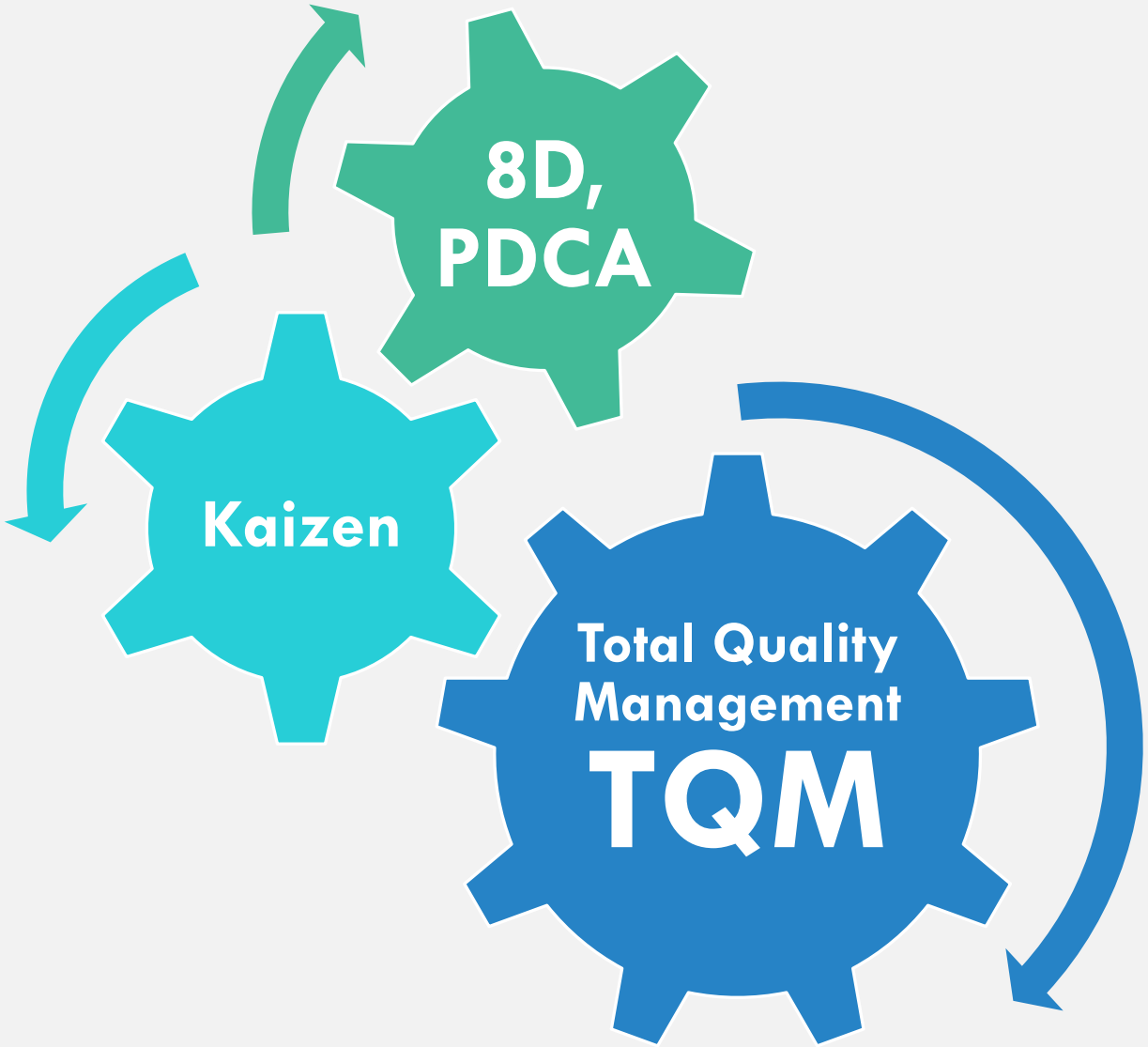


8D PROBLEM SOLVING:
TOOLS & METHODS

A.R. Alvarez

Basic 8D Problem Solving: Tools & Methods

A.R. Alvarez

Part 1

Basic 8D Problem Solving: Tools & Methods

A.R. Alvarez

Part 1

Problem Solving Outline

- **Part 1: Overview of Methods (Plan)**
  - Problem Solving Principles
  - Contrasting Different Approaches
  - PDCA / 4D & 8D Framework
  - D1 – D2: Form Team & Define Problem
- **Part 2: Step-By-Step Problem Solving (Do)**
  - D3: Implement Containment
  - D4: Identify Possible Root Causes
  - D5: Identify Root Cause Corrective Actions
- **Part 3: Problem Solving Wrap-Up (Check & Act)**
  - D6 – D8: Verify Corrective Actions, Prevent Recurrence, Document Results & Recognize Team
  - Appendix

Methods For Problem Solving ?

