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Lean Six Sigma Green Belt Study Guide

Name: _____

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Letter from the Director

First, let me congratulate you for pursing your Lean Six Sigma Green Belt certification and welcome to the American Association for Lean Six Sigma Certification (AALSSC). Obtaining a Lean Six Sigma certification is one of the most rewarding and valuable professional accomplishments you can achieve. The professional opportunities for a Lean Six Sigma Green Belt are vast and apply all industries. This is an exciting time for Lean Six Sigma professionals and let me be the first to welcome you to the community.

The amount of knowledge required for an AALSSC certification is extensive, but not overwhelming. **You can do it!** The core tenants of AALSSC certifications is they must be relevant and attainable. By only testing the most relevant tools and methods within Lean Six Sigma we have removed some of the knowledge areas deemed not relevant enough – thus making the exam more attainable. As a certified Lean Six Sigma Green Belt you will be expected to effectively facilitate teams, be a process improvement specialist, and a problem solving expert. The exam tests your knowledge, skills and abilities across these focus areas.

This is your study guide, treat it as such. Write your name on it, complete it using your words and follow the concepts outlined. By writing you will retain the information and make this study guide a useful part of your reference library. Plus, this study guide can be used when taking an AALSSC Green Belt certification exam.

Good luck and welcome to AALSSC – your road to success.

Erik Christensen

Mr. Erik Christensen, LSSMBB
Director of Certification

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Section #1 - Introduction

Background

Lean Six Sigma:

- Lean Six Sigma is the combining of two methodologies – Lean and Six Sigma.
- Lean Six Sigma takes advantage of the "value--added" focus of Lean while maintaining statistical tools of Six Sigma.
- Toyota is the company credited with pioneering Lean and Motorola is credited with pioneering Six Sigma.

Green Belt skill set (expectations):

- Problem solving
- Process improvement
- Team facilitation

Quality and Value:

Value: What customers are willing to pay for.

Quality: Meeting or exceeding customer expectations.

Q: How are quality and customer satisfaction related? Who defines quality?

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The Green Belt's Impact

Green Belt impact is felt the strongest across four primary areas

1) Cost of Poor Quality (COPQ) – Costs that would disappear if systems, processes and products were perfect.

Obvious costs: Overtime wages, scraped products, energy, warranty claims, raw materials, etc.

Hidden costs: Reputation, word of mouth, brand value, loss of repeat customer, employee morale, etc.

Notes:

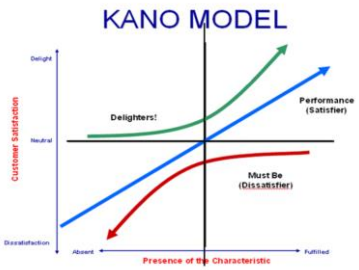
2) Opportunity losses – By spending resources to respond to and fix defects the company is not exploring new ways to satisfy the customer.

Following the Kano Model seek to find ways to provide customers with "wow" factors

Satisfier: Customer asks for

Dis-satisfier: Customer expects to be there without asking

Delighter: Customer does not know to ask for it



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The Green Belt's Impact

3) Employee Morale - Lean Six Sigma is founded on the core concept of respect for people.

A bad process defeats a good employee

A process that permits employee success and offers a chance to work with pride increases morale

High morale increases productivity, energizes the work force and reduces turn-over

Notes:

4) Workplace safety – A safe work environment shows respect for employees and what they contribute.

Physical work areas and processes are intertwined.

Costs of employee injury is high.

Notes:

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Section #2 - Six Sigma Overview

Six Sigma overview

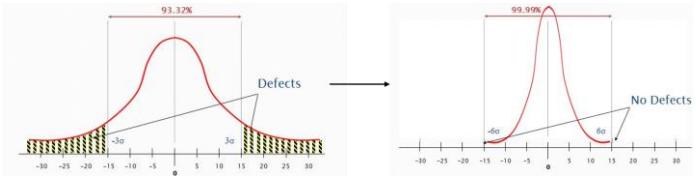
Sigma σ is a statistical unit of measure which reflects process capability

Sigma is mathematical term: Deviation from the mean

6 deviations from the mean – if measuring quality, a six sigma process would only produce 3.4 defects per million opportunities (DPMO)

Follows DMAIC stage gate cycle for project execution.

