LEAN SIX SIGMA INTRODUCTION

WITH PROCESS MAPPING TUTORIAL

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OVERVIEW OF LEAN

- What is Lean?
  - Started in mid 70's as TQM, Total Quality Management.
  - Standardized process for the Toyota Production System
  - Designed for production plants to improve flow, increase speed, and reduce cycle time.
  - Over time Lean Manufacturing became Lean Thinking for non-manufacturing industries.
- Key Concepts of Lean
  - 5S – Sort, Set, Shine, Standardize, Sustain
  - JIT – Just-In-Time, schedule resources to arrive when production begins & just before customer delivery required
  - Visual Controls – Display operations status in easy to view format so corrective action can be taken immediately.
  - Design for Production – Performance is a function of design variables allowing design tweaks to increase performance.

LEAN THINKING

- Gain value with less work.
- Eliminate Waste
- Processes which fail to create value are deemed waste.
- Optimize processes
- Processes which are redundant or time consuming should take priority.
- Processes overly complex or confusing should be broken down into multiple simpler processes.
  - A sign of overly complex processes are those which require involvement from many different departments and/or has varying quality of its output.

7 wastes – Think about how you deal with information

- Transport (Transaction Costs)
- Inventory (Excess Work In Progress)
- Motion (Wasted Effort)
- Delays
- Overproduction
- Over-processing
- Defects (Rework)

LEAN THINKING – REDUCING WASTE

- Making only what customer wants when they want it eliminates Overproduction:
  - Overproduction of features occurs often in traditional IT because stakeholders are only given one opportunity to present their system needs every 5 to 10 years. Recognizing that this is their only chance, stakeholders specify everything they've ever dreamed of with the hope that it will deliver value.
    - **Reorganize your work to deliver small batches of features frequently.**
    - **Use cross-functional teams with short cycle times.**
    - **Incorporate a customer feedback loop to insure users really want features.**
- The main cause of excess Inventory is overproduction:
  - Overproduction is made worse by doing the work in specialist teams that throw it over the fence to the next team at the end of a phase. When work enters a team in a big batch it blocks other work and takes a long time to process. When the team is slow, under-resourced or has a long lead time then work sits in a queue for a long time.
    - **Set up cross functional teams to do the work for each requirement Just in Time to meet customer demand.**
    - **Set up a Kanban board for each team with columns for request, analyze, design, build, test and deploy. You can clearly see where work piles up.**

OVERVIEW OF SIX SIGMA

- What is a sigma?
  - The Greek letter Sigma, σ, is a statistical term used to represent the standard deviation. It is a measure of variation.
- What is a Sigma Level?
  - Defect Rate or Confidence Rate – Most processes perform at 3-4 Sigma Level, 0r 99% Confidence, 1% Defective.
- What is 6σ?
  - Goal is to eliminate defects & reduce variation.
  - 6σ performs at 99.999999% Confidence, Improves products 100 times more than 4σ.
  - When your product is 6σ it tells your customers that the quality level is excellent.
- Key Concepts of Six Sigma
  - Limit defects & variability in business processes.
  - Provide a means to measure quality, defects, and success.
  - Provide a framework for businesses to shape strategy, align with customer needs, & improve the effectiveness of processes.

DIFFERENCES & SIMILARITIES

- Differences between Lean & Six Sigma
  - Ownership
    - **Lean aims to continually improve across all operations, requires culture change.**
    - **Six Sigma aims to reduce variation in specific areas of operation.**
  - Procedure
    - **Lean is all about transferring knowledge to implement culture change.**
    - **Six Sigma is structured to root cause, test hypothesis, validate, then implement solution.**
- Similarities between Lean & Six Sigma
  - Goals are to reduce cost/waste, add value to bottom line, satisfy your customers, & reduce defects.
  - Both involve commitments from Management to support efforts.
  - Technical expertise is required from Engineering, Operations, Sales & Management.
  - Team-based methodologies used to:
    - **Set Baseline - Map & evaluate current processes.**
    - **Benchmark – Consider alternatives & develop viable alternatives.**
    - **Implement Improvement & Evaluate the effects.**
    - **Review changes in performance & improve Quality.**

OVERVIEW OF LEAN SIX SIGMA

- It is a management approach as well as a set of tools and techniques.
- Customer / Market / Profit / Shareholder focused for clear Project Definition.
- Can yield significant financial benefits in any industry.
- Focused on results: Customer Satisfaction, Improved Quality, Reduced Costs, Increased Revenue.
- Requires Solid Baseline to track improvement metrics.
- Tracks progress & evaluates it's value based on savings.
- Requires training at all levels to sets clear goals & expectations.

