The 8 Disciplines Problem Solving Process
Application to a Medical Device

Engineers are problem solvers.

Problem-Solving is a discipline to be mastered for success in any field of engineering.

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Outline

- A Short History of Problem Solving
- Elements of Effective Investigation
- Dealing with Variability
- 8D (Disciplines) Problem-Solving
- Real Examples

History of Problem Solving

- The concept of problem solving is an old one.
- The industrial revolution brought more complicated problems.
- Thus a scientific approach to problem solving was created.
- This approach was taught to specialists. But mostly, problem solving has been left to individuals.
- To increase problem solving efficiency, some companies started teaching standardized, team methods.

8D History

- The U.S. Government first standardized the "8 Disciplines" process (8D) during the Second World War.
- It was later popularized by the Ford Motor Company in the 1980s. 8D became a standard in the Auto, Assembly, Semiconductor and other industries worldwide.
- While its genesis focused on manufacturing, it is being applied throughout the enterprise, from design to customer service and everywhere in between.
- The 8D Problem Solving Process is used to identify, correct and eliminate problems. The method is useful in product and process improvement. It establishes a standard practice, with an emphasis on facts. It focuses on the origin of the problem by determining Root Cause.

Problem-Solving Methods and Principles

Why when two separate groups use a problem solving process on a similar problem, one succeeds and one fails?

- Organizational Structure is required to support problem solving.
  - *Hierarchy of responsibility and lines of communicating results must be in place before effective, formal problem solving can begin.*
  - *We see adverse human dynamics when structure fails*
- Problem solving involves more than just following a few given steps. It requires a disciplined way of thinking and knowledge of certain tools, methods and principles.

Improving Job Methods: US War Production Board

1945 JMT card (front)

HOW TO IMPROVE

JOB METHODS

A practical plan to help you produce GREATER QUANTITIES of QUALITY PRODUCTS in LESS TIME, by making the best use of the Manpower, Machines and Materials, now available.

STEP I—BREAK DOWN the job.

1. List all details of the job exactly as done by the Present Method.
2. Be sure details include all:
   —Material Handling.
   —Machine Work.
   —Hand Work.

"Write it as you see it
Not as you remember it."

STEP II—QUESTION every detail.

1. Use these types of questions:
   WHY is it necessary?
   WHAT is its purpose?
   WHERE should it be done?
   WHEN should it be done?
   WHO is best qualified to do it?
   HOW is the "best way" to do it?
2. While questioning consider:—
   Materials, Machines, Equipment, Tools, Product Design, Layout, Work-place, Safety, Housekeeping.

"Write down each idea."

1945 JMT card (back)

STEP III—DEVELOP the new method.

1. ELIMINATE unnecessary details.
2. COMBINE details when practical.
3. REARRANGE for better sequence.
4. SIMPLIFY all necessary details:
   —Pre-position materials, tools and equipment at the best places in the proper work area.
   —Use gravity-feed hoppers and drop-delivery chutes.
   —Let both hands do useful work.
   —Use jigs and fixtures instead of hands for holding work.
5. Work out your idea with others.
6. Write up your proposed new method.

"Make the work easier and safer."

STEP IV—APPLY the new method.

1. Sell your proposal to your "boss."
2. Sell the new method to the operators
3. Get final approval of all concerned on Safety, Quality, Quantity, Cost.
4. Put the new method to work. Use it until a better way is developed.
5. Give credit where credit is due.

"Continue until a better way is found."

JOB METHODS PROGRAM

TRAINING WITHIN INDUSTRY, INC.

14600 DETROIT AVE. CLEVELAND 7, OHIO

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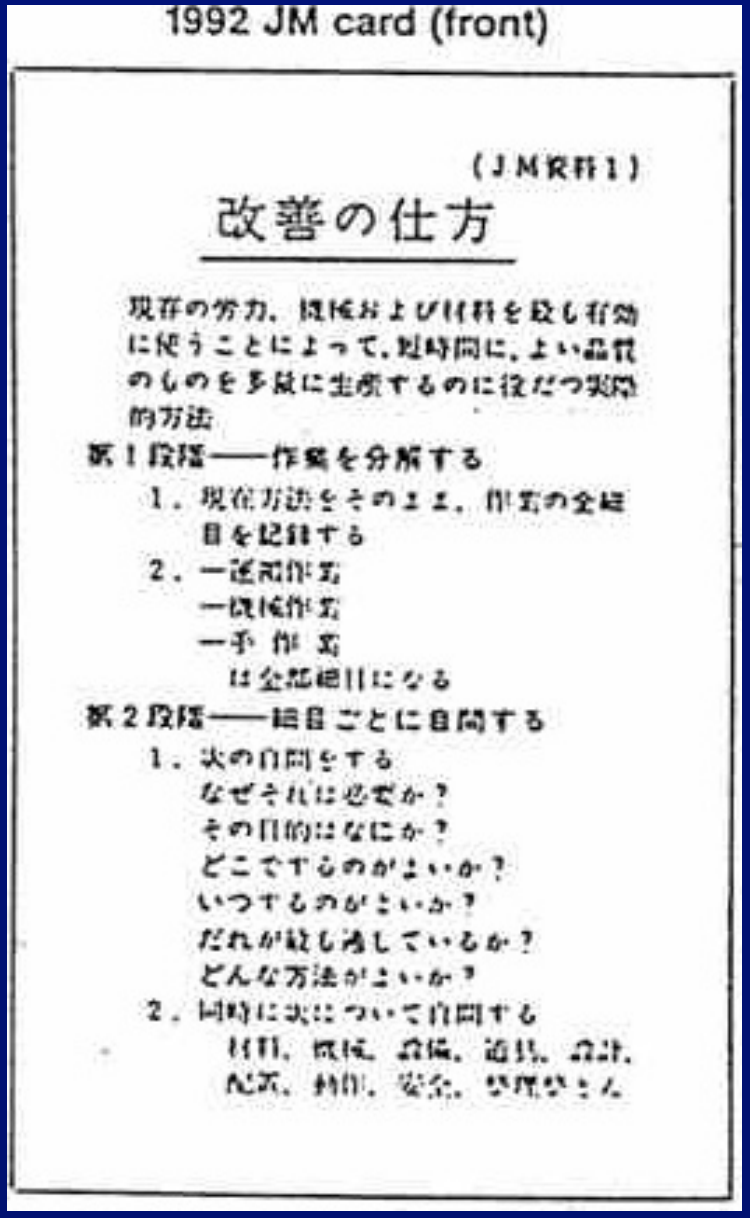
Kaizen: Japan Inc. Adopts

