DMAIC – THE PATH TO CONTINUOUS IMPROVEMENT

DEFINE
Define the problem and the ideal in terms of the target to achieve.

MEASURE
Collect relevant data about the process and the problem.

ANALYSE
Analyse the process to identify the cause-effect relationship between inputs and outputs. Identify the vital few root causes.

IMPROVE
Determine the optimum values for key contributing process inputs. Implement solutions to eliminate the root causes.

CONTROL
Establish standards and controls to sustain improvements in the long run.
<table>
<thead>
<tr>
<th>DMAIC METHODOLOGY</th>
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<table>
<thead>
<tr>
<th>The 5-Step DMAIC Methodology Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Define</strong></td>
</tr>
<tr>
<td><strong>Measure</strong></td>
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<td><strong>Analyze</strong></td>
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<tr>
<td><strong>Improve</strong></td>
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<td><strong>Control</strong></td>
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DEFINE

DEFINE - ensures the team is all clear on what the problem is and that it is the right problem. The goal is to prevent the team jumping to solution mode.

DEFINE DELIVERABLES

• Communication Plan
• Project Charter
• SIPOC
• RACI Matrix
• S.M.A.R.T. Goal Setting
• S.W.O.T. Analysis Diagram
Purpose and Benefits

• A communication plan provides a tool to provide stakeholders with information. This plan formally defines who should be given specific information, when that information should be delivered and what communication channels will be used to deliver the information. This tool should trigger dialog among key stakeholders.
## Project Communication Action Plan

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Message</th>
<th>Communicator</th>
<th>Schedule</th>
<th>Delivery Method</th>
<th>Status</th>
<th>Comments</th>
</tr>
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Purpose and Benefits:

- The Project Charter should describe the continuous improvement initiative and should include the objectives, how it will be carried out, and who the stakeholders are. This document should clearly define the purpose, as well as the approach to achieve the stated goals and establish expectations around progress, deliverables, issue management, and roles and responsibilities.
## Project Charter - TEMPLATE

### Project Title

<table>
<thead>
<tr>
<th>PROBLEM STATEMENT</th>
<th>GOAL STATEMENT</th>
</tr>
</thead>
</table>

### BUSINESS CASE

<table>
<thead>
<tr>
<th>In-scope</th>
<th>Out-of-Scope</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CTQ's</th>
<th>Defect Definition</th>
</tr>
</thead>
</table>

### WHO- Process Owner, Champion, Team Leader and Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Role/Responsibility</th>
<th>Time Commitment</th>
</tr>
</thead>
</table>

### WHEN- High-level timeframe of the phases

<table>
<thead>
<tr>
<th>PHASE</th>
<th>DATE</th>
<th>DATE</th>
<th>DATE</th>
<th>DATE</th>
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<tbody>
<tr>
<td>Define</td>
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<td>Measure</td>
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<td>Improve</td>
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</tbody>
</table>

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Purpose and Benefits

A SIPOC Diagram is a powerful tool to show who is providing inputs and receiving outputs from a process. **SIPOC** stands for the five elements mapped in the diagram:

- **Suppliers**
- **Inputs**
- **Process**
- **Outputs**
- **Customers/Clients/Constituents.**

This diagram gives you high level insight into who those suppliers and constituents are that influence and benefit from the process, as well as the inputs needed to make the process run, and the outputs that result.
**SIPOC- TEMPLATE**

**How to use:**

- **SUPPLIERS**- Who supplies inputs to the process?
- **INPUT**- What're the key inputs needed for expected outputs?
- **PROCESS**- What are the activities involved for the process to transform inputs to outputs?
- **OUTPUT**- What're expected outputs of the process?
- **CUSTOMERS**- Who're the true customers of the process?
Continuous Improvement
RACI Matrix (Responsible, Accountable, Consulted, Informed)

**Purpose and Benefits** - A RACI matrix allows you to clarify role assignments within your project team or within your process mapping.

