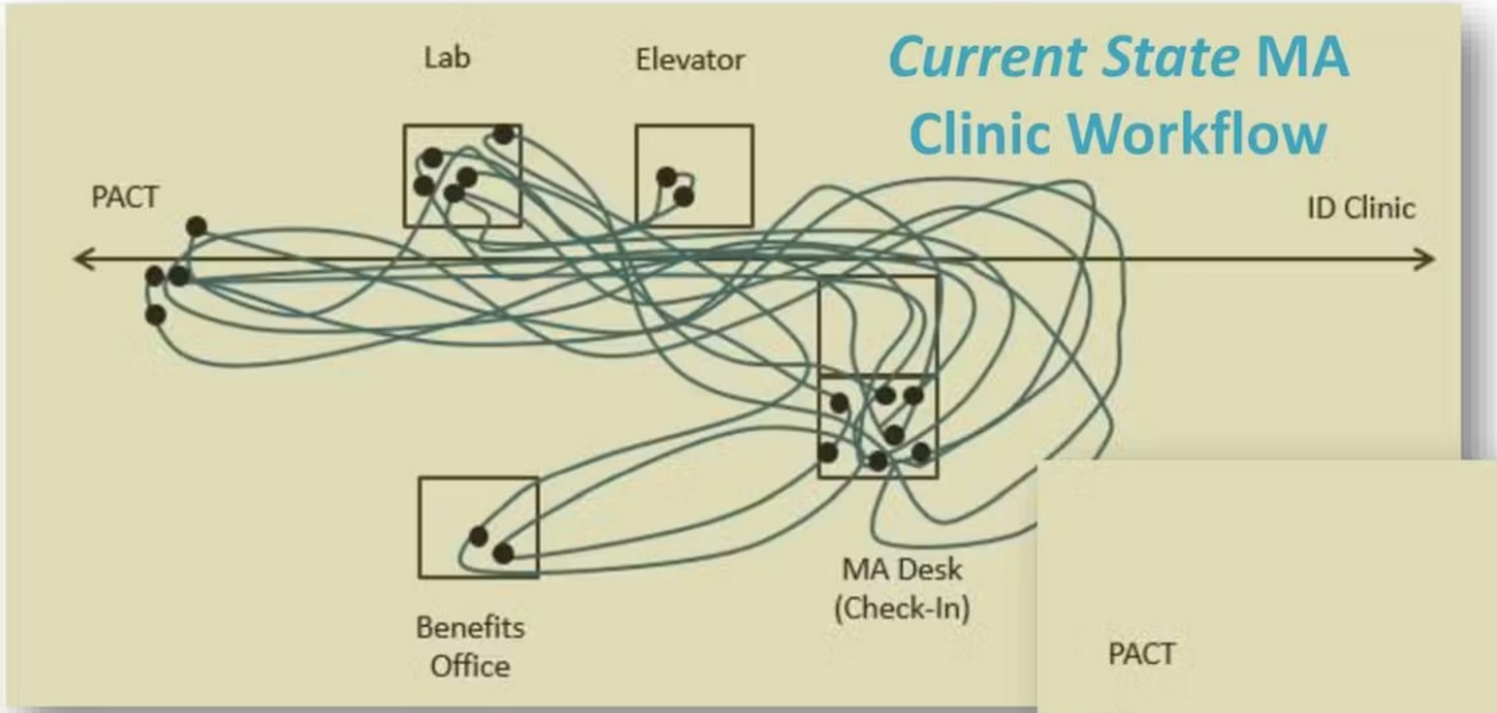
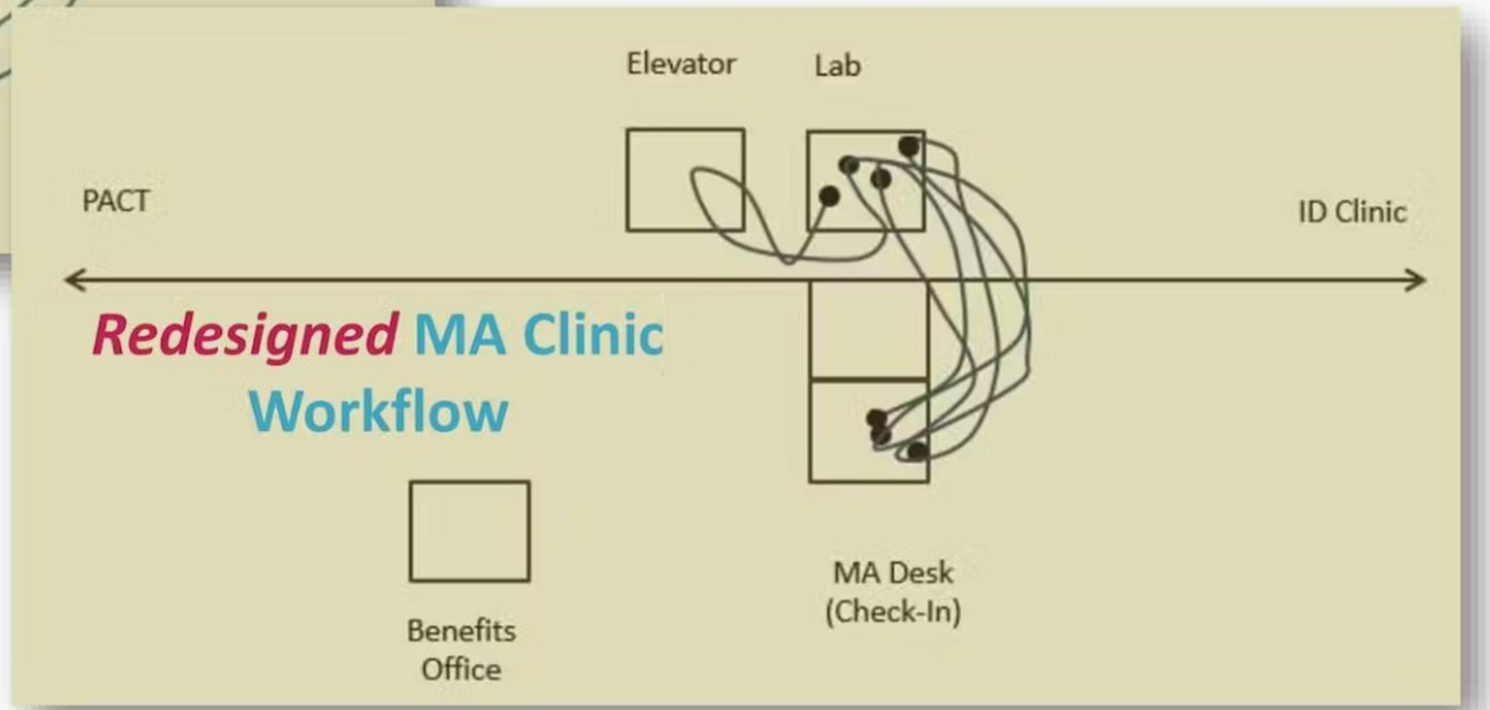
SWIM LANE DIAGRAMS

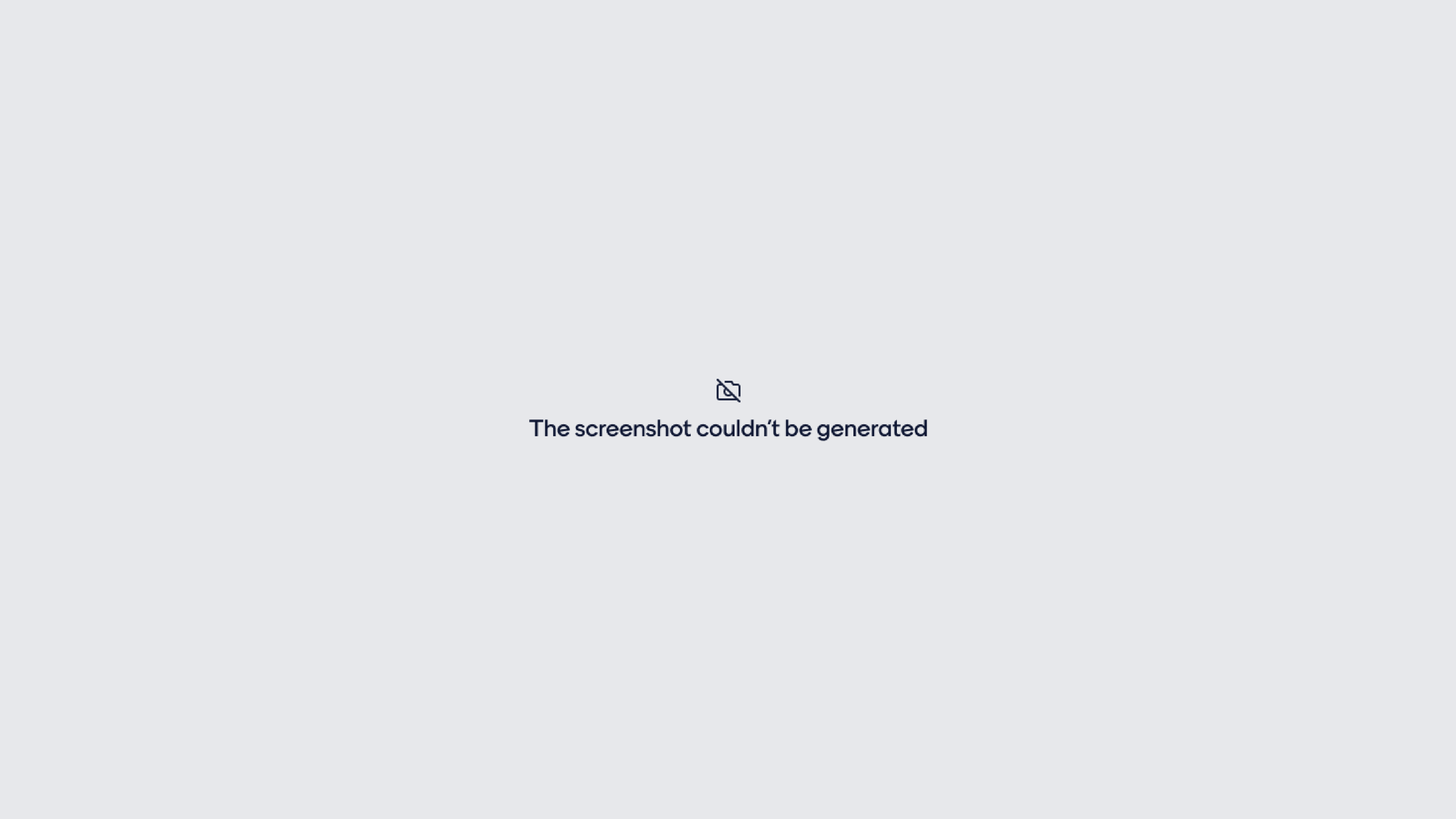
A swim lane diagram is a type of process map with categorized lanes for portions of the process or concurrent processes.



SPAGHETTI BEFORE AND AFTER



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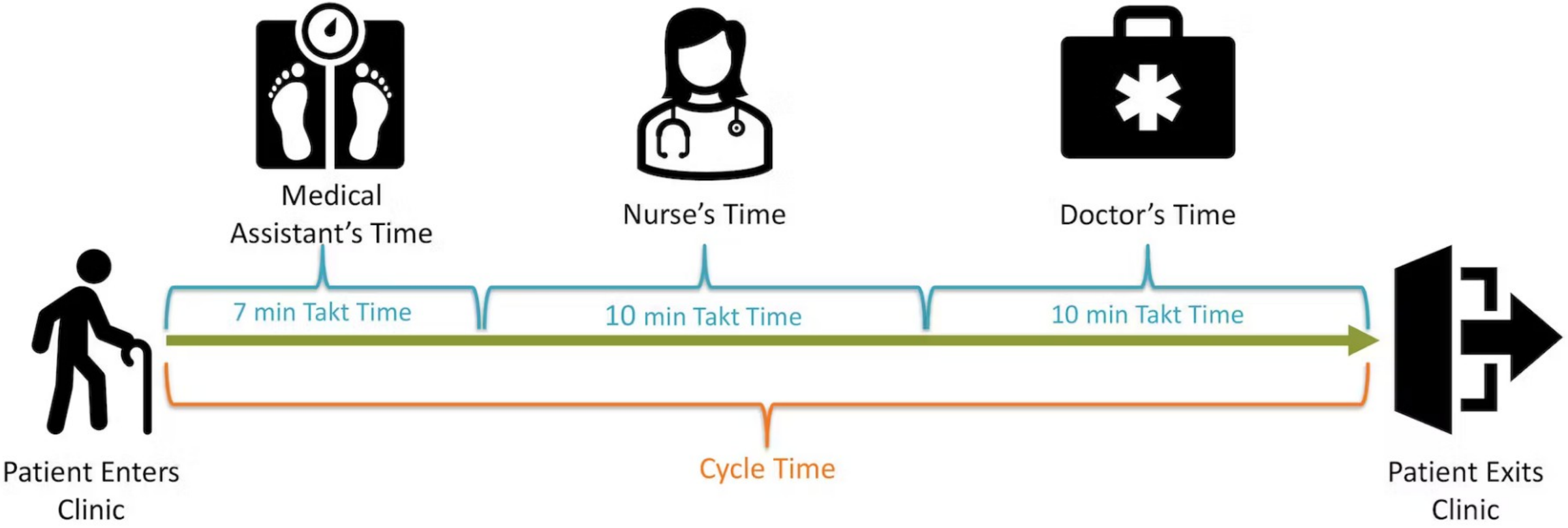
What is Takt Time vs. Cycle Time?