1992 JM card (front)



（JM資料1）

改善の仕方

現存の労力、設備および材料を最も有効に使うことによって、短時間に、よい品質のものを多量に生産するのに役だつ実際的方法

第1段階——作業を分解する

1．現在方法をそのまま、作業の全細目を記録する

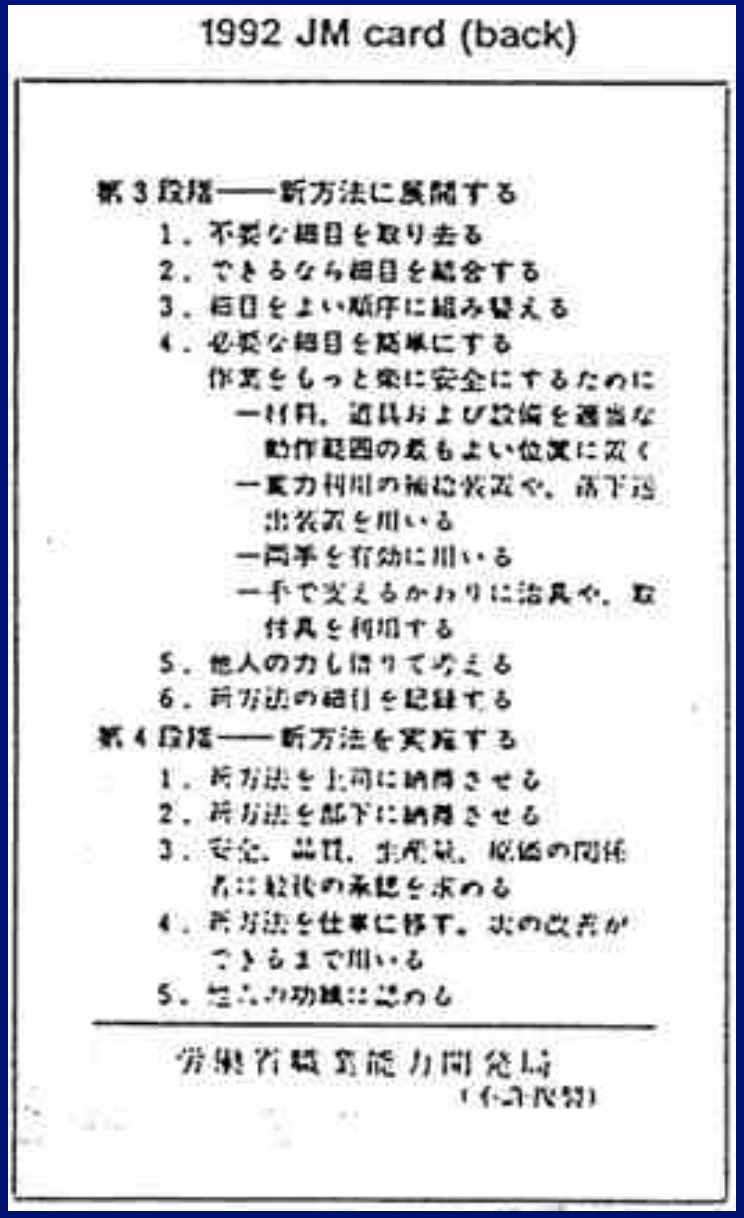
2．一連続作業
　一段階作業
　一手 作 業
　は全部細目になる

第2段階——細目ごとに自問する

1．次の自問をする
　なぜそれは必要か？
　その目的はなにか？
　どこでするのがよいか？
　いつするのがよいか？
　だれが最も適しているか？
　どんな方法がよいか？

