Management Problem Solving Techniques for Decision Makers

ASA 2013 Annual Conference
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FAA-DER  FAA-DAR

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TRAINING PROVIDED TO THE AVIATION COMMUNITY
Overview

1: Introductions/Purpose
2: Approaches to solving problems
3: Where do problems come from? (CARs)
4: Defining some terms
5: Steps to an effective Problem Solving Strategy (RCA)
6: Management tools for problem-solving with examples
7: Summary
Exercise

While pouring yourself a cup of coffee in the cafeteria, a supervisor of Customer Service walks up to you for help:

Supervisor: “You know, ever since Sally was transferred to my department, reported customer complaints have skyrocketed! I had my best employee, Sam, train her. I really need some help here. Any suggestions?”

1. What is your impression of the Supervisor?
2. What is your impression of Sally’s performance?
3. What do you recommend?
4. What information (data) have you collected and analyzed to support your recommendations?
4 Modes of Problem Solving

Predictive mode:
- Based on current performance what is the likelihood of achieving objectives?

Proactive mode:
- Analyzing past failures and looking for future improvements

Preventive mode:
- Putting in place solutions before problems occur

Reactive mode:
- Solving the problem that has occurred
Traditional Approach

- Fire Fighting
- Quick Fix
- Not taking enough time for analysis
- Going from one crisis to another
- Look for the guilty party - "Who did that?"
- Generate laundry list of solutions to firefight the symptoms
- Narrow-focus results in sub-optimization of system
- Focus on $ metrics alone and hope processes improve

System Approach

- Many factors making up a complex situation
- Fully understanding the problem. Address the systemic root cause(s)
- Permanently fix and improve performance
- Seek total understanding of the process:
  - “How did that happen?”
- Take time to understand the big picture
- Elicit dialogue, diverse perspectives, to apply the solution
- Optimize the whole enterprise
- Focus on improving processes that actually effect performance metrics
The Scientific Process

- Identify a problem
- Gather Information
- Formulate a hypothesis
- Design and Experiment
- Record and Organize Data
- Analyze Data
- Draw Conclusions

Use conclusions to develop a new hypothesis
The Management Process
Applies the Scientific Method (PDCA cycle) to Management Systems . . .

Activities planned → Activities executed → Results reported

Activities adjusted ← RCs & CFs Identified ← Problems Investigated
The Audit Process

Applies the Scientific Method (PDCA cycle)
to Management Systems . . .

Audit planned → Audit executed → Results are reported

Corrective action → RCs & CFs Identified → Event Investigation
Steps of an Effective Problem Solving Strategy (RCA)

Management Problem Solving

QMS Root Cause Analysis

They are one in the same!!!
So, where do Management Problems come from?

From unintended results!
EXERCISE #1
In your own words...

1. What does “problem” mean?
2. What does “problem solving” mean?
3. What does “Root Cause Analysis” mean?
4. What does “Corrective Correction” mean?
5. What does “Corrective Action” mean?
5 Steps to an Effective Problem-Solving Strategy

1. Conduct Investigation (Data Collection)

2. Perform Root Cause Analysis (using problem-solving management tools)

3. Implement Corrective Actions

4. Report your Results

5. Follow Up to Prevent Recurrence
Management Problem-Solving Tools

- Used by hundreds of major corporations including: Boeing, Airbus, NASA, Lockheed, Apple, Microsoft, GE, ASQ, major universities, FAA, DOD, ICAO etc.

- Six Sigma, Lean Manufacturing, Certified Quality Managers.

- Taught at major universities in Quality Management, Industrial engineering, Operations Management & MBA programs.
# Management Problem-Solving Tools

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| The 5 Whys                           | **Root Cause Analysis Techniques**                   |
| Brainstorming                        |                                                      |
| Barrier Analysis                     |                                                      |
| Human Performance/ Human Factors     |                                                      |
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<td>12. Human Performance/ Human Factors</td>
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</table>
1. Check Sheet Example

EVENT: Pick Tickets w/ incorrect shipping instructions
TIME PERIOD: 01 Feb to 28 Feb 2013
OBSERVER:  Bob Smith