- **Takt time** is the *rate* at which a finished product needs to be completed in order to meet customer demand.
- **Cycle time** is the average time it takes to complete one unit.
- Total takt time of all parts in the process should come close to but not exceed the total cycle time of one complete unit.

Takt Time/Cycle Time Example



Total Takt time = 27 minutes out of a possible 30 minutes to complete the appointment

Process Focus
What is Waste "Muda"?

- Waste is any action or step in a process that does not add value to the customer.
  - "anything that the customer does not want to pay for"
- Waste is a strain on an organization's resource

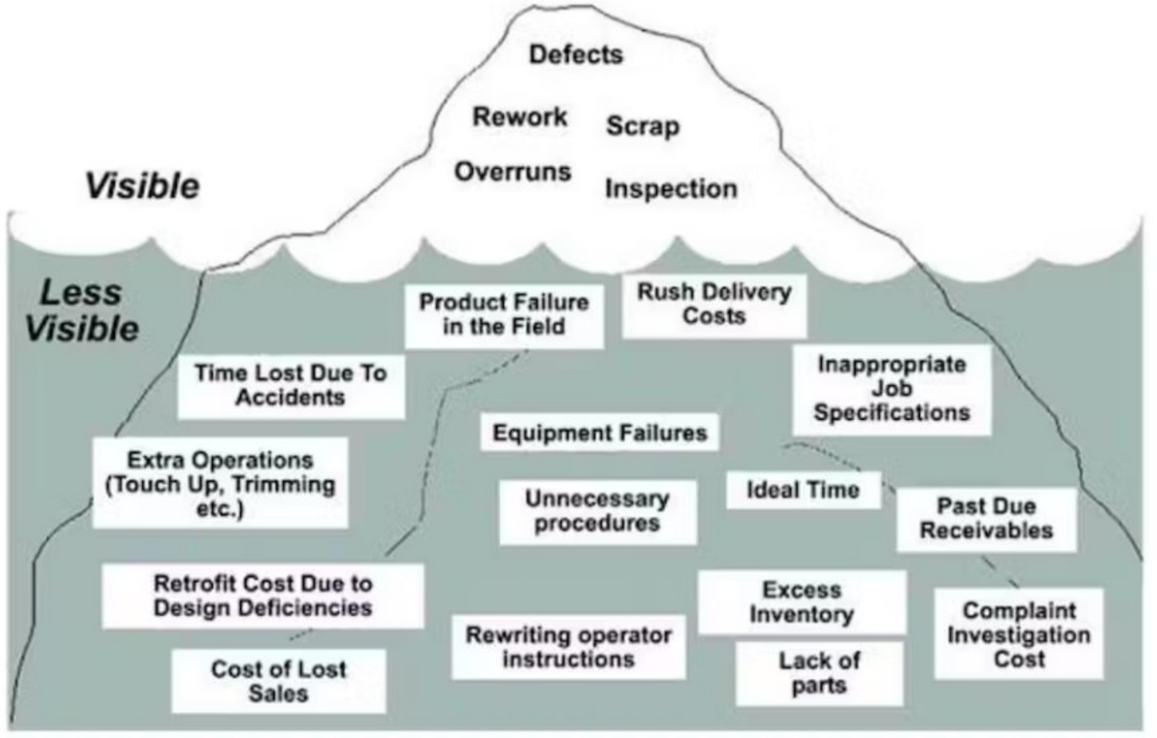
The 8 Wastes of Lean Manufacturing

- Defects
- Overproduction
- Waiting
- Transportation
- Inventory
- Motion
- Extra-Processing
- Human Potential

Defects

Errors or corrections due to work not being done correctly

- Countermeasures for defects
  - Focus on the defects that occur frequently
  - Evaluate or redesign the process
  - Standardize the work



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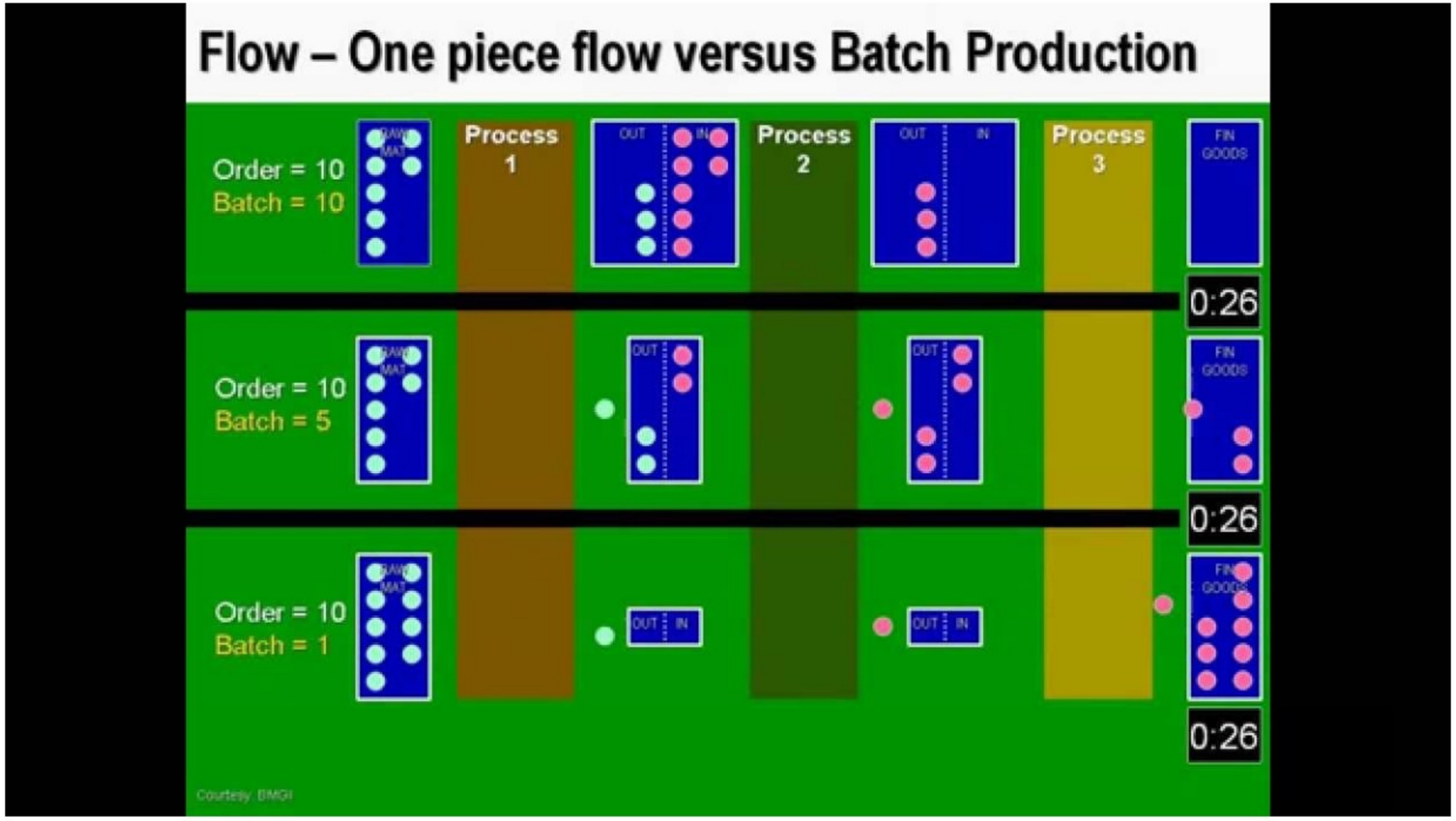
Overproduction

Occurs when a product or element of a product is being produced before being asked for or requested

- Countermeasures for Overproduction
  - Just In Time philosophy
    - Pull vs. Push
  - Takt Time – ensures that the rate of manufacturing between stations are even
  - Reduce batching and adopt one-by-one flow
  - Kanban System



Flow - one piece flow versus batch production

Waiting

Waste from the time spent waiting for the next process step to occur

Transportation

Unnecessary movement of patients, specimens, and supplies.

Supplies in Room

Nurses making multiple trips to supply room

Plan…Spaghetti diagram or tracking of trips to supply room..for what?

Do…Place supplies in the patient room …small test.. Provide key bracelet

Study…Savings: 700-800 trips to the supply room saved each week

Act…Spread to other rooms

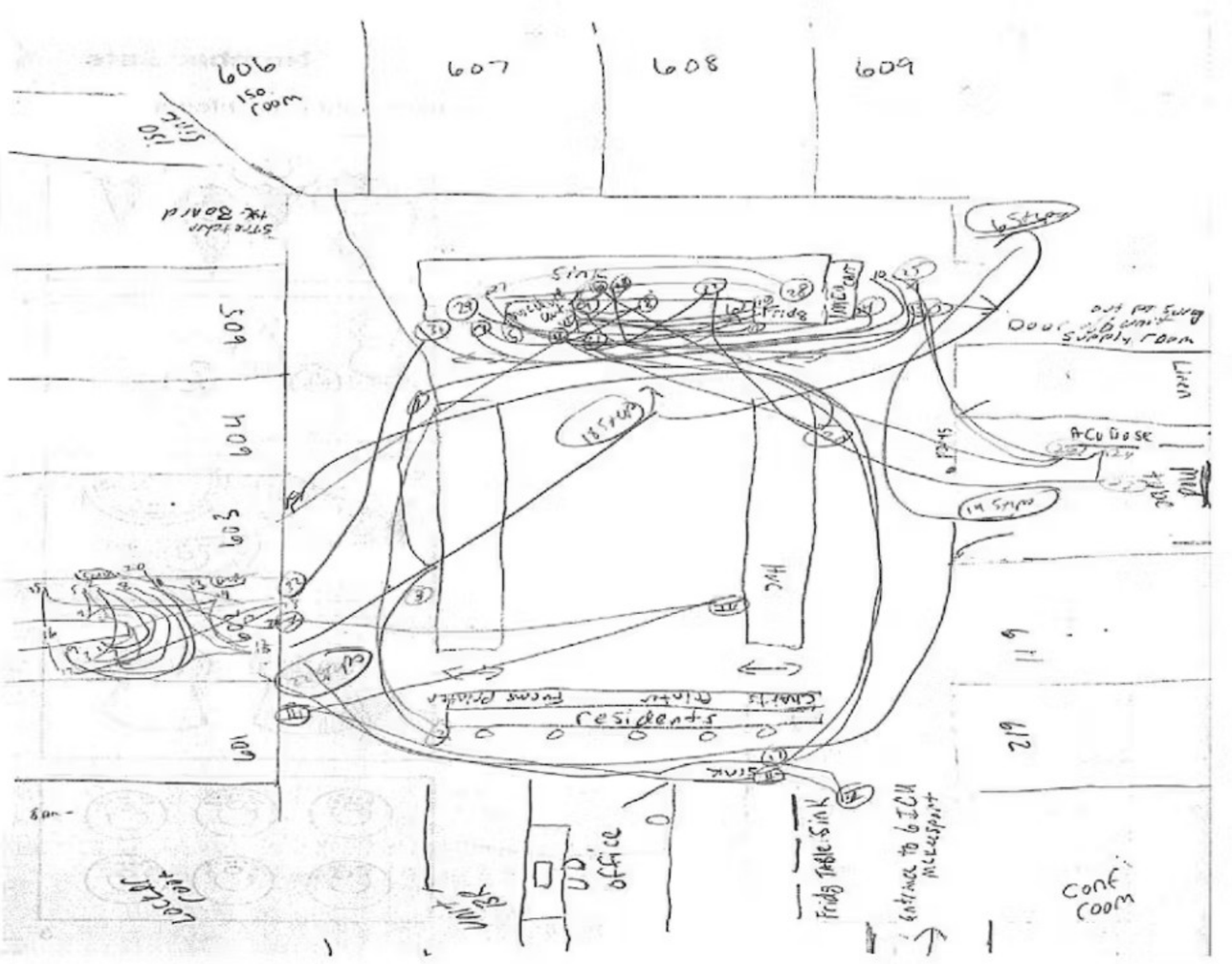
Translated to 17.5-20 hrs of nursing time saved per week!!

Inventory

Storing excess drugs/supplies, including unnecessary equipment and resources

Motion

Wasted time and effort related to unnecessary movements by people



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Extra-processing

Wastes related to more work or higher quality than is required

"overutilization"

Human Potential

Wastes due to underutilization of people's talents, skills, and knowledge

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What are the 5 S's?

5S is a tool aimed at the elimination of waste and building efficiency, but it is also known as the five pillars of a visual workplace.

SORT

Sort and separate needed items and not needed items in an area to help identify waste.

STRAIGHTEN

Arrange needed items so they are ready and easy to use. Clearly identify item locations so they can be found/returned easily.

SHINE

Keep environment/ workspace clean to maintain quality and identify defects easily.