- Define
- Measure
- Analyze
- Improve
- Control



Focus efforts following the transfer function Y=f(x) – which means the output (Y) is the function of the inputs(x).

Six Sigma's primary objectives is to reduce process variation

International standards organization (ISO): Helps organization produce high quality goods (continuous improvement)

- Companies can get ISO certified

Malcom Baldrige national quality award – presented by POTUS annually

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Lean Overview

Lean is a systematic approach to identify waste, focus activities on eliminating it, and maximize (or make available) resources to satisfy other requirements.

Lean is term used to describe Toyota Production System (TPS)

Lean fundaments

- Go/See: Go to the Gemba and see processes first hand
- Ask why: Question assumption, find root causes
- Show respect: Provide employees with a safe, functional work environment

Gemba: The place of actual work.

Kaizen: Continuous Betterment (Improvement).

Q: What actions are managers expected to take based on these concepts? How do these concepts shape organizational culture?

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TIM WOOD (U)

Concept: Understand value adding vs. non-value adding steps in a process.

- Defined by the customer
- Identify and eliminate waste (TIM WOOD U)
- Waste is like a saboteur who is disrupting normal operations

Transportation: Movement of material, information, people or equipment that does not add value

Inventory: More information, projects, material on hand than is needed right now

Motion: Movements of people that does not add value

Waiting: Idle time created when material, information, people, or equipment is not ready

Over-Production: Generating more than is needed right now

Over-Processing: Effort that creates no value from the customer viewpoint

Defects: Work that contains errors, re-work, mistakes or lacks something necessary

Under-Utilization: Any failure to use the time and talents of people

WIP: Work in process (not raw material, not finished goods) – form of inventory waste.

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Principles of Lean

1. Define value from the standpoint of the end customer.

2. Map the value stream.

3. Create flow by making the steps occur in tight sequence.

4. Let the customers pull value from the process by keeping pace with the rate of customer demand.

5. Continuously improve and strive for the "Ideal" process.

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Seeing the Process

Concept: Teams must be able to see and analyze a process before they can improve it.

Tool: Process walk – see first-hand how processes are being accomplished.

Literally walk the process from start to finish, then from finish to start – best done in pairs

Capture data, take measurements, speak to workers

Notes:

Tool: Spaghetti diagram – visual display of motion or transportation waste.

Diagrams the motion or transportation of a product or employee.

Shows how the process moves through the physical world – basis for layout changes

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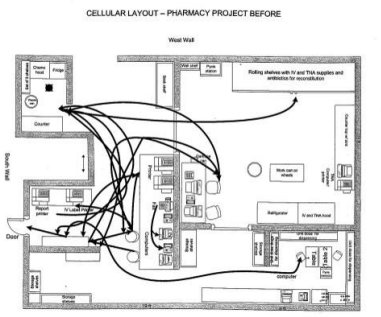

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Seeing the Process

Tool: Value stream map – visual display of all the actions taken to bring a product or service to the customer.

Three types:

Current state: How we do it today

Ideal state: Perfect world process

Future state: Target process with less waste

Swim lanes: VSM format that shows movement of process between department

- Value added step: Customer would pay for it, done correctly the first time and changes the form, fit or function
- Non-Value added step: Does not meet above criteria
- Business value: Non-value adding steps required for business purposes (Ex. paying taxes, reporting data).

