8D Training

ASQ Tucson Old Pueblo Section

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Introduction/Overview
Problem Solving Inhibitors

- **Problem Described Incorrectly** – problem description was not clear enough or thorough enough to focus the Team on solving the correct issue.

- **Problem-Solving Effort Rushed** – to move quickly, steps in the problem-solving process are skipped.

- **Poor Team Participation** – team members do not participate effectively, so team failed to consider all the causes (lack of cross-functional expertise).

- **No Logical Process** – A disciplined system to prioritize, analyze, and review data/information was not used.

- **Lack of Technical Skills** – Statistical and problem-solving methods are not known by team members.
Management Impatience – Due to lack of knowledge of the problem-solving process, management demands to know exactly when a problem will be solved. This pressure causes the team to make an inadequate analysis.

Misidentified Root Cause – A potential cause is quickly identified as a root cause, concluding the problem investigation. However, the problem returns since the true root cause was not eliminated.

Permanent Corrective Actions Not Implemented – Although a root cause may be identified, action is taken to fully implement the permanent corrective actions. These actions often require management to approve costs and implement.
Types of Problem Solving

• Reactive (8D, 10-step)
  o Activities undertaken to respond to a specific Customer complaint (e.g. – product return) where a corrective action response is requested

• Proactive (A3)
  o Activities undertaken to address performance gaps identified by data analysis (e.g. – key metrics)

• Day-to-Day (“quick kills”) - PDCA
  o “Just do it” activities (e.g. – equipment breakdown)
  o No team required
What Is Meant by 8D?

It is short for “Eight Disciplines,” which are eight distinct steps of a systematic process for solving problems.

Where does it come from?
There are several problem-solving approaches available, such as Kepner-Tregoe, the Deming Cycle, A3, PDCA, etc. Ford Motor Company combined many of the successful elements from these into their Team Oriented Problem Solving (TOPS) Workshop, which this approach is based on.

Corrective action reporting from many diverse customers requires applying the 8D approach.

8D = TOPS
8D Problem Solving Methodology

1. Initiate Project Team
2. Define The Problem
3. Implement Containment Actions
4. Identify Root Causes
5. Develop and Verify Solution
6. Implement Corrective Actions
7. Prevent Problem Recurrence
8. Recognize Project Team

Problem Discovered!
Problem Resolved!

Quality Concepts & Methods Support These 8 Steps
Applying 8D Methodology

- Predicated on team approach.
- Use for a cause-unknown situation (all significant problems, not just Customer Returns)
- Fact-based, data-driven decision making. “If you can’t prove it, don’t say it!”
- Eliminate the Problem, not the Symptom
- Requires action planning and documentation for each step of the process.
- Focus on effectively using the process, NOT on writing the report.
- Keep an open mind – facts/data will guide us
## 8D vs. Continuous Improvement

<table>
<thead>
<tr>
<th><strong>8D PROCESS</strong></th>
<th><strong>CONTINUOUS IMPROVEMENT PROCESS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use an 8D process where there is a deviation between actual performance and expected performance. 8D is a reactive process.</td>
<td>Use a continuous improvement process where the actual performance meets the expected performance, but a higher level of performance is desired. Continuous Improvement is a proactive process.</td>
</tr>
<tr>
<td>Step 1: Form a team</td>
<td>Use a team approach</td>
</tr>
<tr>
<td>Step 2: Describe the problem</td>
<td>1. Initiate improvement project</td>
</tr>
<tr>
<td>Step 3: Implement containment actions</td>
<td>2. Identify customer needs</td>
</tr>
<tr>
<td>Step 4: Identify root causes</td>
<td>3. Understand current process</td>
</tr>
<tr>
<td>Step 5: Develop and verify solution</td>
<td>4. Characterize process with data</td>
</tr>
<tr>
<td>Step 6: Implement corrective actions</td>
<td>5. Design new process</td>
</tr>
<tr>
<td>Step 7: Prevent problem recurrence</td>
<td>6. Pilot and verify new process</td>
</tr>
<tr>
<td>Step 8: Congratulate the team</td>
<td>7. Standardize new system</td>
</tr>
<tr>
<td></td>
<td>8. Recognize team</td>
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</table>

The use of Six Sigma methods involves continuous improvement and innovation via specific tools used to:

Define; Measure; Analyze; Improve; and Control
Advantages of 8D Methodology

Why Use 8D?