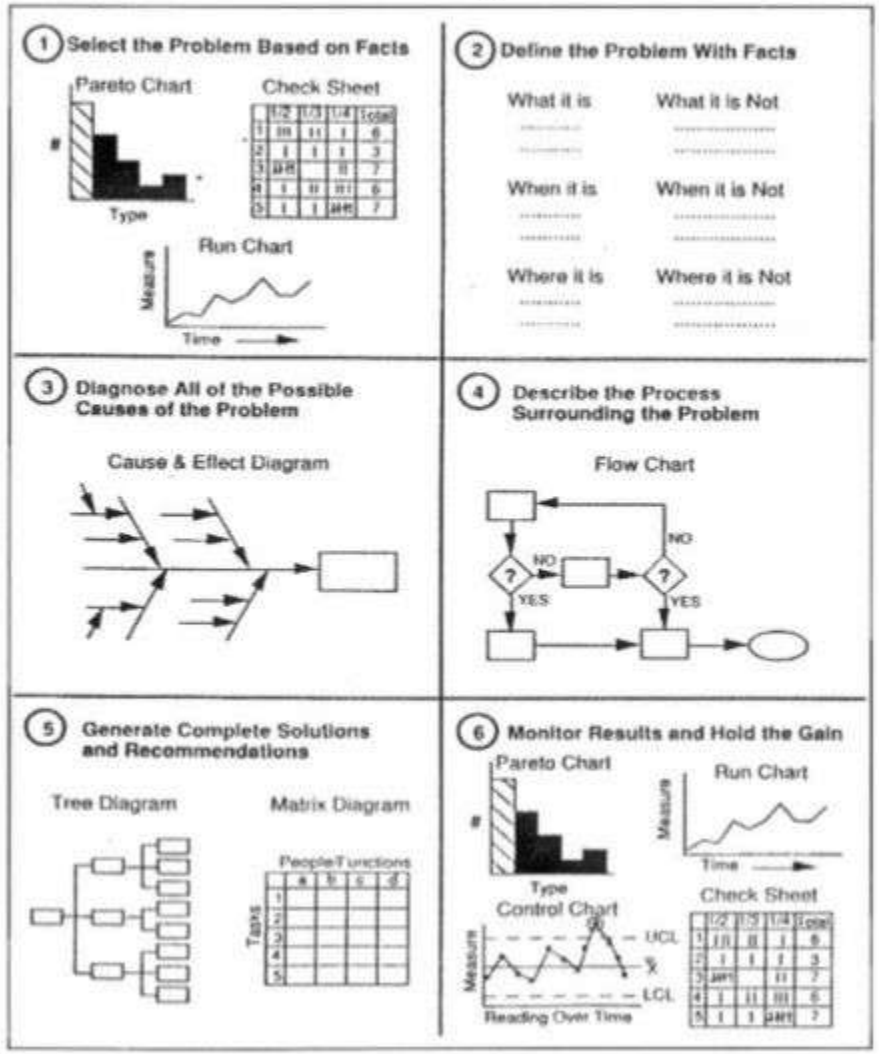
No One Way to Problem Solving Success

But Some Are Better Than Others

Good Ones Have Many Common Elements

Integrate Different Perspective

Utilize Simple Tools

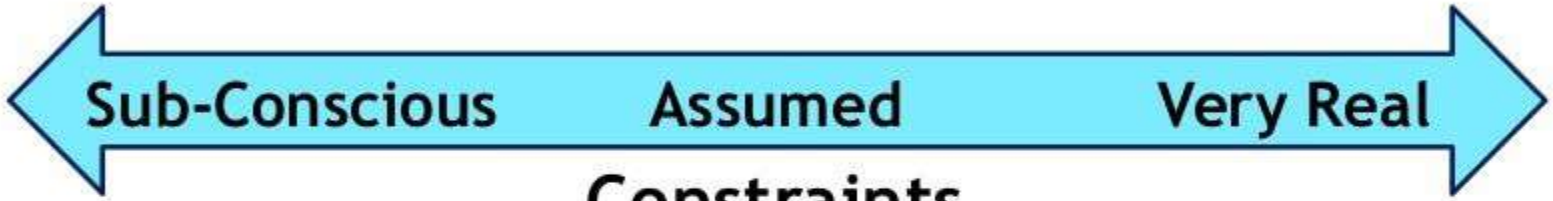


Ask & Answer Simple Questions

- What is The Problem?
- Why is it a Problem?
- What Are The Goals?
- How Long Will it Take to Solve?
- How Much Will it Cost to Solve?

Get Tracked & Managed Like a Project

Avoid Artificial Constraints



Constraints

- Constraints Will Always Exist
- Real Constraints Need to Be Respected, But Also Challenged
- Where Can Constraints Appear During Problem Solving?
- How Do You Become Aware & Overcome Constraints?

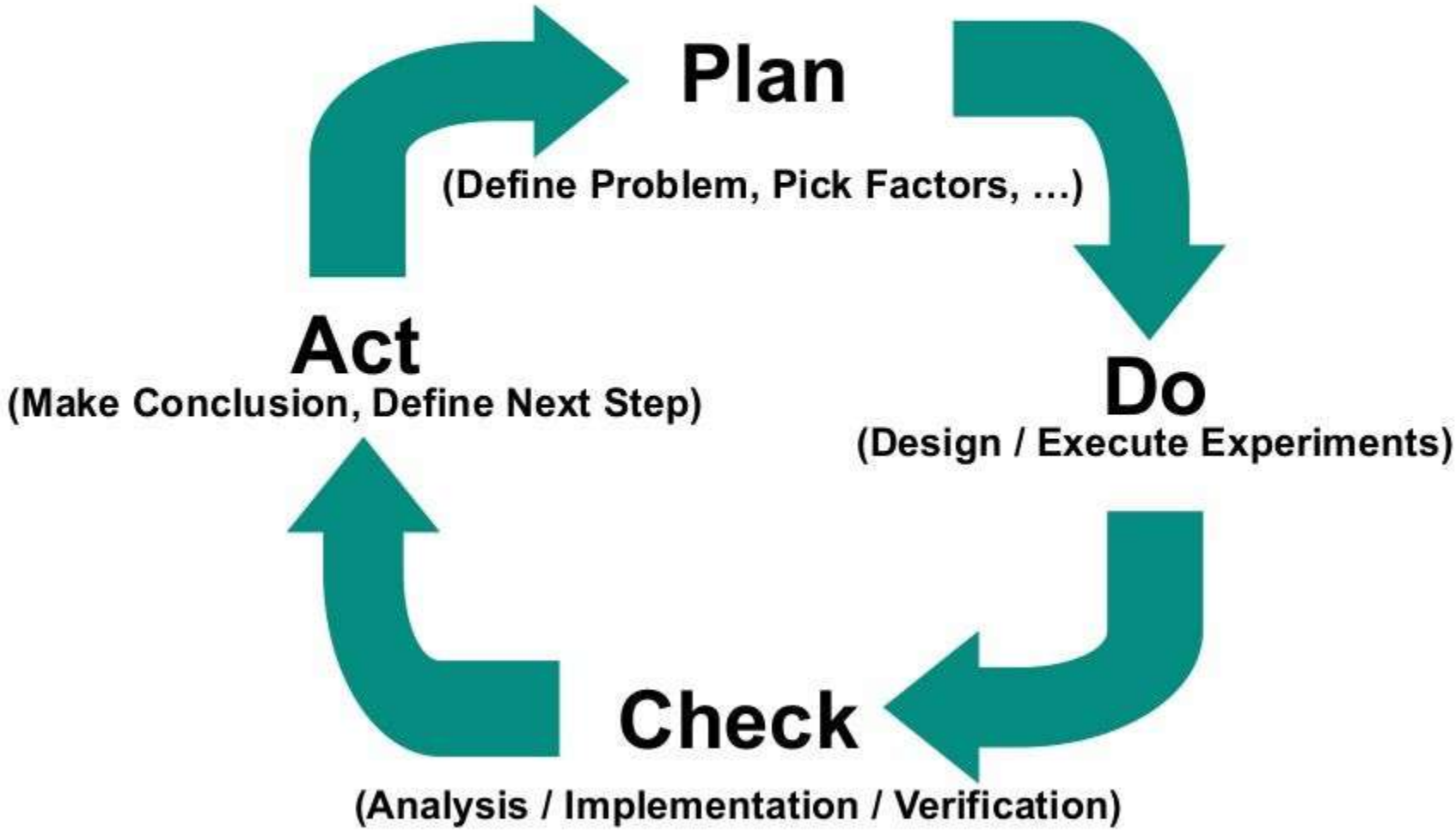
Fit Method to Problem

Different Problems May Require Different Approaches

Be Adaptive

Use as Simple an Approach as Possible

PDCA: Problem Solving



FOCUS Problem Solving Method

- **F**ind the Problem (Often the Problem Finds You)
- **O**rganize a Team
- **C**larify Problem
- **U**nderstand Problem
- **S**elect Solution

How is It Similar? How Different? How Complete?

http://www.mindtools.com/pages/article/focus-model.htm?utm_source=nl&utm_medium=email&utm_campaign=13May14#np

Kepner - Tregoe

1. Define the Problem (Situation Appraisal)
2. Describe the Problem (Problem Analysis)
3. Establish Possible Causes (Decision Analysis)
4. Test the Most Probable Cause (Potential Problem Analysis)
5. Verify the True Cause

How is It Similar? How Different? How Complete?