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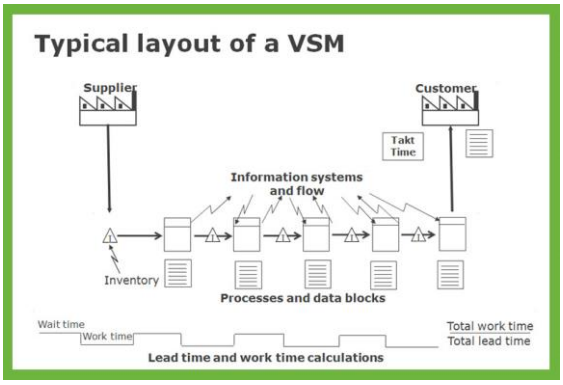

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Timing the Value Stream and Action Planning

Concept: Capture real data for how long operations take.

- Lead Time – total time to transform input to output
- Cycle Time – time for operator to complete work and return to starting position.
- Touch Time – time spend working on item
- Takt Time: Determines rate of production
  - Operating time divided by customer requirements
  - Convert time for easy math (hours to minutes or minutes to seconds)
- Work in Process (WIP) – in-process inventory (no longer raw material, not finished goods)

Notes:

Takt Time Example: Customers demand 15 products every two hours: 15/2 hours = 15/120 minutes = 8 minutes

8 minute takt time: we must make one product every 8 minutes to meet customer demand (pace of production)

Practice calculating takt time below

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Timing the Value Stream and Action Planning

Develop an action plan to document who is going to do what, when.

Concept: To make the change from current state to future state value stream maps people must act. These actions are prioritized and documented on an action plan.

Tool: PICK chart – used to prioritize the action plan.

Possible, Implement, Consider, Kill

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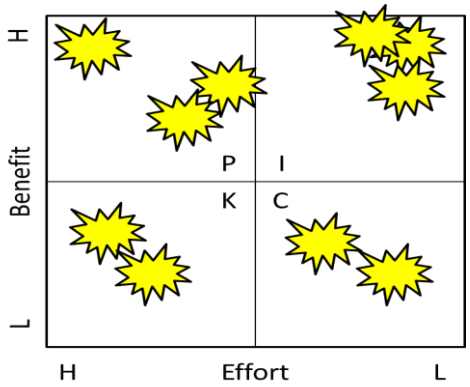

Tool: Action Plan – identify actions necessary to accomplish goal.

Various formats exist, all accomplish the same objective: Capture the actions necessary to move toward goal accomplishment

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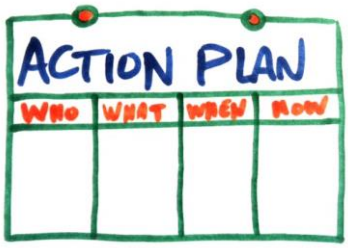

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Section #3 - Facilitation

Team facilitation

Concept: Facilitators contribute structure and process to interactions, so groups can function effectively and make *high quality decisions.*

To be an effective facilitator one must begin by believing the comments below:

- People are intelligent, capable and want to do the right thing
- Groups can make better decisions than any one person can make alone
- Everyone's opinion is of equal value; regardless of rank or position
- People are more committed to the ideas and plans that they have helped to create

Change Management

Improving processes requires people to change how or what they do, any change in work requires some level of change management.

Q x A = I: The quality of the solution multiplied by the *acceptance of the people* who must implement the solution equals the impact of that solution.

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Facilitation – Facilitator Tools

Concept: Facilitators use various tools and strategies to help teams achieve goals.

Two general purpose facilitator tools are:

- Parking Lot:
  - Capture pre-mature ideas without losing team members
  - Potentially good ideas are not lost
- Plan for and begin meetings/events using 3-step process
  - Purpose: Why are we having this meeting (also tells who needs to attend)
  - Process: How are we going to accomplish purpose
  - Time: How much time will this meeting take

Facilitators use different tools depending on the situation.

- open-ended questions: encourage discussion
- close-ended questions: to get a yes or no answer
- probing questions: Dig deeper
- repeating back: Clarify assumptions
- active listening: paying attention to verbal and non-verbal communications

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Team Facilitation - Stages of Team Development

Concept: Groups of people go through stages as they transform into a team.