- Provides a Structure
  - Systematic, yet flexible
  - Superior to usual methods
  - Efficient interdepartmental communication
- Common Approach
  - Widespread familiarity
  - Effective management evaluation and control
  - More skills and creativity
  - Buy-in eases implementation
- Teamwork
  - Good data is indisputable
  - Eliminates personal biases
- Fact Based
- Quality Methods
  - Tied to Deming philosophy
  - Powerful and commonly available statistical tool
  - 8D provides framework for application of methods
- Documentation
  - Standard format for reporting all actions
  - Later reference provides insight to problem solutions
Step 1: Initiate the Project Team

Quality Concepts & Methods Support These 8 Steps

- 1. Initiate Project Team
- 2. Define The Problem
- 3. Implement Containment Actions
- 4. Identify Root Causes
- 5. Develop and Verify Solution
- 6. Implement Corrective Actions
- 7. Prevent Problem Recurrence
- 8. Recognize Project Team

Problem Discovered!

Problem Resolved!
Objective

Establish a team of people with product and process knowledge, skill in the various technical disciplines, and allocated time and authority to implement actions to solve a problem.

Supporting Concepts and Methods

• Employee involvement/participative
• Team leadership skills
• Meeting facilitation skills
Team Composition

Members
Good team members are persons who are:
1. **Willing** to contribute
2. **Capable** of diagnosing problems
3. **Trainable** in the use of improvement methods
4. **Team players**, rather than individual participants

Team size
3 to 7 people is optimum. With fewer than 3 members, creativity and skills are limited and with more than 7 the team is too large for effective team dynamics.
   - Experts with specific skills can be rotated in and out of the team as their skills are needed.
Team Formation

Multi-discipline Project Teams

- Identify the expected time commitment from team members and ensure availability
  - Management support needed
- Goals must be clearly specified, quantifiable, and supported by all.
Doing business today is tougher than ever: 
- more demands 
- complex problems 
- Need to avoid wasted money, time, and effort.

A team of individuals can combine their skills/knowledge to solve these problems that are beyond the capability of any one person to solve alone.

Why a Team Approach?

Advantages of Teams

Skills
- more talent
- more experience
- more knowledge
- more technical competence
- cross departmental lines
- increased productivity (more theories and ideas)
- increased dignity, morale

Communication
- consensus decision-making
- buy-in to changes
- job enrichment

Participation
- better solutions
- solutions more likely to be accepted
- responsibility to complete slated mission

Effectiveness
Pitfalls To Avoid

• No leader empowered to implement ideas
• No champion assigned or available to assist the team in time of need
• Personality conflicts, domination by one member, negative attitudes (Why am I here?)
• Excessive management expectations, not enough time
• Insufficient problem solving skills by members
• Undefined progress – No sense of urgency, no goals
• Lack of data/facts, not shared by all

“If you don’t know where you’re going, any road will get you there”

“If there’s a doubt, then there is no doubt...Get the FACTS!!”
Step 2: Define the Problem

Quality Concepts & Methods Support These 8 Steps
To define the extent of the problem and its effects in quantifiable terms, resulting in a narrower focus for containment and root cause-finding efforts.

Supporting Concepts and Methods

- 5W2H
- Is/Is Not Analysis
- Check Sheets

- Pareto Diagrams
- Control Charts
Define the Problem

“A problem well stated is a problem half-solved.”
Charles Kettering

- Rarely will a problem description be complete/final at the beginning of the 8D process
- Problem cannot be completely described until it is well understood
  - Problem Description should be revised and updated to incorporate new facts/data
- Quantify the gap between what “is” and what “should be”
1. Customer Complaint
2. 5W2H
3. Data Collection
   a. Flow diagram
   b. Collect Data (attribute and variable)
   c. Stratify (check sheets and paretos)
   d. Statistical data (SPC, Cpk, etc)

4. Comparative Analysis
   a. Is/Is Not
   b. Table of known facts

5. Formulate Problem Statement
   a. Include benchmark
   b. Incorporate all important facts
   c. Concise and precise
Customer Complaint

• Describe the symptoms experienced by the customer (user) in their terms.