<table>
<thead>
<tr>
<th>Category</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avionics</td>
<td>III</td>
</tr>
<tr>
<td>Expendables</td>
<td>III</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>II</td>
</tr>
<tr>
<td>Pneumatics</td>
<td>III</td>
</tr>
<tr>
<td>Structures</td>
<td>II</td>
</tr>
<tr>
<td>Other</td>
<td>I</td>
</tr>
</tbody>
</table>
## 2. Pareto Analysis

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>NUMBER OF DEFECTS</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor design</td>
<td>80</td>
<td>64 %</td>
</tr>
<tr>
<td>Wrong part dimensions</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Defective parts</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Incorrect machine calibration</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Operator errors</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Defective material</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Surface abrasions</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td><strong>125</strong></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>
2. Pareto Chart Example

The Pareto Chart illustrates the causes of poor quality with the following percentages:

- Poor Design: 64%
- Wrong dimensions: 13%
- Defective parts: 10%
- Machine calibrations: 6%
- Operator errors: 3%
- Defective materials: 2%
- Surface abrasion: 2%

These percentages reflect the relative impact of each cause on the poor quality of the product.
3. Flow Chart

Start/Finish → Operation → Operation → Decision → Operation

Operation → Decision → Start/Finish

Decision → Operation → Operation
3. Flow Chart Example
Documentation process

- Stage 1: Creation
  - Create initial draft
  - Review draft
  - Incorporate review comments
  - Re-draft document
  - Approved document

- Stage 2: Polishing
  - Proofread text
  - Produce final draft
  - Check final draft
  - Approved document

- Stage 3: Production
  - Layout text
  - Review layout
  - Produce print masters
  - Print copies
4. Histogram
4. Histogram

- Bar-graph used to show the distribution of a set of data
- Helps determine:
  - If a process is in control (steady-state; bell-shaped)
  - If outcomes of two processes are combined in one set of data (Bi-modal; double-hump)
    - e.g. day-shift & night-shift; airline customers and distributor-customers
4. Histogram Bi-Modal Example
5. Scatter Diagram
5. Class Exercise

Your boss wants to improve efficiency in your inventory operations. The current process to receive and stock bulk inventory takes 4 ¾ hours per crate. Your boss has proposed a new process. You conducted a test and gathered the following data that describes the new proposed process. The data is shown below:

<table>
<thead>
<tr>
<th>Trial</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (Hours)</td>
<td>7.5</td>
<td>6.4</td>
<td>5.8</td>
<td>5.4</td>
<td>5.1</td>
<td>4.9</td>
<td>4.8</td>
<td>4.6</td>
</tr>
</tbody>
</table>

### New Proposed Process Test Results

- **Comparing Processes**
  - **Current process**: Average = 4.75 hours/process
  - **Proposed new process**: Average = 5.6 hours/process
    - Range = 4.6 to 7.5 hours/process

A rival department head doesn’t like your boss, doesn’t like change, and believes in sticking with the current “tried-and-true” process. He wants to leave things “just the way they are”!

The rival has evaluated the above data (your data!) to support his position. Based on his review (of your data!) he claims your boss’s new process will require 5 hours and sometimes up to 7 ½ hours per crate; a possible 68% increase in workload above the way things are being done now!

He chants in the halls, “Don’t fix what’s not broken!”

Your boss and the rival supervisor have been called into the President’s office to settle this matter and make an executive decision to either:

1. Roll out your boss’s new process, or
2. Abandon the new idea and leave things the way they are.
So, what is the right decision?

(1) Roll out your boss’s new process?
   or

(2) Abandon the new idea and leave things the way they are?
5. Comparing Processes

![Graph comparing New Process and Current Process](image-url)
5. Comparing Processes

Current Process 1\textsuperscript{st} 40 crates
Labor = (4.75)(40) = 190 m-hrs
2\textsuperscript{nd} 40 crates = 190 m-hrs

New Process 1\textsuperscript{st} 40 crates
Labor = \(\sum 1\text{thru } 40 = 160 \text{ m-hrs}\)
2\textsuperscript{nd} 40 crates:
(3.2)(40) = 128 m-hrs (62 m-hrs savings)
6. Control Chart