Forming: Friendly, lofty discussion, conceptual ideas

Storming: Non-productive stage, team bickers

Norming: Process of pulling team out of storming by focusing on objectives, using team norms, agenda items

Performing: Mutual respect and pro-active behaviors, team respect develops

Adjourning: Formal disbanding of the team

As the team moves through the stages the facilitator become less directive and more delegating

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Facilitation - Decision Making

Concept: Facilitators and teams need decision making tools because of the complexity or difficulty of decision to be made.

Phase I – Generate list of possible ideas or solutions.

Tool: Brainstorming – fast paced idea generation. Laughter is a sign of good brainstorming.

Notes:

Additional Tool: Nominal Group Technique – focused idea generation. Write a partial sentence and force team to develop 20 possible endings to the sentence.

The way we can acquire new customers is _____

Notes:

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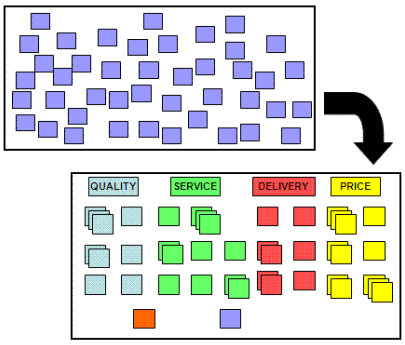
Facilitation - Decision Making

Phase II – Organize and narrow the ideas or solutions.

Tool: Affinity Diagram – categorize like ideas.



Provides structure to brainstorming ideas

Notes:

Additional Tool: N/3 – reduce the total number of ideas to make it more manageable.

Take total number of ideas and divide by 3 – must remove 1/3 of ideas from consideration. Forces de-selection.

Notes:

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Facilitation - Decision Making

Phase II (cont) – Organize and narrow the ideas or solutions.

Tool: Multi-voting – identify popular ideas and ideas to be removed from consideration.

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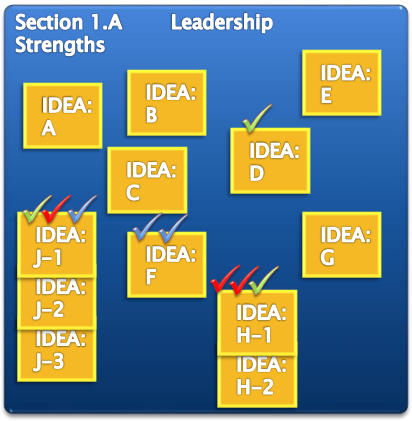

Tool: Advocate – allowing an individual to present a position.

Get an expert prospective.

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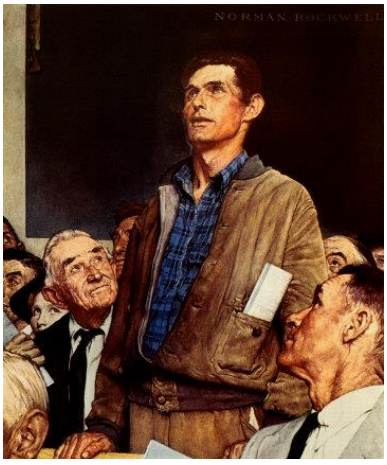

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Facilitation - Decision Making

Phase III – select way forward keeping Q x A = I in mind

Tool: Straw Poll – informal vote that will highlight way team is going.

Notes:



Tool: Consensus voting – determine if all team members either agree or can live with decision.

Check team status with agree (Thumbs up), can live with it (Thumb sideways) or cannot live with it (Thumbs down)

If any team member is thumbs down, cannot live with it – investigate why and resolve before moving forward

Notes:



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Facilitation – Team Members and Events

Bring people together to form teams and accomplish a specific objective.