For each step/activity on the matrix it is indicated who is:

- **Responsible** for taking action to complete the task
- **Accountable** for the completion of task
- **Consulting** resource for the task
- **Informed** on status of process step/activity

*Prior to completing the RACI Matrix for your process, create operational definitions specific to your organization for Responsible, Accountable, Consulted, and Informed.*
### RACI Matrix - GUIDELINES

**How to Use:**

- For each task/step put an R, A, C, or an I in the box corresponding to the appropriate stakeholder for that role.

- Every step should have someone in the R and A roles (sometimes it might be the same person/work group)

- When improving a project, try to limit the number of people “Responsible” for a given step/task

- Not every step will necessarily have a C or I role.

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**RACI Chart**

<table>
<thead>
<tr>
<th>ROLE</th>
<th>Project Leadership</th>
<th>Project Team Members</th>
<th>Project Sub-Teams</th>
<th>External Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initiate Phase Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request Review by PMO</td>
<td>A/C</td>
<td>R/A</td>
<td>A/C</td>
<td>A</td>
</tr>
<tr>
<td>Submit Project Request</td>
<td>R</td>
<td>A/C</td>
<td>A/C</td>
<td>A</td>
</tr>
<tr>
<td>Research Solution</td>
<td>I</td>
<td>R/A</td>
<td>A/C</td>
<td>C</td>
</tr>
<tr>
<td>Develop Business Case</td>
<td>I</td>
<td>A/C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Plan Phase Activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create Project Charter</td>
<td>C</td>
<td>R/A</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Create Schedule</td>
<td>I</td>
<td>I</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Create Additional Plans as Required</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
</tbody>
</table>

**RACI Symbols**

- **R** - Responsible
- **A** - Accountable
- **C** - Consulted
- **I** - Informed

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Continuous Improvement

S.M.A.R.T. Goals

Purpose and Benefits:

• S.M.A.R.T. goals can serve as the project objective, marching orders or charge for the project leader and team.

• S.M.A.R.T. goals provide a framework for considerations that need to be evaluated.

• S.M.A.R.T. goals increase the likelihood of success by having a solid understanding of the desired end result before you start working.

• At the completion, any stakeholder should be able to refer back to the project or process improvement objective(s) and determine whether it was successful.
<table>
<thead>
<tr>
<th>Specific</th>
<th>Measurable</th>
<th>Attainable</th>
<th>Relevant</th>
<th>Time-bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>What to accomplish?/Why?</td>
<td>How will I measure progress/success?</td>
<td>How can it be accomplished?</td>
<td>Is it worthwhile?</td>
<td>What is the time frame</td>
</tr>
</tbody>
</table>

S.M.A.R.T Goals - TEMPLATE
Continuous Improvement
S.W.O.T. Analysis

Purpose and benefits
- A Strengths, Weaknesses, Opportunities and Threats Analysis allows you and your team to visually layout the good and the bad for your project, process, team, organization, or individuals. This allows you to:
  - better understand your project/process
  - address weaknesses
  - deter threats
  - capitalize on opportunities
  - take advantage of strengths
  - develop goals and strategies for achieving them,
S.W.O.T. Analysis - TEMPLATE

**S** - STRENGTHS
- Things your company does well
- Qualities that separate you from your competitors
- Internal resources such as skilled, knowledgeable staff
- Tangible assets such as intellectual property, capital, proprietary technologies etc.

**W** - WEAKNESSES
- Things your company lacks
- Things your competitors do better than you
- Resource limitations
- Undervalued unique selling proposition
- Underserved markets for specific products
- Few competitors in your area
- Emerging need for your products or services
- Press/media coverage of your company

**O** - OPPORTUNITIES
- Emerging competitors
- Changing regulatory environment
- Negative press/media coverage
- Changing customer attitudes toward your company

**T** - THREATS
- Helpful (Positive)
- Harmful (Negative)

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MEASURE - involves more numerical studies and data analysis than the DEFINE phase. This phase focuses on measurement system validation and gathering root causes.