2．同時に次について自問する
　材料、設備、設備、道具、設計、配置、動作、安全、管理など。

1992 JM card (back)



第3段階——新方法に展開する

1．不要な細目を取り去る

2．できるなら細目を結合する

3．細目をよい順序に組み替える

4．必要な細目を簡単にする
　作業をもっと楽に安全にするために
　一材料、道具および設備を適当な動作範囲の最もよい位置に置く
　一重力利用の補助装置や、落下運出装置を用いる
　一両手を有効に用いる
　一手で支えるかわりに治具や、取付具を利用する

5．他人の力を借りて考える

6．新方法の細目を記録する

第4段階——新方法を実施する

1．新方法を上司に納得させる

2．新方法を部下に納得させる

3．安全、品質、生産量、原価の関係者に最後の承認を求める

4．新方法を仕事に移す。次の改善ができるまで用いる

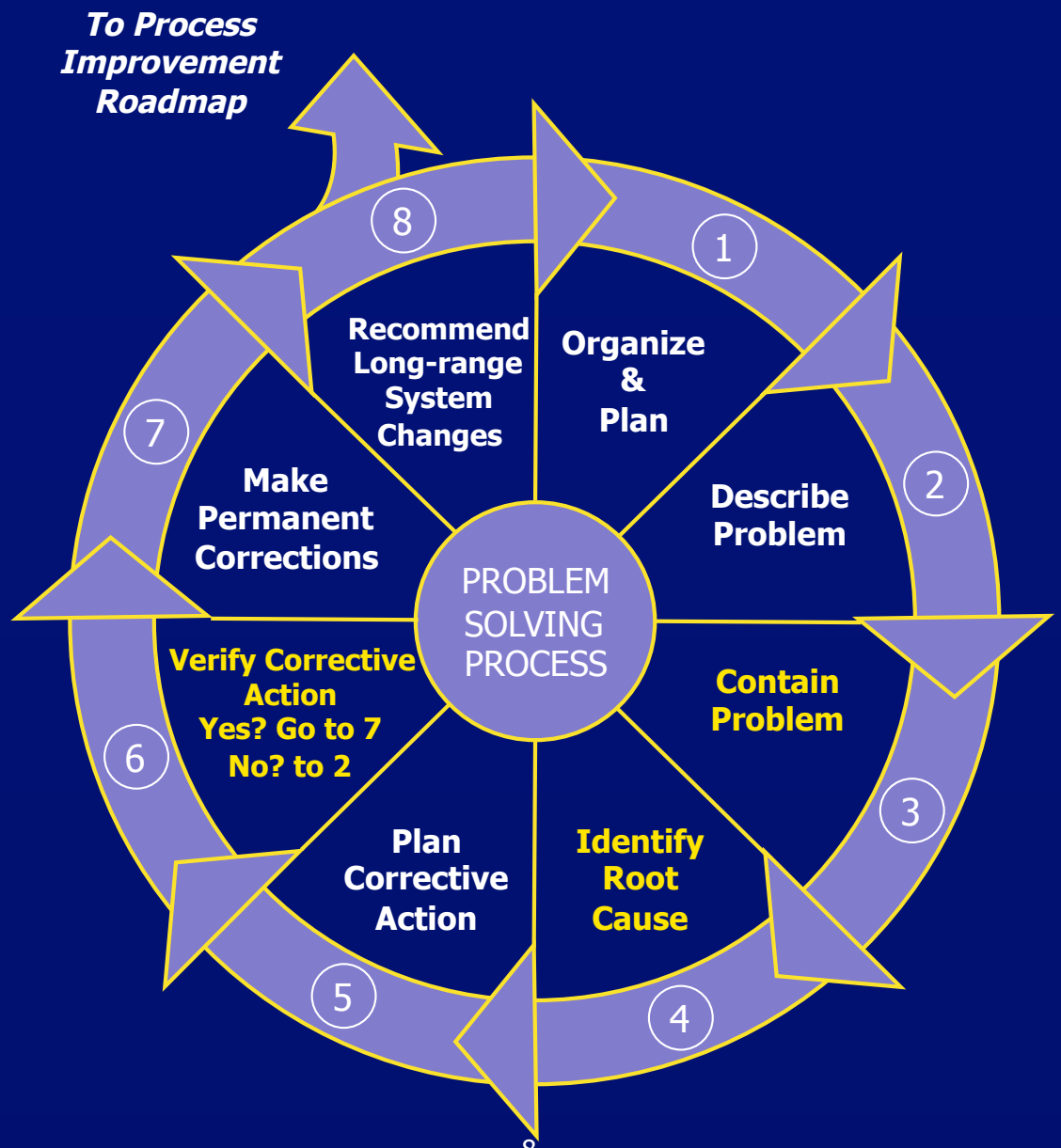
5．[illegible]功績に認める

労働省職業能力開発局
（JM資料）

"8 D-Like" Problem-Solving Process

Focus on containment, root cause and verifying corrective action

Used by semiconductor company in 1990s



The Bigger Picture

Learning From Mistakes and Successes

- Test Escapes
- Japanese Power Plant

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The Bigger Picture

Learning From Mistakes and Successes

Lessons Learned

- Test Escapes
  - Be systematic in problem solving
  - Don't jump to conclusions
  - Ask the people who know best
  - Ask next level questions
  - Be objective and use data