One quality of a team is they have a common goal

Team roles:

Champion: Person with organizational authority and approves use of resources for project

Process Owner: Person with authority and accountability for the process being improved

Facilitator: Manage meeting(s) and enables change

Team Leader: Leads team thru process – normally an expert who is accountable for specific project results

Team members: cross functional experts brought together to solve a specific problem / improve a process

Events:

- Value stream mapping event 2-3 days: Map a current process, no changes are made
- Point Kaizen – 1-2 day events within team leaders span of control.
- Kaizen Blitz – 4-5 days event that goes across multiple function areas.
- Project – 3-6 months event focused on multiple business areas.

Q: What experiences have you had with events?

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Section #4 – Problem Solving

Problem solving

Concept: Green Belts us a structured problem-solving method: 8-step

1. Define the problem
2. See and analyze the process
3. Determine the root cause
4. Identify strategy and select
5. Implement strategy
6. Evaluate results
7. Prevent regression and replicate
8. Commit to continuous improvement

The is no magic in the number 8, any method will work. Just have a method.

When attempting to solve a problem there are proven tools and methods which increase chance of success.

Tool: Problem Statement - a clear, concise statement of what's wrong. A problem clearly defined is a problem half solve.

Notes:

Tool: SIPOC – provides project scope.

High level look at project. Prevents scope creep.

Develop in reverse - COPIS

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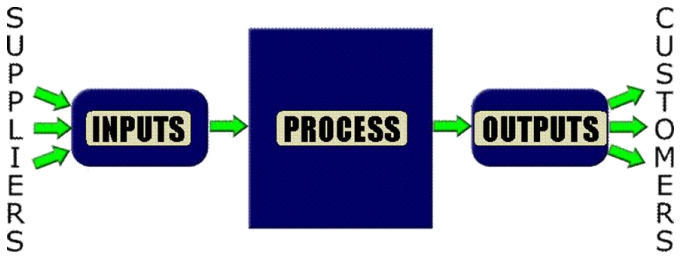

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Problem solving

Metrics

Concept: There is a need to measure improvements to claim an improvement.

Metrics - Quantifiable measures that can assess the performance of a process.

Purpose of a metric is to drive behavior.

Core four metrics are: Cost, quality, delivery, and safety

- Do not subordinate one metric for another and call it process improvement.

Metrics can be the root cause of the problem or behaviors we are experience

Notes:

Project or Event Documentation

When executing a Lean Six Sigma event there is a need for documentation

Charter: Official document that authorizes project/kaizen event to move forward.

A3: Single page document organized to emphasis cause/effect, uses data for objectivity, forces brevity and shows alignment between effort and objective.

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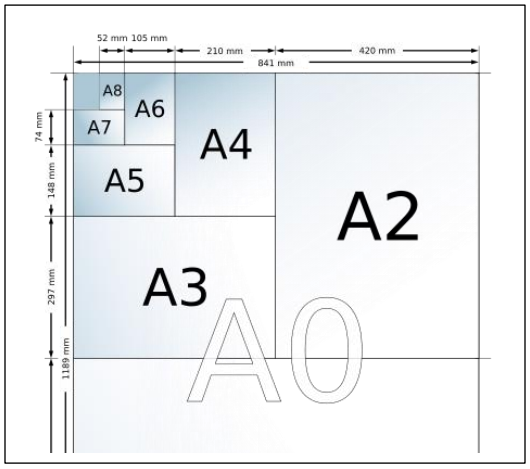

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Change Management and Stakeholders

Refresher: Q x A = I

Stakeholders: individuals with a real or perceived interest in the outcome of your project/event

Use a power/interest chart to help determine how to handle each stakeholder

- Primary
  - Process Owners
  - Internal Customers
  - External Customers
- Other effected organizations
- Others (suppliers, gov't depts., regulatory bodies, etc.)
- Who else?