MEASURE DELIVERABLES

- Pareto Principle
- Data Collection Summary
- Process Mapping
- CTQ Tree
Purpose and Benefits

The Pareto Principle is often referred to as the 80/20 rule—**80% of consequences stem from 20% of causes**. In projects, 80% of the users’ needs are met by 20% of a system’s features. In software development, 80% of support requests stem from 20% of software bugs. In safety, 80% of injuries stem from 20% of hazards.

This principle is used to:

- Develop project priorities (processes to focus on)
- Draw focus to the greatest number of user-requested needs
- Illustrates the concept of minimum viable product (MVP)
Pareto Principle - GUIDELINES

How to Use:
• Step 1: Measuring – identify the problems and document them in a table. ...
• Step 2: Determine their order of importance. ...
• Step 3: Mark or score each recorded problem. ...
• Step 4: Group the identified problem and add the marks or scores. ...
• Step 5: Time to act
Continuous Improvement - Data Collection Plan

Purpose and Benefit

The Data Collection Plan is created during the Measure phase. It is a detailed document which describes the exact steps as well as the sequence that needs to be followed in gathering the data for the given Six Sigma project.

The steps include:
1. Identify the questions that you want to answer.
2. Determine the kind of data that is available.
3. Determine how much data is needed.
4. Determine how to measure the data.
5. Decide who is going to collect the data.
6. Determine where the data will be collected from.
7. Decide whether to measure a sample or the whole population.
8. Determine in what format the data will be displayed.
# Data Collection Plan - TEMPLATETE

<table>
<thead>
<tr>
<th>TYPE OF MEASURE</th>
<th>WHAT? What are we measuring?</th>
<th>WHY? Why are we measuring this?</th>
<th>HOW? How do we collect and record the data?</th>
<th>WHEN? When do we collect the data?</th>
<th>WHERE? Where in the process?</th>
<th>WHO? Who will collect it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
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<tr>
<td>In-process</td>
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<tr>
<td>Input</td>
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</tbody>
</table>

**WHAT?**
- What are we measuring?

**WHY?**
- Why are we measuring this?

**HOW?**
- How do we collect and record the data?

**WHEN?**
- When do we collect the data?

**WHERE?**
- Where in the process?

**WHO?**
- Who will collect it?
Continuous Improvements - Process Mapping

Purpose and Benefit

• Process mapping is used to visually demonstrate all the steps and decisions in a particular process. A process map or flowchart describes the flow of materials and information, displays the tasks associated with a process, shows the decisions that need to be made along the chain and shows the essential relationships between the process steps.

• Creating a process map helps organize processes and makes information visible to everyone. By creating a process map or flowchart, you are producing a visual example of the process to better understand it and see areas for improvement.

All work is a process

- Sleep Interrupted → Get Up? → Yes: Breakfast? → Yes: Fix Breakfast → Eat Breakfast
- No: Wait
- No: Decide What to Wear → Get Dressed → Look Good? → Yes: Close Up House → Leave for Work
  - No: Leave for Work

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Process Mapping Guidelines

How to Use:

- Step 1: Identify the problem. What is the process that needs to be visualized?
- Step 2: Brainstorm activities involved.
- Step 3: Figure out boundaries.
- Step 4: Determine and sequence the steps.
- Step 5: Draw basic flowchart symbols.
- Step 6: Finalize the process flowchart.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>What it signifies</th>
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<tbody>
<tr>
<td></td>
<td>Terminal</td>
<td>Used both where the process starts and ends.</td>
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<tr>
<td></td>
<td>Activity</td>
<td>Task or activity in the process.</td>
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<tr>
<td></td>
<td>Decision point</td>
<td>A decision is made. Different process paths and actions are taken as result from different decisions.</td>
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<tr>
<td></td>
<td>Subprocess</td>
<td>Sub-process steps included within this item.</td>
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<tr>
<td></td>
<td>Document</td>
<td>A written or electronic document is produced as an output of actions in the process.</td>
</tr>
<tr>
<td></td>
<td>Database</td>
<td>Database of information involved with this step.</td>
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<tr>
<td></td>
<td>Input / Output</td>
<td>Input or output to a process, such as information or a report.</td>
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<tr>
<td></td>
<td>Connector</td>
<td>Continue process map on another page when it won’t fit on only one. Put a letter [A or B, etc.] inside the circle where you end on one page, and put that same letter in another circle at point the process continues on the next page.</td>
</tr>
</tbody>
</table>
Critical to Quality (CTQs) are the key measurable characteristics of a product or process whose performance standards or specification limits must be met in order to satisfy the customer. These outputs represent the product or service characteristics defined by the customer (internal or external) are parameters that defines the requirements of the customers.

CTQs are very important while developing a product or service. In Six Sigma and other continuous improvement projects too, CTQ plays a critical role as the main purpose of many of these projects is to provide a product or service that satisfies the customers on various parameters.

CTQs characteristic or component that has a direct effect whether the overall process or product is perceived by the customer to be of acceptable quality. Identification of specific, measurable critical to quality (CTQ) characteristics is essential for meaningful and measurable business process improvement.
How To Use

• **Need** – This is the starting point for understanding how to delight the client. Needs are what your product or service must deliver to customers to make them happy.

• **Driver** – These are the elements that your customers will use to judge how well your product or service meets their needs. Identifying drivers gives project teams another level of understanding about how to satisfy their customers.

• **Requirement** – These are measurable performance standards that drivers must meet to satisfy the customer. Requirements help project teams measure the quality and performance of the product or service.
ANALYZE - The ANALYZE phase of DMAIC helps project teams identify problems in the production process that cause product defects. The ANALYZE phase provides tools to help spot the problems and determine if these problems are the root causes of defects.

ANALYZE DELIVERABLES

- TIM WOOD
- Fishbone Diagram (Ishikawa)
- Five-Whys
- Root Cause Analysis
Continuous Improvement – T.I.M. W.O.O.D.

Purpose and Benefits

There are seven original wastes (Muda). They are often referred to by the acronym ‘TIMWOOD’.

- T – Transportation
- I – Inventory
- M – Motion
- W – Waiting
- O – Overproduction
- O – Over processing
- D – Defects
### T.I.M. W.O.O.D. Guidelines

#### Process Waste

<table>
<thead>
<tr>
<th>T</th>
<th>I</th>
<th>M</th>
<th>U</th>
<th>W</th>
<th>O</th>
<th>O</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Information, Inventory</td>
<td>Motion</td>
<td>Underutilization</td>
<td>Waiting</td>
<td>Overproduction</td>
<td>Overprocessing</td>
<td>Defects</td>
</tr>
</tbody>
</table>

**Unnecessary movement of materials, files, and other items related to the work**
- Paperwork and hard-copy files going from one office to another
- Sending documents or other items to another city or region for processing

**“Work in process” beyond what is required to serve the customer**
- Files of forms, booklets, other printed items
- Rows of jam-packed file cabinets
- Long list of incomplete requests
- Big backlog of inquiries
- Backup of emails from customers
- Long line of customers (on phone or in person)

**Unnecessary movement of people doing the work**
- Moving from one area or office to another
- Cubicle to cubicle
- Going to the copier, scanner, fax
- Retrieving documents from multiple file boxes
- Excess keystrokes

**Instances in which available workplace resources are not fully leveraged to produce and deliver service**
- Underutilized:
  - Staff skills
  - Office space
  - Technology
  - Data
  - Institutional knowledge