• Ensure the complaint is clearly and fully understood
  o Direct customer contact (ask clarifying questions)
  o Customer representatives may be on the team
  o Understand the problem from the customers’ viewpoint
Characterize the problem for further analysis through 5W2H:

**Who?** Identify who is associated with the problem. Which customer(s) are complaining? Which internal group(s) are complaining?

**What?** Describe the problem adequately. What is the defect and gap from “target”? What part or object is involved? Does the severity of the problem vary?

**Where?** If the defect occurs on a part, where is the defect located? Use a location check sheet. Where was the defect found (geographically)? What is the geographic distribution of complaints?
When? Identify the time when the problem started and past history (trends). Do all production shifts experience the same frequencies? What time of the year does the problem occur? When did the nonconformance occur? What was operating time? What shift? What season?

Why? Define why this is a problem for the Customer or organization. Translates “how big” (see next slide) into total business impact.
How? In what mode of operation was the problem discovered? What procedures were being used? What environmental conditions were present?

How Big? Quantify the extent and severity of the problem (quantity, percent, cost, DPPM, etc)
Is/Is Not Tool

Search:
Search for a comparative basis (act like a detective, include similar parts/situations). Put boundaries around the problem to narrow the search for a root cause. Ask numerous questions and gather as much data as possible to establish the “facts” of the problem.

• Who is experiencing the problem?
• Where was the discrepancy observed?
• Where on the part is the defect?
• When was the issue observed?
• How many bad parts are in the system?
• Who could be experiencing the problem but is not?
• Where could the issue have been observed but was not?
• Where on the part could the defect be but is not?
• When could the issue have been observed but was not?
• How many bad parts could be in the system but are not?
### Known Facts:
Make a table of the facts discovered in the Search.

<table>
<thead>
<tr>
<th>Is</th>
<th>Is Not</th>
<th>Get Info On</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the object with the defect?</td>
<td>What could be, but is not, the object with the defect?</td>
<td></td>
</tr>
<tr>
<td>What is the defect?</td>
<td>What could be, but is not, the defect?</td>
<td></td>
</tr>
<tr>
<td>Where is the object with the defect observed?</td>
<td>Where could the object with the defect be observed, but is not?</td>
<td></td>
</tr>
<tr>
<td>Where is the defect on the object?</td>
<td>Where could the defect be on the object, but is not?</td>
<td></td>
</tr>
<tr>
<td>When was the object with the defect first observed?</td>
<td>When could the object with the defect first have been observed, but was not?</td>
<td></td>
</tr>
<tr>
<td>When was the object with the defect been observed since then?</td>
<td>When could the object with the defect have been observed since then, but was not?</td>
<td></td>
</tr>
<tr>
<td>When is the defect first observed in the cycle of the object?</td>
<td>When could the defect first be observed in the cycle of the object, but is not?</td>
<td></td>
</tr>
<tr>
<td>How many units of the object have the defect?</td>
<td>How many units of the object could have the defect, but do not?</td>
<td></td>
</tr>
<tr>
<td>How much of each unit is affected?</td>
<td>How much of each unit could be affected, but is not?</td>
<td></td>
</tr>
<tr>
<td>How many defects are on each unit?</td>
<td>How many defects could be on each unit, but are not?</td>
<td></td>
</tr>
<tr>
<td>What is the trend?</td>
<td>What could be, but is not, the trend?</td>
<td></td>
</tr>
</tbody>
</table>
Ask questions to understand what is different between the “Is” and “Is Not” conditions:

- Helps to focus the thoughts towards the specific problem area
- Avoids trying to “boil the ocean” by making problem scope more manageable
- Important, but often overlooked step in process
Problems appear because something has changed. The search for the root cause is a search for changes. Ask, “What changes have occurred?”

- What changes have occurred in the plant?
- What new suppliers are being used?
- Have any new operators been hired?
- Has new material been used? A new batch?
- Is the process capability the same as usual?
- Was the weather unusual when the problem occurred?
### Is/IsNot Worksheet