Types of stakeholder resistance:

- Political – Perceived loss of influence (emphasize larger vision)
- Technical – Fear of technology (Give hands on training)
- Organizational – Perceived loss of control (Involve them project and give credit)
- Individual – Fear of change (Establish rapport)

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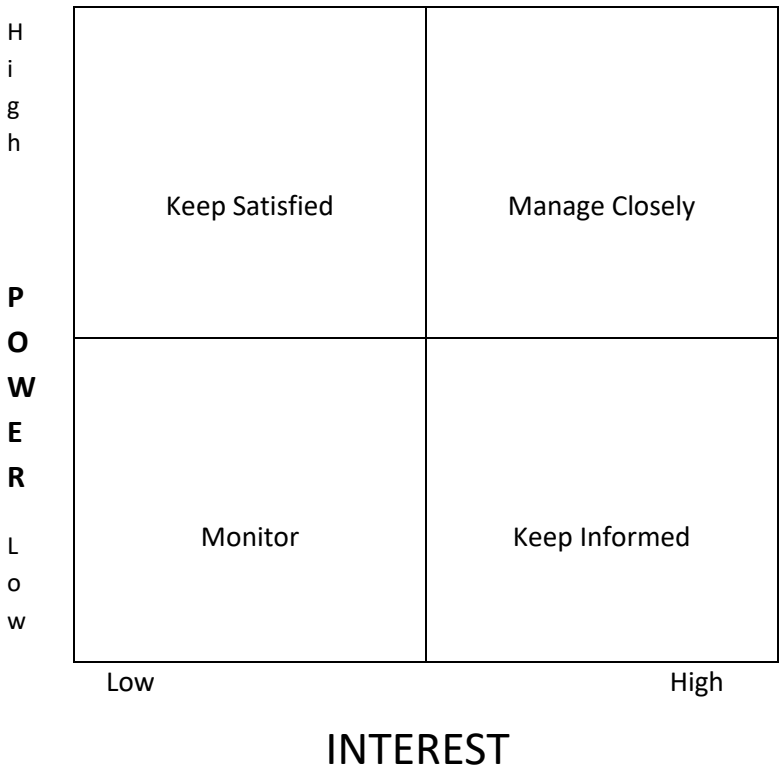

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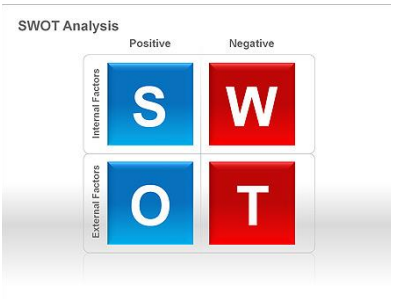
Problem Solving – SWOT and SMART

Tool: SWOT analysis – internal and external analysis of a team or organization.



Strengths (Internal)

Weaknesses (Internal)

Opportunities (External)

Threats (External)

Notes:

Tool: SMART goal setting – used a filter to goals are valid.



- Specific
- Measurable
- Attainable
- Relevant
- Time-bound

Notes:

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Root Cause Analysis Tools

Concept: To prevent problem reoccurrence solutions must address the root of the problem.

Two types: statistical (analyzing data) and non-statistical (using the knowledge and wisdom of people).

Tool: Cause and Effect Diagram (Fishbone diagram) - provide structure to brainstorming.

- Targeted brainstorming – structure developed prior to brainstorming

- 6Ms is most common branches: Man, method, machine, materials, measurement, mother nature (environment)

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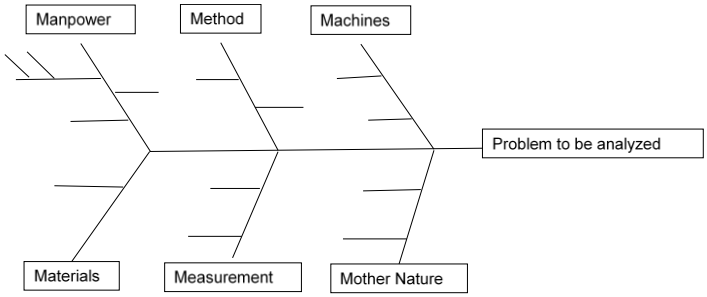

Tool: Run Chart - Monitor the behavior of a variable over time.