- Japanese Power Plant
  - Communicate results
  - Follow through with verification
  - Knowledge and organized thinking beats poor planning and panic

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The Bigger Picture of Problem Solving

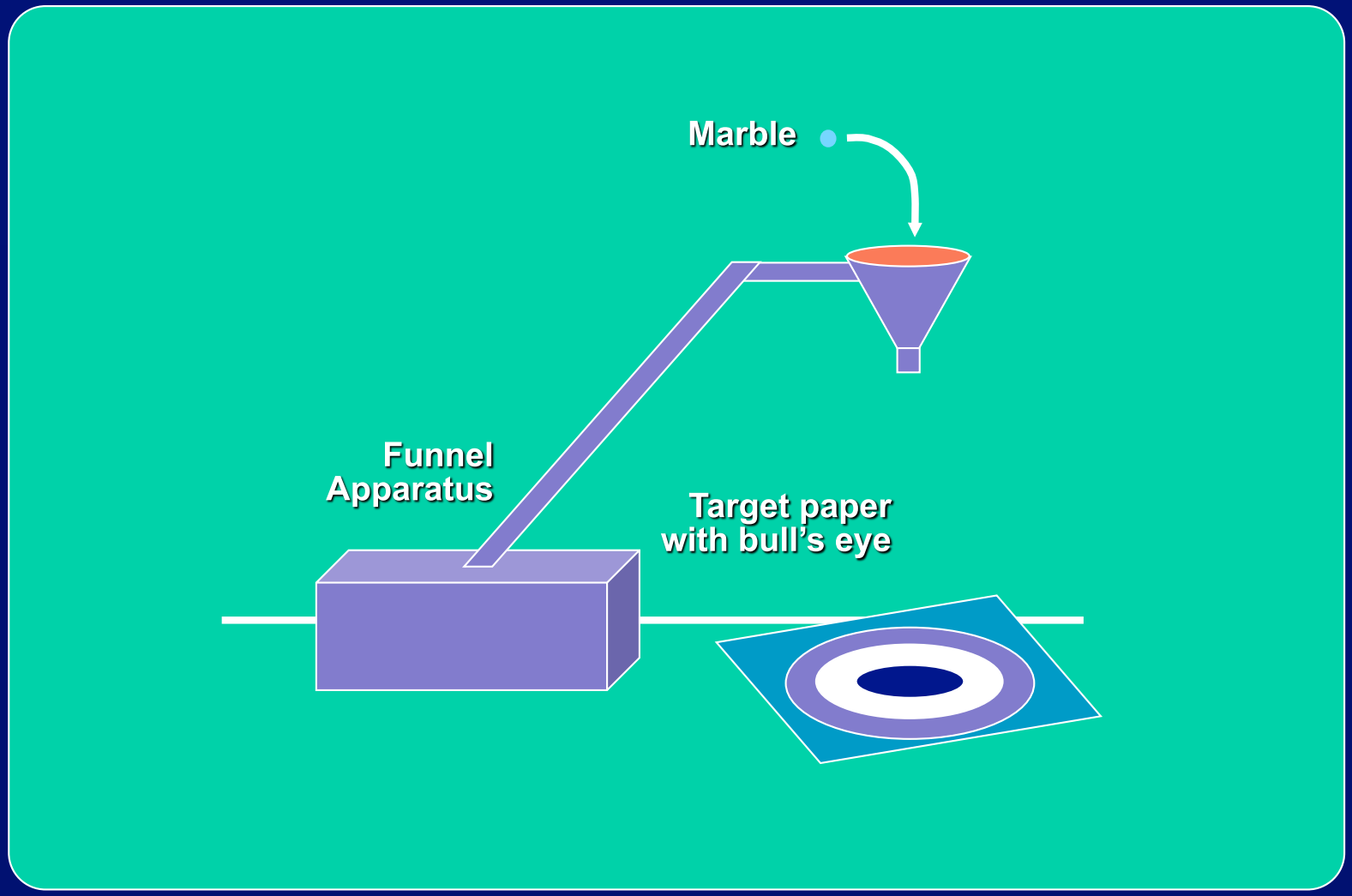
Elements of Objective Investigation

- Creative Thinking
- Knowledge of Data Analysis & Statistics
  - Statistical Thinking
  - Statistical Methods
  - Data Analysis
  - Graphical Analysis
- Knowledge of Subject Matter
- Basic Skills & Tools

Statistical Thinking:

"Facing the Unpredictable"
Understanding Variability
And
Knowing How To Deal With It

Deming Funnel Experiment



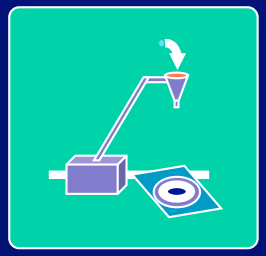
The Funnel Experiment Rules

Rule 1 - Leave the funnel fixed.

Rule 2 - Move the funnel from its last position to compensate for the last error.