STANDARDIZE

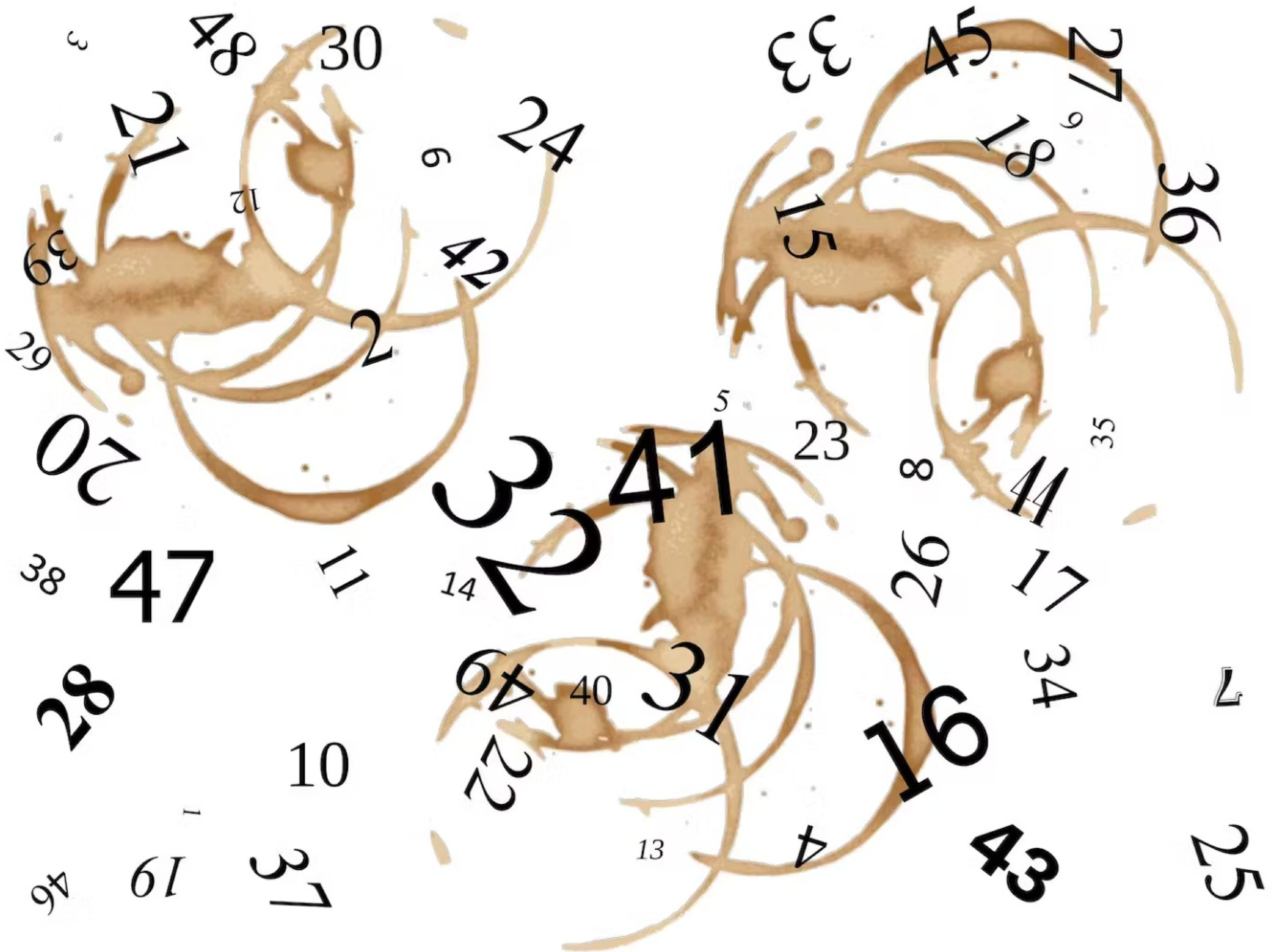
Revisit the first 3 S's frequently to confirm the Gemba (the factory floor).

SUSTAIN

Keep to the rules to maintain the standard and continue to improve.

The 5S numbers game

This game is for you to better understand the concepts of 5S Methodology



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29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

Benefits of the 5S System

Reduces:

- Waste
- Downtime
- Defects
- Delays
- Hunting and gathering
- Questions

Improves:

- Safety
- Customer satisfaction
- Person satisfaction
- Standardization
- Visual Control

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Lean Checklist: Activities, Connections, Pathways

- Are your activities clear and standardized?
  - Can 5 front-line staff articulate the process?
  - What visual cues or other supports reinforce the process or do you rely on memory alone?
- Are your connections clear and standardized?
  - To whom and how do you pass on information or people or supplies?
  - Are you passing on quality work? Do you know?
  - Who do you call if you have a question?
- What does the pathway look like from the patient perspective?
  - How does the patient or end user experience care?

Lean Checklist: Apply lean flow principles

- Identify push systems and replace them with pull when possible.
- Remove or reduce batches – move towards one-by-one.
- Check to see if takt time and cycle time match.
- Look for places to use stores to reduce waste.
- Identify visual cues and human factors design to make the process more reliable.
  - Consider – How clear is your process to a new hire?
  - How much is the right way built into the system?

Lean Checklist - Remove Waste in Work

Identify and remove waste – Examples:

- Transport – Moving people, products, information
- Inventory – Keeping inventory levels at a minimum
- Motion – Bending, walking, lifting, searching
- Over production – Making more than is immediately required
- Over processing – Doing more than what is needed
- Defects – Errors, rework
- Employee creativity

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Lessons learned

- How can you apply the principles of lean to your workplace?
  - Removing waste
  - Incorporate a Pull vs a Push system
  - One-by-one process vs a Batch process
  - Clarity of activities
  - Clarity of connections
  - Connected pathway
  - Use of Kanban or visual cues

- Consider - Who is A in your workflow? Who is B? Who is the shipper?

What Can We Do With the Extra Time?

- Get more customers
- Build new products
- Create a sales dept
- Staff education and training
- Market the business
- Start a quality program—how to build it more efficiently
  - Use 2x4s instead of 1x4s for example
- Eliminate jobs
  - You could, but rather keep the people and expand services to make more $$

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Planning for Improvement

Six Sigma (6σ)

Dogs Have Problem Solving Skills

Medical mistakes harm more than 1 in 10 patients. Many are preventable.

At least 12 percent of preventable errors caused permanent disability or death, according to a review of studies involving over 300,000 patients.

2003: Space shuttle Columbia disaster

Feb. 1, 2003: Space shuttle

CBS NEWS / *March 23, 2015, 8:13 AM*

Chrysler exploding gas tank "remedy" not enough for some

HEALTH

Medical devices for pain, other conditions have caused more than 80,000 deaths since 2008

By ASSOCIATED PRESS / NOVEMBER 25, 2018

BUSINESS

General Motors Settles Case That Triggered Ignition-Switch Recall

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Lean/Six Sigma

- **Lean**
  - Guiding principles-based operating system
  - Relentless elimination of all waste
  - Creation of process flow and demand pull
  - Resource optimization
  - Simple and visual

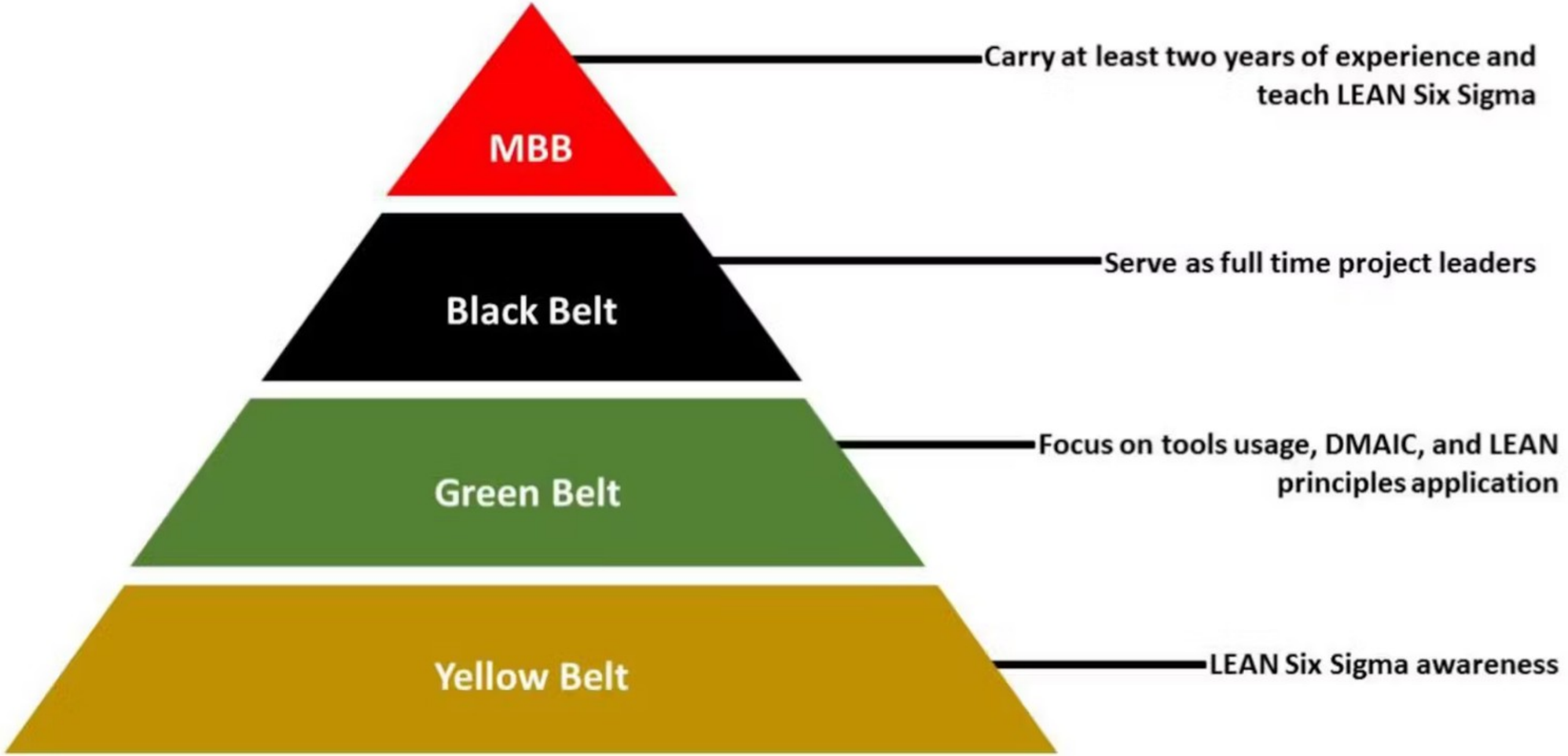
Strength: Efficiency

- **Six Sigma**
  - Focus on voice of the customer and voice of the process
  - Data and fact-based decision making
  - Variation reduction to near perfection levels
  - Analytical and statistical rigor

Strength: Effectiveness

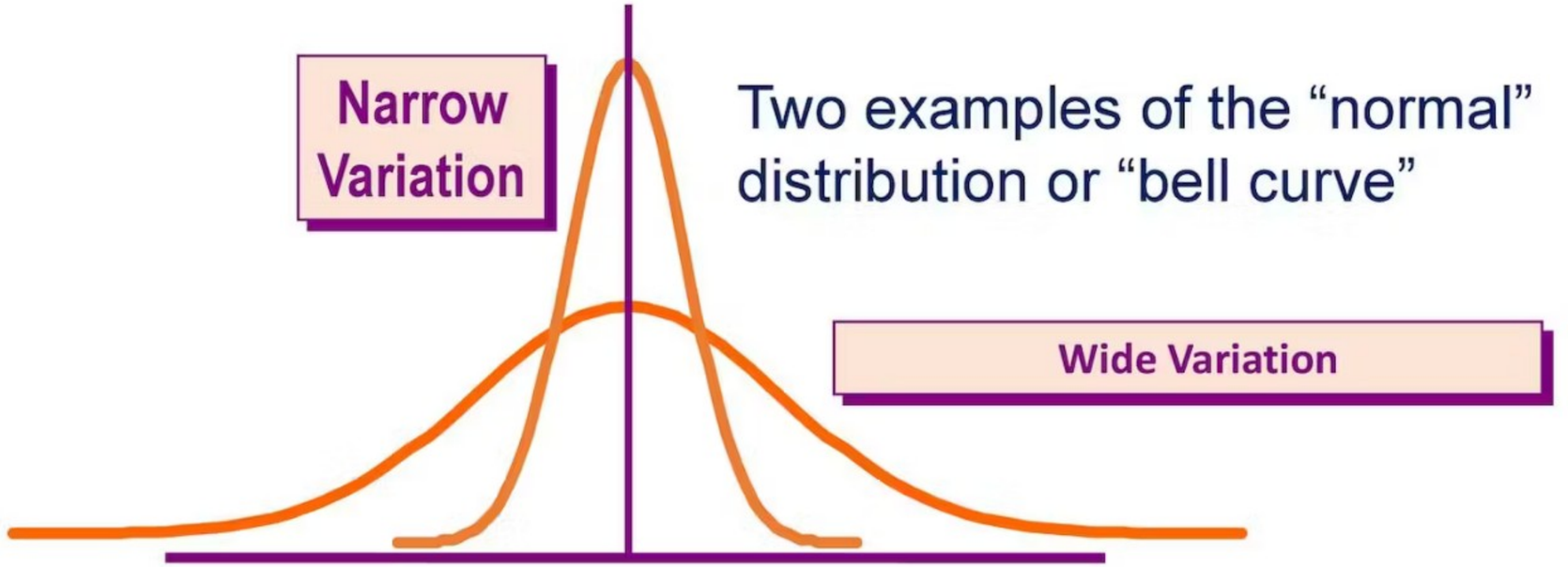
An Extremely Powerful Combination!

LEAN Six Sigma Organizational Structure



What is Six Sigma as a Symbol?