<table>
<thead>
<tr>
<th>Who? (internal and/or external)</th>
<th>Is</th>
<th>Is Not</th>
<th>Differences</th>
<th>Changes</th>
<th>Get Information On?????</th>
</tr>
</thead>
<tbody>
<tr>
<td>What? (object) (defect)</td>
<td>What Customer is impacted?</td>
<td>What Customers are not impacted?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where? (geographically) (on object)</td>
<td>Where is the object with the Defect observed?</td>
<td>Where could the object with the Defect be observed, but is not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the Defect?</td>
<td>What is the Defect?</td>
<td>What could be, but is not the Defect?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When? (first seen)</td>
<td>When was the object with the Defect first observed?</td>
<td>When could the object with the Defect first have been observed, but was not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(when else seen)</td>
<td>When has the object with the Defect been observed since then?</td>
<td>When could the object with the Defect have been observed since then, but was not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(when seen in process or life cycle)</td>
<td>When is the Defect first observed in the cycle of the object?</td>
<td>When could the Defect first be observed in the cycle of the object, but is not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Why? (impact of problem)</td>
<td>What is the impact of the Defect on the Customer?</td>
<td>What could the impact be, but is not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How? (operating mode/environment)</td>
<td>What operating mode was the object in when the Defect was observed?</td>
<td>What operating mode could the object have been in when the defect was observed, but was not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How Big? (total count) (area/percentage) (count per unit) (trends)</td>
<td>How many units of the object have the Defect?</td>
<td>How many units of the object could have the Defect, but do not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How much of each unit is affected?</td>
<td>How much of each unit could be affected, but is not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>How many Defects are on each unit?</td>
<td>How many Defects could be on each unit, but are not?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>What is the trend?</td>
<td>What could be, but is not; the trend?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Questions shown are examples and may be modified for each specific problem.
Note: Specific category for each questions is less important than getting the information itself.
Note: Table can be expanded to include other facts/test results as they are learned.
Develop Problem Statement

The Problem Statement is the expression of the difference between what should have happened and what actually happened

- Includes the baseline or benchmark for good performance
- Contains reference to one problem only
  - Each problem is unique and need to be clearly understood in order to be solved
- Should include information from all of the 5W2H sections
Common Pitfalls

Common pitfalls when writing problem statements include:

• Problem statement is too general (lacks detail and specifics). A “general” problem is difficult to solve correctly.
  
  • Problem statement describes a root cause instead of problem effects
    
    o Don’t get into a root cause debate at Step 2
    o Step 4 is for determining the root cause
    o Step 2 is for clearly describing the problem to be solved and quantifying the effects on downstream users or customers

• Embedding a solution in the problem statement. When we embed a solution into the problem statement
  
  o Steps 5 and 6 are for solutions (corrective actions)
  o Don’t get locked into a decision before all facts are known
Problem Statement with Embedded Solution
Revise order processing procedures to remedy recent delays in processing customer orders.

Revised Problem Statement
Frequent delays and errors in processing orders for all customers during the last two months.

How could this statement be improved further?…
Step 3:
Implement Containment Actions

Quality Concepts & Methods Support These 8 Steps:

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8. Recognize Project Team
To define, implement, and verify the effectiveness of temporary actions to isolate customers from the effects of the problem.

Supporting Concepts and Methods

• Manufacturing records
• Histograms
• Control Charts
Containment Actions are:

- Intended to protect a Customer from effects of a problem
- A temporary fix to buy time for root cause analysis and C/A implementation (“stop the bleeding”)
- Not cost effective (use good business sense and judgement when choosing)
- Quick fixes designed only to address the effect of a problem (usually detection-based)
- Must remain in place until permanent C/A implemented
- Must include a review of product at all phases (see next slide for details)
  - Step applies to all Quality issues, not just Product Returns
Material/Product Locations (containment)

- Raw Material
- Semi-finished Goods (WIP)
- Finished Goods
- At Customer
- At Supplier
- In transit (from Supplier or to Customer)
- Shipping and/or Receiving Dock
- Materials on order (future shipments from Supplier)
Implement Containment Actions

Common Containment Actions:

• 100% inspection to sort out defects
• Stop production from a known source of the problem
• Purchase parts rather than make in-house
• Single source to one rather than multiple suppliers
• Use back-up tooling (fewer cavities/nests)
• Others?

Do not consider containment action a permanent solution to a problem!
Containment Follow-Up

After implementing containment actions, verify their effectiveness by measuring effects in quantifiable terms.