Rule 3 - Use the target as a basis for adjustment. Move the funnel from the target to compensate for the last error.

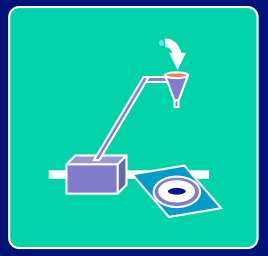
Rule 4 - Strive for uniformity, not necessarily at the target, by setting the funnel over the last drop.



Illustrating the 4 Rules

http://www.symphonytech.com/dfunnel.htm

Some Things Take Time to Learn !



FIXED

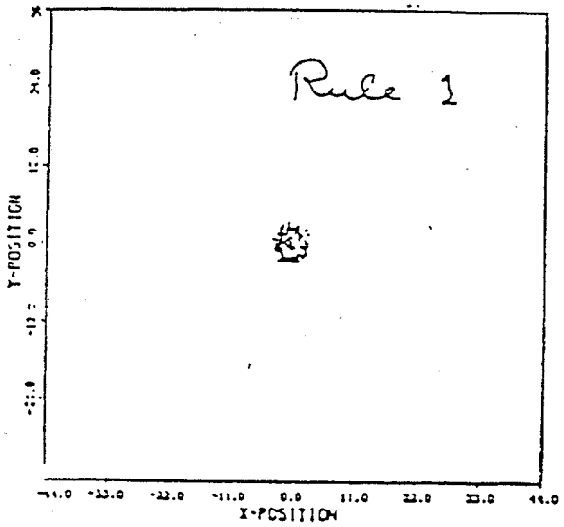
Illustrating the 4 Rules

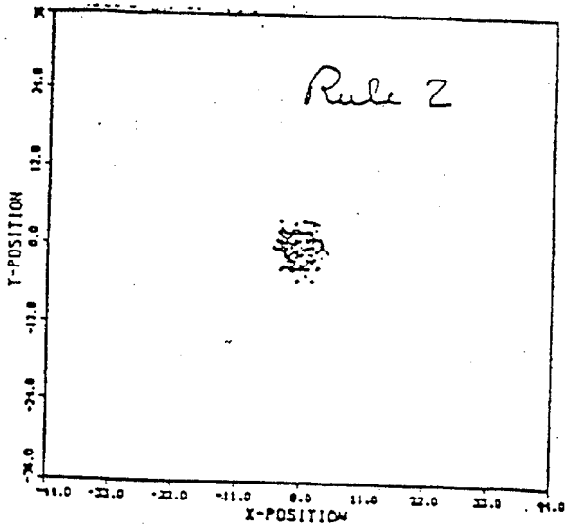
FROM TARGET

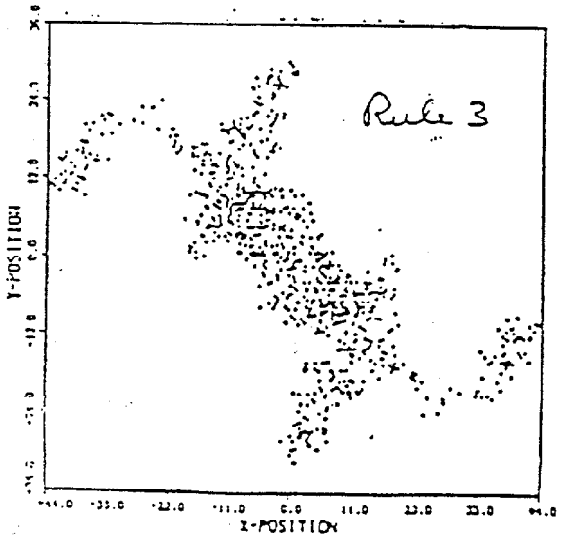
THE FUNNEL

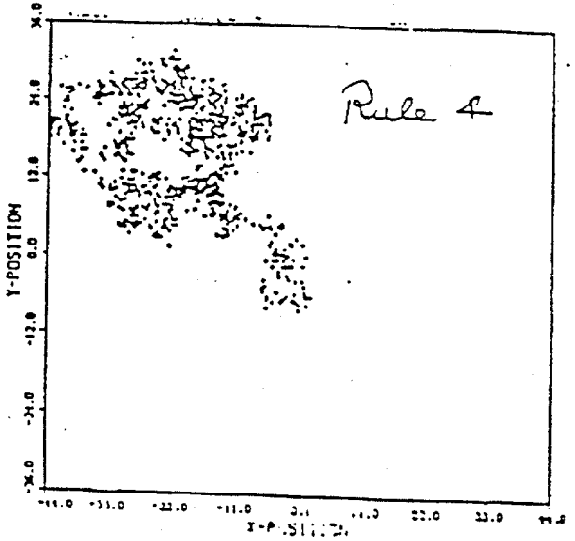
Simulation by Professor Thomas J. Boardman and Harry Iyer, Colorado State University, Fort Collins, Colorado.

Rules 1, 2, 3, 4 are described by Deming in OUT OF THE CRISIS (Center for Advanced Engineering Study, Massachusetts Institute of Technology, 1986).









