EaglePicher™ Technologies, LLC
An OM Group Company

**NASA Supply Chain
Quality Assurance Conference**

October 2014

SPACE PROGRAM
MISSION   ASSURANCE   SUMMIT

EaglePicher™
Technologies, LLC
An OM Group Company

Root Cause Analysis &

Effective Corrective Actions:

A Suppliers' Perspective

Presenter: **Forrest Reed**

Vice President, Quality Assurance/Lean Six Sigma

EaglePicher Technologies

EPT Profile

Specialist in Design and Manufacture of Batteries, Battery Management Systems, Battery Chargers, Energetic Devices for Defense, Space and Commercial, Alternative Energy Storage, and Implantable Medical Device Applications

➢ *A wholly owned subsidiary of OM Group (NYSE: OMG) of Cleveland, OH.*

➢ *HQ in Joplin, MO*

➢ *Plant Locations*
- *Joplin, MO*
- *Seneca, MO*
- *Pittsburg, KS*
- *Vancouver B.C.*
- *Rothenbach, Germany (JV with Diehl)*

➢ *Expertise in >25 Chemistries*

➢ *Millions of Specialty Batteries Delivered From Thousands of Designs*

Headquarters - Joplin, Missouri
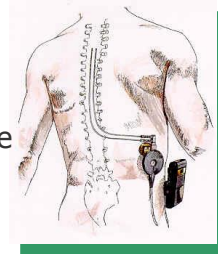
EaglePicher Market Segments

Medical Power:
- Batteries
  - Lithium Ion
  - Lithium Manganese Dioxide
  - Lithium Carbon Monofluoride
  - Lithium Thionyl Chloride
  - Microcell
  - Nickel Cadmium

Distributed/ Commercial Power:
- Batteries
  - Sealed Lead Acid
  - Lithium Thionyl Chloride

Alternative Energy Storage
- Hybrid Power Storage Systems
- HEV Systems

Aircraft:
- Batteries
  - Lithium Ion
  - Nickel Cadmium
  - Nickel Metal Hydride
  - Primary Lithium
- Electronics
- BMS

Power Engineering Services:
- Chargers
- Analyzers
- Test Systems
- Custom Battery Packaging
- BMS

Unmanned Vehicles
- Batteries
  - Lithium Ion
  - Lead Acid
  - Nickel Cadmium
- Custom Battery Packaging
- BMS

Missiles:
- Batteries
  - Thermal
  - Silver Zinc
  - Lithium Oxyhalide
  - Custom Packaging
- Energetic Devices

Portable Power:
- Batteries
  - Lithium Sulfur Dioxide
  - Lithium Manganese Dioxide
  - Lithium Carbon Monofluoride
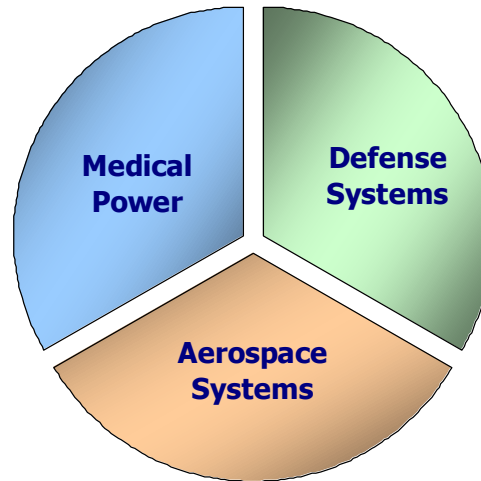 - Lithium Thionyl Chloride

Oil and Gas:
- Downhole Communication Batteries
- Subsea Accumulator
- Subsea Power Pyramid
- Subsea Reserve Power

Launchers:
- Batteries
  - Silver Zinc
  - Lithium Ion

<Courtesy of NASA>

Satellites:
- Batteries
  - Nickel Hydrogen
  - Lithium Ion
- Electronics
- BMS

<Courtesy of NASA>

Medical Power

Defense Systems

Aerospace Systems
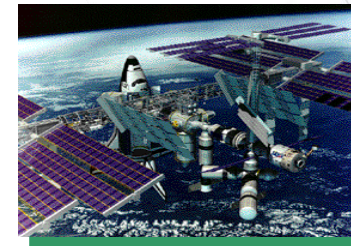
Scope of EPT Quality Organization