UCL = 23.35
LCL = 1.99
$\bar{c} = 12.67$
### Table

<table>
<thead>
<tr>
<th>Month</th>
<th>QTY</th>
<th>REJ</th>
<th>%REJ</th>
<th>%MR</th>
<th>UCL</th>
<th>LCL</th>
<th>%REJ(ave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 01</td>
<td>21</td>
<td>5</td>
<td>23.8%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 02</td>
<td>16</td>
<td>4</td>
<td>25.0%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 03</td>
<td>24</td>
<td>3</td>
<td>12.5%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 04</td>
<td>13</td>
<td>3</td>
<td>23.1%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 05</td>
<td>22</td>
<td>4</td>
<td>18.2%</td>
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<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
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<tr>
<td>2012 06</td>
<td>24</td>
<td>6</td>
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<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
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<tr>
<td>2012 07</td>
<td>22</td>
<td>3</td>
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<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
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<tr>
<td>2012 08</td>
<td>7</td>
<td>2</td>
<td>28.6%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
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<tr>
<td>2012 09</td>
<td>6</td>
<td>2</td>
<td>33.3%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 10</td>
<td>6</td>
<td>0</td>
<td>0.0%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 11</td>
<td>8</td>
<td>3</td>
<td>37.5%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>2012 12</td>
<td>13</td>
<td>2</td>
<td>15.4%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
</tr>
<tr>
<td>Totals:</td>
<td>182</td>
<td>37</td>
<td>20.3%</td>
<td></td>
<td>59.01%</td>
<td>0.00%</td>
<td>20.33%</td>
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</table>

MRave = 14.54%

**Increasing variability.**

**Losing control of the process.**

### Chart 1

- **COMPANY 339**
- % REJECTS
- %REJ, UCL, LCL, %REJ(ave)

### Chart 2

- **COMPANY 339**
- Range chart with Shewhart Control Limits
- Series 1, Center = 0.1454, UCL = 0.4756, LCL = 0, Zone A Above, Zone B Above, Zone A Below
7. Cause and Effect Diagram

Illustrates relationships between a given effect and its possible causes. (same as Fishbone; Ishikawa; 5-Ms)

Approach:
- Identify problem
- Define major categories of possible causes
- Identify possible causes/root causes within each category
7. Cause-Effect Diagram

Quality Problem

Measurement
- Faulty testing equipment
- Incorrect specifications
- Improper methods
- Inaccurate temperature control
- Dust and Dirt

Human
- Poor supervision
- Lack of concentration
- Inadequate training

Machines
- Out of adjustment
- Tooling problems
- Old / worn

Environment
- Defective from vendor
- Not to specifications
- Material-handling problems

Materials
- Poor process design
  - Ineffective quality management
  - Deficiencies in product design

Methods (Process)
- Ineffective quality management
  - Deficiencies in product design
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| 9. Brainstorming | |
| 10. Barrier Analysis | |
| 11. Human Performance/ Human Factors | |
8. The 5-Why Analysis

A technique where you start by re-stating the identified problem, then continue to ask more fundamental questions until you arrive at the root cause of the problem.

Let’s look at 3 examples....
8. 5-Why Problem Example

An elderly man picked up his medicine prescription at a local Pharmacy. Upon returning home his wife read the label on the medicine bottle and discovered he was prescribed the wrong medicine. She called his doctor’s office on the phone and complained about the mix-up.
Q 1: *Why* did the patient get the incorrect medicine?  
   *A 1*: Because the prescription was wrong.

Q 2: *Why* was the prescription wrong?  
   *A 2*: Because the doctor made an incorrect decision.

Q 3: *Why* did the doctor make an incorrect decision?  
   *A 3*: Because he did not have complete information in the patient’s chart. The chart was missing the results of the patient’s latest laboratory report.

Q 4: *Why* wasn’t the patient’s medical chart updated?  
   *A 4*: Because the doctor’s assistant had not entered the results of the latest laboratory report.

Q 5: *Why* hadn’t the doctor’s assistant charted the latest laboratory report?  
   *A 5*: Because the lab technician telephoned the results to the receptionist, who forgot to tell the assistant.