Plot data point across time – find patterns, cycles, trends

Find the root cause using data measurements over time

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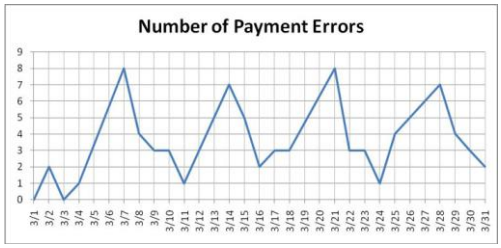

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Root Cause Analysis Tools

Tool: Pareto Chart – find the few causes that have the greatest impact (aka the 80/20 principle).

Few causes will have the majority impact.

Separates the vital few from the trivial many.

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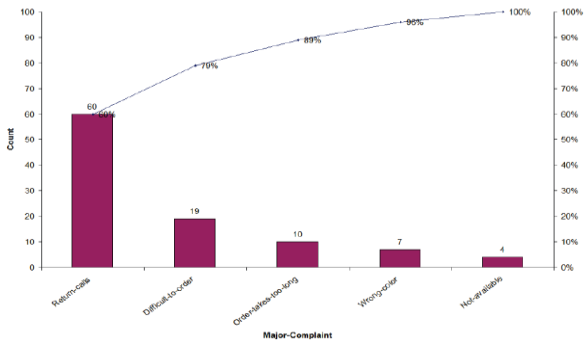

Tool: 5 Whys analysis – Ask "why did that occur" five times and you will find the root cause.

Drill down the problem by asking why.

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Root Cause Analysis Tools

Risk analysis is the planning for problems that have not yet occurred.

What *could* happen vs. what *did* happen

Tool: Failure Mode and Effects Analysis (FMEA) – quantifiably measure and compare risk, then determine what course of action to take for each.

How could the process fail and what is the effect of that failure?

- Severity x occurrence x ability to detect = Risk priority number (RPN)

Compare RPNs to find highest number and develop strategies to reduce RPN.

Notes:



Develop FMEA below

Failure Mode and Effects Analysis (FMEA) Worksheet

System, Product, or Process:				Owner:			
Background				Rating			
Description	Potential Failure Mode	Potential Effect of Failure	Root Causes	SEV	OCC	DET	RPN

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Section #5 – Lean Six Sigma Countermeasures

5S, standard work and visual management

Concept: Use proven best practices for continuous improvement.

- *Tool:* 5S – organize the physical work place for process excellence. 5 step process to organize work area
    - Sort: Remove the un-necessary
        - Red tags are used to identify items to be disposed of later
        - Red square is the term used to describe the area where red tagged items are brought
    - Straighten: Place the necessary in the optimal location
        - Point of use (POU) thinking – the more often tools or materials are used the closer they should be to the work area.
    - Shine: to clean and inspect
        - Find sources of grime and search for/eliminate safety hazards
    - Standardize: Incorporate first 3Ss into regular duties (checklists, processes, etc.)
    - Sustain: Leadership audits communicates importance
        - Inspect what you expect

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Lean Six Sigma Countermeasures

Tool: Standard Work - agreed upon set of work procedures and best practices that document the interaction of people, materials and machines.

Inconsistent process = inconsistent results. Consistent process = expected results.

Developed by the people who do the work – key for Q x A = I

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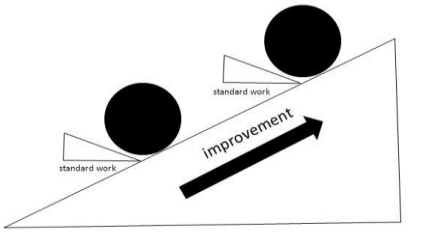

Without a standard, there can be no Kaizen (improvement)

Tool: Visual Management – make the workplace visual using colors, shapes, lines, etc.