WHAT ARE BLACK BELTS?

- Certified through Accredited Providers
  - ASQ - American Society for Quality
    - Professional Association for Black Belt holders
    - Recognized as authority in Six Sigma Certification
  - IASSC – International Association for Six Sigma Certification
    - Provides Professional Association & accreditation for Trainers
    - Recognized as authority in Lean Six Sigma Certification
  - SSC – The Council for Six Sigma Certification
    - Recognized as Industry Standard for both SS & LSS by US Gov't
    - Also provides accreditation for trainers, but requires Body of Knowledge
    - No Professional Association
- Trained to implement standardized methodologies
  - Lean Six Sigma borrows techniques from multiple methodologies.
  - Six Sigma is strict in following only Six Sigma approved techniques.
- Manages Black Belt Projects
  - Follows a slightly different flow than PMI PMP.

TECHNIQUES & TOOLS USED

- DMAIC Methodology
  - Define, Measure, Analyze, Improve, Control
- Quality Function Definition
- Process Mapping
  - Gather information, highlight handoffs, inputs vs outputs,
  - Build draft review with team, update map.
- Value Stream Map
  - Analyzes process map to reduce steps and/or increase quality by 10%!
- Pareto Analysis
  - 80/20 Rule – Doing 20% of the effort can result in 80% of the benefit.
  - Reviews all possible courses of action, zeros in on most effective.
- Design of Experiments (DOE)
  - Pilot program to test theories may be necessary.
- Minitab
  - Statistical Analysis Software for Black Belts
  - Templates available for project management.

DMAIC METHODOLOGY EXAMPLE

Lean Six Sigma Methodology and Roadmap for Common Tool Usage

Define	Measure	Analyze	Improve	Control
Project Charter				
Process Map				
Rolled Throughput Yield				
Quality Function Deployment				
	Value Stream Map			
	Cause & Effect Matrix			
	Potential Failure Mode and Effect Analysis			
	Data Collection & Sampling			
	Measurement System Analysis			
	Pareto Analysis			
	Capability Study			
		Components of Variation		
		Hypothesis Testing/Confidence Intervals		
		Design of Experiments		
Control Plan				
				Celebrate

PROCESS MAPPING TUTORIAL

Objectives

1. Provide overview of types of maps
2. Link Process Mapping with process improvement
3. Explain how to create a process map

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TYPES OF MAPS

- Draft Process Map
  - One of the first steps in the Lean Six Sigma process
  - Critical for process improvement to reduce/remove variation
  - Big Picture View from start to finish explaining how all projects flow.
  - Can be done at Managerial level using known flows and SOP.
- Refined Process Map
  - Conduct interviews with Developers & Software Validation Engineers.
  - Document common variations from SOP & expected process.
- Value Stream Map
  - From the process map add how the information flows.
  - Measure the performance of each step.
  - Analyze performance to focus on 7 types of waste.
  - Optimize, Prioritize, and create a Future State Map.

PROCESS MAPPING - COMMON ISSUES

- More questions than answers
- Dynamic
- Parallel activities, rather than sequenced
- Communication necessary
- Documentation necessary
- May be difficult to know where to start
- You may not be the expert

A PROCESS MAP IS

- Used to begin EVERY project!
- A graphical tool to illustrate the way a process is currently working
- Dynamic
- A team effort done by "walking the process"
- A tool to GAIN PROCESS KNOWLEDGE!

USES OF PROCESS MAPS

- Learn about a process through questioning
  - Data collection
- Determine details of a project
  - What factors to investigate or omit
  - Where and how to sample
  - Identify process owners
- Evaluate ALL types of processes
  - Management, Administrative, Financial, Service, Design, Manufacturing

PROCESS MAPS DESCRIBE

- **Major activities/tasks**
- **Value added and non-value added steps**
- **Process boundaries**
- **Inputs (x's)**
- **Outputs (y's or Y's) being measured or in need of measurement systems**
- **Where data is (or should be) collected**
- **Current operating parameters**