- The effectiveness of the Containment Action must be monitored to ensure proper protection of the customer is maintained.
- The benefit of a Containment Action must last until the root cause is identified and permanent corrective action is implemented.
- Decision making tools are used in this step to ensure proper thought is given when choosing the actions.
- Risk assessment is an important step during the decision-making process.
Interim Containment Process

1. Decide to use interim containment
2. Establish criteria for decision making
3. Choose best containment action
   - No
     - Will customer be isolated from the defect?
       - Yes
         - Defect eliminated?
           - Yes
             - Corrective Action complete?
               - Yes
                 - Discontinue Containment Actions
               - No
                 - Continue monitoring containment effectiveness
                   - Yes
                     - Corrective Action complete?
                       - Yes
                         - Discontinue Containment Actions
                       - No
                         - Discontinue Containment Actions
     - No
       - Will the containment avoid creating other problems?
         - Yes
           - Implement the interim containment
             - Plan the action
             - Monitor Progress
             - Evaluate results
             - Defect eliminated?
               - Yes
                 - Corrective Action complete?
                   - Yes
                     - Discontinue Containment Actions
                   - No
                     - Continue monitoring containment effectiveness
                       - Yes
                         - Corrective Action complete?
                           - Yes
                             - Discontinue Containment Actions
                           - No
                             - Discontinue Containment Actions
               - No
                 - Continue monitoring containment effectiveness
                   - Yes
                     - Corrective Action complete?
                       - Yes
                         - Discontinue Containment Actions
                       - No
                         - Discontinue Containment Actions
           - No
             - Continue monitoring containment effectiveness
               - Yes
                 - Corrective Action complete?
                   - Yes
                     - Discontinue Containment Actions
                   - No
                     - Continue monitoring containment effectiveness
                       - Yes
                         - Corrective Action complete?
                           - Yes
                             - Discontinue Containment Actions
                           - No
                             - Continue monitoring containment effectiveness
Interim Containment is a legitimate method to buy time.

Containment Actions Compare to the Band Aid Approach

<table>
<thead>
<tr>
<th>Interim Containment</th>
<th>Characteristic</th>
<th>Band Aid Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Attack Symptoms</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Added Costs</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>Monitored During Use</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Documented</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Effectiveness Verified</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>Replaced by Permanent CAR</td>
<td></td>
</tr>
</tbody>
</table>

Interim Containment Liabilities
1. May be forgotten and remain in effect
2. Costly due to sort/rework
3. Not necessarily 100% effective
4. Risks must be assessed (Customer, Plant)
Step 4: Identify Root Cause(s)

Quality Concepts & Methods Support These 8 Steps

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Problem Discovered!

Problem Resolved!
To identify and test potential causes using the problem description and test data to isolate and verify the root cause.

**Supporting Concepts and Methods**

- Brainstorming
- C/E Diagrams
- 3L5W (3-leg 5-Why)
- Histograms
- Control Charts

- Capability Studies
- Gage R&R
- Scatter Diagrams
- Design of Experiments
- FMEAs
Types of Root Cause

2 types of root cause:

“Occurrence” Root Cause:
- A breakdown in prevention activities (e.g. – training, drawings, fixtures, etc)
- The specific local cause that resulted in the specific problem reported

“Escape” Root Cause”:
- A breakdown in an inspection/detection operation
- Explains why the defect/problem was allowed to “escape” to a downstream operation (e.g. – next mfg step or Customer)

Both types of Root Cause must be addressed:
- Only addressing “occurrence” allows similar causes to continue to escape to the Customer (appears to be a repeat occurrence)
- Only addressing “Escape” leaves unnecessary waste (e.g. – scrap/rework) in the system
The Fact Funnel

- Data Input
- Data Input
- Data Input
- Data Input
- Data Input
- Is/Is Not
- Differences
- Changes Noted
- Hypotheses Testing
- Likely Causes

Root Cause
Brainstorm Potential Causes

A good way to produce a maximum amount of ideas is to conduct a brainstorming session:

• **Cause-and-effect diagram (C/E Diagram)** is an excellent tool to assist in brainstorming for causes
• All possible causes of the problem should be identified
• The more detailed the C/E diagram, the greater chance the root cause will be included

All likely, potential, and even improbable causes discussed in the meeting should appear on the fishbone (cause and effect) diagram.
Cause and Effect Diagram

> Reasons For Nonconformance

PEOPLE  METHODS  EQUIPMENT

MATERIAL  MEASUREMENT  ENVIRONMENT

< Reasons Not Detected

PEOPLE  METHODS  EQUIPMENT

MATERIAL  MEASUREMENT  ENVIRONMENT

PROBLEM
(Effect)
Ask Five Whys

Review symptoms – or effect – of the problem. To drive your team’s understanding from the effect to the causes, ask, “Why?” five times!