- **AS - 9100**
- **N A S A**
- **ISO-13485**
- **D O D**
- **F A A**
- **M D A**
- **D C M A**

Director

Quality Assurance

| Defense Weapon Systems **3** | Energetic Devices **1** | Aerospace Power Systems **3** | Medical Implantable Cells **2** | Alternative Energy Storage **1** |
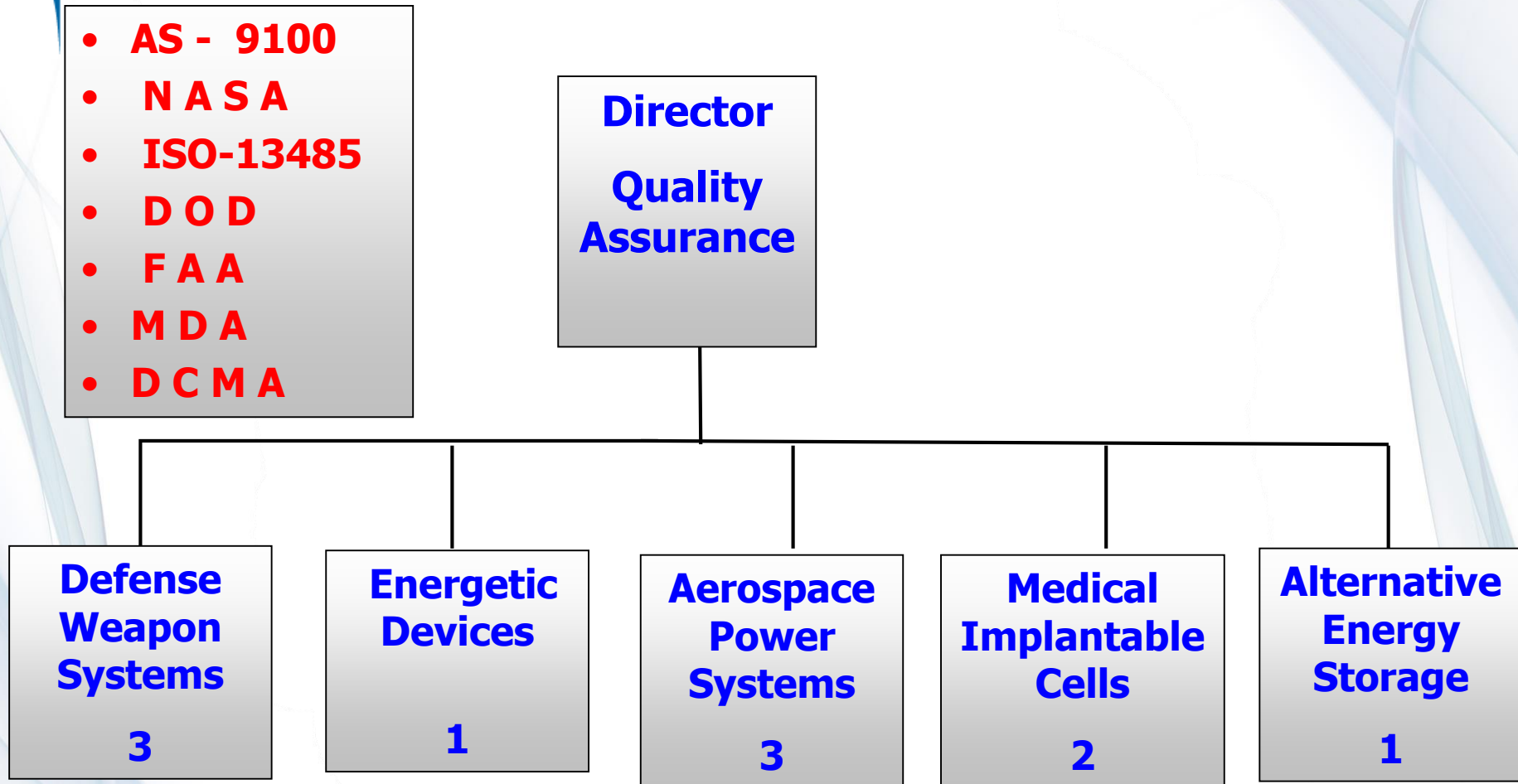
About 120 QA employees at U.S. sites