σ sigma is a letter of the Greek alphabet used to signify standard deviation, a measure of variation



Six Sigma

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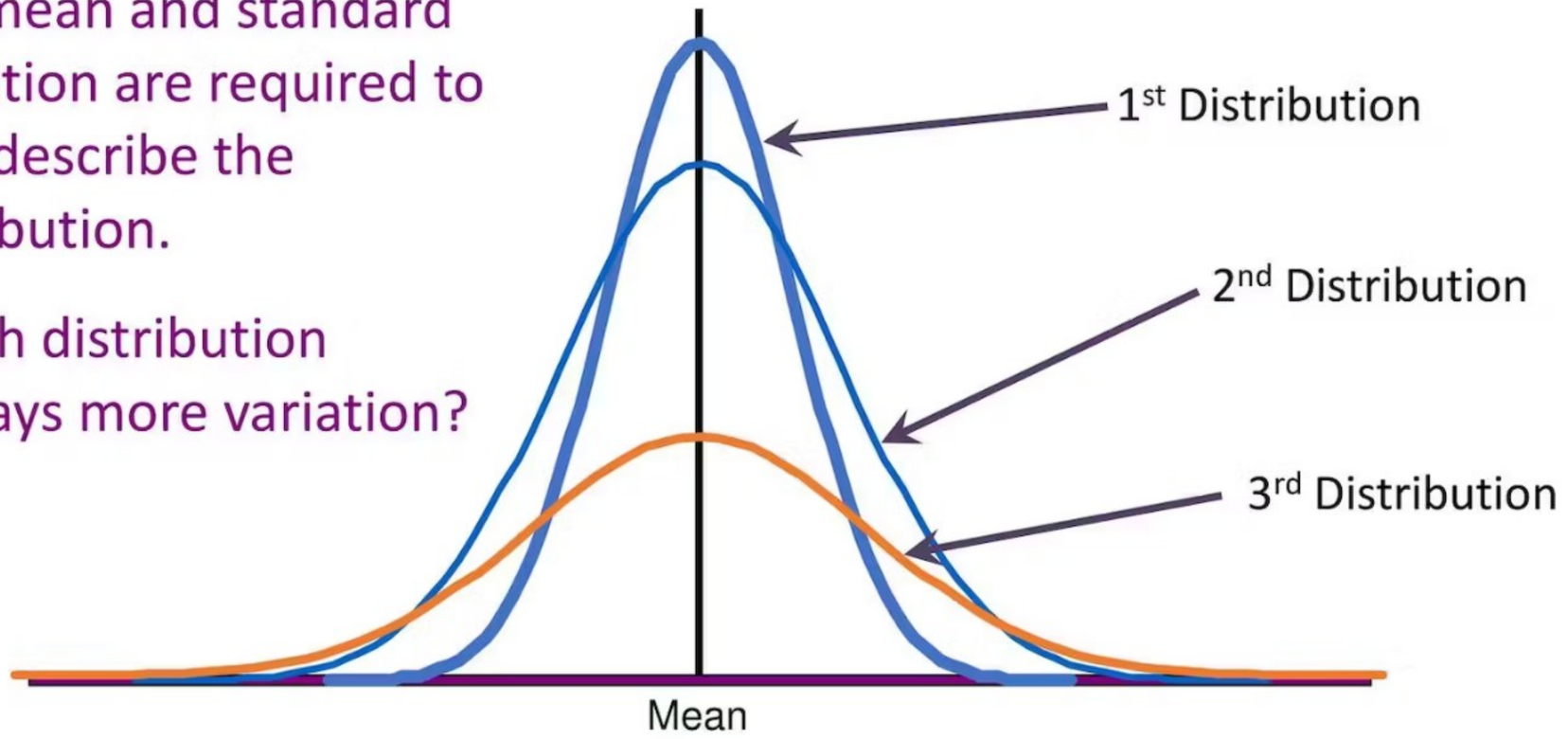
Normal Distribution

The mean and standard deviation are required to fully describe the distribution.

Which distribution displays more variation?



The means are the same but the standard deviations differ.

Six Sigma

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What is Six Sigma…as a Benchmark?

Yield	Defects per Million Opps.	Cost of Poor Quality	Sigma Level	Where does Healthcare fit on this continuum?
99.9997%	3.4	<10%	6	**World Class Manufacturing Performance**
99.976%	**233**	**10-15%**	**5**	
99.4%	**6,210**	**15-20%**	**4**	**Industry Average**
93%	**66,807**	**20-30%**	**3**	
65%	**308,537**	**30- 40%**	**2**	**Non Competitive**
50%	**500,000**	**>40%**	**1**	

Source: Journal for Quality and Participation, Strategy and Planning Analysis

Six Sigma

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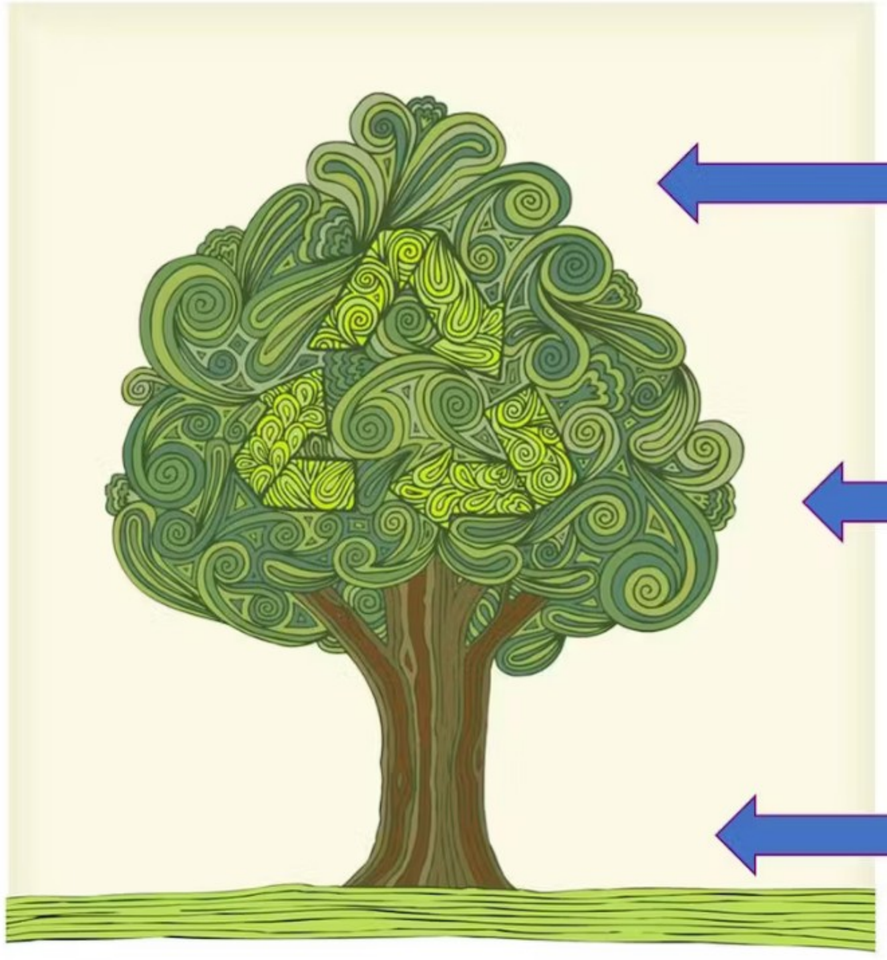
What is Six Sigma…in our daily lives?

99% Good (3.8 Sigma)	99.9997% Good (6 Sigma)
20,000 lost articles of mail per hour	Seven articles lost per hour
Unsafe drinking water for almost 15 minutes each day	One unsafe minute every seven months
5,000 incorrect surgical operations per week	1.7 incorrect operations per week
Two short or long landings at most major airports each day	One short or long landing every five years
550 wrong drug prescriptions each day	68 wrong prescriptions per year
No electricity for almost seven hours each month	One hour without electricity every 34 years

Lean and Six Sigma Improvements



Six Sigma Improvements

- Higher level of analysis
- Riskier
- Additional resources and planning needed
- In one word “Refine”

Lean Improvements

- More easily identified
- Moderate analysis
- Less risky; engenders buy-in
- Low resource and planning needs
- In one word “Streamline”

***** No Brainers *****

Rapid Improvement

- Ground fruit
- In one word “Simple”

Where is Lean & Six Sigma applied today?

- Originally started in manufacturing
- Today practiced in:
  - HEALTHCARE
  - FINANCE
  - EDUCATION
  - BUSINESS
  - GOVERNMENT
  - RETAIL
  - DISTRIBUTION
  - NOT-FOR-PROFIT
  - EVERYWHERE

Six Sigma UPMC LIFE CHANGING MEDICINE

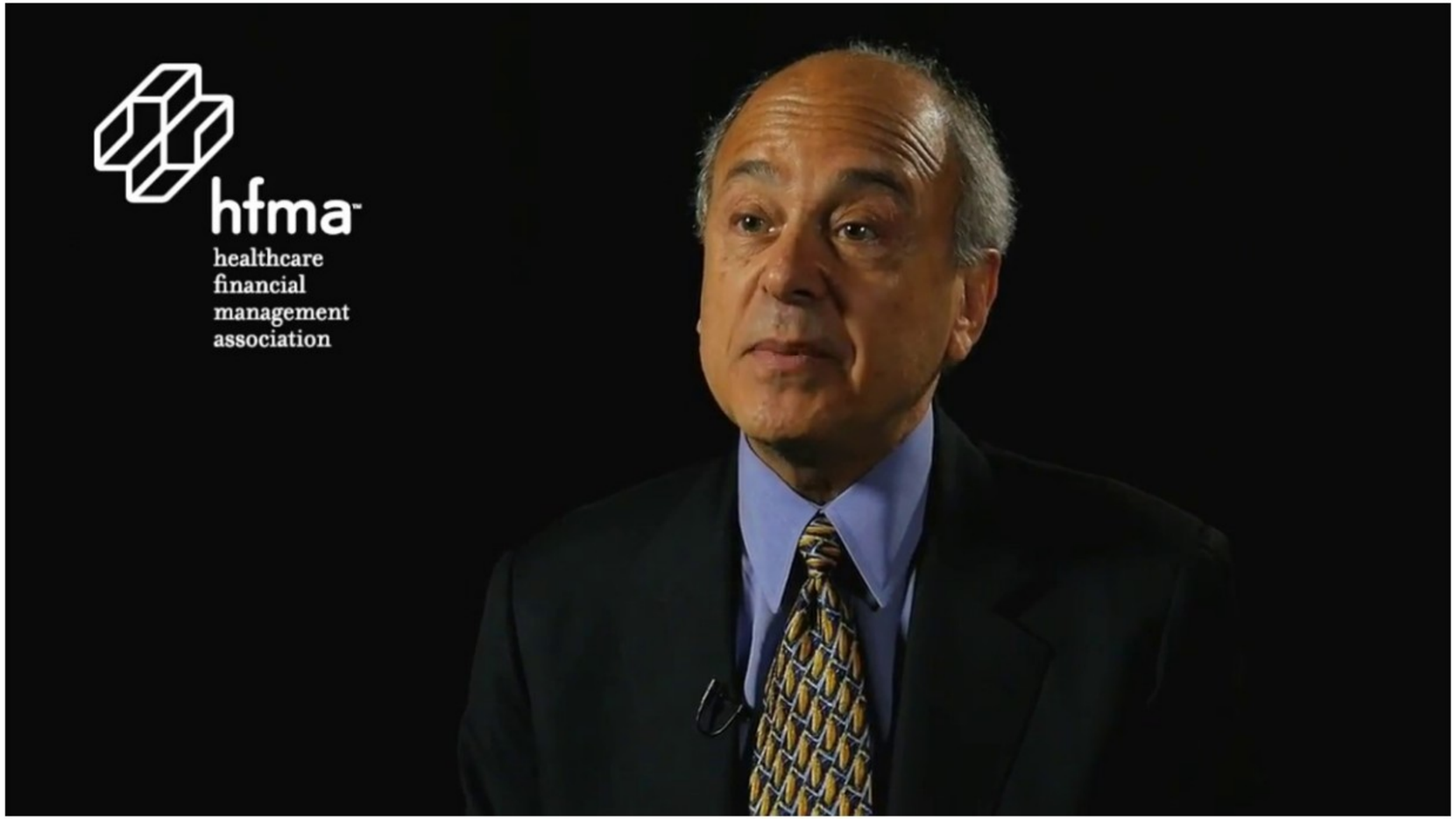
Lean Six Sigma Implementation's TWO CRITICAL FACTORS

- **Process** (Tools)
  - Continuous Improvement
  - Quality & Customer Focus
  - Metrics & Statistical Analysis
  - Kaizen and DMAIC

- **People** (Culture)
  - Leadership & Communication
  - Mutual Trust & Respect
  - Team Based Systems & Teamwork
  - Employee Utilization & Engagement
  - Change Management

Human Sigma: A Fundamental "Reality" for Any Process Improvement Effort

- We borrow the term and expand on the concept developed by
  - J. Fleming, C. Coffman, & J. Harter. (2005). Manage your human sigma. *Harvard Business Review*, July-August.
- Human Sigma: **Any change in *process* requires a change in *behavior***
  - All processes are basically ***Human Processes***
  - Changing a process means the goal must be ***Changing Human Behavior***
  - Students must think ***purposely*** about how to change behavior as part of their improvement strategies
  - An important aspect in managing *stakeholders*



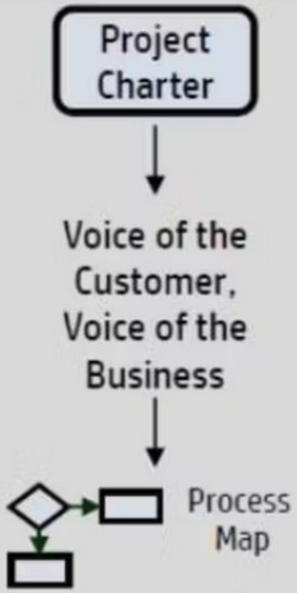
The Power of Zero

Six Sigma Improvements are...