Example – machine stoppage

Typical (one Why) exchange:

“How did the machine stop?”
“Fuse blew due to an overload.”

Corrective action: Replace the fuse: End of problem?
Five Whys (continued)

Five-Why Exchange

Machine stopped

Why? (1) Fuse blew (overload)
  Why? (2) Lubrication inadequate
  Why? (3) Pump not working
  Why? (4) Axle damage
  Why? (5) Impurity in pump

Corrective Action: Install a filter on the lubrication pump.

Ask “Why?” until the answer is not known or can’t be controlled... then proceed with the investigation.
Five Whys (continued)

This tool allows the user to reduce the likelihood of solving effects, rather than the base problem itself.

- Is this a good permanent solution to the problem?
- Could we have asked “Why?” once more?
- Does a filter on the lubrication pump act as a permanent solution?

- HINT: What must you do with a filter? (Clean/replace)
    How did the impurity get into the fluid or pump?
3-Leg 5-Why Analysis Work Sheet

Enhances basic 5-Why tool. Use all (3) paths to thoroughly investigate why the specific nonconformance occurred, why it was not detected by process controls, as well as why the overall governing system, policies, procedures, or process allowed this nonconformance (and perhaps others like it) to occur. Check continuity of logic by reading back using the “Therefore” test.

Verification Criteria:
The underlying root cause has been reached only when the final why satisfies this criteria:

- It initiates and causes the event we are seeking to explain.
- It is directly controllable.
- The elimination of that root cause will result in the elimination or reduction of the problem.
Select Root Cause

Interpret data and develop potential hypothesis
  - Many different ideas may exist as to what the true cause of a problem is.

Compare all hypothesis to is/is not data (investigation facts)
  - The true cause will have all facts either supporting the explanation of being unrelated.
  - Any fact refuting a hypothesis means that either the fact is incorrect (bad data) or the hypothesis needs revision.

Continue research as needed
  - Verify/validate facts in question.
  - Revise hypothesis or identify cause interactions.

Always applies to “occurrence” root cause, but can also apply to “escape” root cause.
Be Willing to Re-evaluate

Many have the mistaken belief that data-oriented problem solving consists of collecting relevant data, analyzing the results, and determining the correct solution. After data is collected, new questions arise, and original assumptions may change. More than one iteration is usually necessary to find the root cause. The path is not a straight line, but rather a spiraling one.
Verification

Turn It On…Turn It Off

Through experimentation (or simulation), verify that the real root cause has been found. It should be possible to create and eliminate the problem by installing and removing the cause.

The true root cause should be able to explain all of the data and facts collected up to this time.
Step 5: Develop & Verify Solution

Quality Concepts & Methods Support These 8 Steps

1. Initiate Project Team
2. Define The Problem
3. Implement Containment Actions
4. Identify Root Causes
5. Develop and Verify Solution
6. Implement Corrective Actions
7. Prevent Problem Recurrence
8. Recognize Project Team

Problem Discovered!

Problem Resolved!
Objective

To select from alternative solutions to the problem and verify that the problem causes are eliminated, without introducing new problems.

Supporting Concepts and Methods

- Brainstorming
- Risk Assessment
- Capability Studies
- Decision Matrix
- Gage R&R
- Control Charts
Choose & Verify Corrective Action

- Corrective action decision criteria is established through the decision making process
- Objectively evaluate each possible action against a predetermined decision criteria
- Prove that the corrective action (or combination of actions) will eliminate the problem
  - Conduct verification tests
  - Remove containment temporarily
    - Only normal production influences should be present
- Establish indicators to ensure the defect is eliminated with high confidence
Verify the Solution

It is critical to verify that the solution will eliminate the problem.

- Review should happen before implementation of the corrective action
  - Prove that the fix will work as planned
  - No unintended negative consequences

Verification Approaches:
- Design Verification Testing
- Production Validation Testing
- Bench/Lab Testing
- Simulation
1. **Describe the end result**
   - What is the overall objective that must be achieved?