Edmond's Creative Problem Solving

Step 1 - Curious Observation

Step 2 - Is There a Problem?

Step 3 - Goals & Planning

Step 4 - Search, Explore, & Gather the Evidence

Step 5 - Generate Creative & Logical Solutions

Step 6 - Evaluate the Evidence

Step 7 - Make the Educated Guess (Hypothesis)

Step 8 - Challenge the Hypothesis

Step 9 - Reach a Conclusion

Step 10 - Suspend Judgment

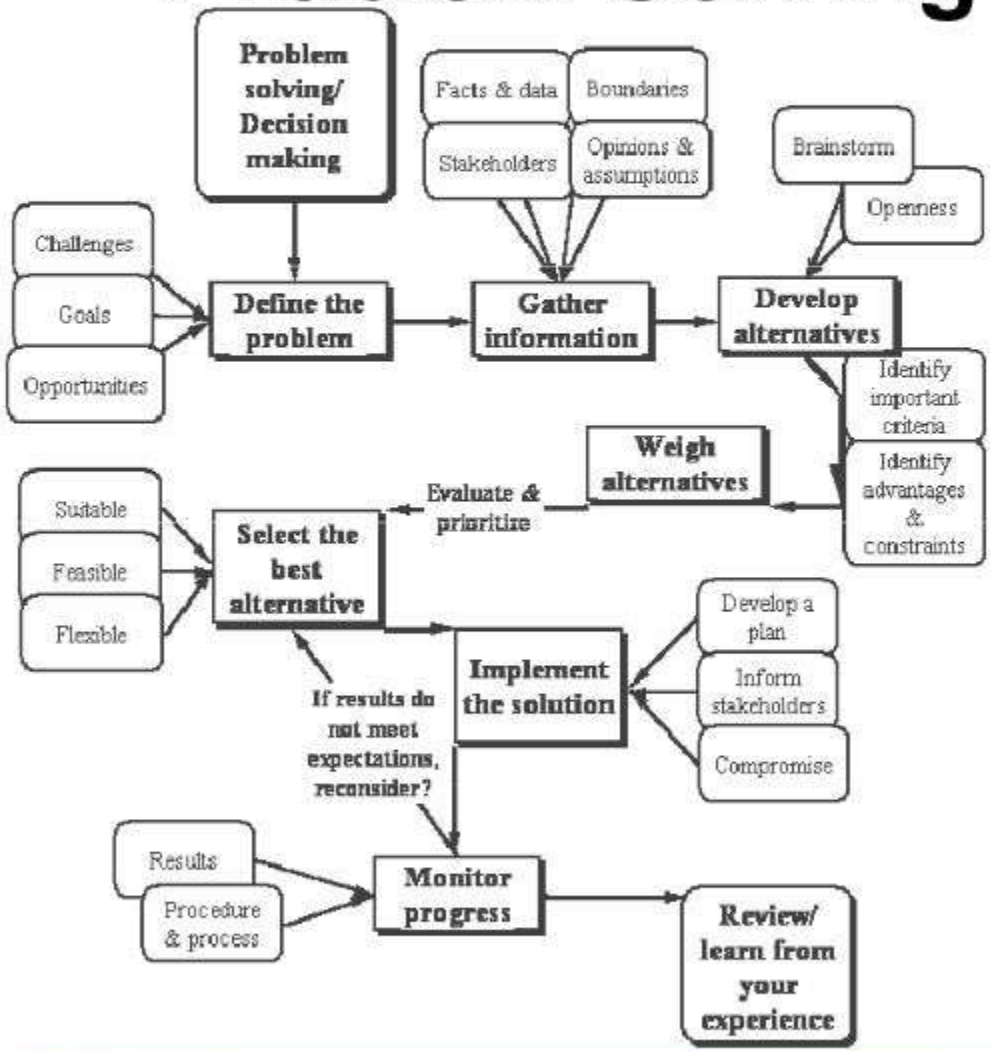
Step 11 - Take Action

Template in Appendix

How is It Similar? How Different? How Complete?

http://www.problemsolving.net/ps9-3of4-fullproblem.html

Problem Solving Concept Map



How is It Similar?

How Different?

How Complete?

http://www.studygs.net/problem/problemsolvingo.htm

Consensus-Oriented Decision-Making

The CODM model was developed by psychologist, Dr. Tim Hartnett, and it was published his 2010 book Consensus-Oriented Decision-Making

Consensus-Oriented Problem Solving??

- Frame The Problem
- Have an Open Discussion
- Identify Underlying Concerns
- Develop Proposals
- Choose Direction
- Develop Preferred Solution
- Close

How is It Similar? How Different? How Complete?

http://www.mindtools.com/pages/article/codm.htm?utm_source=nl&utm_medium=email&utm_campaign=13May14#np

8D Problem Solving Method

Adapted From "The 8 Discipline Problem Solving Process, Brenda Roos)

8D Problem Solving Method

- **Problem Solving Methodology That:**
  - Clearly Defines a Problem
  - Allows for Appropriate Interim Containment Action
  - Analyzes Problems Using Data & Basic Statistical Tools
  - Drives to Find The Root Cause of The Problem
  - Corrects The Problem By Eliminating The Root Cause
  - Implements Mistake Proofing to Prevent Reoccurrence
  - Uses "Lessons Learned" Concepts as Prevention Step

Don't Limit 8D's Use to Just Customer Related "Quality" Problems

It Doesn't Need to Be 8D, 4D is Fine in Many Situations

8D Project Overview Template

Problem Definition	
Performance Gap: Actual = Target =	Customer Line Fallout 1,000 PPM < 10 PPM
Time in Existence	90 Days
Time to Solve	< 7 Days
Product/Service	Touch Sensor
Customer	Apple
Organizations	PE, TE, Mkt
Priority (1 – 5)	4
Team Lead	Isabel
Team	KY, TA, KG, ..