Lean Six Sigma Framework

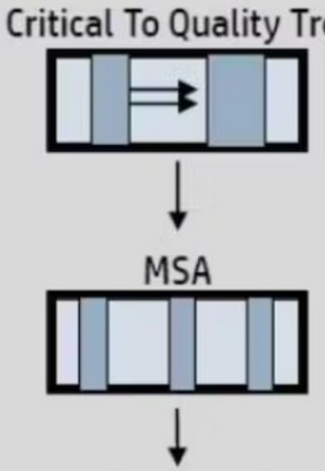
1. Define
Describe the problem

- Project Selection
- Project Charter
- VOC, VOB
- Problem Statement
- Process Map/SIPOC



2. Measure
Collect baseline data

- CTQ Metrics
- Meas. Sys. Analysis
- Summary Statistics
- Process Capability
- Control Chart



3. Analyze
Identify the root cause

- Pareto Chart
- Run Chart
- Cause and Effect
- Scatter Diagram
- Value Analysis

4. Improve
Select the best solution

- Brainstorming
- Benchmarking
- Force Field Analysis
- Criteria Test
- FMEA

5. Control
Sustain the gains

- Statistical Process Control
- Control Plan
- Cost-Benefit Analysis
- Mistake Proofing

Six Sigma

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Define Phase

- Project Selection
- Building your team
- Select a project champion
- Project Charter
- Voice of Customer (VOC), Voice of Process (VOP)
- Problem Statement
- Process Map/SIPOC

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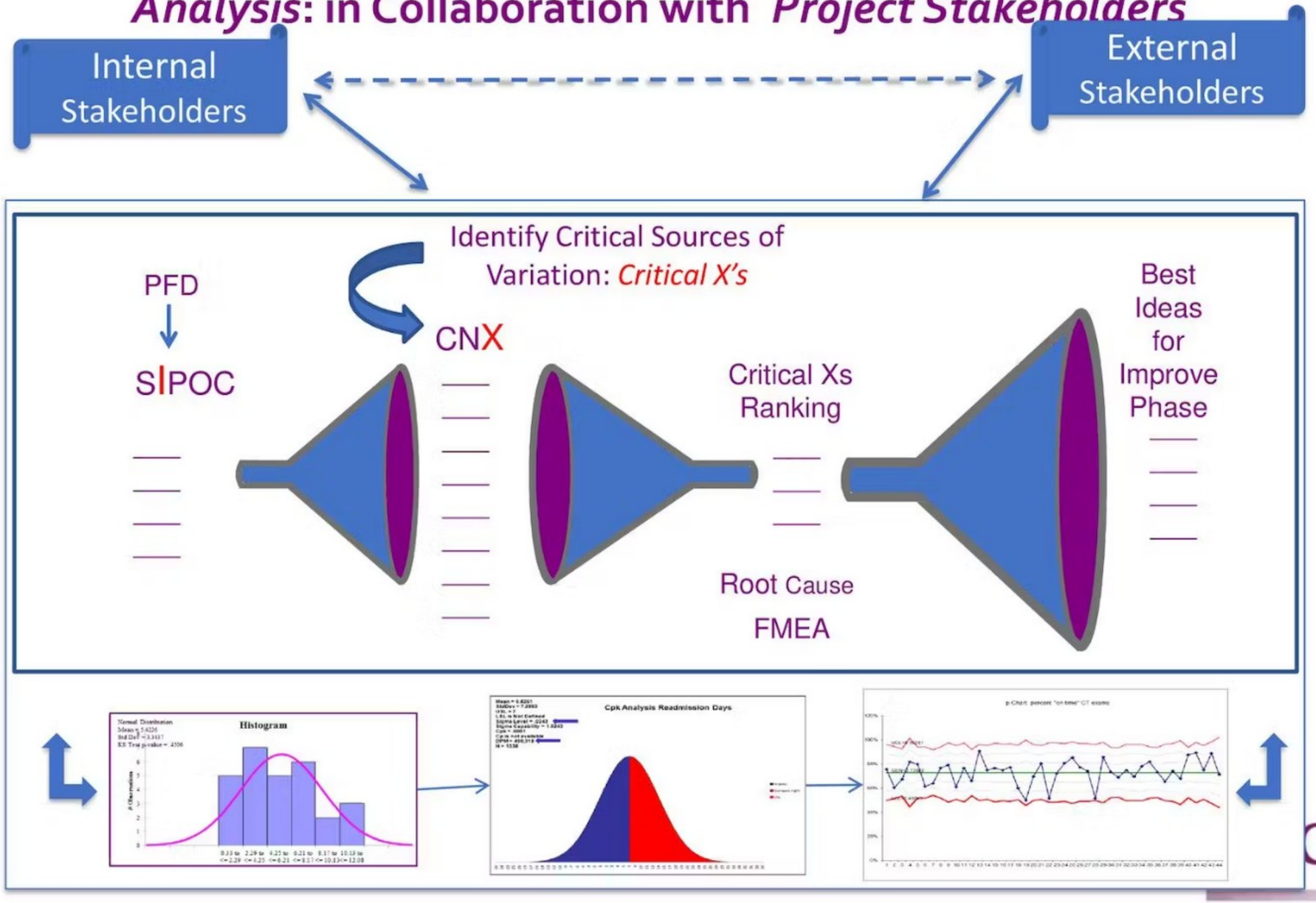
Iterative Funnel

The Search for Critical *Sources of Variation* Combined with *Data Analysis*: in Collaboration with *Project Stakeholders*



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Iterative Funnel

- Is used to prioritize improvements most likely to yield the desired process and outcome measures.
- Includes *ranking* the critical sources of variation (i.e., the "Critical Xs")
  - leads to root cause analysis and brainstorming of interventions
- The entire process within the Iterative Funnel is a representation of a collaborative effort with ***Internal and External Project Stakeholders.***

SIPOC: Components of a Process

- A tool to identify the suppliers and customers of a process
- Identifies the basic components of the process in question:

Suppliers – **Inputs (X's)** - **P**rocess - **O**utputs - **C**ustomers

  - Inputs: high level sources of variation

- Think: **Faster – Better – Cheaper**

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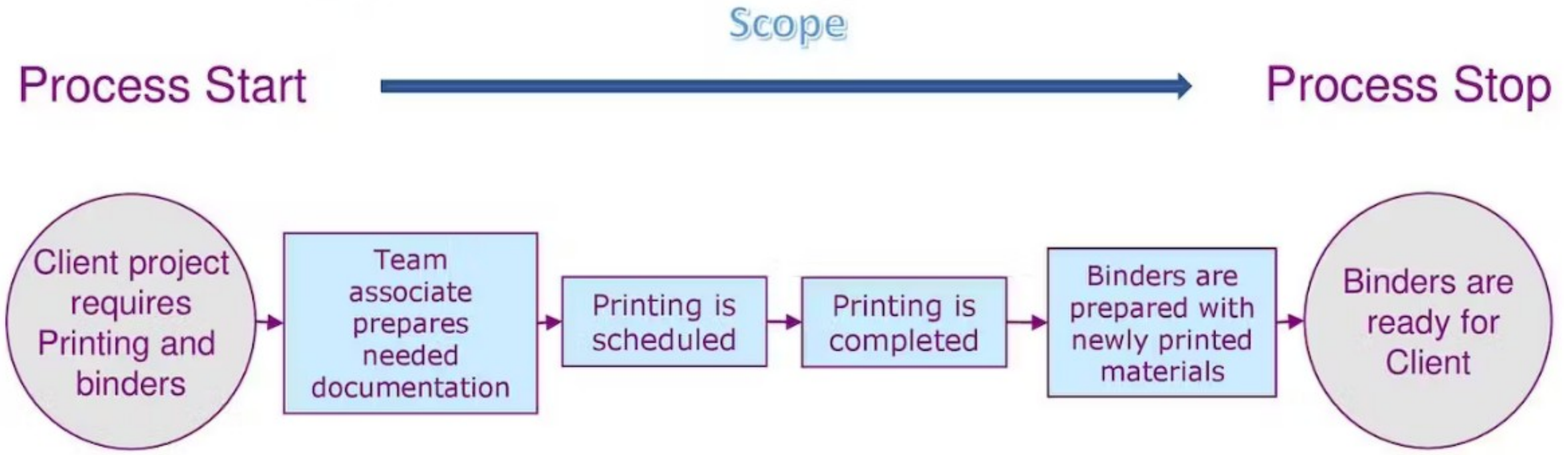
Define Phase
High-Level Process Flow



Define Phase
SIPOC

S	I	P	O	C
Suppliers	**Inputs**	**Process**	**Outputs**	**Customers**
Providers of the Inputs(People, Companies, Technology)	**Inputs required to perform the process**	**High-Level Process Description:**	**Outputs of the Process**	**Receivers of the Outputs or Customers that are affected if the process & outputs break down**
Clients	Information needed to print binders	Prepare Needed Documentation	All Necessary Documentation	Scheduler
Associate	All Necessary Documentation	Schedule Printing	Schedule Documentation	Production
Scheduler	Schedule Documentation	Execute Printing	Printed Material	Associate
Production	Printed Material	Prepare Binders for Client	Completed Binders	Client

What is critical X?

Measure Phase

- Measurement/Data
- Summary Statistics
- Process Capabilities
- Control Charts

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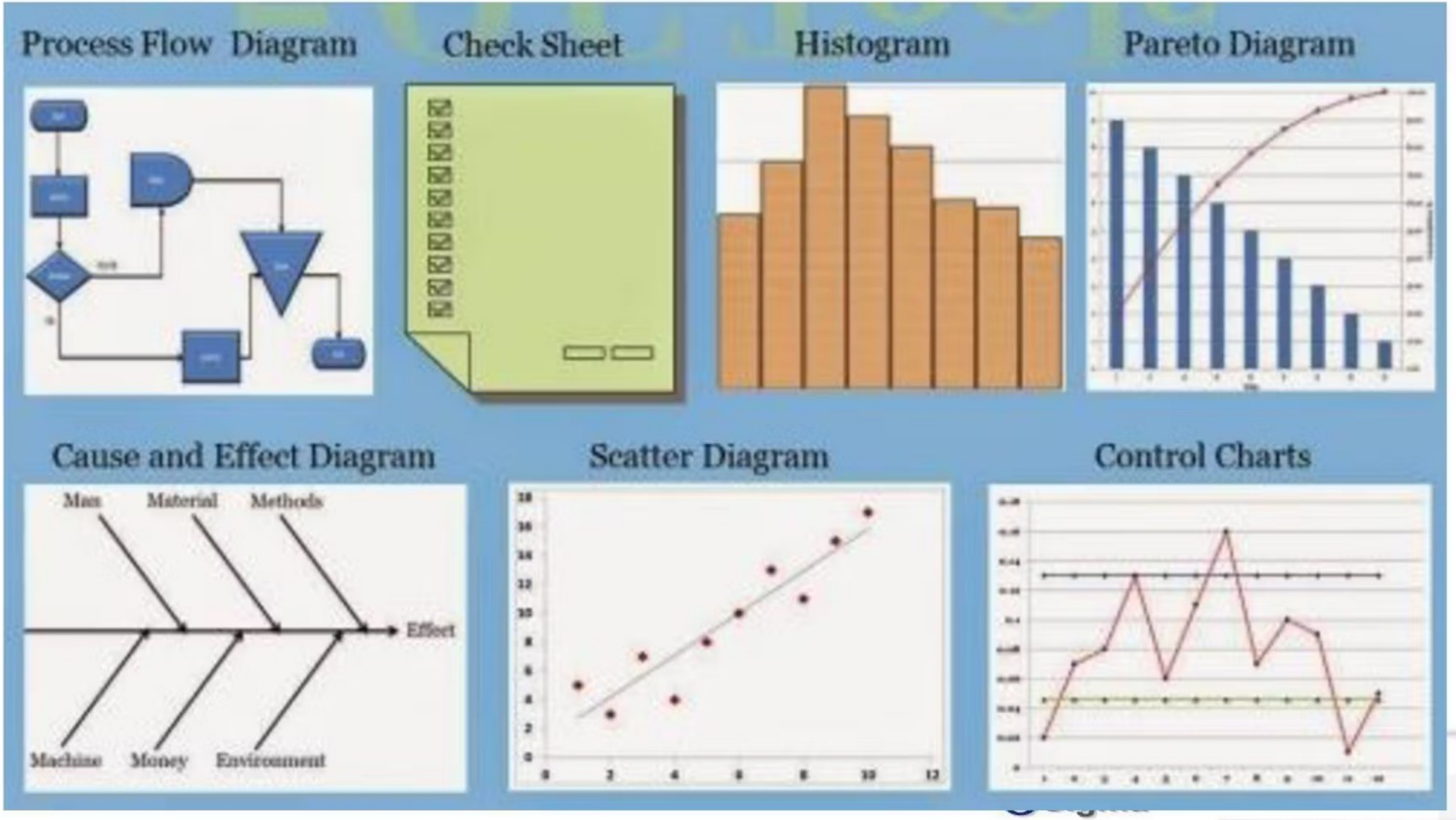
Steps to Measurement

- Data drives decisions and actions! Serves as evidence
- Data are measurements or observations we record and use to describe, understand, optimize, or control something such as a process.
- Select what to measure
- Measure for a reason
- Have a process for measurement
- Plan and measure performance
- Utilize existing Data