PROCESS MAP ≠ PROCESS FLOW CHART

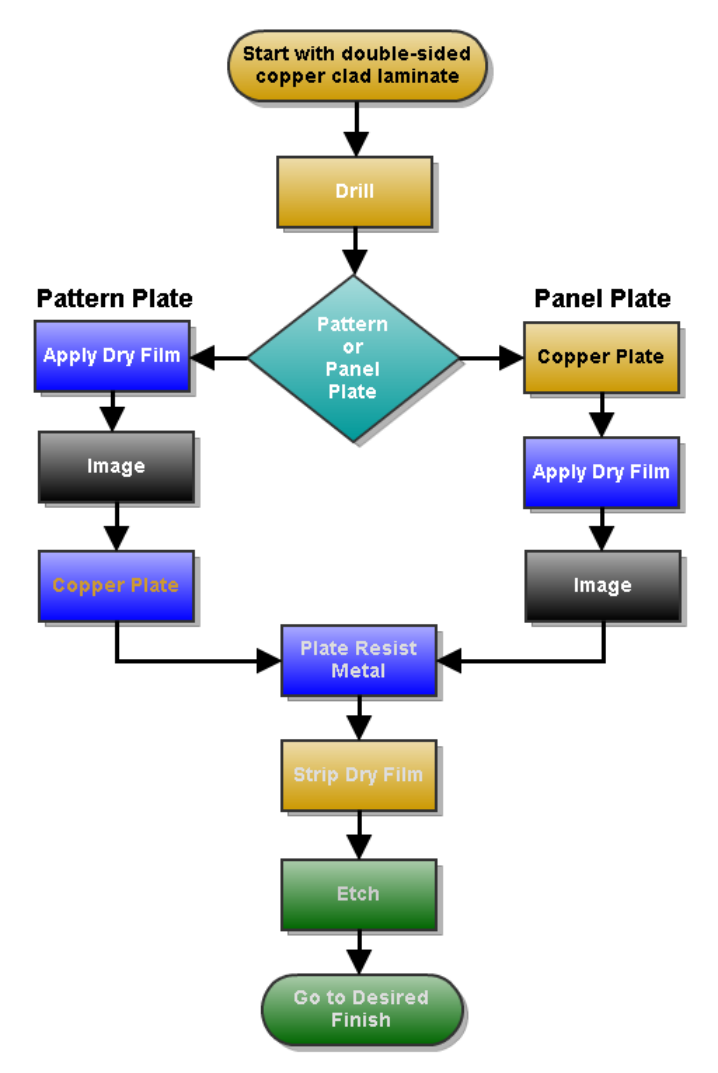
PROCESS MAP

- Shows inputs and outputs
- Shows the steps of the flow of the process
- May or may not show decisions
- Shows the steps of how the process actually works
- Helps streamline flow
- Helps make process improvements by understanding, and controlling inputs to eliminate variation