**Delays between one process step ending and the next beginning**
- Nonproductive time
- Waiting for:
  - Equipment
  - Delivery
  - Catchup
  - Supplier
  - Mail/shipper
  - Voice approval
  - Sign-off
  - Needed info

**Producing outputs beyond what is needed and for immediate use**
- Processing too many
- Processing in advance of requests
- Throwing away or shelving the excess
- Things getting outdated
- Attitude of “we have to be ready”

**Adding value to a service beyond what customers want or will pay for**
- Double-checking, inspecting
- Bells and whistles
- Better than good enough
- Trying to “delight” the customer when “satisfying” is enough
- Reports that nobody reads

**Any aspect of the service that compromises quality in the eyes of the customer**
- Processing errors
- Inaccuracies
- Incorrect forms, materials
- Misleading information
- Broken links
- Difficult to read
- Forms, instructions difficult to understand
- Wasted materials

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Continuous Improvement –
Fishbone Diagram (Ishikawa)

Purpose and Benefits

A Fishbone Diagram is often used to identify and organize the potential causes of a business problem in an easy and understandable format. It is used to identify the sources of process variation which caused the problem to occur. It is called this way because of its shape that looks like a fishbone. Also called Ishikawa.

Let PEMME guide you!

P - People
E - Equipment
M – Methods
M – Materials
E - Environment
Fishbone Diagram - GUIDELINES

How-to-Use

Fishbone Diagram demonstrates Cause and Effects.

1. Agree on the problem statement (also referred to as the effect). This is written at the mouth of the “fish.”

2. Agree on the major categories of causes of the problem (written as branches from the main arrow). Major categories often include: equipment or supply factors, environmental factors, rules/policy/procedure factors, and people/staff factors.

3. Brainstorm all the possible causes of the problem. Ask “Why does this happen?” As each idea is given as a branch from the appropriate category (places it on the fishbone diagram). Causes can be written in several places if they relate to several categories.

4. Again asks “Why does this happen?” about each cause. Write sub-causes branching off the cause branches.

5. Continues to ask “Why?” and generate deeper levels of causes and continue organizing them under related causes or categories.
Continuous Improvement – 5 Why

Problem: Ran through a red light.

Why? Late for work.
Why? Woke up late.
Why? Alarm clock broke.
Why? Didn’t check if it worked.
Why? Forgot to do it last night.

Purpose and Benefits

The 5 Whys is a basic root cause analysis technique used in the Analyze phase. To solve a problem, we need to identify the root cause and then eliminating it. Therefore, main goal of the is to drill down to the bottom of problem to find out problem of occurrence or root cause and thereby preventing its recurrence. The benefits include:

• Helping identify the root cause of a problem.
• Determining the relationship between different root causes of a problem.
• It is one of the simplest tools; easy to complete without statistical analysis.
5 Why Analysis Template

Problem/Defect

1st Why?

2nd Why?

3rd Why?

4th Why?

5th Why?

Answer what caused the specific situation

Answer why the problem wasn’t detected

Answer what system(s) failed

Should be at the root cause near 5th question

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Continuous Improvement - Root Cause Analysis (RCA)

Purpose and Benefits

Root cause analysis (RCA) is a systematic process for identifying “root causes” of problems or events and an approach for responding to them. Root Cause Analysis leads to the underlying source of the defect/fault/problem, so the team can design solutions and change the process to permanently eliminate it.

Understanding Root Causes

- **Symptoms**
  - Result or outcome of the problem
  - What you see as a problem (Obvious)
  - *Achy, weak, tired*

- **The Problem**
  - Gap from goal or standard
  - *Fever*

- **Causes**
  - “The Roots” – system below the surface, bringing about the problem (Not Obvious)
IMPROVE

IMPROVE – The IMPROVE phase of DMAIC determines a solution which is based on the uncovered problem in the first three phases. The IMPROVE Phase consists of generating a potential solution, validating the pilot solution, mitigating risk and developing a roll out plan for implementation.