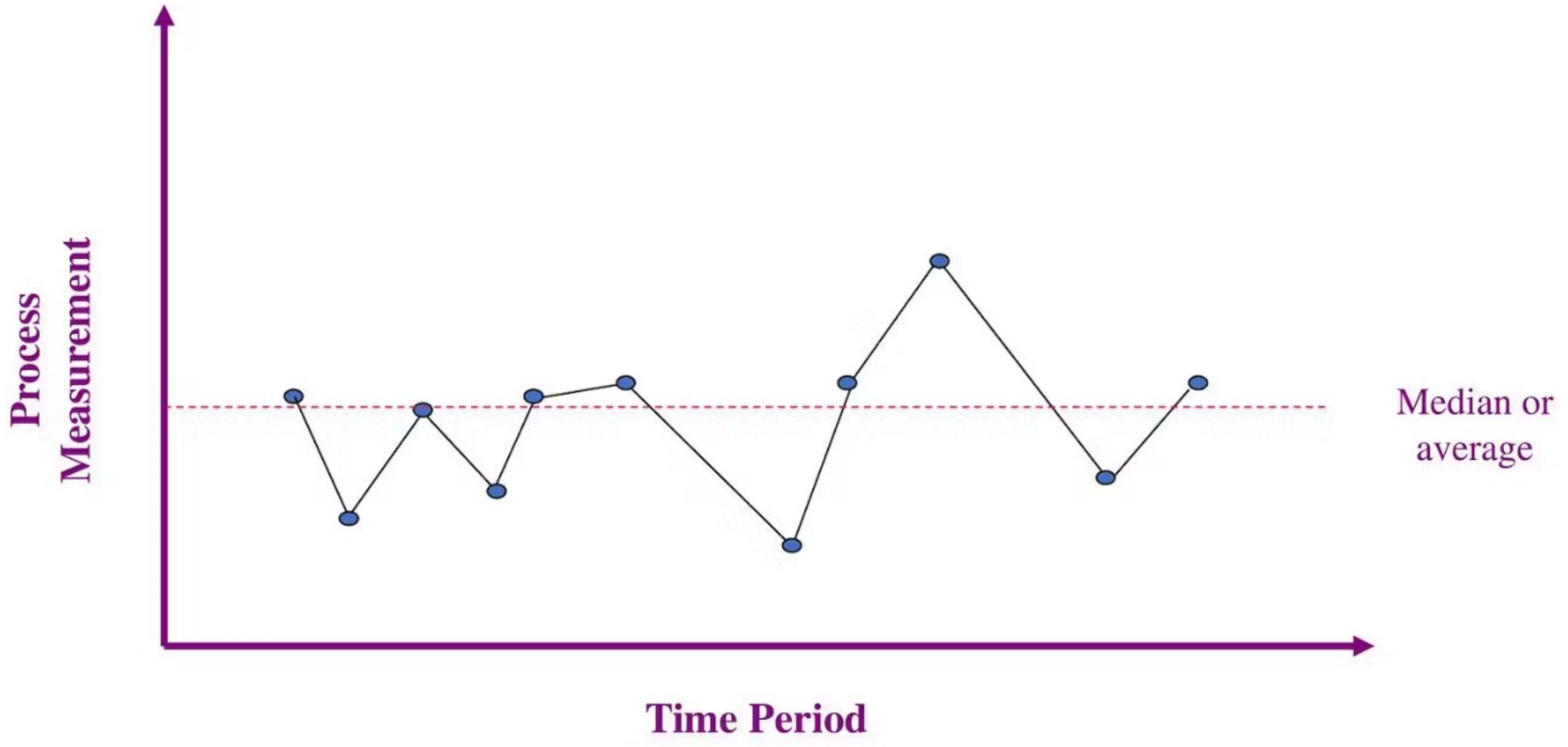
Seven Classic Tools



Run Chart

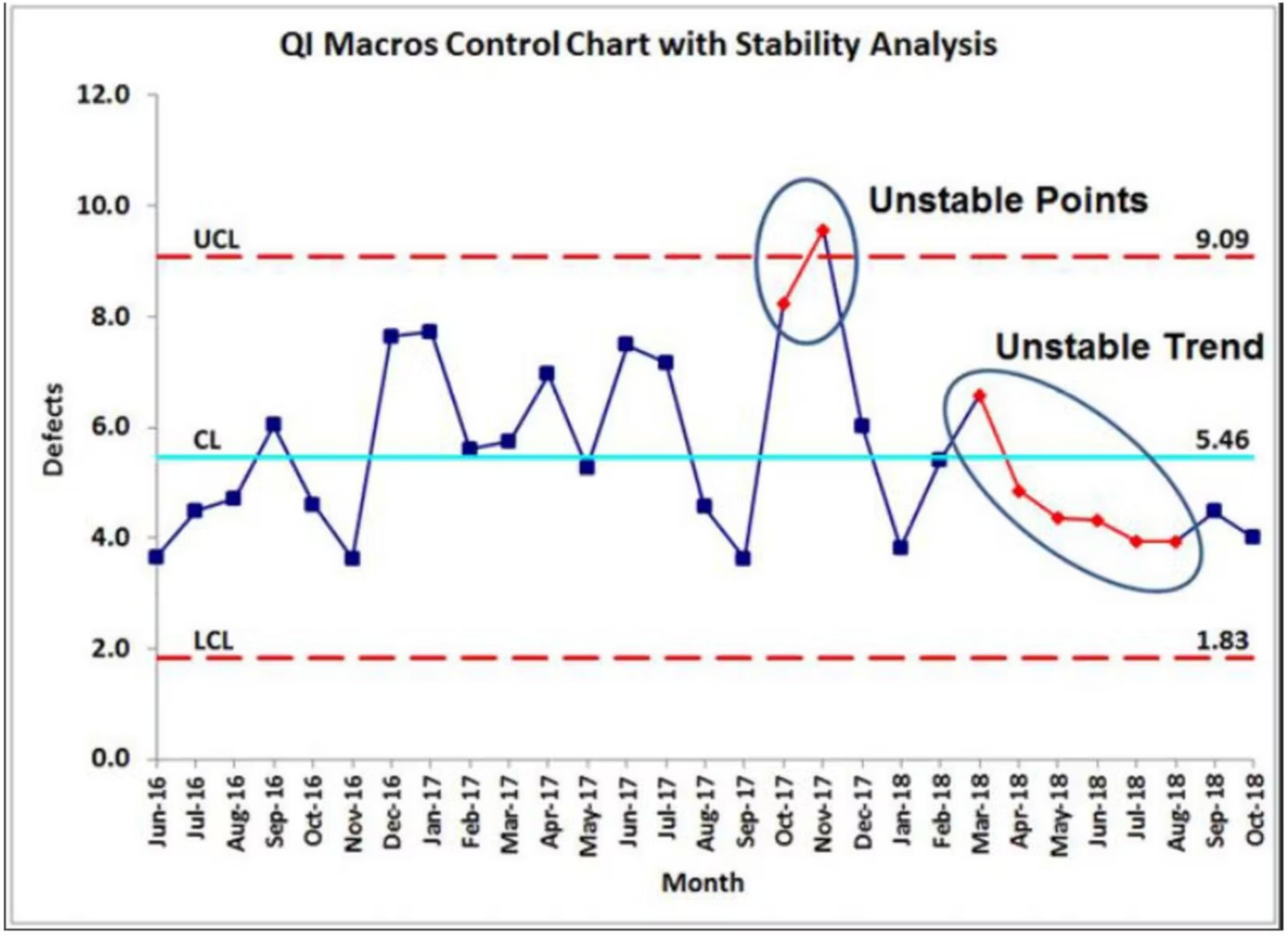
- Also called a *time series plot*
- A trend line can be added to a run chart
- Graphical method showing current process performance over time
- Utilizes continuous data and requires time/date labels
- A run chart shows:
  - Variation *over* a period of time versus a Histogram which is a snapshot *in* time
  - The data points in the order in which they occur
  - Shows the variation in the process result over time

Example of a Run Chart



Control Chart

- Another graphical method of showing current process performance
  - Control Charts can be used in multiple phases of an improvement project:
    - Define / Measure / Control
- Shows process performance over time
  - Utilizes continuous data
- Control Charts:
  - Can determine if a process is in control
  - Can identify specific causes of noise variation


QI Macros Control Chart with Stability Analysis
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Defects
UCL
CL
LCL
9.09
5.46
1.83
Unstable Points
Unstable Trend
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Nov-16
Dec-16
Jan-17
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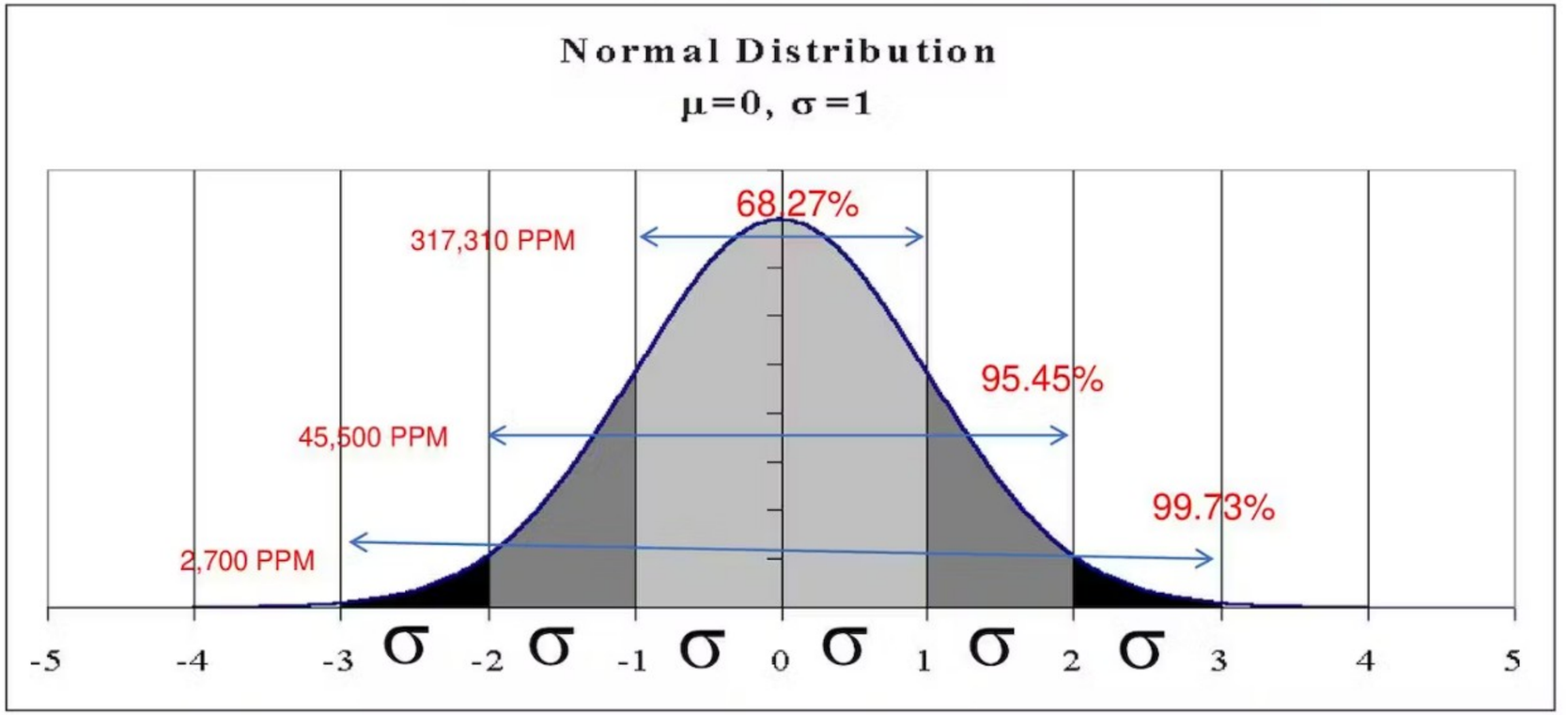
Aug-18
Sep-18
Oct-18
Month

A Statistical Measure of Performance

A Normal Distribution (Bell Curve)



A normal (bell curved) distribution is 6 standard deviations wide!

Most of the data is in the middle (+/- 1 standard deviation).