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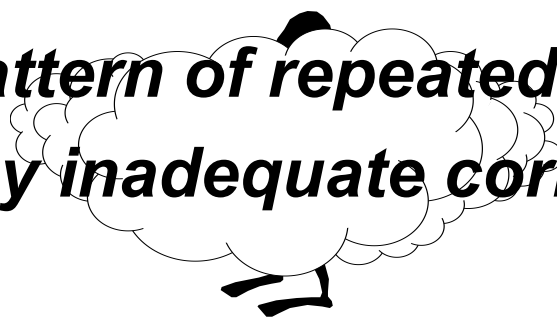*March 2005 a Level 3 CAR issued to EaglePicher by DCMA and MDA,*

- <u>*Joint Industry Team at EPT for QMS Review :*</u> *Raytheon, Boeing, Orbital Science and Lockheed Martin, led by MDA.*

Cause listed :

"Systemic pattern of repeated non-conformances caused by inadequate corrective actions"

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Where we were then..

Problem Reports Aging

January 2005

481 = Total Open Reports
165 = Overdue, 90+ days

Total Open Non-Conformance Reports = 481

Reports Open Greater Than 90 days = 165

Good

| | <15 Days | 15-30 Days | 30-45 Days | 45-60 Days | 51-90 Days | >90 Days |

Discovery Leads to Action

Discovery items:

## *Action areas:*

| Discovery items:	Action areas:
1. Incomplete R/C and C/A structure & content.	Require **objective evidence** of R/C analysis and implementation of C/A .
2. Inconsistent approach to determine a Root Cause	Default **R/C analysis method**
3. Poor planning for and implementation of C/A changes.	Determine how we and the customer, could **evaluate** the effectiveness of changes.
4. Inadequate or missing information to support problem closure.	Established **specific internal expectations** for information and data flow to the customer.

What we did….part 1
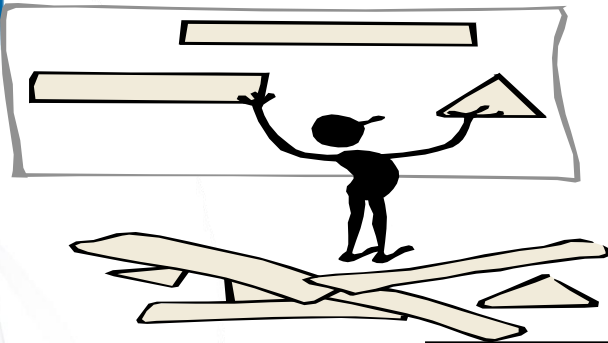
Incomplete R/C and C/A structure and content.
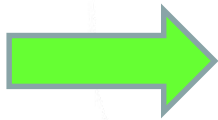
Require <u>objective evidence </u>of R/C analysis and classify local or systemic.

- *Established a CORRECTIVE ACTION BOARD (CAB) at each site with Operations, Engineering and Quality.*

- *<u>Purpose</u>: Monitor and measure the R/C and C/A process with consistent criteria and expected outcomes;*