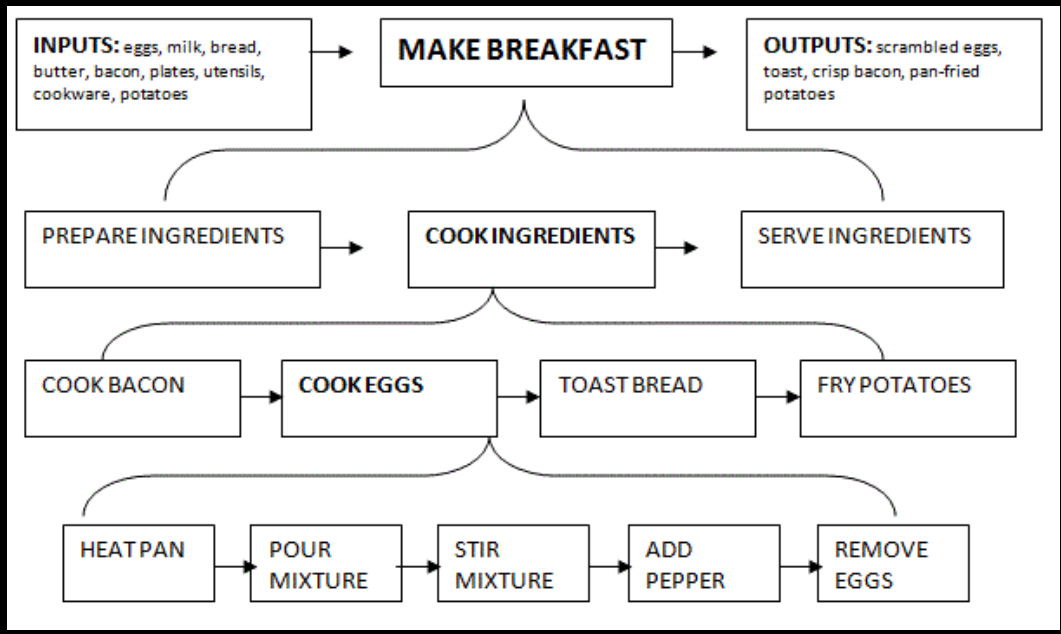
(Process) Flow Chart

- Does not show inputs and outputs
- Shows the flow of the process
- Shows decisions and alternate pathways
- May not show the process steps as-is. Rather, it may reflect the process as it should be (for your ISO procedure, for example)
- Helps streamline flow
- Does not focus on reducing variation

FLOW CHART EXAMPLE



PROCESS MAP EXAMPLE



PROCESS MAPS AND FLOW CHARTS

Value Stream
Flow charts
Reduce Waste

Process maps
Drive reduction
in variation

Our primary focus will be on
Process Mapping

PROCESS MAPPING TERMS

- Input variables may influence process steps
  - X's or factors
- Output variables or customer requirements
  - "Big Y's" when referring to final output
  - "Little y's" when referring to measurements taken upstream

$$Y = f(x_1, x_2, \ldots, x_k)$$

Understand and control the x's to control the Y's

PROCESS MAPPING STEPS

1. Identify the ***process*** and its primary inputs and outputs (50,000 ft. view)
2. Identify all ***steps*** in the process (5,000 ft. view)
3. List ***output variables*** at each step
4. List ***input variables*** (and operating parameters) at each step
5. ***Classify*** each input variable as **C**ontrollable, **N**oise or a **S**tandard operating procedure

A Belt should have the Process Map complete within the first meeting with the team.

PROCESS MAPPING STEPS – DO NOT

1. DO NOT Map the process how you think it should happen. Map how it currently happens.
2. DO NOT restrict your map to only processes in your department.
3. DO NOT attempt to map a process before you identify the beginning and end.
4. DO NOT get bogged down with the details.
   - You can add details once a high level flow has been developed.
   - Forget about how & why the process exists.

STEP 1: (HIGH LEVEL) IDENTIFY THE PROCESS AND INPUTS/OUTPUTS

- Identify external inputs
  - Raw materials
  - Energy requirements
  - Incoming information
- Identify end customer requirements (outputs, or Y's)
  - Deadline
  - correct quantity
  - perfect quality
  - CTQ Trees – critical to quality are the key measurable characteristics of the process.
    - Performance metrics
    - Specification limits
- First focus on what the processes are rather than how they interact with each other.
- **List the Process Name with its Inputs & Outputs**