IMPROVE DELIVERABLES

• 5 S’s
• Plan, Do, Check, Act (PDCA)
• Error Proofing
Continuous Improvement – 5 S’s

Purpose and Benefits

- 5S is a system for organizing spaces so work can be performed efficiently, effectively, and safely. This system focuses on putting everything where it belongs and keeping the workplace clean, which makes it easier for people to do their jobs without wasting time or risking injury.

SORT
Distinguish needed items from unneeded items and eliminate the latter.

STRAIGHTEN
Keep needed items in the correct place to allow for easy and immediate retrieval.

SHINE
Keep the workplace neat and clean. Inspect through cleaning.

STANDARDIZE
Make up the rules, follow and enforce them. Make a part of the regular work routine.

SUSTAIN
Review new standards. Maintain established procedures.
5S - GUIDELINES

1. SORT
   Organization - keeping only what is necessary and
discard everything else - when in doubt, throw it out

2. SET IN ORDER
   Orderliness - arranging and label only necessary
items for easy use and return by anyone

3. SHINE
   Cleanliness - keeping everything swept and clean
for inspection - for safety and preventative
maintenance

4. STANDARDIZE
   Standardized cleanup - the state that exists when
the first three pillars or "S's" are properly maintained

5. SUSTAIN
   Sustaining the discipline - making a habit of
property maintaining correct procedures

SORT When in doubt, move it out
SET IN ORDER A place for
everything, and return everything to its place
SHINE Clean up your work area
STANDARDIZE Set rules for use
that the entire team supports and agrees to
SUSTAIN Make 5S a habit by
integrating it into your daily work routines

OFFICE OF RESEARCH ADMINISTRATION
Continuous Improvement – PDCA (Plan, Do, Check, Act)

Purpose and Benefits
PDCA is an iterative four-step management method used in business for the control and continuous improvement of processes and products. Plan, Do, Check, Act allows organizations to make improvements in business processes and methods while continually evaluating the results to ensure that the organization takes steps to improve efficiency.
The Plan-Do-Check-Act Procedure

- **Plan**: Recognize an opportunity and plan a change.
- **Do**: Test the change. Carry out a small-scale study.
- **Check**: Review the test, analyze the results, and identify what you’ve learned.
- **Act**: Take action based on what you learned in the study step. If the change did not work, go through the cycle again with a different plan. If you were successful, incorporate what you learned from the test into wider changes. Use what you learned to plan new improvements, beginning the cycle again.
Continuous Improvement – Error Proofing

Purpose and Benefits

- **Error-proofing** refers to the implementation of fail-safe mechanisms to prevent a process from producing defects. This activity is also know by the Japanese term poka-yoke. Poka-yoke/Error Proofing is any mechanism or device in a process that helps eliminate defects by preventing, correcting, or drawing attention to human error as they occur.
Error Proofing - GUIDELINES

- Obtain or create a flowchart of the process. Review each step, thinking about where the errors are likely to occur.
- For each potential error, work back through the process to find its source.
- For each error, think of potential ways to make it impossible for the error to occur. Consider:
  - Elimination: eliminating the step that causes the error.
  - Replacement: replacing the step with an error-proof one.
  - Facilitation: making the correct action far easier than the error.
- If you cannot make it impossible for the error to occur, think of ways to detect the error and minimize its effects.
- Choose the best mistake-proofing method or device for each error. Test it, then implement it.
CONTROL

CONTROL – The CONTROL phase is the conclusion of the team’s journey. The focus of this stage is to make sure that the action item created in the Improve Phase is well-implemented and maintained. Several tools are used in this stage to make sure that variables are within its limits. This is the handoff phase to the Process Owner to maintain the gains.