CAB – Corrective Action Board
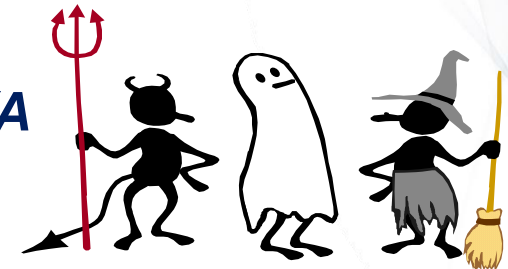
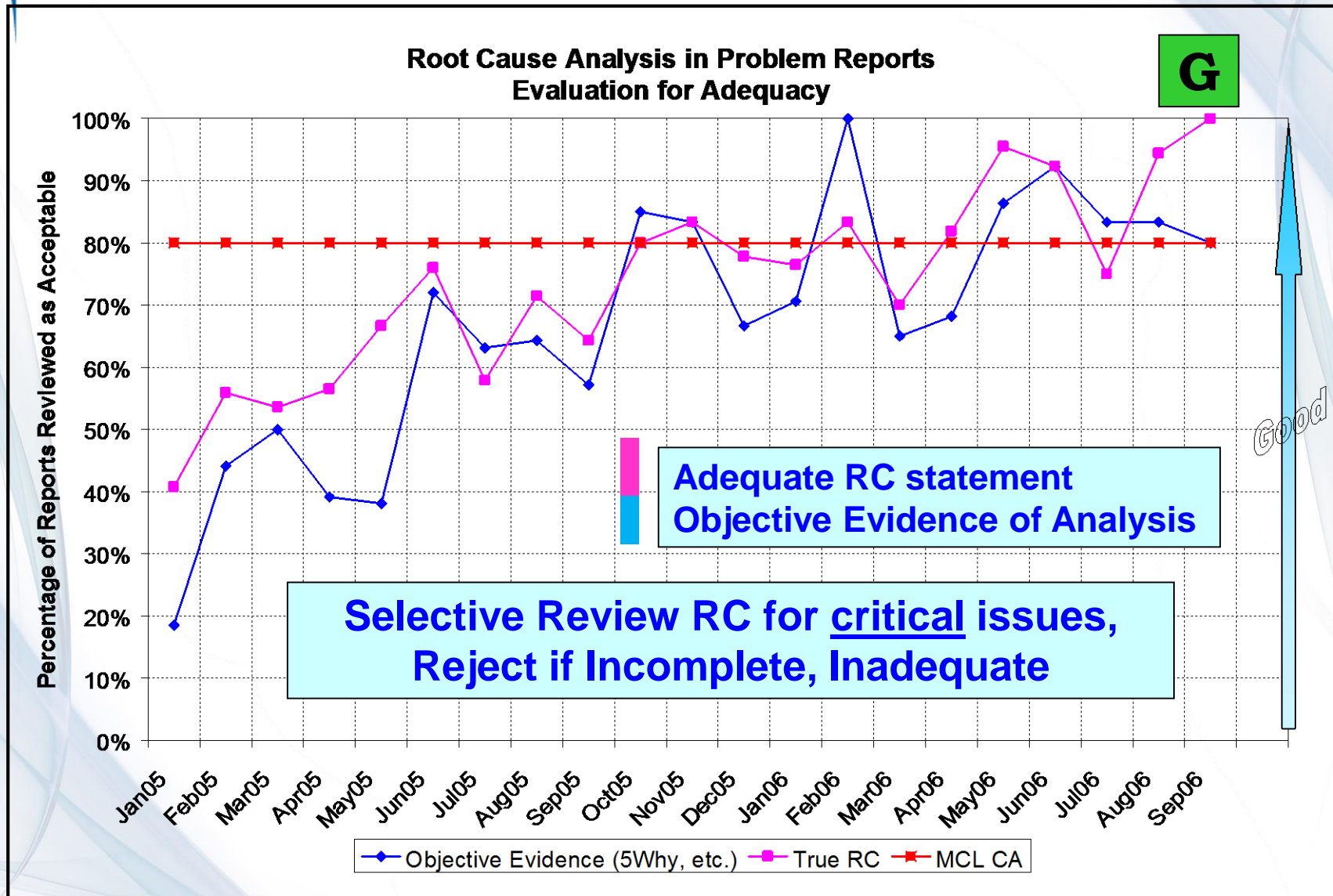**Key guidelines for CAB; Conduct a structured evaluation of R/C   C/A process.**

1. **ROOT CAUSE:** meets the basic defined criteria and objective evidence for Root Cause analysis.

2. **CORRECTIVE ACTION:** Ensure C/A addresses the R/C and has Objective Evidence of C/A implementation.

3. **VERIFICATION:** Identify a plan for evaluation that is documented, is linked to R/C + C/A and can be measured.