Business Impact	
Revenue	$10M
Customer Relationship	Medium
Organization	High

Problem Complexity	
Type (L,M,H)	Medium
COL Budget (Fcst/Actual)	4
Time Per Cycle	24 Hrs

Key Requirements
Eliminate Customer Line Fallout
No Change in Any Product Spec
< 3% Increase in Product Cost
< 10% Increase in Step Mfg Cycle Time

Containment Impact
Customer: None
Manufacturer: 5% Yield Loss ($0.50)
Mfg: 20% Capacity Reduction (1Mu/Mth)
Mfg: 10% Increased Cycle Time (6 Hrs)

Root Cause / Corrective Action
RC Hypothesis/Confirmed: Test Hole at X
CA Status: In Progress

	D1	D2	D3	D4	D5	D6	D7	D8
At D1	3/13/13	3/13/13	3/16/13	3/18/13	3/19/13	3/20/13	3/22/13	3/24/13
Previous Review	3/13/13	3/13/13	3/16/13	3/23/13	3/24/12	3/25/13	3/26/13	3/27/13
Current Plan	3/13/13	3/13/13	3/17/13	3/23/13	3/25/13	3/25/13	3/26/13	3/27/13

Note: Add Any Key Customer Delivery Dates / Description Above if Different From Dx

4D Project Overview Template

Problem Definition	
Performance Gap: Actual = Target =	Customer Line Fallout 1,000 PPM < 10 PPM
Time in Existence	90 Days
Time to Solve	< 7 Days
Product/Service	Touch Sensor
Customer	Apple
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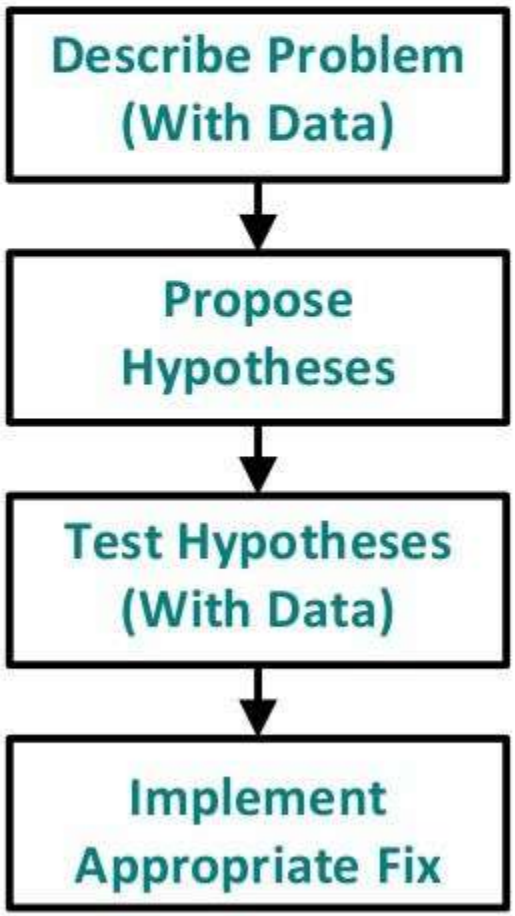
Root Cause / Corrective Action
RC Hypothesis/Confirmed: Test Hole at X
CA Status: In Progress

	Plan	Containment	Root Cause Identified	Root Cause CA Implemented
At D1	3/13/13	3/13/13	3/16/13	3/18/13
Previous Review	3/13/13	3/13/13	3/16/13	3/23/13
Current Plan	3/13/13	3/13/13	3/17/13	3/23/13

Note: Add Any Key Customer Delivery Dates / Description Above if Different From Above

Best Practices in Problem Solving

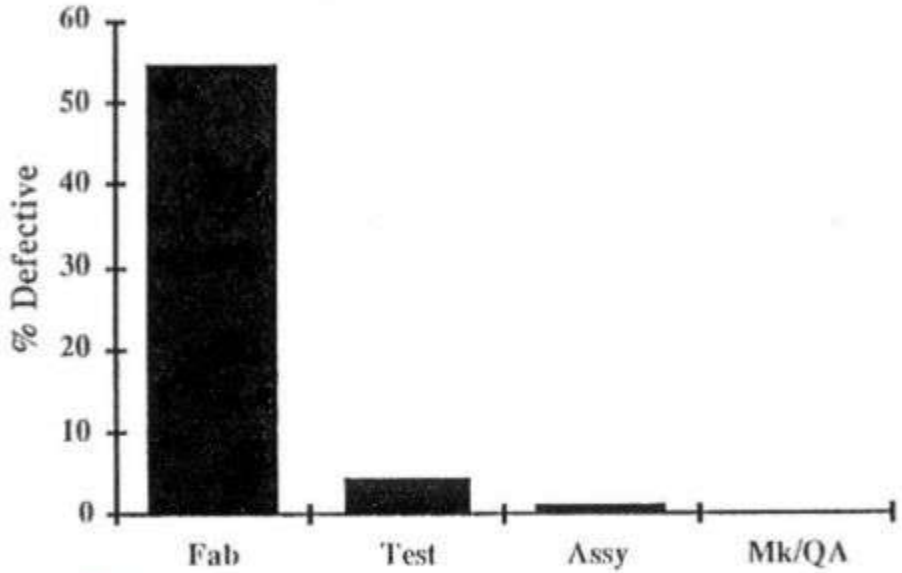
(Don't Over-Complicate)



- Clear, Concise Problem Definition
- Starts With Broad Perspective
- Gets Alignment Across Organizations
- Breaks Down Problem
- Questions Data, Knowledge Base, Assumptions
- Critically Focuses Data
- Eliminates Artificial Constraints
- Drives Convergence & Critical Path
- Is Self-Correcting
- Balances Planning & Doing
- Balances Root Cause Fix & Containment
- Is Properly Tracked & Progress Communicated
- Appropriately Documented