EXAMPLE - STEP 1

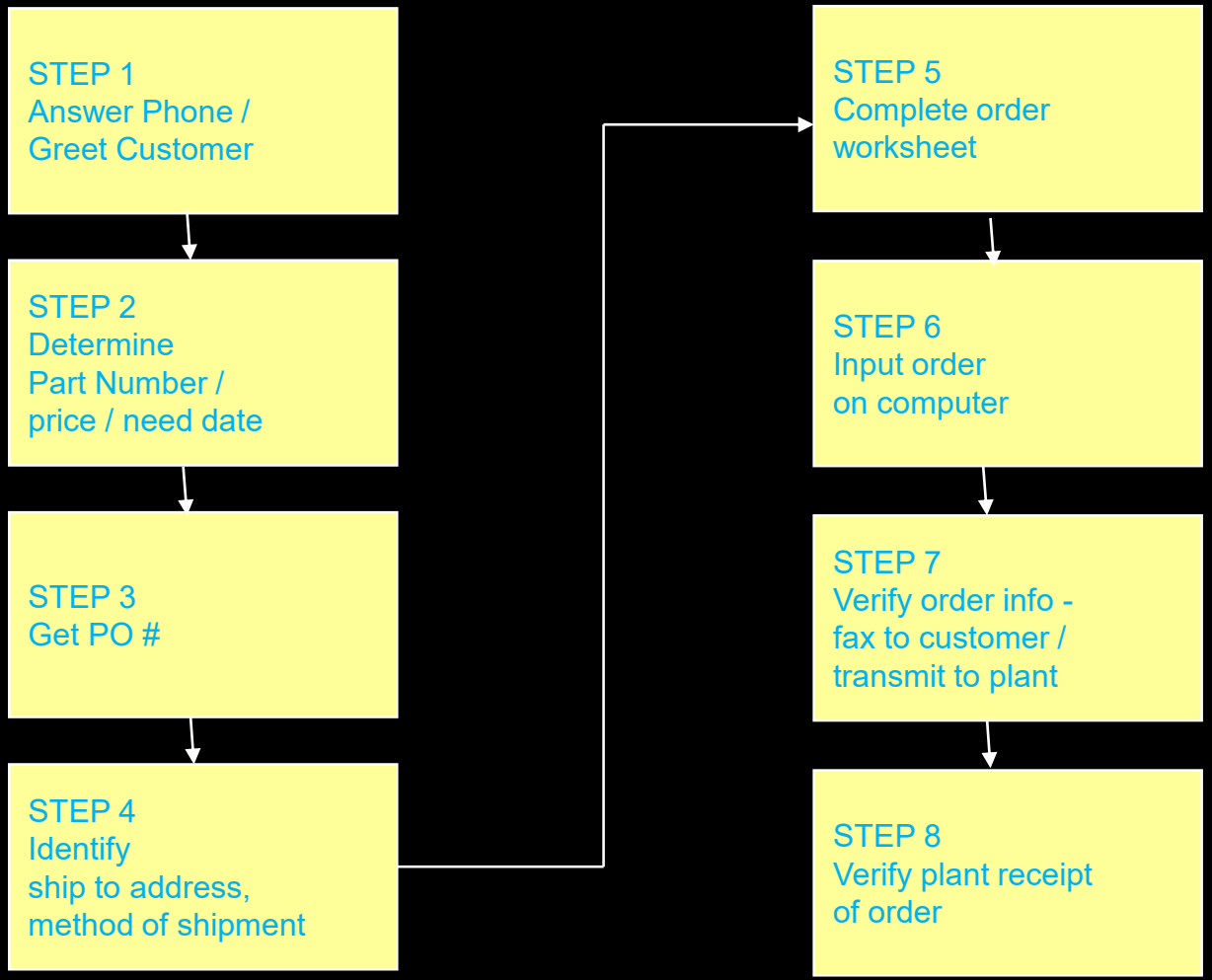
The 50,000 ft. view

STEP 2: IDENTIFY ALL STEPS IN THE PROCESS

- Identify the process flow steps
  - Tips – Try to show in 3 – 8 Steps
  - Start with the end and the beginning. Then, fill in the middle.
- Include all value-added and non value-added steps
  - Process steps, inspection/test, rework, scrap points

- WALK THE PROCESS!
  - A Process Map isn't done on the computer!
    - Use a whiteboard with post-it notes.
  - While you walk the process you will also be identifying x's and y's (next steps)

EXAMPLE - STEP 2

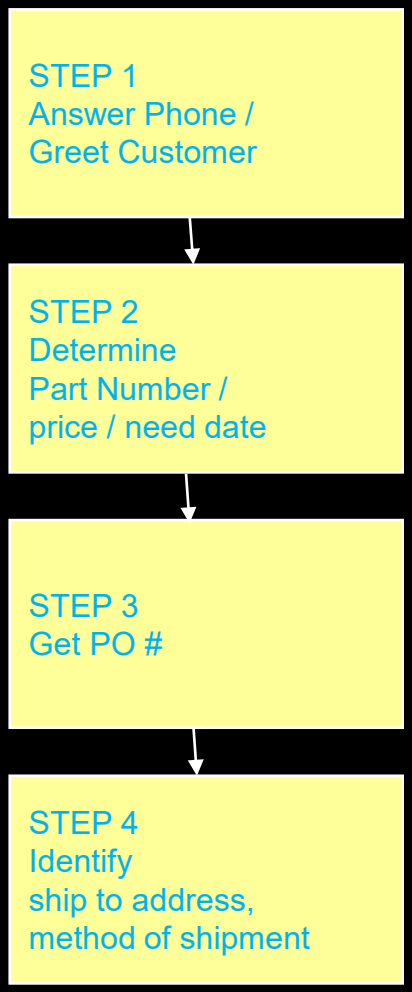


STEP 3: LIST OUTPUT VARIABLES

- Include all output variables of each step in the process (the y's).
  - Defines the scope and objectives of the process
  - Indicates where measurements are taken during the process
  - Labels and differentiates between what is and what is not currently measured
  - Defines "In-Process" parameters (y's) which are measured UPSTREAM from the final output (Y)