Root Cause Analysis

**Root Cause Analysis in Problem Reports
Evaluation for Adequacy**

G

Adequate RC statement
Objective Evidence of Analysis

**Selective Review RC for <u>critical</u> issues,
Reject if Incomplete, Inadequate**

Good

Legend: Objective Evidence (5Why, etc.) — True RC — MCL CA

Corrective Action Adequacy

Corrective Action Plans in Problem Reports
Evaluation for Adequacy

G

Objective Evidence of Action

CA connected to RC

Reviewed critical CA / Returned if Incomplete or Inadequate

Legend: ◆ Objective Evidence ■ CA Addresses RC ✱ MCL CA

What we did….part 2
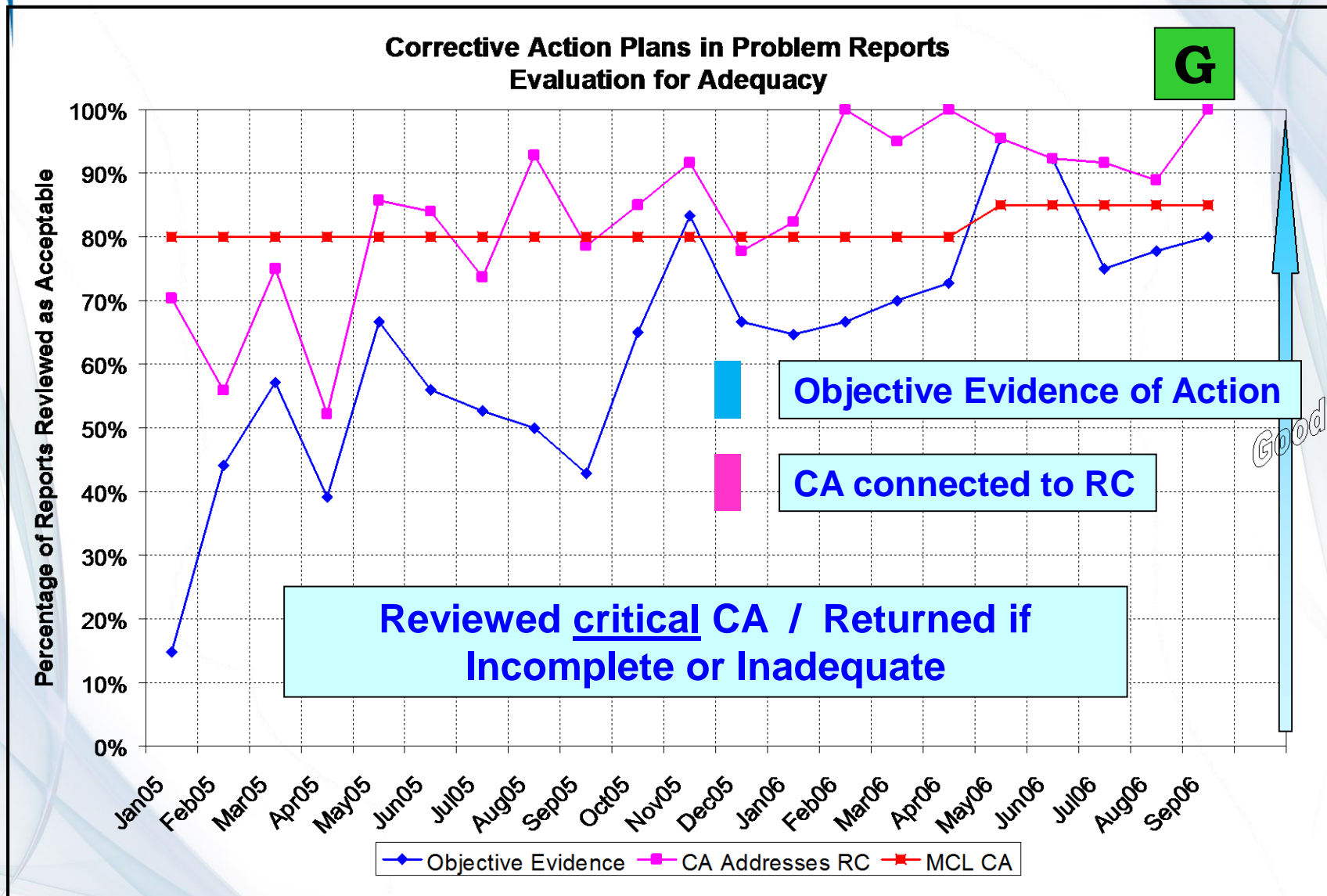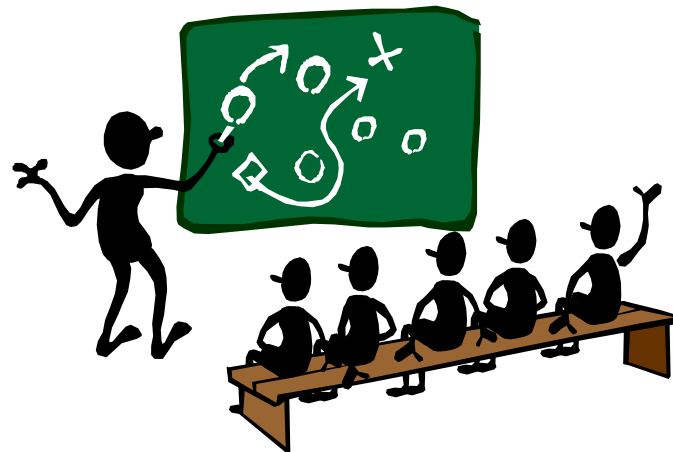
Inconsistent approach to determine a R/C and development of a solution