Pick Your Problems: Pareto Analysis

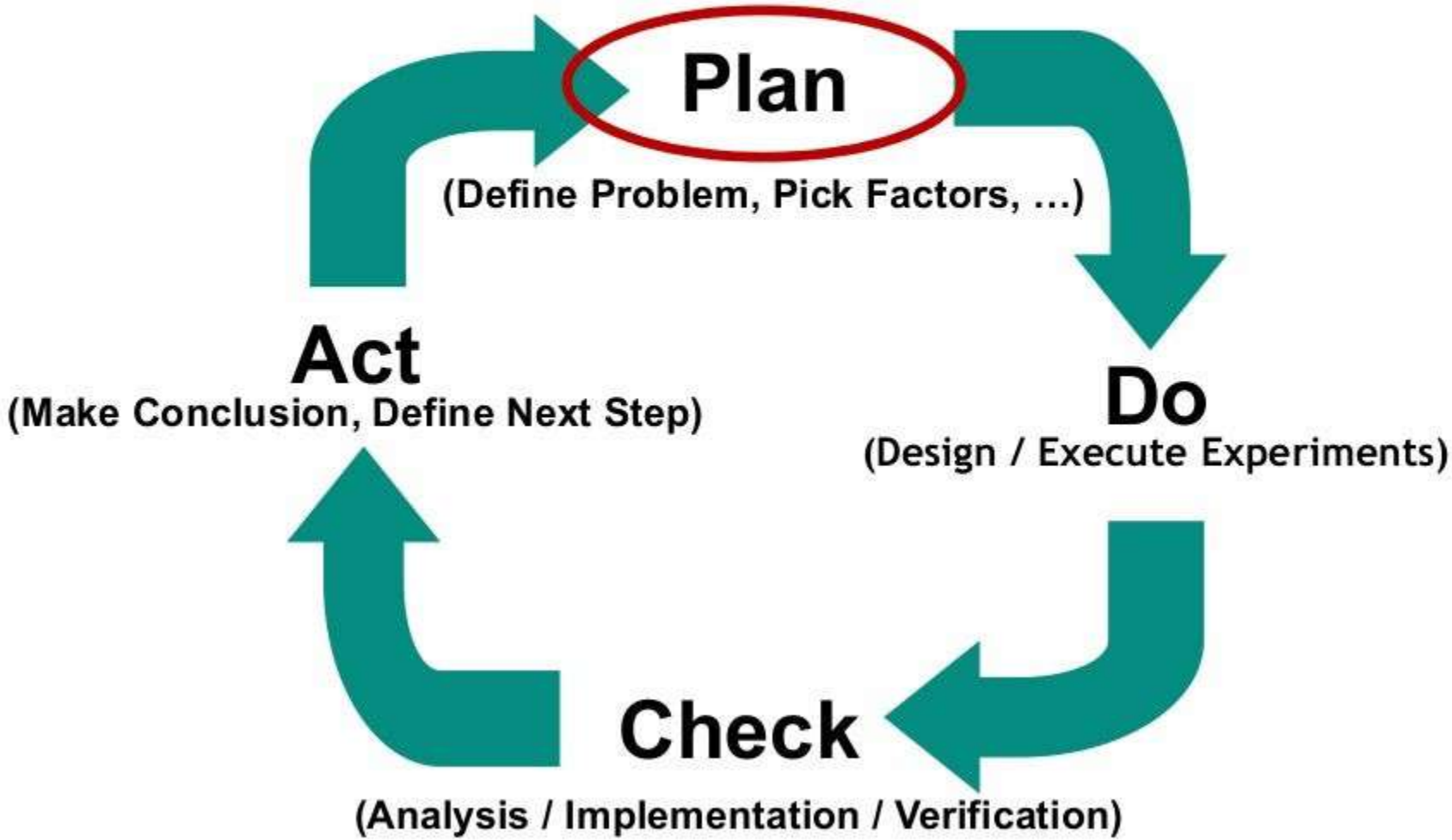
- Vital Few, Trivial Many
- Many Things Need Improvement
- Where To Start?