FROM LAST

Some Things Take Time to Learn !

OVER LAST

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The Funnel Experiment Conclusions

1. Solving a system problem is different from unintentional tampering with the system.
   - *Deming: Tampering with a statistically stable system only makes it worse.*
2. If we don't know how to control variability, variability will control us!
3. Problem solving requires knowledge of
   - variation
   - data analysis
   - the system itself.

The 8D Problem Solving Process

D 1 – Description of Problem

D 2 – Team Member Selection

D 3 – Containment

D 4 – Root Cause

D 5 – Implementation of Permanent Solution

D 6 – Prevent Reoccurrence

D 7 – Verification

D 8 – Recognition

We have assigned three components to each discipline: Purpose – Tools – Principles

Problem Solving Toolbox

Majority of problems can be solved using simple tools and methods.

- Two categories of problem solving tools:
  1. Tools useful for organizing ideas, concepts and processes
  2. Tools useful for collecting, organizing and analyzing data

(i.e., Turning Data into Information)

D 3 – Containment

Purpose of this Discipline:

To come up with a speedy solution even if it is a temporary one for the short term.

This is where the "Rubber Hits the Road".

Tools for D 3:

- Brainstorming
- Cause & Effect Diagram
- Flow Chart
- Pareto Chart
- Decision Matrix

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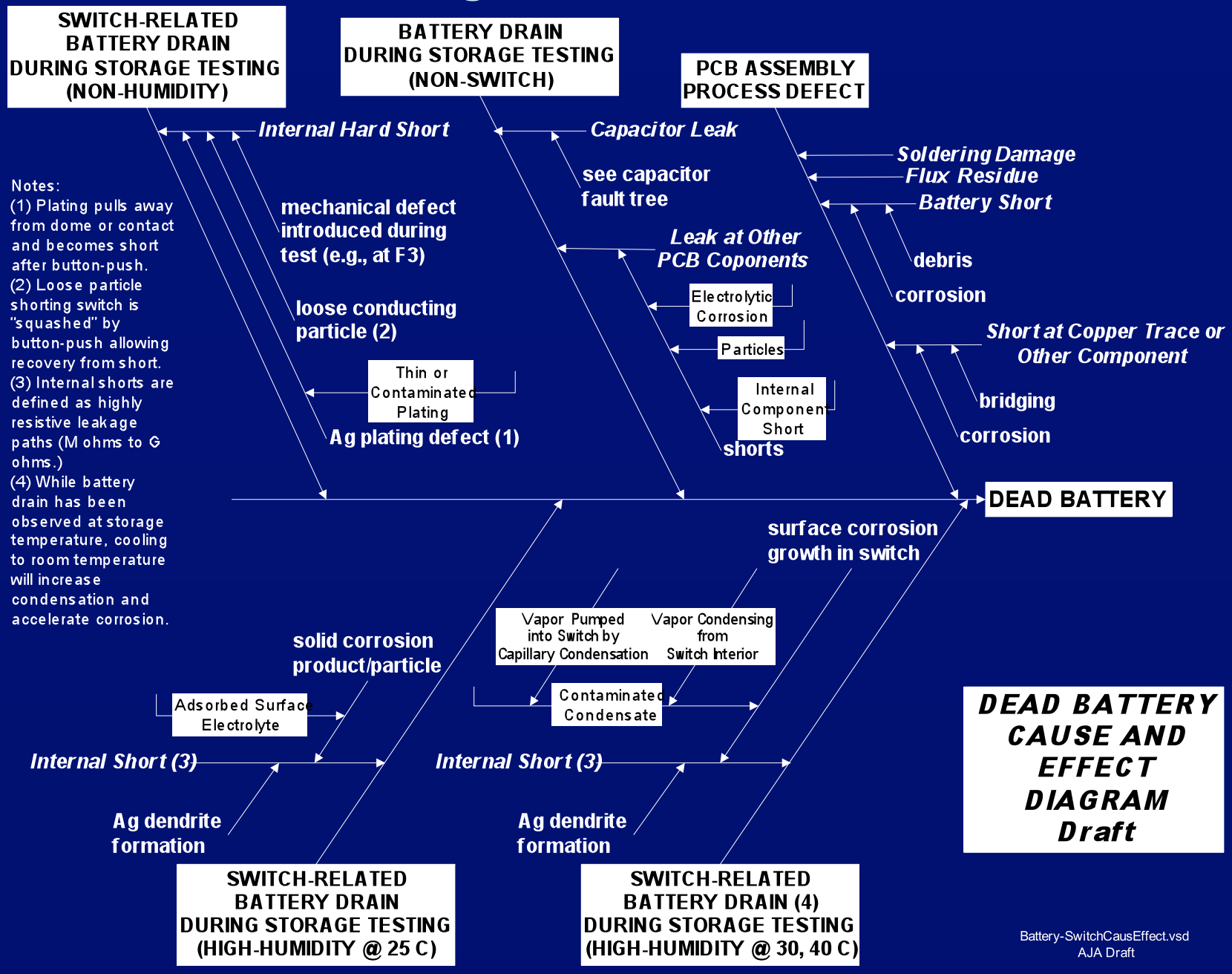
Containment Analysis Tool: Cause & Effect Diagram

- The Cause-and-Effect diagram is an effective tool for facilitating a brainstorming session on causes, and for organizing the results.
- It is also a very useful communication tool.
- A Cause-and-Effect diagram consists of main categories of causes and all related sub-causes.
- Some main categories often used are *equipment, materials, methods, people, policies, and procedures*.