*Solution: Develop a formal system for tracking lab reports.*
“At least 1.5 million Americans are sickened, injured or killed each year by errors in prescribing, dispensing and taking medications.”

Drug errors cause at least:
- > 400,000 preventable injuries and deaths in hospitals each year
- > 800,000 in nursing homes and facilities for the elderly
- 530,000 among Medicare recipients treated in outpatient clinics
8. 5-Why Example #1

**Summary of Problem:**
Internal audit 003 completed on 11/15/07 has findings identified that were not closed. Escalation process not followed nor was a Corrective Action Request issued.

**Cause Analysis:**
(Show the logic of your identification of the major or root cause(s) by answering the 5 Whys below:

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<th>Cause</th>
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<tr>
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</tr>
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<td>Cause:</td>
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**Major or Root Cause(s):**
Internal audit findings were not being addressed through the CAR process, resulting in oversight and lack of commitment.

**Preventive Corrective Action(s) to Stop Problem Recurrence:**
To ensure all non-conformances are addressed without undue delay Q123-34 (ABC, Inc. QMS Audit Procedure) has been updated, to require a Corrective Action Request be issued for all non-conformances found during the QMS audit process.

**Effectivity(s) of Preventive Corrective Action:**
(Identify serial numbers, batch numbers, manufacturing dates, or other means of identification or products already shipped to Lockheed Martin Aeronautics affected by original problem. Also, identify at what unit serial number, batch number, or manufacturing date this problem will be fixed: |
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Who is the escalation process left to the discretion of? Is this allowed by your SOP?
**Summary of Problem:**
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But why was the SOP not followed? – Inadequate procedure?
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Internal audit findings were not being addressed during the Corrective Action Request process, resulting in oversight and lack of commitment.

Preventive Corrective Action(s) to Stop Problem Recurrence:
To ensure all non-conformances are addressed without undue delay Q123-34 (ABC, Inc. QMS Audit Procedure) has been updated, to require a Corrective Action Request be issued for all non-conformances found during the QMS audit process.

Effectivity(s) of Preventive Corrective Action: (Identify serial numbers, batch numbers, manufacturing dates, or other means of identification or products already shipped to Lockheed Martin Aeronautics affected by original problem. Also, identify at what unit serial number, batch number, or manufacturing date this problem will be fixed):

It either was or was not escalated – not both!
Summary of Problem:
Internal audit 003 completed on 11/15/07 has findings identified that were not closed. Escalation process not followed nor was a Corrective Action Request issued.

<table>
<thead>
<tr>
<th>Cause Analysis: (Show the logic of your identification of the major or root cause(s) by answering the 5 Whys below:)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WHY?</strong></td>
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<td><strong>WHY?</strong></td>
</tr>
</tbody>
</table>

Major or Root Cause(s):
Internal audit findings were not being addressed through the CAR process, resulting in oversight and lack of commitment.

Preventive Corrective Action(s) to Stop Problem Recurrence:
To ensure all non-conformances are addressed without undue delay Q123-34 (ABC, Inc. QMS Audit Procedure) has been updated, to require a Corrective Action Request be issued for all non-conformances found during the QMS audit process.

Effectivity(s) of Preventive Corrective Action: (Identify serial numbers, batch numbers, manufacturing dates, or other means of identification or products already shipped to Lockheed Martin Aeronautics affected by original problem. Also, identify at what unit serial number, batch number, or manufacturing date this problem will be fixed:)

Why not!??
This is just a restatement of the finding and is not a root cause. You need to address why CARs take a backseat to vacations & Holiday schedules. For instance, is this a symptom of lack of Top Management commitment? Some digging may be required here.
What are your plans to train employees and top management in the revised procedures?
Who is the escalation process left to the discretion of? Is this allowed by your SOP?

But why wasn't the SOP followed? – Inadequate procedure?

It either was or was not escalated – not both!

Why not!?

This is just a restatement of the finding and is not a root cause. You need to address why CARs take a backseat to vacations & Holiday schedules. For instance, is this a symptom of lack of Top Management commitment? Some digging may be required here.