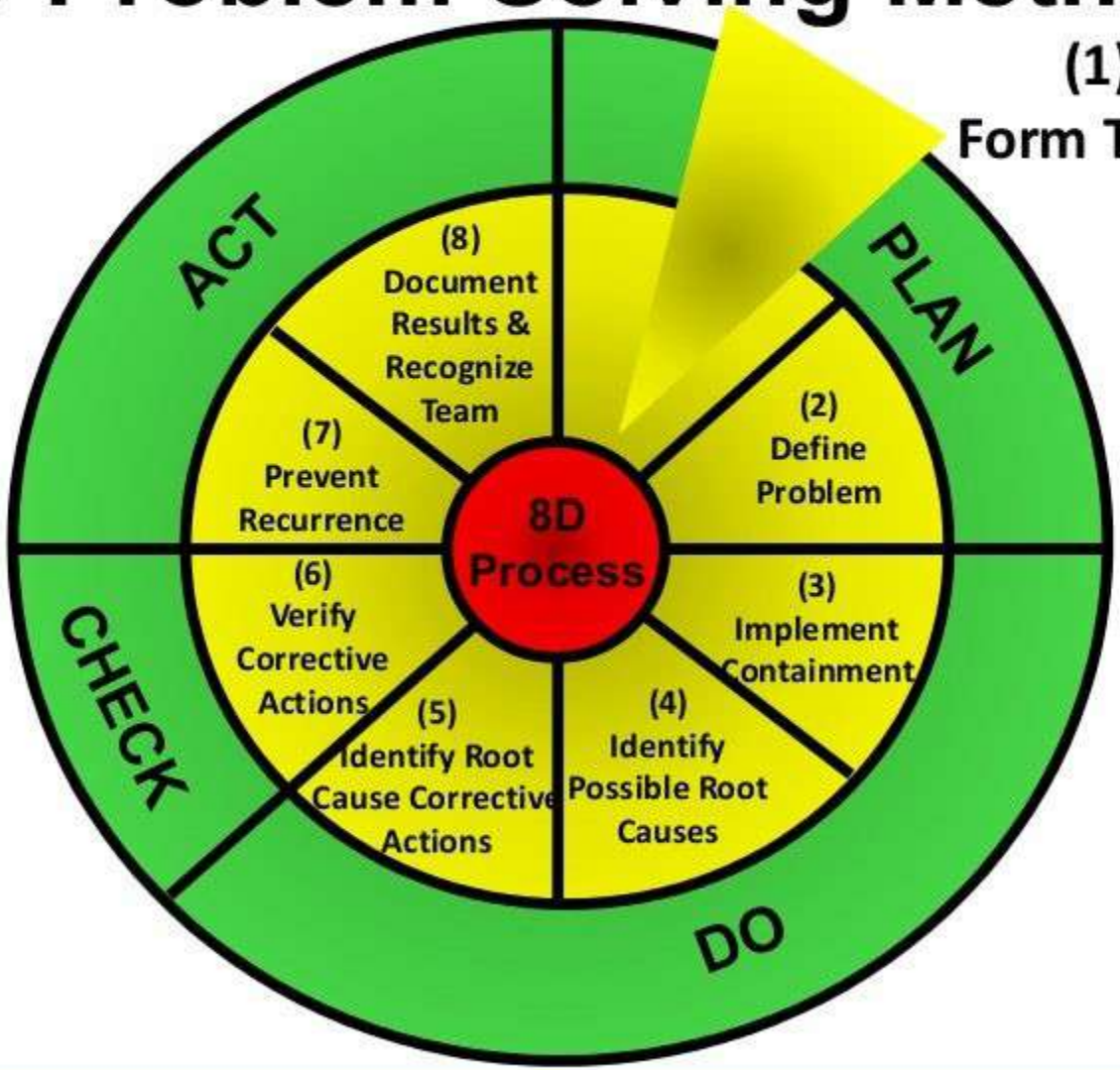
- Cooperation
- Communication


WE ARE BEING
CONTROLLED
BY THE RANDOM
OUTCOMES OF A
COMPLEX SYSTEM
Samuel
CN

PDCA: Problem Solving



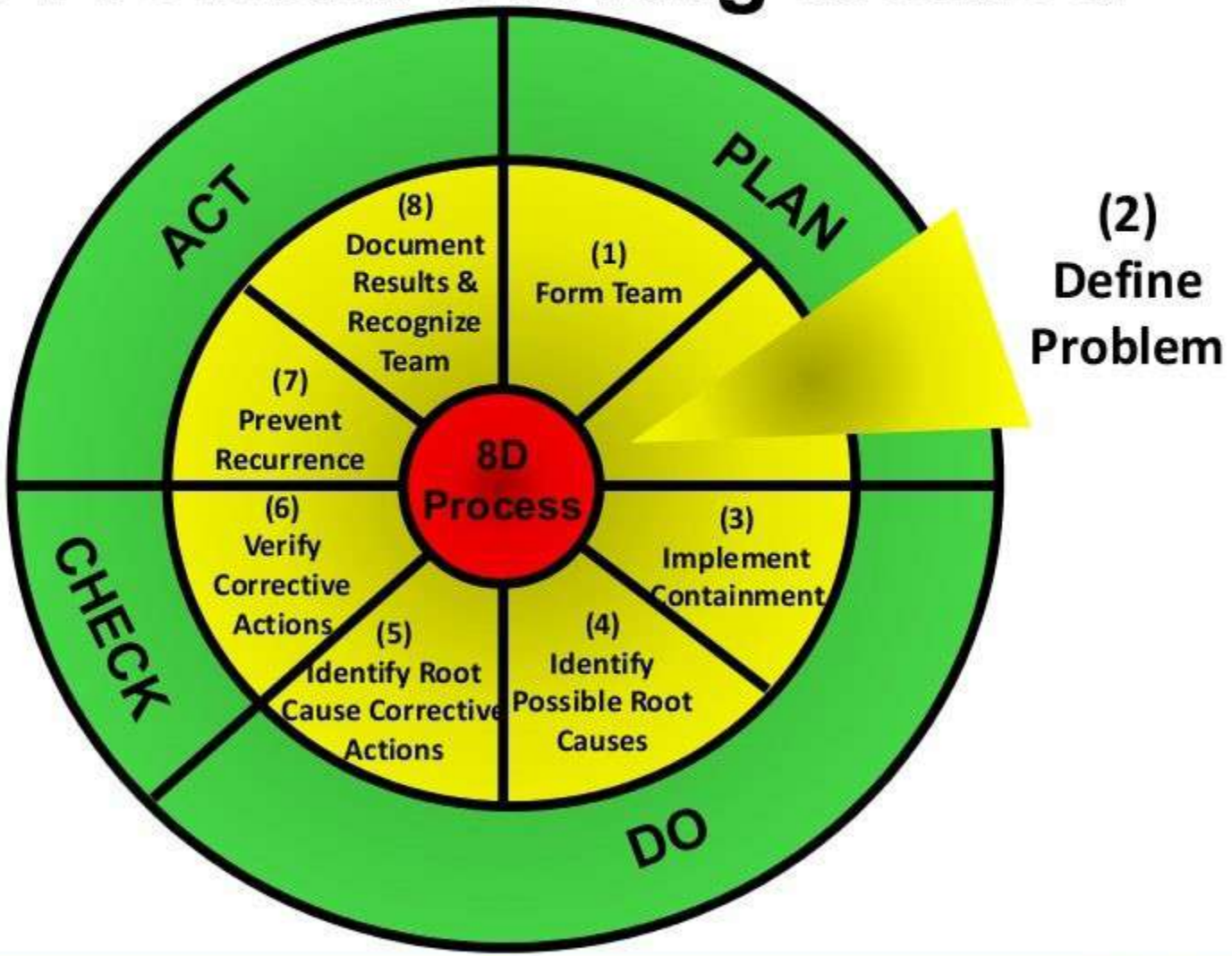
8D Problem Solving Method



I. Form Team

- Who Should Be on the Team?
- Start Small, Grow Team as Problem Definition (D2) Evolves
- Team Leader
- Team Members (Cross-Functional?)
- Roles & Responsibilities
- "Rapid" Decision Making Process
  (Recommend, Agree, Performs, Input, Decides)
- How to Determine Priority?

8D Problem Solving Method



II. Problem Definition

- **Arguably The Most Important Step in the Process**
- **But The One Most Often Done Poorly**
- **Insure That Problem (& Size) is Real – Don't Assume!**
- **Problem Definition Elements:**
  - Products or Service Impacted
  - Quantified Performance Gap (Scope): Current vs. Target
  - Temporal: 1) Time in Existence, 2) Time to Solve
  - Quantified Impact: Both Company and Customer
  - Priority (Dollarizing Extent of Problem Helps Set Priority)
- **Specify Both Financial and Non-Financial Impact**
- **Specify Not Just Desired Outcome, But Also By When**
- **Modify Team as Necessary**

Problem Landscape: Urgency

- **Crises:**
  - Fast Action, Big Differences
  - Simple Experiments
- **Development/Yield Enhancement**
  - More Time, Smaller Differences, Cause & Effect
  - 2 Level Factorials, Blocked Designs
- **Discovery**
  - Longer Time, Complete Knowledge
  - Response Surface, Steepest Ascent

D. Welter, Motorola

Problem Landscape: Assumptions

- Assumptions Guide Behavior, Affect Thinking and Therefore Problem Solving
- Broad Categories: Casual, Prescriptive & Paradigmatic
- You Can't Help But Make Assumptions; Dig Deep Enough & You'll Always Hit an Assumption
- Implicit or Hidden Assumptions Abound
- Some are Good, Even Necessary; Some Not So Good
- How to Uncover Assumptions?
- How to Differentiate "Good" vs. "Bad" Assumptions?

Problem Landscape: Data

- What Data Do You Need at This Stage?
- What Do You Really Know? (Fact, Not Speculation)
- How Much Data Do You Need?
- How are You Going to Get It?
- How Long is It Going to Take You to Get It?

Initial Data Gathering

3 Ws: First Order What, When, Where

IS	IS NOT
■ What It is:	■ What It is Not:
■ When It is:	■ When It is Not:
■ Where It is:	■ Where It is Not:

Initial Data Gathering

Possible Actions & Questions

- 5 Whys (= How)
  (Used Both in Problem Definition & Subsequent Steps)
- Extent ?
- How ?
- Does it Interact ?
- "Solved" Before ?
- What Can Be Done to Clarify Problem?
- Preliminary Hypothesis Driven?
- Who Can Help?
- . . .

Expanded Data Gathering

5 Ws . . . and . . . 2 Hs

(Who, What, Why, Where, When) (How Many, How Often)

IS

Who
- Who is affected by the problem?
- Who first observed the problem?
- To whom was the problem reported?

What
- What type of problem is it?
- What has the problem (part id, lot #s, etc)?
- What is happening with the process?
- What changed?
- Do we have physical evidence of problem?

Why
- Why is this a problem?
- Is the process stable (Or Unstable)?

IS NOT

Who
- Who is not affected by the problem?
- Who did not find the problem?

What
- What does not have the problem?
- What could be happening but is not?
- What could be the problem but is not?

Why
- Why is it not a problem?

After ABB 8D Worksheet

Initial Data Gathering: Expanded

IS	IS NOT
Where ▪ Where was the problem observed? ▪ Where does the problem occur?	**Where** ▪ Where is the problem not observed? ▪ Where is the problem not located?
When ▪ When was the problem first noticed? ▪ When has it been noticed since?	**When** ▪ When could the problem have been noticed but was not?
How Much/ Many ▪ How well can problem be measured (gauge)? ▪ Quantity of problem (ppm)? ▪ How much is it costing dollars, people, & time?	**How Much/ Many** ▪ How big could the problem be but is not?
How Often ▪ What is the trend (continuous, random, cyclical)? ▪ Has the problem occurred previously?	**How Often** ▪ What could the trend be but is not? ▪ Why hasn't the problem been seen before?