➡️ **Default R/C analysis method**

Specific focus on

ROLES

RESPONSIBILITIES

ACCOUNTABILITY *with consistent expectations.*

Elements for CAB review

EXAMPLE solution steps during R/C and C/A reviews

CAB review codes:

- IR   = Initial Response
- HD   = Hardware Disposition
- CC   = Containment Complete
- RCc   = Root Cause Analysis Complete
- RCa   = Root Cause Analysis Acceptable
- CAPg   = Corrective Action Plan Generated
- CAPi   = Corrective Action Plan Implemented
- CAPc   = Corrective Action Plan Complete
- VAPi   = Verification Action Plan Implemented
- ExtCir   = Extenuating Circumstances
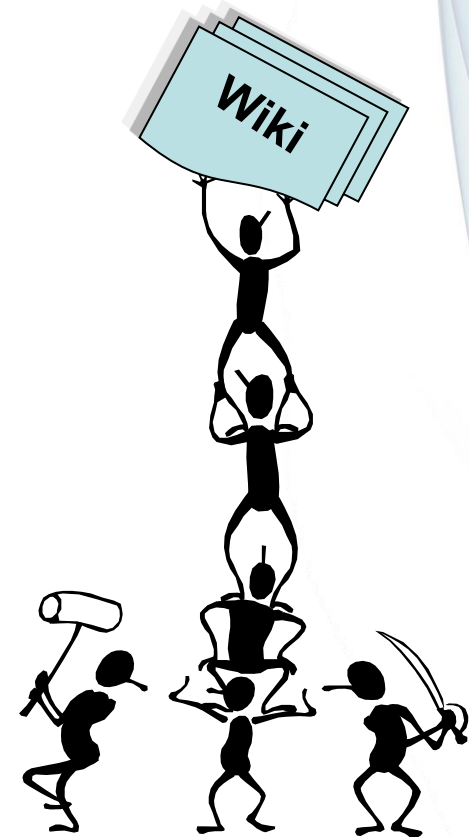
ACCOUNTABILITY in CAB reviews

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Problem #	Assigned to	Opened	Area	Brief Description	IR	HD	CC	RC c	RC a	CAPi	CAPc	VAPi	Ext Cir	Last Known Update
13669	Quee, Eric	4/15/2013	Xroads	Oven malfunction on NCA	Y	Y	Y	N						4/18/2013
13673	Ware, Curtis	4/15/2013	SOZ	108-Cell cover	Y	N	Y							4/29/2013
13675	Bond, James	4/15/2013	APS-RLF	MAR-9516 S/N 00063	N	Y	Y	N						5/7/2013
13677	Bond, James	4/15/2013	APS-RLF	MAR-9516-D BMS 116	N	N	Y	N						5/1/2013
13685	Jordan, David	4/17/2013	ED	1SE609 LAT failure	Y	N	Y	Y	Y	Y	N	N		5/7/2013
13694	Gullett, Jason	4/18/2013	APS-B11	EAP-9470 Lot 51 Re-LAT Instructions	N	N	Y	N						5/2/2013
13695	Quee, Eric	4/18/2013	Xroads	Power outage causing oven malfunction on NCA	Y	Y	Y	N						4/22/2013
13713	Shope, Darin			9419 Lot 10 cell cases material	Y	Y	Y	N						4/23/2013
13721	Ware				Y	Y	Y							5/6/2013
13723					N	N	Y	N						5/2/2013
137						Y	N	N						4/25/2013
1							N	N						4/26/2013
1						Y	N							5/9/2013
13						Y								5/13/2013
1370						Y	Y	Y	Y	Y	N	N		5/9/2013
13762					N	N	Y	N						5/1/2013
13776	Richter, C			eld	Y	Y	N							5/14/2013

- **Each open PR is updated in weekly CAB meetings.**
- **Status data communicated through ERP system.**
- **Summary updates go into Balanced Scorecard.**