IMPROVE DELIVERABLE

• Process Monitoring Plan
• Control Chart
• PFMEA (Process Failure Modes and Effects Analysis)
PROCESS MONITORING PLAN

Purpose and Benefits

- **Process Monitoring Plan** is used while observing a process. A monitoring plan helps define: Key process and output measures for ongoing measurement of the improved process. When data is to be collected and at how often. Define the method for gathering, recording, and reporting data on the measures.
**PROCESS MONITORING PLAN TEMPLATE**

<table>
<thead>
<tr>
<th>Name of the Measure</th>
<th>Input, Process or Output?</th>
<th>What is the Target?</th>
<th>Method of Data Capture</th>
<th>Checking Frequency</th>
<th>Person Responsible</th>
<th>Upper/Lower Trigger Point</th>
<th>Who Will Respond?</th>
<th>Reaction Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1: Order Lead Time</td>
<td>O</td>
<td>less than 16 minutes for cold food; Less than 20 minutes for hot food</td>
<td>Time stamp, in and out</td>
<td>Daily</td>
<td>Server</td>
<td>Over 18 minutes for cold food; Over 22 minutes for hot food</td>
<td>Manager</td>
<td>Observe the process to see why it's taking longer. Make the corrections. Are the orders still being processed in FIFO order? Are Servers turning orders into the kitchen immediately after taking them? Are we stocked at point of use through peak hours?</td>
</tr>
</tbody>
</table>
Purpose and Benefits

- **The Control Chart** - is a graph used to study how a process changes over time. Data are plotted in time order. A **control chart** always has a central line for the average, an upper line for the upper control limit, and a lower line for the lower control limit.
The general step-by-step approach for the implementation of a control chart is as follows:

- Define what needs to be controlled or monitored.
- Determine the measurement system that will supply the data.
- Establish the control charts.
- Properly collect data.
- Make appropriate decisions based on control chart information.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous data, one figure at a time</td>
<td>Individuals and Moving Range I &amp; MR Chart</td>
</tr>
<tr>
<td>For example: A team is tracking the length of time, measured in days, it takes to process claims. They are randomly selecting one completed claim each day and plotting the time it took to complete that one claim.</td>
<td></td>
</tr>
<tr>
<td>Continuous data, averages with small sub-group sizes</td>
<td>Average and Range X bar &amp; R Chart</td>
</tr>
<tr>
<td>For example: A team is tracking cycle time, measured in days, for claims processing. They are randomly selecting five completed claims each day and plotting the average cycle time.</td>
<td></td>
</tr>
<tr>
<td>Continuous data, averages with large sub-group sizes</td>
<td>Average and Standard Deviation X bar &amp; S Chart</td>
</tr>
<tr>
<td>For example: A process owner is monitoring call length, measured in minutes and seconds. Each day, the average length for all calls received is plotted. The call center receives over 100 calls per day.</td>
<td></td>
</tr>
</tbody>
</table>
PFMEA (Process Failure Modes and Effects Analysis)

Purpose and Benefits

- **PFMEA (Process Failure Modes and Effects Analysis)** is a methodical approach used for identifying risks on process changes. The Process FMEA initially identifies process functions, failure modes their effects on the process. If there are design inputs, or special characteristics, the effect on end user is also included. The severity ranking or danger of the effect is determined for each effect of failure.
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Fill carafe with water</td>
<td>Wrong amount of water</td>
<td>Coffee to strong or weak</td>
<td>Faded level marks on carafe</td>
<td>Visual Inspection</td>
<td>Replace old carafe</td>
<td>Mel</td>
<td>Carafe replaced 9/15</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>24</td>
</tr>
</tbody>
</table>

**PFMEA (Process Failure Modes and Effects Analysis) - TEMPLATE**
To improve a business process, follow these steps.

- Map processes.
- Analyze the process.
- Redesign the process.
- Acquire resources.
- Implement and communicate change.
- Review the process.
If you have questions or need assistance with implementing Process Improvements or the DMAIC Process, contact the DRAGON TEAM!

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