What are your plans to train employees and top management in the revised procedures?
8. 5-Why Example #3

(Let’s revisit Sally!)
Exercise # 3

While pouring yourself a cup of coffee in the cafeteria, a supervisor of Customer Service walks up to you for help:

Supervisor: “You know, ever since Sally was transferred to my department, reported customer complaints have skyrocketed! I had my best employee, Sam, train her. I really need some help here. Any suggestions?”

1. What is your impression of the Supervisor?
2. What is your impression of Sally’s performance?
3. What do you recommend?
4. What information (data) have you collected and analyzed to support your recommendations?
Step #1 Perform Event Investigation:

Supervisor: “You know, ever since Sally was transferred to my department, reported customer complaints have skyrocketed! I had my best employee, Sam, train her. I really need some help here. Any suggestions?”

So, what exactly is the problem?...
Problem Statement:
It was brought to the attention of Top Management that there has been a recent increase in customer complaint submittals.
Conduct Interviews

**Supervisor:** “You know, ever since Sally was transferred to my department, reported customer complaints have skyrocketed! Sam trained her. I really need some help here. Any suggestions?”

**Sally:** When Sam trained me before I took over full-time he told me I didn’t need to complete the Customer Complaint form, even though it is required by Procedure A02. The procedure isn’t very clearly written but it requires the form to be completed and forwarded to the CS Manager for every customer complaint received, so that’s what I do.

**Sam:** The Customer Complaint form? Sally shouldn’t be using it. It’s a waste of time to fill them out! I’ve been here for over 10 years and nobody ever reads those forms. We stopped using that ‘ole thing long ago. Don’t worry, if there’s a real complaint we fix it right on the spot! We don’t need a *form* to tell us what to do. We’ve always done it this way!
Review current CS Procedure A02

A review of the Customer Service Procedure was conducted and Section 7 was found to be ambiguous with respect to the use of the Customer Complaint form. See below except from Procedure A02:

“Section 7:
Any customer complaints should be documented and responded to by the CS Manager (ref: Form # 123).”
Review distribution history of Procedure A02

1) Not all CS staff were aware of or had access to the procedure at point of use.

2) Not all CS staff had access to or were aware of the intended use of the Customer Complaint form.

Step #4 Review training records.

Employee training records show no training had been conducted in the requirements of Procedure A02.
Step #2 Conduct RCA (5-WHY Analysis)

Q 1: **Why** is there an increase in customer complaints?  
   *A 1:* Because more Customer Complaint forms are being submitted than previously.

Q 2: **Why** are more Customer Complaint forms being submitted?  
   *A 2:* Because a new employee is submitting them.

Q 3: **Why** is a new employee submitting them?  
   *A 3:* Because Procedure A02, while not clearly written, requires all customer complaints to be recorded and reported to the CS Manager using Customer Complaint form.

Q 4: **Why** were they **not** reported by previous staff?  
   *A 4:* Employees lacked training resulting in a lack of awareness of company requirements; company norms take priority over following company procedures.

Q 5: **Why** do company norms take priority over following company procedures?  
   *A 5:* Because a culture of complacency allows management to disregard company policy, resulting in a corporate attitude that employee training and following company procedures are not necessary.
#1 Event Investigation:
1) Interviewed CS Manager and Staff
2) Reviewed distribution history of Procedure A02
3) Reviewed current CS Procedure A02
4) Reviewed employee training records
5) Conducted a 5-Why Analysis

#2 Root Cause:
1) A culture of complacency allows management to disregard company policy, resulting in a corporate attitude that employee training and following company procedures are not necessary.

2) This caused employees to disregard company procedures resulting in some of the staff not recognizing the importance in forwarding the Customer Complaint form to the CS Manager.
#3 Correction:
1. Reviewed CS files to ensure all completed forms were forwarded to the CS Manager.

2. Addressed all customer complaints that were previously unknown to management.

#4 Corrective Action:
1. Top Management communicated throughout the organization the need for compliance with company policy.

2. Conducted training with CS Management and staff regarding the importance in following company procedures.

1. Revised Procedure A02 to Rev A to more clearly describe the use of the Customer Complaint form.

2. CS Manager trained the staff on the use of the new Procedure A02, Rev A and documented the training in their training files.