## Poor planning for implementation of C/A changes
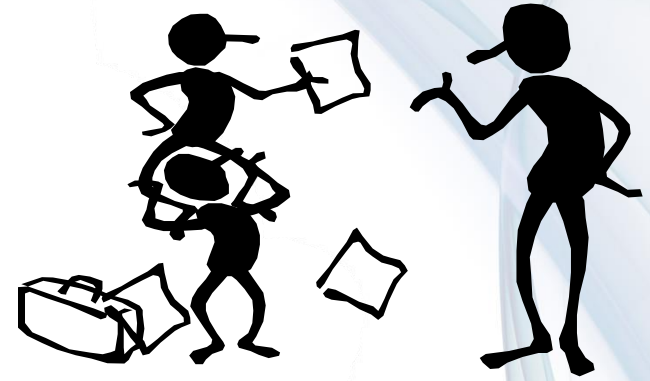
➡️ **Determine how we and the customer can evaluate the effectiveness of changes.**

Customer and Internal communications:

- *Understand and agree to the scope.*

  - *Know what it will look like at the end*

    - *Changes: Who, What, When, Where*

      - *How will you know change is effective?*

Document that the same problem did not repeat at this process within the agreed time frame

Lessons in Communication

It worked for us*
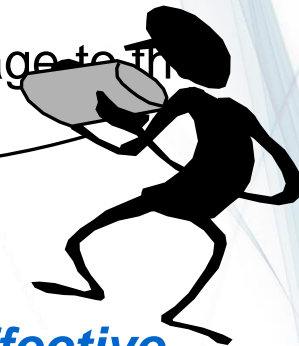
1. In the beginning, focus on a high level C/A <u>structure</u>:

   a) *What will be changed, what will it be changed to, how will you make the change.*

2. Constantly take the <u>pulse</u> of the project.

   a) *Frequency of data, metric type, comparative ranking.*

3. Understand the status of your <u>grip</u> on the customer.

   a) *Manage scope creep.*

4. Metrics represent the <u>health</u> of your QS and provide a message to the customer.

   a) *Start simple but deliver a message.*

5. Start with the end in mind.

   a) *It is my responsibility (supplier) to ensure CA is effective.*

* It Worked for Me, Gen. Colin Powell, Retired

What we did….part 4

Established **specific internal expectations** for information and data flow to the customer.

Customer and Internal communications: CAOFD

- *Complete*
  - *Accurate*
    - *On-Time*
      - *Format*
        - *Distribution*