Six Sigma

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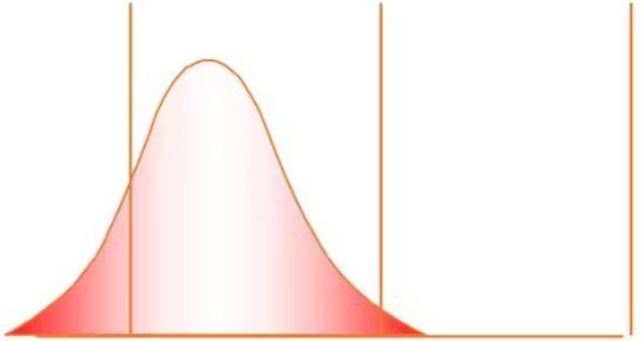
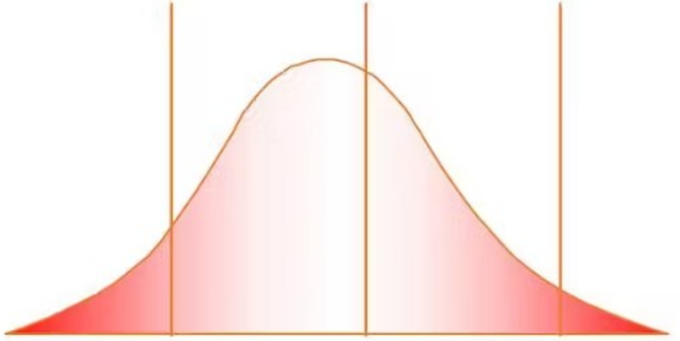
Process Performance Levels vs. Customer Expectations

Off-Target

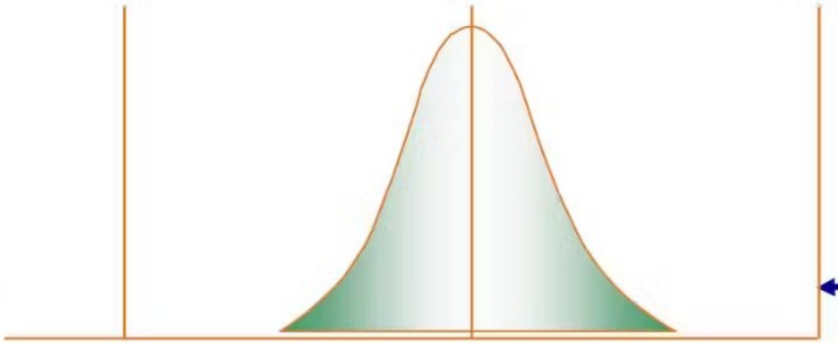


Too Much Variation



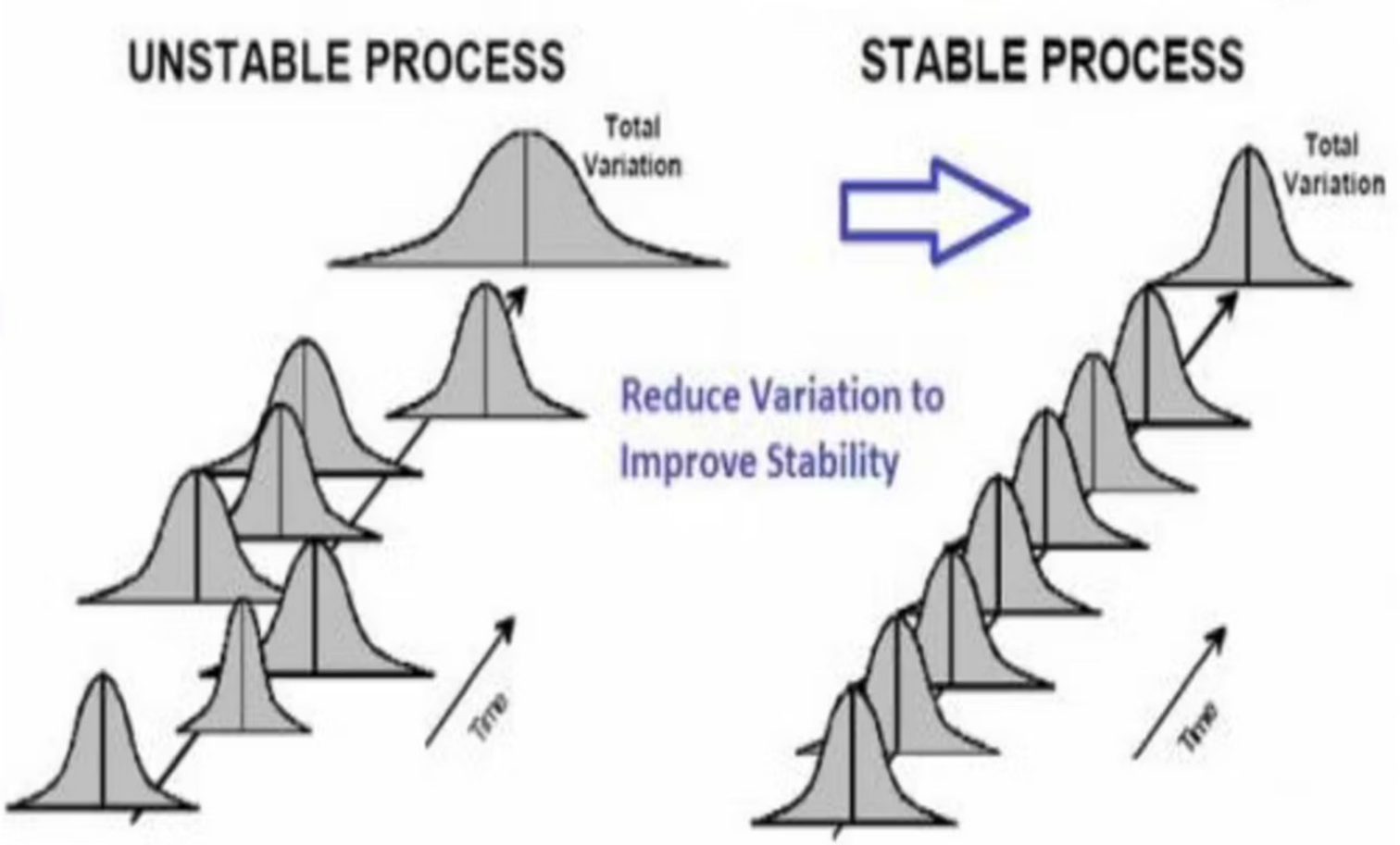
Centered
On-Target

Center
Process



Reduce
Spread

Process variation



UPMC LIFE CHANGING MEDICINE

Wide variation is a good sign that your process is improving

Analyze Phase

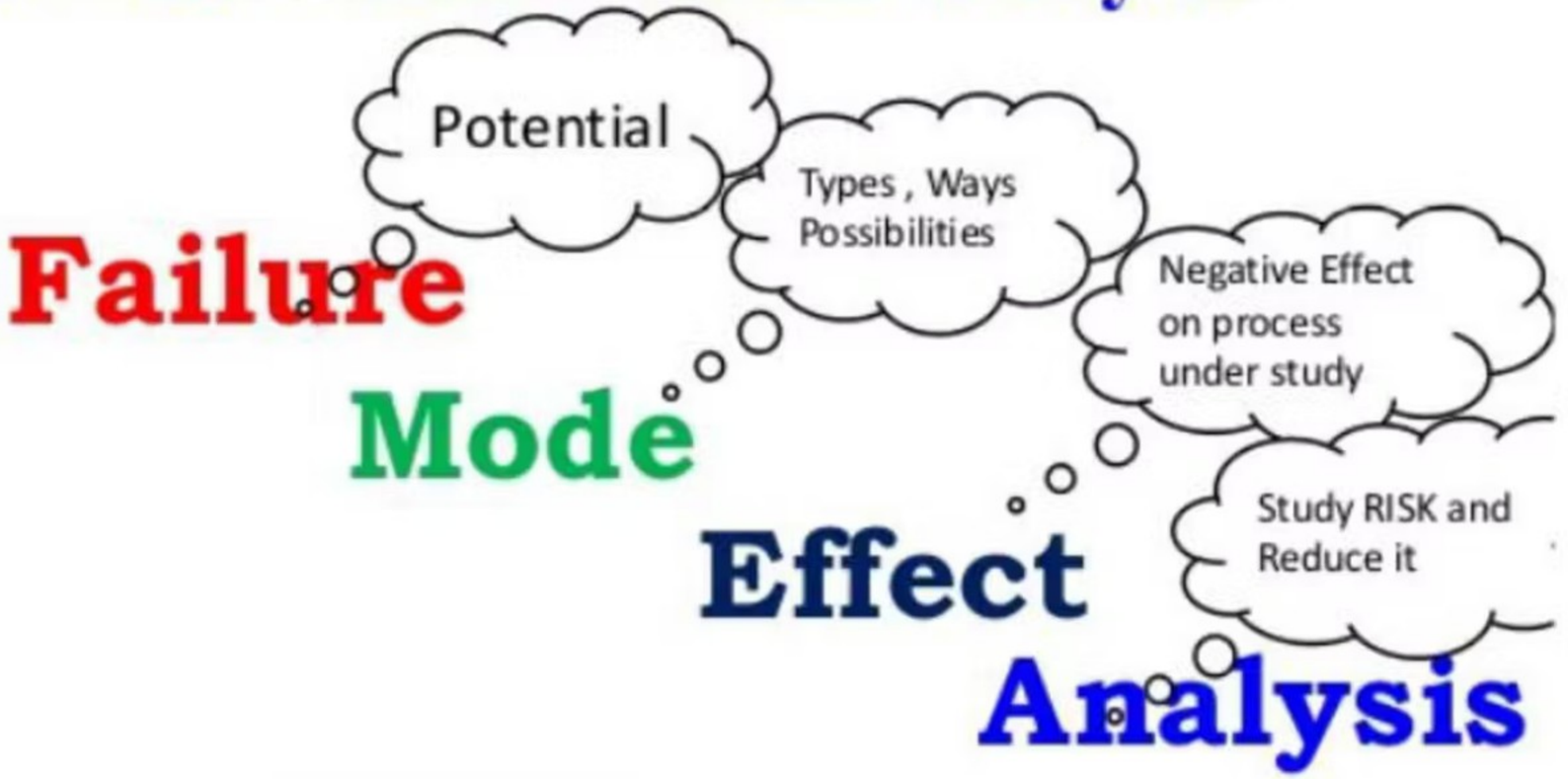
- Root Cause Analysis (using appropriate tools)
  - Pareto Chart
  - Fishbone Diagram
  - 5 Whys
- Failure Mode Effects Analysis (FMEA)
- Statistical Analysis

Analyze Phase

- Identify and analyze all possible causes (X's) for the undesirable output
- Identify and understand which of the possible causes (X's) are the biggest contributors to the undesirable output
- Identify which causes (X's) are within the team's control
- Identify methods to verify the suspected big causes (X's)
- Identify data needed to validate the suspected big causes (X's)
- Perform statistical tests to confirm suspected big causes (X's)
- Determine improvement targets for the big causes (X's)