Cause & Effect Diagram

Searching for Containment



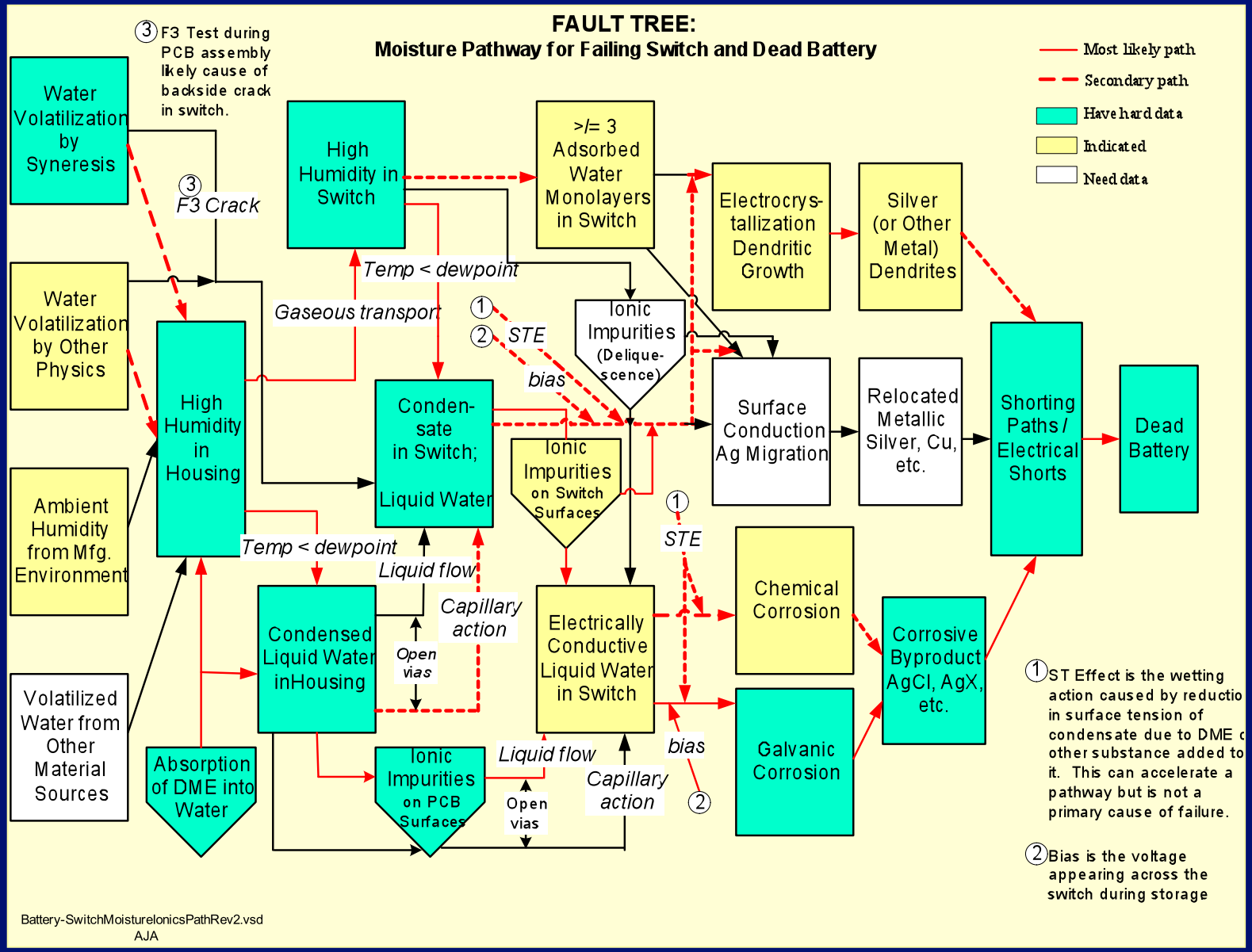
Battery-SwitchCausEffect.vsd
AJA Draft

Containment Analysis Tool: Flowchart

- Flowchart is a form of communication as well as analysis; it is a picture of a process, step-by-step. A picture is more powerful than the written word.
- A flowchart consists of a set of connecting symbols (rectangles, diamonds, triangles, etc.).
- Each symbol shows one step in the process, and contains a short written statement describing the step.
- The very act of generating a flowchart helps develop focus.

Fault Tree in Flow Chart Form

Searching for Containment



Rules/Principles/Pointers for D 3

- At the start of D 3, every member of the team should have the same understanding and interpretation of what the problem is.
- Write down a clear statement of Containment Objectives.
- The Objectives should be unambiguous.
- Do not jump to premature conclusions.