Two components:

Visual display: Share information – people all have same understanding of status

Visual control: Drive the actions of people – communicating where to go and why using visuals

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Lean Six Sigma Countermeasures

Poka-Yoke, quick changeover, leveling and cell design

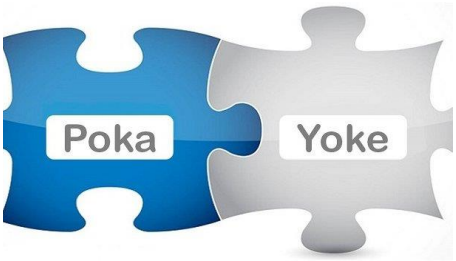
Tool: Mistake Proofing (Poke-Yoke) – use a 100% inspection device to automatically detect errors so they are NOT passed to the next stage of the operation.

Reduces the cost of poor quality by preventing errors from becoming defects

Most mistakes are inadvertent in nature

Green Belts ask better questions "Could we implement an error proofing device?" not "Who did it?"

Notes:



Tool: Quick changeover (SMED) – reduce the amount of time a machine is off when making a change.

SMED: Single minute exchange of dies – developed by Shigeo Shingo. (enables flow)

Reduces the running of large batches, which increases WIP/inventory.

Pit crew thinking for the machines in our operations

Two categories of steps:

Internal: Must be completed when the machine is off
External: Can be completed while the machine is running (before shut down or after start up)

Analyze current process, identify internal/external steps, convert internal to external, reduce all steps by removing waste

Notes:



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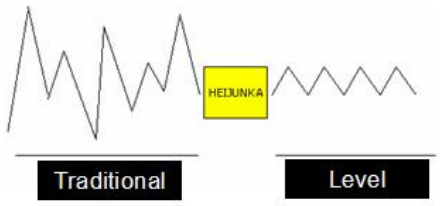
Lean Six Sigma Countermeasures

Tool: Heijunka – level the work to reduce system strain and enable "pull" production.

Known as leveling or load leveling.

Have all work sections producing at the same pace – removing bottlenecks / flow stoppers

Notes:

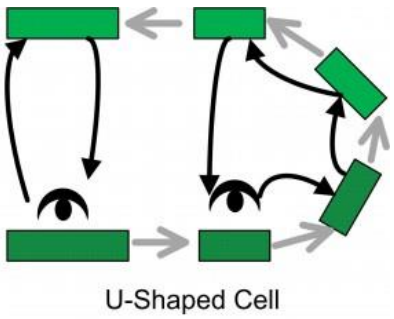


Tool: cellular design – put people, materials and information in the same place.

U-shaped cells need 5S, standard work, visual management and error proofing

Ability to turn on and off cells depending on customer buy signal – *enables Pull*

Notes:



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Sustainment Actions

Concept: Prevent regression and commit to continuous improvement.

Tool: Audits - To sustain improvements leadership and audits are necessary.

Inspect what you expect – leadership inspections communicate to employees what is important.

5S sustainment audits, error proofing inspections to ensure they still work as designed, preventative maintenance, etc.

Notes:

Tool: Continuous Improvement (CI)

By continuously doing 5S, kaizen or other waste elimination events TIM WOOD (U) does not have the opportunity to creep back in.

This becomes the organizational philosophy and how we do business.

Training, education, promotion, recognition and other programs are based on waste elimination and operation excellence.

Culture of continuous improvement (CI) begins to develop - Leadership responsibility.

Parking lot items can be source of CI ideas or work processes for next kaizen event.

Notes:

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Sustainment Actions

Tool: Replication: repeat success for maximum impact across organization.

Beware of "not invented here" syndrome

Replication by performance measure – by showing what is possible a new standard can be developed and managers/executives can be held accountable to achieving measurable (attainable) results.

Notes:

Best of luck!

Luck: *When preparation meets opportunity*

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AALSSC
112 S. Water St., Suite 109
Henderson, NV 89015

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