What is FMEA

Failure Mode Effect Analysis

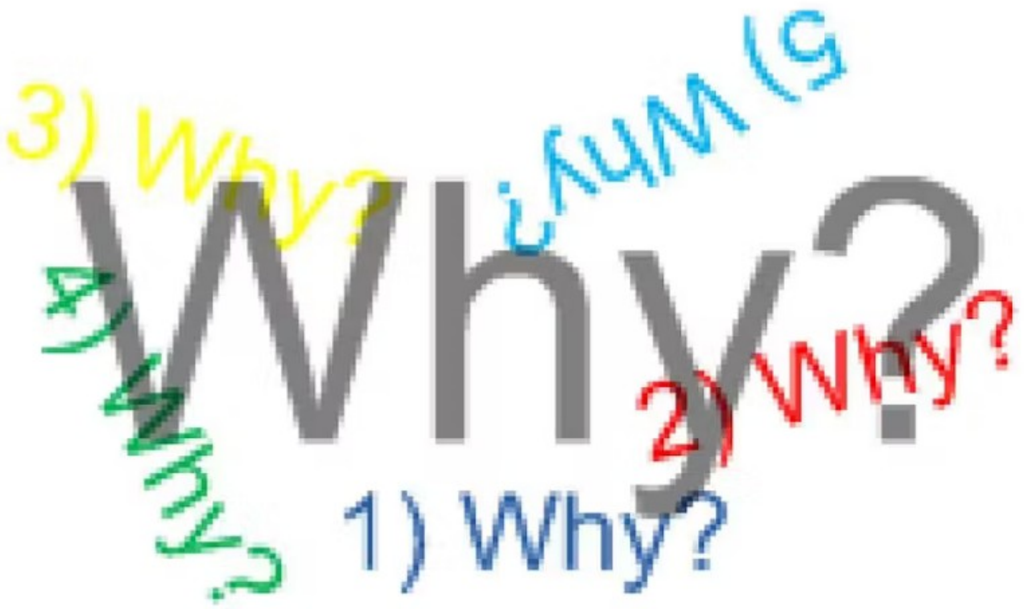


What can go **WRONG** in your process or product

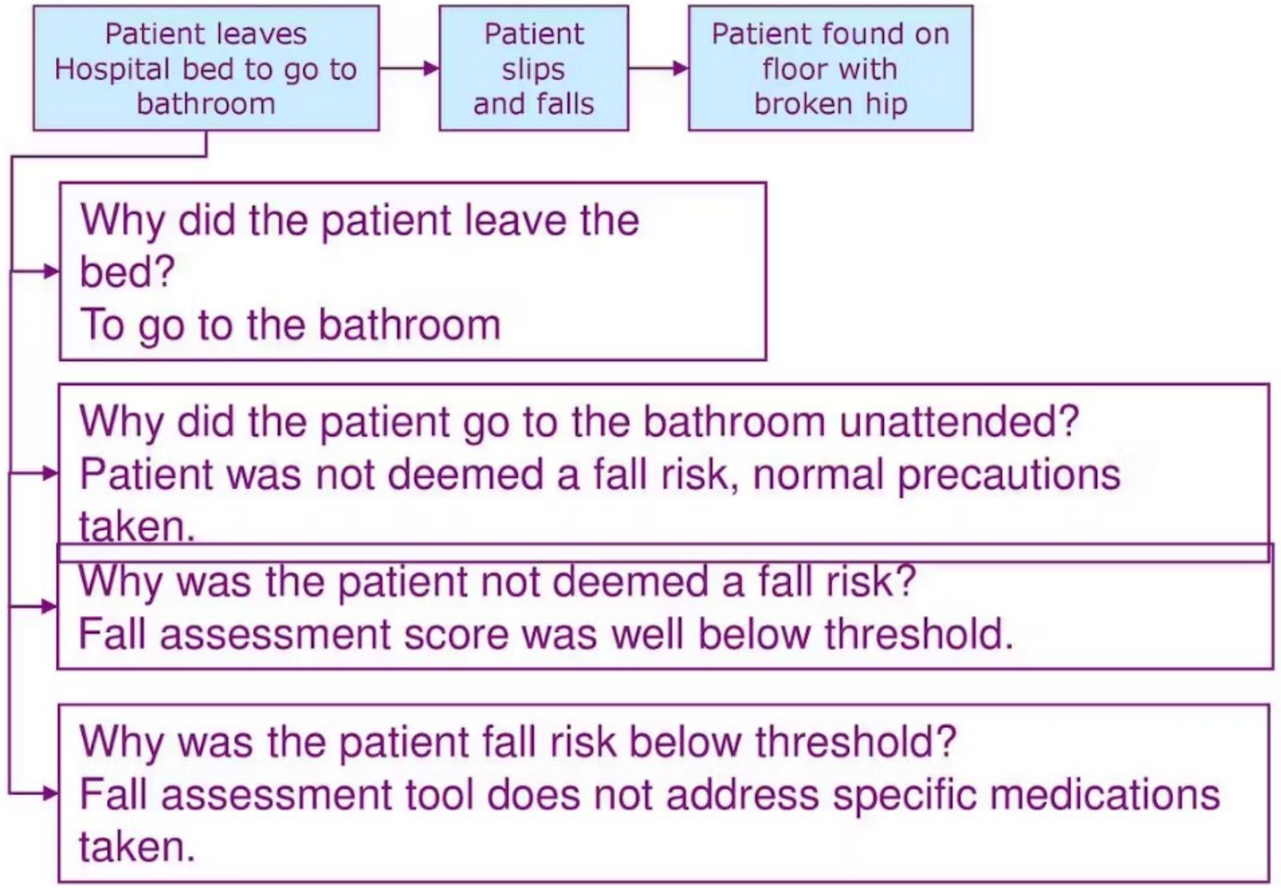
IFE
HANGING
EDICINE

The 5 Why's

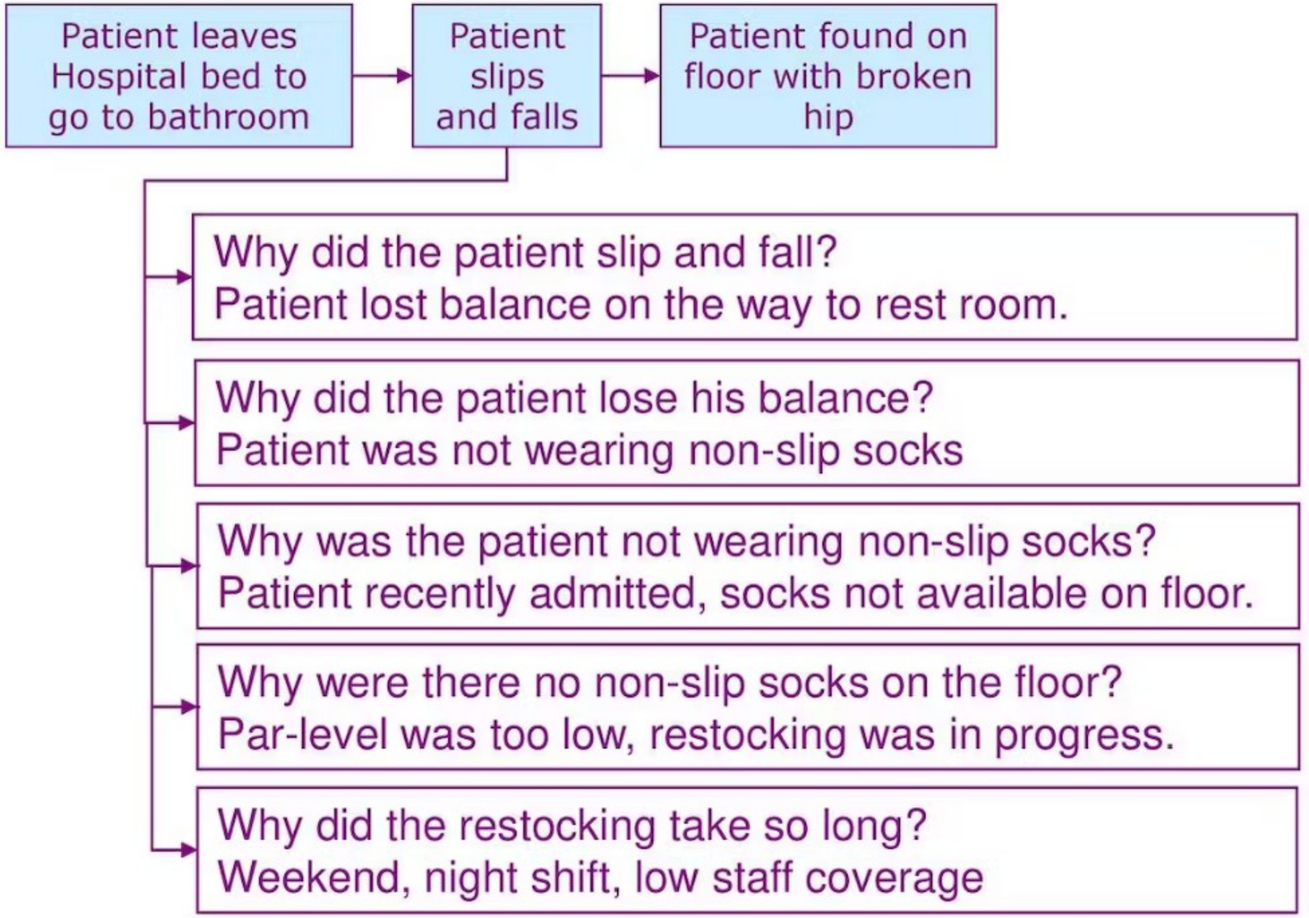
- For each step in the process ask:
  - What problems occurred during this step?
  - Why did these problems occur?
- If the answer from the first question does not provide the root cause, keep asking "why?" until the root cause is reached.



5 Why's Example



Another 5 Why's Example



Why is it important to ask the 5 why's?

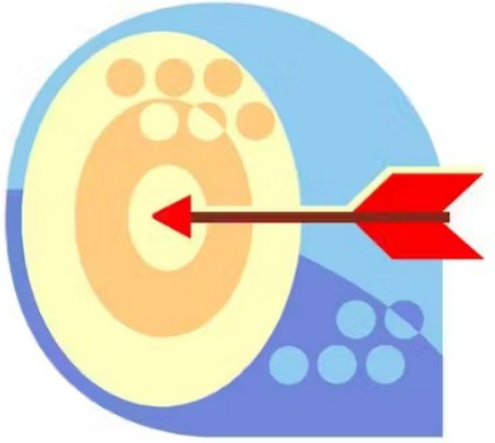
Waiting for responses ...

Improve Phase

- Improve Solutions Recommendations
- Impact Effort Matrix
- Future State Process Map
- Pilot Project Implementation Plan
- Cost of Poor Quality

Improve Phase - Key Objectives

- Generate a list of comprehensive solutions
- Develop a future state process map
- Develop a pilot implementation plan and dashboard
- Test improvements



Apply Criteria to Develop Solutions

- Determine criteria to evaluate ideas
  - Solves the problem
  - Cost and effort
  - Time to implement
  - Authority required to approve
  - Legal
  - Simplicity/Complexity
  - Others…
- Create the Short List

Impact Effort Matrix

- The Impact/Effort Matrix is used to assess potential impact of solutions against estimated cost or effort.
- This type of diagram is also known as an Impact/Cost matrix.

Sample Priority Matrix

Impact Priority	Schedule Priority: HIGHER			LOWER
HIGHER	**Required (P1)** Work stoppage will occur and no workaround exists OR Regulatory, Program Directive, or contractual requirements will not be met.	Work Stoppage	Regulatory	Audit Finding	Program Directives
	Significant (P2) High impact to resources and/or systems OR Workaround requires excessive time, cost and/or resources.	High impact to production (significant cost to resources)	Significant cost reduction to a currently expensive workaround	Break-fix not stopping production but has high impact	System retirement/ system replacement
	Moderate (P3) Moderate impact to resources and/or systems OR Workaround requires some increase in time, cost and/or resources.	No risk (easy to change, minimum resource effort), moderate benefit	Low risk (minimum resource effort), moderate benefit	Medium risk (reasonable change required), moderate benefit	High risk (extensive change), moderate benefit
	Minor (P4) Minimal impact to resources and/or systems OR Workaround in place with minimal time, cost and/or resources.	No risk (easy to change, minimum resource effort), minor benefit	Low risk (minimum resource effort), minor benefit	Medium risk (reasonable change required), minor benefit	High risk (extensive change), minor benefit
LOWER	**Low (P5)** Administrative change or system nuisance with no impact OR Watch item	Administrative change	System or process nuisance; cosmetic change	Watch Item: Cost prohibitive	Watch Item: not technologically feasible at the present time

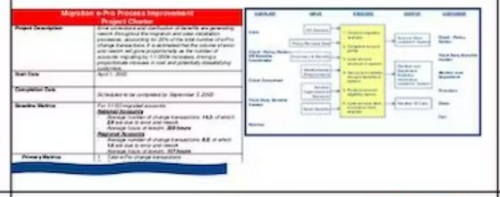
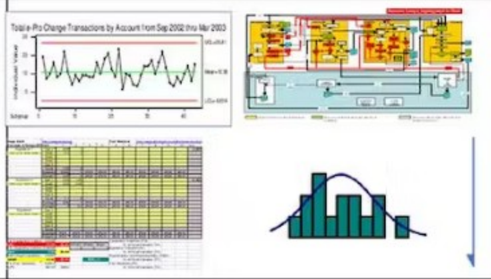
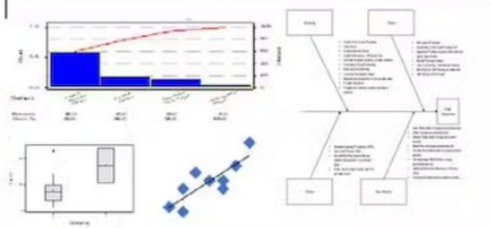
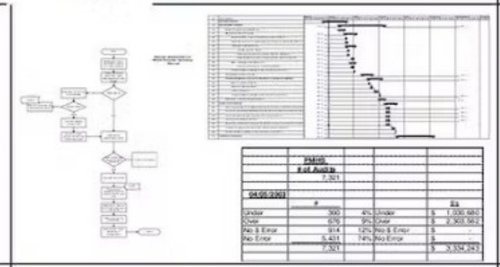
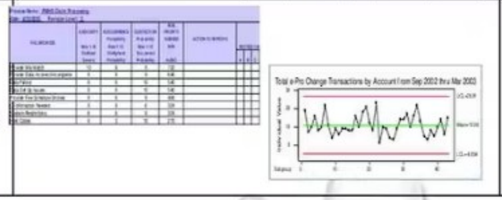
Control Phase

- Detailed Control Plan
- Training Plan
- Communication Plan
- Capability Transfer Plan & Execution Documentation

Control Phase - Key Activities

- Prepare improvements & project for full scale implementation
- Finalize Cost of Poor Quality
- Prepare sustainability & distribute project plan
- Prepare Hand-off to Process Owner
- Develop Control Plan
- Complete final team leader project documents
- Celebrate with the Team!

Six Sigma Process Improvement Road Map

	Phase Objectives	Key Activities	Possible Tools and Techniques	Key Deliverables
1.0 Define Opportunity	Document the problem statement and establish the charter. Demonstrate alignment with the Business metrics and strategies. Determine Customer requirements and performance standards.	▪ Select Team with Champion ▪ Develop problem statement ▪ Develop Charter ▪ Create SIPOC ▪ Address gap between VOC and process ▪ Estimate financial benefits		▪ Problem Statements ▪ Project Charter ▪ SIPOC map ▪ COPQ or CODND ▪ Communication Plan
2.0 Measure performance	Develop a reliable and valid measurement system of the business process to effectively evaluate the success of meeting customer requirements.	▪ Obtain Customer requirements ▪ Create overall project plan ▪ Develop measurement plan & compile project metrics ▪ Determine defect tracking requirements ▪ Assess baseline performance-estimate process capability ▪ Measurement Systems Analysis		▪ Process Description ▪ Project Plan & Timeline ▪ Metrics and collection plan ▪ Baseline Performance results ▪ Process capability analysis ▪ Lean Tools Assessment ▪ Measurement Systems Analysis ▪ Process model – 'as is'
3.0 Analyze Opportunity	Utilization of data techniques to gain insight into process. Divide data into groups based on key characteristics and assess the root causes of errors and poor performance. Determine where to focus efforts for improvement.	▪ Statistical tests / tools ▪ FMEA ▪ Pareto chart ▪ Correlation/Regression ▪ Fishbone Diagram ▪ Box plot ▪ Hypothesis Testing ▪ Describe findings – identify potential root causes RCA ▪ Validate findings		▪ Data relationships ▪ Validated Key Input Variables (KPIVs) & Key Output Variables (KPOVs) ▪ Prioritize sources of variation ▪ root causes ▪ Identify & communicate potential improvements ▪ Summarize benefits & annualized financial benefits
4.0 Improve Performance	Identify key change opportunities and proactively test for optimization. Develop implementation and communication plan including a change management approach to assist the organization in adaptation of the improvements.	▪ Design of Experiments – describe purpose & build test/ analysis strategy ▪ Evaluate and Confirm results ▪ Analyze KPIVs ▪ Create action plan for implementation including change management and communication needs ▪ Buy-in assessment		▪ Quantified relationship between key input and key output variables ▪ Defined process improvements including impacts and benefits ▪ Implementation Plan ▪ Process model – 'Should be' ▪ Impacted Employees are Trained
5.0 Control Performance	Definition of optimal process settings and conditions with specified metrics. Implementation of improvements with a control plan to assess & maintain gains.	▪ Implement improvements ▪ Evaluate results ▪ Integrate & manage improvements in work processes ▪ Complete closure activities		▪ Document process change ▪ Control plan ▪ Determine new process capability ▪ Leverage opportunities for replication ▪ Communicate results ▪ Financial audit ▪ Hand-off to process owner

Share a key takeaway

Waiting for responses ...

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