Rules/Principles/Pointers for D 3 (More)

- Speed vs. Completeness. If having a "fix" is urgent, then the speed for containment takes priority over the completeness and permanency of the solution.
- Communicate the containment decisions to all affected parties.
- If fix is permanent, verify (D 7) and stop here.
- Make sure the "temporary fix" does not become permanent! In many busy organizations, when the "fire is out" with a temporary solution, the priority drops and people move to other "fires".

D 4 – Root Cause

Purpose of this Discipline:

If Containment (D 3) is not a permanent solution, then identifying the Root Cause to find a permanent solution is the next step.

Tools for D 4:

- Brainstorming
- Flow Chart
- Cause & Effect Diagram
- Pareto Chart
- Decision Matrix
- "5 Whys" Analysis
- Data Logs
- DOE (if applicable)
- Sample Survey / Questionnaire
- Data Analysis: Histograms, Summary Statistics

Root Cause Analysis Tools
"5 Whys" Example

Problem: *The Washington Monument was Disintegrating*

Why?

Use of harsh chemicals.

Why?

To clean pigeon droppings.

Why so many pigeons?

They eat spiders and lots of spiders at monument.

Why so many spiders?

They eat gnats and lots of gnats at monument.

Why so many gnats?

They are attracted to the light at dusk.

Solution: *Turn on the lights at a later time.*

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Failing to go the Distance in Root Cause Analysis
The BP Horizon Disaster in the Gulf of Mexico

- Blowout Preventers Tested in Deep Water Drilling on 83 Wells in 1998 & 1999
- 117 Failures of Varying Severity
- Failure Analysis Results

  - http://www.boemre.gov/tarprojects/319/319AA.pdf

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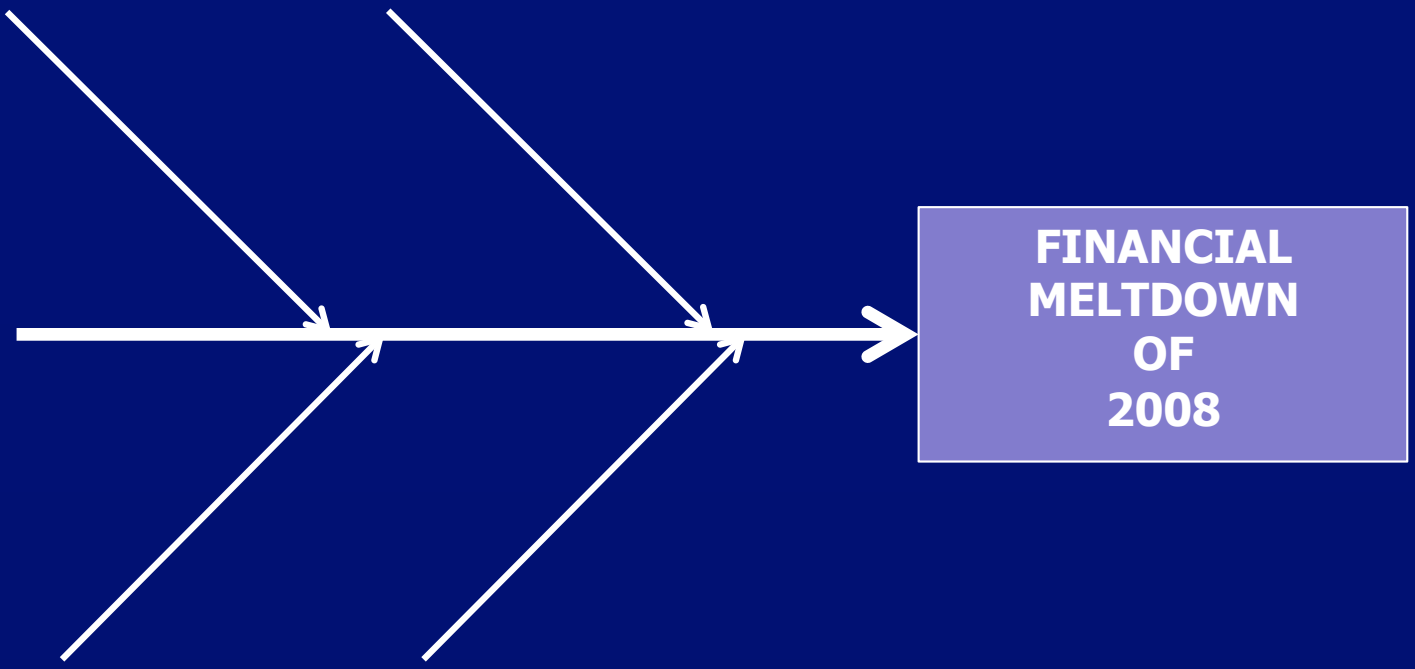
"I have a dream……"



Conclusions

- Companies, groups, individuals benefit by adopting a logical problem solving approach
- Use "The Elements of Objective Investigation”
- Develop knowledge of variability and know how to deal with it
- Start with your knowledge of subject matter and your best experience, but be objective and use data:

  “In God We Trust, Everyone Else Must Bring Data”
- Pay attention to the human side of the organization when seeking and implementing the solutions.