Basics for Communication
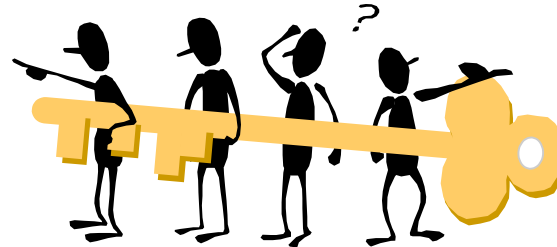
C A O F D
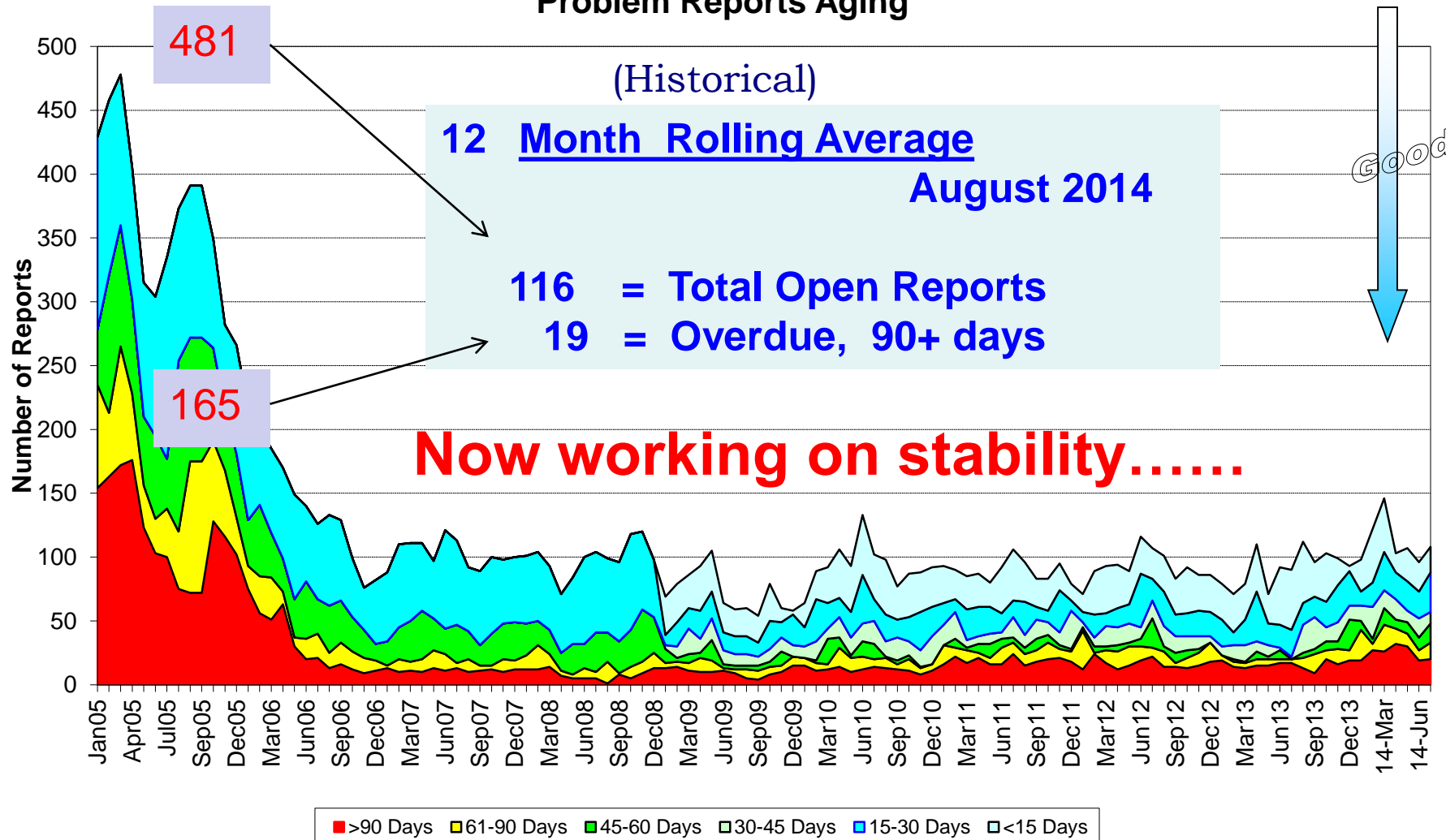
- **Complete**: Every area or field appropriate to the issue will contain data, will comply to expectations;

- **Accurate**: All data submitted will be accurate,

- **On-time** : Submission will be within the agreed time frame,

- **Format** : Submission will be in the agreed format,

- **Distribution** : Completed set of data will be distributed as agreed and is identified within the system.

Items of Enlightenment

- **Established a "One Company" set of metrics :**
  Enterprise Balanced Score Card

- **Adopted a philosophy of expectations :**
  Roles – Responsibility – Actions – Accountability

- **Understand that customer communication toward effective R/C , C/A may involve a "healthy discord".**

- **Focus on the integrity of the data and documented evidence used to support R/C , C/A and Verification activities.**

SAND CHART HISTORY

Problem Reports Aging

481

(Historical)

12   Month Rolling Average
                              August 2014

116   = Total Open Reports
19   = Overdue, 90+ days

165

Now working on stability……

Good

Legend: ■ >90 Days ■ 61-90 Days ■ 45-60 Days □ 30-45 Days ■ 15-30 Days □ <15 Days

X-axis: Jan05, Apr05, Jul05, Sep05, Dec05, Mar06, Jun06, Sep06, Dec06, Mar07, Jun07, Sep07, Dec07, Mar08, Jun08, Sep08, Dec08, Mar09, Jun09, Sep09, Dec09, Mar10, Jun10, Sep10, Dec10, Mar11, Jun11, Sep11, Dec11, Mar12, Jun12, Sep12, Dec12, Mar13, Jun13, Sep13, Dec13, 14-Mar, 14-Jun

Y-axis: Number of Reports (0, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500)

A Suppliers look at
Root Cause / Corrective Actions

As a supplier, acknowledge that we don't always "color inside the lines," but we must have objective evidence to:

a) know who, when, where and why things did or did not happen,

b) identify what will be changed, what it will be changed to and how the change will be made,

c) understand the impact of the change,

d) demonstrate that these changes are <u>effective</u>.

Questions
or
Comments