Tip: May be easier to list the outputs and inputs (Steps 3 and 4) by step before moving on to the next step

EXAMPLE - STEP 3



Output Variables

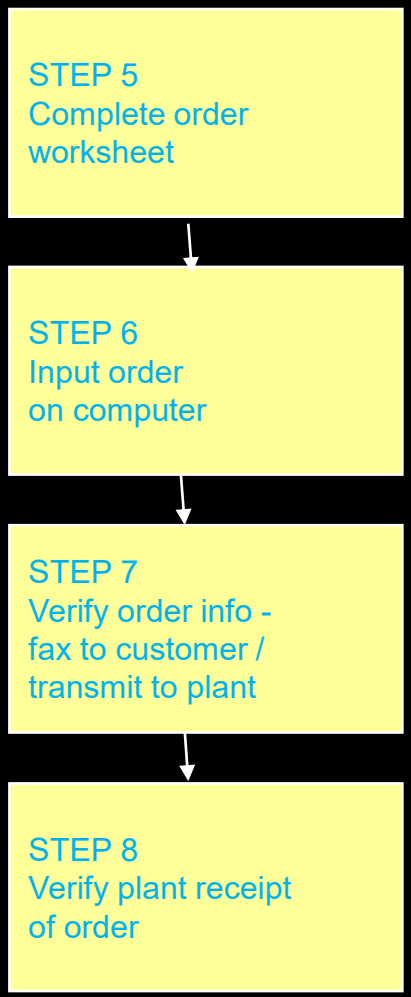
- Prompt answer
- Live body

- Customer info
- Pricing
- Availability

- Customer PO

- Ship to address
- Method of shipment

EXAMPLE - STEP 3 (CONTINUED)



Output Variables

- Complete order info from customer
- Order in computer
- All fields completed
- Promise date
- Printed confirmation
- Correct info
- Confirmation to customer
- Order sent to plant
- Completed order entry

STEP 4: LIST INPUT VARIABLES

- List all input variables for each step in the process (x's or factors)

STEP 5 - CLASSIFY INPUT VARIABLES

- Classify the input variables
  - CONTROLLABLE INPUTS (C)
  - NOISE INPUTS (N)
  - STANDARD OPERATING PROCEDURES (S)

NOTE: Further experimentation confirms the estimated classification! THESE CAN CHANGE!

CONTROLLABLE INPUT variables (C)

Input variables (x's or factors) that can be changed to see the effect on output variables. These are sometimes called Independent Variables

- **x's that are critical (Key Process Input Variables)**
- **x's that have no effect**

NOISE (N)

Inputs that impact the outputs but are:

1. **Uncontrollable**
2. **Too costly to control**
3. **Preferably not controlled**

Example - An environmental variable such as humidity

STANDARD OPERATING PROCEDURE (S)

Inputs that are defined by operating procedures that may be considered "common sense activities"

Examples: Training, Cleaning, Preventive Maintenance

STEPS 4&5

INPUTS		OUTPUTS
•Order worksheet form C •Customer supplied info N	STEP 5 Complete order worksheet	•Complete order info from customer
•Order worksheet C •Computer entry screens C •Lead time info from mfrg. N	STEP 6 Input order on computer	•Order in computer •All fields completed •Promise date •Printed confirmation
•Printed confirmation sheet C •Customer contact info N •Confirmation procedure C	STEP 7 Verify order info - fax to customer / transmit to plant	•Correct info •Confirmation to customer •Order sent to plant
•Correct info in computer C •Mfrg plant contact C	STEP 8 Verify plant receipt of order	•Completed order entry

PREPARING THE PROCESS MAP

- Team Effort
  - Managers
  - Developers
  - Technicians
  - Project Managers
- Possible Inputs to Mapping
  - Brainstorming
  - Operator manuals
  - Engineering specifications
  - Operator experience
  - 6M's
    - Man, Machine (Equipment), Method (Procedures), Measurement, Materials, Mother Nature (Environment)
- Keep it Simple – Draw it out on a whiteboard, use post-it notes for lists (Inputs, Outputs, Step Name, Process Name)
  - Periodically snap photos of the whiteboard.