2. **List the decision criteria**
   - Differentiate between “needs” and “wants”
   - *Pros and Cons* must be measurable and realistic
   - Make sure you cover all the bases and your *Criteria* represent all areas (time, money, law, people, production, etc)

3. **Identify the potential Solutions**
   - Identify all the choices you have that may work
   - Make certain all ideas are included.
   - Balance reactive (inspection-based) and preventive (error-proofing) activities
4. Evaluate the potential solutions
   o Rank options against identified criteria
   o Identify any potential risks of each solution
   o Assess the probability of the risk occurring and the seriousness to your decision if it did occur

5. Choose a solution or set of solutions
   o Use results of assessment (prior step)
     • See next slide for Decision Making Worksheet
   o A robust solution must consider:
     - Cost
     - Timing
     - Effectiveness
     - Implementation Issues
     - Potential Side Effects

Select the option which provides the results you want to create and has acceptable risk connected with it.
### DECISION MAKING WORKSHEET

**CRITERIA (2)**

<table>
<thead>
<tr>
<th>GIVENS:</th>
<th>A 2654 Glenmore</th>
<th>B Build in new subdivision</th>
<th>C 194 Stoney Creek</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>minimum 1400 sq ft.</td>
<td>1438 sq. ft.</td>
<td>Y subdivision restriction min. 1800 sq. ft.</td>
<td>Y lots are large</td>
<td>Y</td>
</tr>
<tr>
<td>yard for dogs - min. 250 sq. ft.</td>
<td>huge yard</td>
<td>Y lots are large</td>
<td>Y corner lot-340 sq. ft.</td>
<td>Y</td>
</tr>
<tr>
<td>within 20 minutes of work</td>
<td>about 12 min. in a.m.</td>
<td>Y 2 min. to interstate!</td>
<td>Y Yes</td>
<td>Y</td>
</tr>
<tr>
<td>minimum 1 car garage</td>
<td>one car garage</td>
<td>Y 2 car garage, std.</td>
<td>Y 1 car garage</td>
<td>Y</td>
</tr>
<tr>
<td>= $120,000</td>
<td>asking $118,500</td>
<td>Y Prelim. est. $145,000</td>
<td>N $115,000</td>
<td>Y</td>
</tr>
</tbody>
</table>

**WANTS:**

| large master bedroom | 7 no; 10' x 11' | 2 14 | yes, 15' x 15' | 9 63 |
| large closets | 6 master is large, others small | 4 24 | all good sizes | 6 36 |
| attached garage | 7 yes! | 10 70 | no, but close | 4 28 |
| low maintenance exterior | 9 brick & alum. siding | 7 63 | stucco | 9 81 |
| neighborhood with sidewalks | 4 yes, crumbly ones | 4 16 | yes - nice | 8 32 |
| good school systems | 5 average | 5 25 | above average | 7 35 |
| separate laundry room | 6 yes | 10 60 | (in basement) | 1 6 |
| mature trees | 3 yes, some | 5 15 | yes - lots | 7 21 |
| near shopping | 2 Kroger - 1 mile Target - 1 mile | 8 16 | shopping ctr. 5 miles | 3 6 |
| no basement | 8 No! | 10 80 | yes, finished, clean | 5 40 |

**RELATIVE MERIT**

| (Total Score): | 550 | 338 |  | 348 |  |
RISK ANALYSIS (6)

"If we do this, what might happen, contrary to our interest?"

<table>
<thead>
<tr>
<th>SOURCES</th>
<th>(CHOICE)</th>
<th>(7) ATTRACTION CHOICES</th>
<th>P</th>
<th>S</th>
<th>P</th>
<th>S</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. RISK</td>
<td>What characteristics of this choice may fail to satisfy totally the GIVENS?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. RISK</td>
<td>What features or characteristics of this CHOICE compromise or threaten an important want?</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3. UNIVERSAL</td>
<td>Do you anticipate problems with this choice in any of the following categories?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>PROCEDURE</td>
<td>Investigate one choice at a time. All threat assessment by same individual or group.</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

"SERIOUSNESS" No. 10 means rejection if probability is certain (10 x 10).
Step 6: Implement Corrective Actions

Quality Concepts & Methods Support These 8 Steps
Objective

Develop implementation action plan:
- Define actions, responsibilities, timing, and req’d support
- Define prevention and protection actions. Involves both action planning and immediate validation of actions.