3. CS Manager scheduled follow-up meetings with staff in one month to assess the effectiveness of CA.
Post-Script –
Is there more work to be done?

✓ Are there other departments experiencing similar issues?

✓ How effective is the company’s training program?

✓ What about other customers and all of those complaints we weren’t aware of?
9. **Brainstorming:**
is a highly structured management tool used to generate a large number of ideas and manage them.

**Procedure:**
- Review problem to be discussed.
- Focus on *why*, *how*, and *what* questions.
- Invite team members to call out ideas.
- Write all ideas on post-its, index cards, or a flip chart.
- Arrange ideas by common categories or themes.
9. Brainstorming Rules

Brainstorming is a formal, recognized management tool.

- Make sure entire team understands the problem statement
- All ideas are to be recorded
- No discussion or evaluation is permitted!
- No criticism is allowed (e.g. laughter, groans, sneers, or “That’s a great idea!”)
- All team members must participate
10. Barrier Analysis

Identifies physical, administrative, and procedural barriers or controls that should (or could) have prevented the problem, but did not.
10. Barrier Analysis

Barriers in place

No Barriers in place
10. Barriers include…

- Inspections
- Approval sign-offs
- Authority rosters
- Double checks
- Required fields in completing on-line forms
11. Human Factors – The Goal

“Maximize human performance and Minimize errors”
# Human Error Estimates

<table>
<thead>
<tr>
<th>System</th>
<th>% Due to Human Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airlines</td>
<td>70-80%</td>
</tr>
<tr>
<td>Air Traffic Control</td>
<td>&gt;70%</td>
</tr>
<tr>
<td>Ships</td>
<td></td>
</tr>
<tr>
<td>Process Control</td>
<td></td>
</tr>
<tr>
<td>Nuclear Power</td>
<td>70%</td>
</tr>
<tr>
<td>Road Transportation</td>
<td>85%</td>
</tr>
</tbody>
</table>
Human Errors

- Human errors can be *minimized*, not eliminated.

- Errors must be:
  - *detected* and *corrected*, or
  - at least *managed*.
11. Human Factors Models

Edward’s SHELL MODEL

• Heinrich’s Domino Theory
• Reason’s Swiss Cheese Model
• Boeing’s MEDA* Error Model

* Maintenance Error Decision Aid
SHELL MODEL

H: Hardware

S: Software

L: Liveware

E: Environment

Manuals, procedures, WI’s, computer programs

Tools, equipment, vehicles

Health, knowledge, attitude, stress, culture, pressure, complacency, norms, awareness, teamwork, leadership, communication

Temp, humidity, noise, light, rain, ice, etc.

1972 Elwyn Edward; 1987 Hawkins (modified)
Human Error - Example
SHELL - Forklift Example

**Software**
- Review Procedures
- Training records
- Equip. maintenance records
- Warehouse warning signs

**Hardware**
- Check brakes, hydraulics
- Warehouse door & ramp
- Door barriers

**Liveware**
- Stress, norms, pressure to get the job done, supervision?

**Environment**
- Slippery surfaces
- Weather
- Light
- Forklift/driver ergonomics
7a. Cause and Effect Diagram Example

**Software**
- Inadequate procedures
- Inadequate training method
- Inadequate maintenance inspections

**Weight/balance placards?**
- Imbalance in hydraulic pressure

**Lack of supervision**
- Pressure to get job done on-time

**Liveware**
- Skill level
- Substance abuse
- Stress/fatigue (duty-time)

**Environment**
- Slippery surface?
- Time of day—sun in eyes?
- Authority protocol not working

**Hardware**
- New/unintentional brake action by operator
- Lack of experience/training
- Imbalance in hydraulic pressure
- Door & ramp operation?
- Poor forklift ergonomics?

**Liveware**
- Liveware

**Forklift Accident**
Summary

✓ Learned the 4 modes of problem-solving.

✓ The “Scientific Method” should be used for all problem investigations.

✓ Management problems and QMS problems are one and the same.

✓ Identified a 5-step structured approach to solving company problems.

✓ Learned 12 management problem-solving techniques and reviewed actual examples for making decisions.
Thanks for attending!

and remember…

“To stop learning…. is to stop living. ”

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Questions?
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