PROCESS MAP QUESTIONS TO VERIFY QUALITY OF MAP

- Does it cover the project scope?
- Who helped develop the map? Did I get the operators input?
- Does it reflect current state or the desired process?
- Are all non value-added steps included?
- Are all inputs and outputs listed?
- Were any quick-hits found from this effort?
- What process steps does the team feel can be eliminated?
- What characterizes controlled and noise variables?
- What measurements are taken within the process? What measurements SHOULD be taken throughout the process?
- Did you and your team "walk the process?" How often?
- What is the next step and what is the timeline?
- Is there a lot of waste to warrant a Value Stream Map first?

RINSE & REPEAT

- Take a break
  - Step out of the room for some time to give yourself a fresh set of eyes.
- Walk the process again
  - Add additional inputs,outputs, or steps to your lists
- Come to a consensus
  - Majority does not rule the room. Everyone should agree that the process map is correct.
- Map additional processes
  - When the process is too complex or confusing it will have many inputs, outputs, or steps (too many to list on a post-it note)
  - These processes will need to be broken down into multiple processes, each with its own inputs, outputs, steps, and flow (with each step with its own inputs & outputs).
- How each process flows from one to the other should be clear by their inputs & outputs.

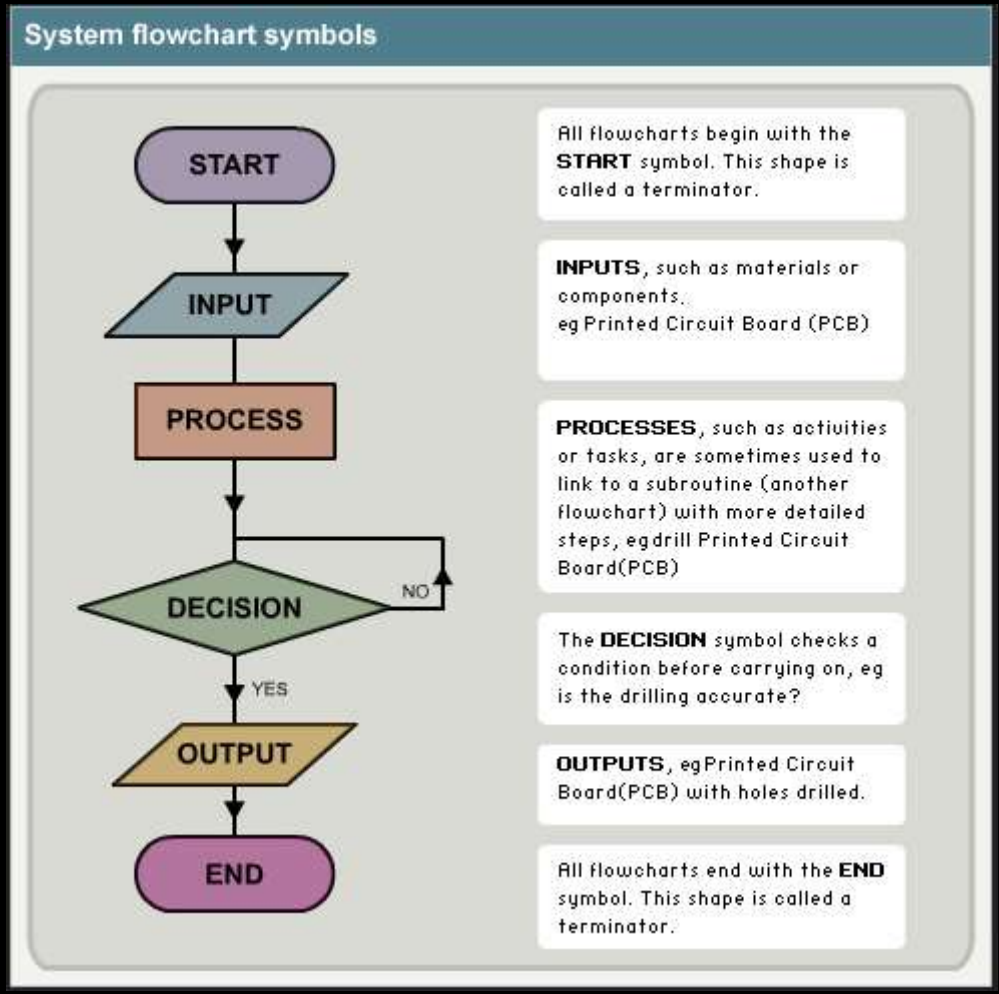
REMEMBER…

Process Maps

ARE NOT

Flow Charts

SYSTEM FLOW CHART



QUESTIONS?

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