Supporting Concepts and Methods

- PDCA process
- Process Flowcharts
- Control Charts
- Standard Work
- Capability Studies
- Control Plans
- FMEAs
- Error Proofing
PDCA Cycle

Plan

Do

Act

Check
Plan

- Develop plan for implementing specific actions
  - What documentation needs to be updated?
    - Work instructions, Drawings, Control Plans, FMEAs, Computer programs, etc
  - What people need to be retrained?
    - Operators, Inspectors, Engineers, other Support personnel
  - What organizations need to be notified?
    - Internal departments, Suppliers, Customers
  - What new problems are presented by changes and how will they be addressed?
    - FMEA, Risk Assessment, etc
  - Who owns each task and what is the targeted implementation date?
  - How will progress be tracked?
  - Develop contingency plans if problems are encountered
  - When will containment actions be removed?
Do

- Execute the Plan
  - Use existing control processes
    - Document control
    - Engineering Change (ECO/ECR)
    - Customer notification (PCN)
    - Supply Chain processes
    - Training processes
  - Identify the effective date of changes

Project Management Tools
- Gantt Charts (High Level)
- Task Lists (Detail Level)
- Report Outs

Even a great plan can fail if not executed properly
Check

• Review process to ensure things are working according to Plan
  o Track progress and determine resources needed to meet commitment dates
  o Review performance results to ensure improvements are being realized
  o Review costs to ensure financial impacts are in line with expectations
  o Ensure that no unintended consequences are happening (quality, efficiency, safety, etc)
Act

• Make necessary adjustments as needed
  o Reapply containment actions if problems still present and revise corrective actions (back to problem solving and “Plan” phase)
  o Deploy resources in different way to get execution back on track
  o Move on to next opportunity if everything is complete and achieving desired results
Remember

Corrective actions remove the root cause of the problem, not just the effect. Corrective actions are permanent. The problem should not be able to return.
Step 7: Prevent Problem Recurrence

Quality Concepts & Methods Support These 8 Steps
Objective

To modify the methods, equipment, materials, process procedures and management systems and practices to prevent related problems from occurring (same or similar issues)

Supporting Concepts and Methods

- Process Flowcharts
- Standard Work
- Error Proofing
- FMEAs
- Control Plans
Types of Preventive Actions

• Sustain the gains for current improvements
  o Update procedures/documentation, training, fixtures, error-proofing, etc

• Similar problems within the same work area
  o Apply improvements to prevent similar problems from occurring
  o Use FMEA to help identify opportunities (e.g. - multiple causes for a single failure mode/symptom)

• Same or Similar problem in another part of the organization
  o Apply improvements to prevent future problems
  o Learn from prior mistakes/problems
  o Share the learning
Lack of Prevention Leads to a Cycle of Waste

- Constantly Working on Past Concerns (Fire fighting)
- Errors, Delays, Patchwork Solutions C.Y.A.
- Emotions High, Stress
- Time Absorber (Fixing Problems)
- Lack of Clear Priorities
Step 8:
Recognize Project Team

Quality Concepts & Methods Support These 8 Steps
Objective

To recognize all the team members for their individual and collective efforts and develop a climate for ongoing improvements.

Supporting Concepts and Methods

- Employee Involvement/Participative Management
- Interpersonal Communication Skills
Recognize the Team

If recognition is not given, team members are less willing to participate and are likely to become discouraged. Recognition and feedback is the most effective method available to shape behavior.

“You get what you expect.”

- Be specific on facts of each individual’s input
- Sincerity in both public and private recognition is required to make it acceptable to the recipient
  - If you don't believe it, the team member won’t either
Recognize the team’s collective efforts (both past and present) in solving the problem and show appreciation for individual contributions. Team members are in the best position to begin this process.

- People respond favorably to sincere, thoughtful recognition.
- Recognition makes people “feel good” about themselves, their achievements, and the organization that took the time to acknowledge them.
- Recognition provides very positive reasons for team members to participate in future efforts.
Forms of Recognition

Top Management Letter
• Deliver at home (Family)
• Post on bulletin board (Co-workers)
• Place in personnel file (Management)

Performance Review
• Include as major contribution

Plaque
• For outstanding contribution
• Personal, and specific to problem solved.

Recognition needs can differ greatly from person to person.