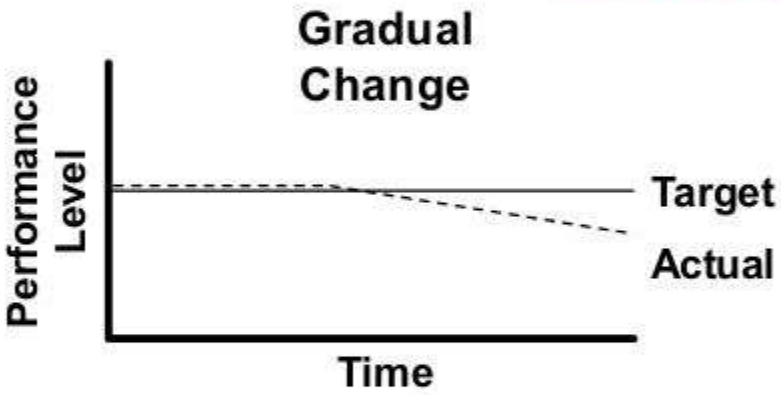
Initial Data Gathering

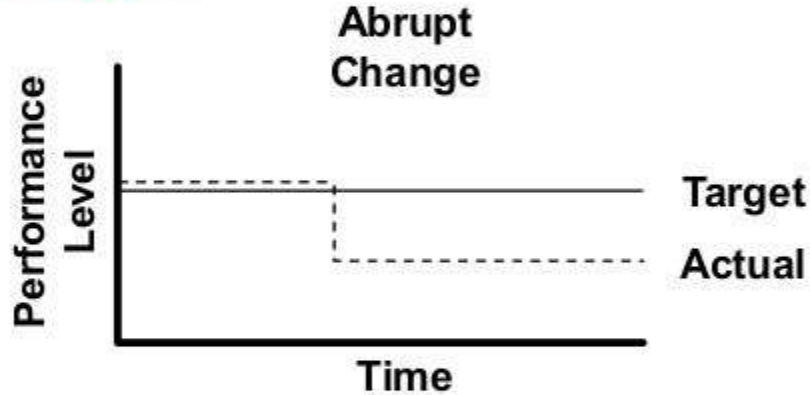
Data Sources & Analysis Tools

- **Data Sources:**
  - SPC Charts
  - Historical (Typically Unstructured) Data Tables
  - . . .
- **Analysis Tools:**
  - Simple (Or Even Multivariate) Correlation Analysis
  - Multi-Vari Charts
  - Distribution Analysis and Box Plots
  - . . .

Something Change . . . Or . . .
"Never Been There" Performance Gap?

"Something Changed"

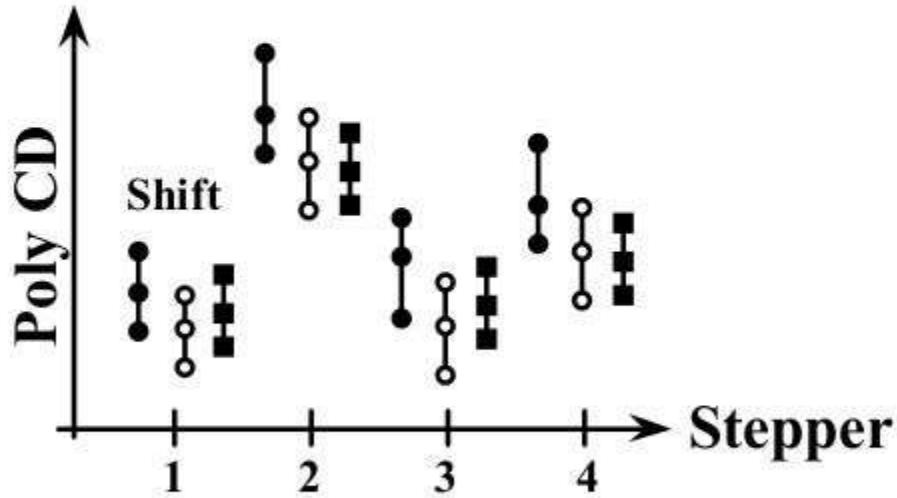




"Never Been There"

Multi-Vari Chart

- **Variation is Composed of Levels; One Level Typically Contains Most of Variation**
- **What Are Levels of Variation?**
  - Die, Wafer, Lot
  - Wafer, Run, Shift
  - Furnace, Bank, Fab
  - Tester
  - Shift
  - Factory / Line



- **De-Constructing Levels of Variation Provides Insight Into Possible Root Causes**

Integrated Problem Solving

Data Driven: Good Data

- When is Data Bad ?
- Under- vs. Over- Standing
- Causality vs. Correlation
- Data (Sample) Bias
- Sufficiency
- . . .

Don't Take "Data" at Face Value

Knowledge Driven: Good Knowledge

- When is Knowledge Bad ?
- Under- vs. Over- Standing
- Applicability
- Capturing & Using Knowledge
- . . .

Don't Take "Knowledge" at Face Value

Question Driven: Good Questions

The Basic Critical Question(s)

- **How do You Know This to Be True?**
  - Response to Information or Descriptive Claim
- **Why Should I (We/They) Do This?**
  - Response to Action, Suggestion, Recommendation . . .
- **What is it About ____ That Makes it Good (Bad/OK)?**
  - Response to Value Judgment

Get Good at Asking Insightful Questions

After Dennis Matthies

Matthies' PQ Basic 7 ⇨ 8

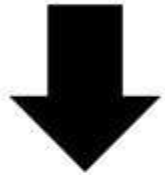
- Go/No Go ⇦ Why Spend Time on This?
- Clarification ⇦ What Exactly do you Mean?
- Assumptions ⇦ What are We Assuming?
- Basic Critical ⇦ How do we Know This is True?
- Causes ⇦ What Caused This?
- Outcomes ⇦ What will be the Effects?
- Action ⇦ What Should be Done?
- Uniqueness ⇦ Is This the Only ...?

Learn to Use The Full Toolkit

After Dennis Matthies

Argument Deconstruction

Conclusion



Reason/Evidence

Assumption 1 . . .
Assumption 2 . . .
. . . Assumption n

Source

Stay Alert to Implicit Assumptions & Weak Source(s)

After Dennis Matthies

Assumptions: Breaking Them Down

Step 1) Brainstorm / Uncover Assumptions Being Made

Step 2) Evaluate: Ask 3 Questions About Each Assumption

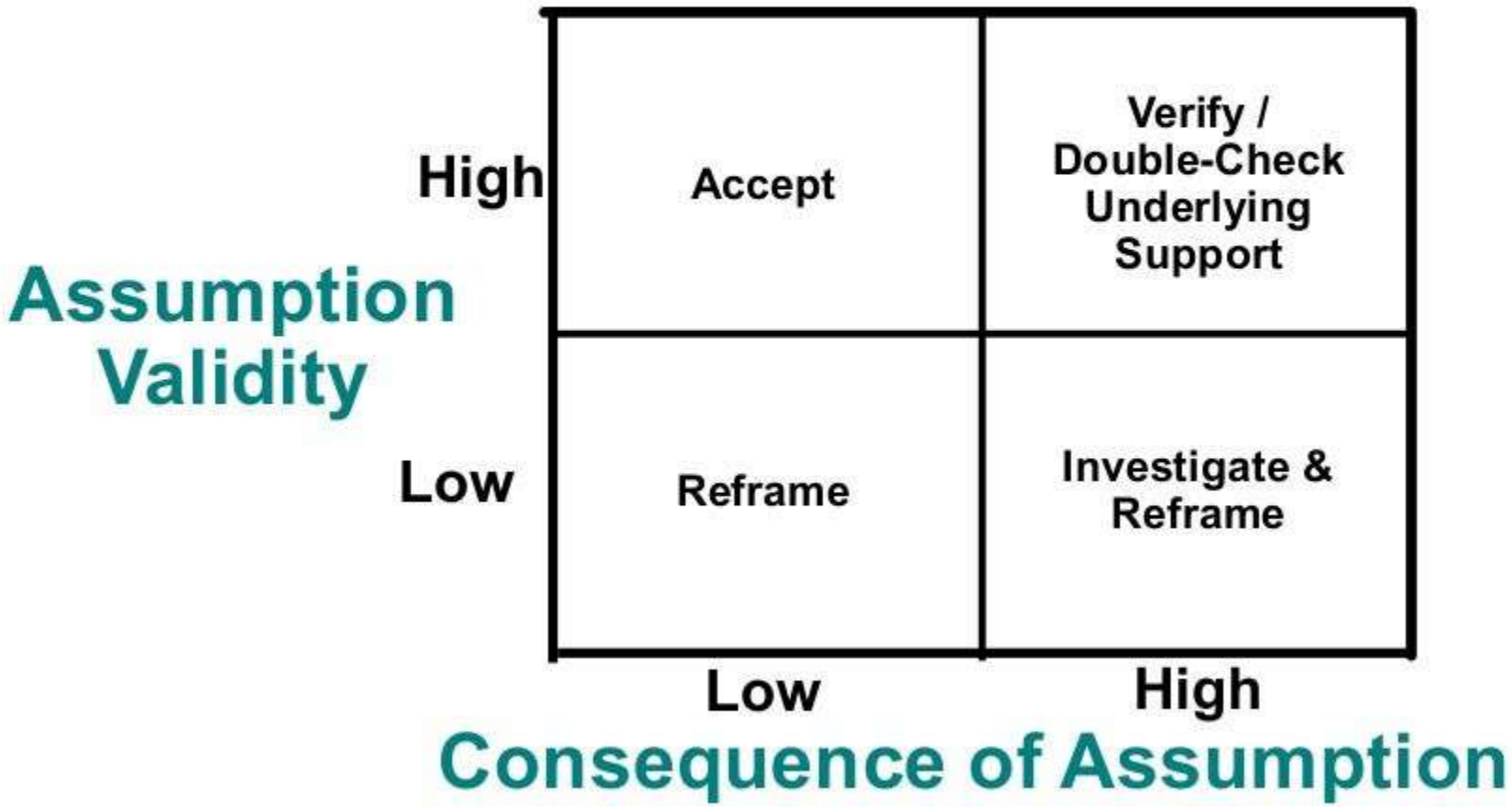
1. How Likely is This Assumption to Be False or Mistaken in Some Way & How?
2. What are the Consequences if this Assumption is False or Mistaken? i.e. How Astray Will it Lead Us? How Long Would it Take to Recover? How Much Harm Will Result?
3. If We Don't Know (or Not Sure) Whether/How Valid This Assumption Is, Would it Be a Good Use of Resources to Investigate Further?

Step 3) Actions Based on Assumption's Validity

- Create 2X2 Matrix (Consequence vs. Validity) & Parse Assumptions (Next Pg); i.e. Sort Assumptions Out That Are Highest Uncertainty/Probability of Being Wrong and That If Not Valid Will Have Significant Consequences
- Make Action Plan For Investigating Those Assumptions Further to Get Broader View of Risk Inherent in Thought Process

After Dennis Matthies

Prioritizing Assumption Evaluation



Assumptions: Basic Questions

- What Are You Assuming?
- What is The Person Next to You Assuming?
- What Inferences Are You Making From Your Assumptions?
- What Could Be Assumed Instead?
- Why Would Someone Make This Assumption?

Reference ??

Assumptions: Sample Questions

- You Seem to Be Assuming _____. Do I Understand You Correctly?
- Your Reasoning Depends on The Assumption That _____. Why Have You Based Your Reasoning on _____ Instead of _____?
- What Background Information or Data Are Your Assumptions Based On? Would Knowing _____ Change Your Assumption in Some Fashion?

Reference ??

Assumptions: Constraints

- Assumptions About Constraints Common
- Sometimes They are Unconscious
- Sometimes They are a Conscious Assumption
- How Do You Uncover Them?

Matthies' 9 Assumption Categories

- **Existence: Assumption That Something Exists**
  When Someone Says, "The Solution to X Is..." They are Assuming That a Problem Exists and That There is a Solution for It.

- **Uniqueness: There is Only One of Something**
  In The Above Example, It is Assumed That There is One Solution and One Problem; If Statement Started With "A" Rather Than "The" No Uniqueness

- **Measurement: Assumption That Something Is Measurable**
  Someone Claims That They Have Found The Solution to X. This Assumes That X is Measurable and that There is an Accurate Way of Measuring Changes in X.

- **Possibility: Something is Possible, or Feasible**
  When Somebody Says That They Are Trying to Solve a Problem, They Are Assuming That Finding a Solution is Possible, or That Under The Circumstances it is Feasible. It Could Be That The Solution is Too Expensive, or Would Take Too Long to Implement, To Be Viable

- **Value: Assumption That Something Is Good Or Bad**
  When Someone Says, "I Have a Great Solution," They are Obviously Attaching a Value Assumption – What is The Measure?"

After Dennis Matthies

Matthies' 9 Category Assumptions

- **Audience: In Statements to Others We Make Audience Assumptions**

  These Often About Shared Meanings, Shared Values, Or Shared Background.
  Ex: Team is Unable to Agree on Which is Solution, X_1 or X_2, is Best. Someone Asks, "What Assumptions Are We Making About How Long X_1 or X_2 Will Take?" Group Realizes That Lack of Agreement Stems From Different Assumptions at About How Long (Or How Hard) X_1 or X_2 Will Take.

- **Category: We Have Categorized Something Correctly**

  Team Leader Tells Manager The Proposed Solution is Too Expensive. It Could Be That Solving The Problem is So Critical That Cost is Secondary – Time is the Key Factor.

- **Similarity: Majority of Thoughts Are Unconscious Analogies**

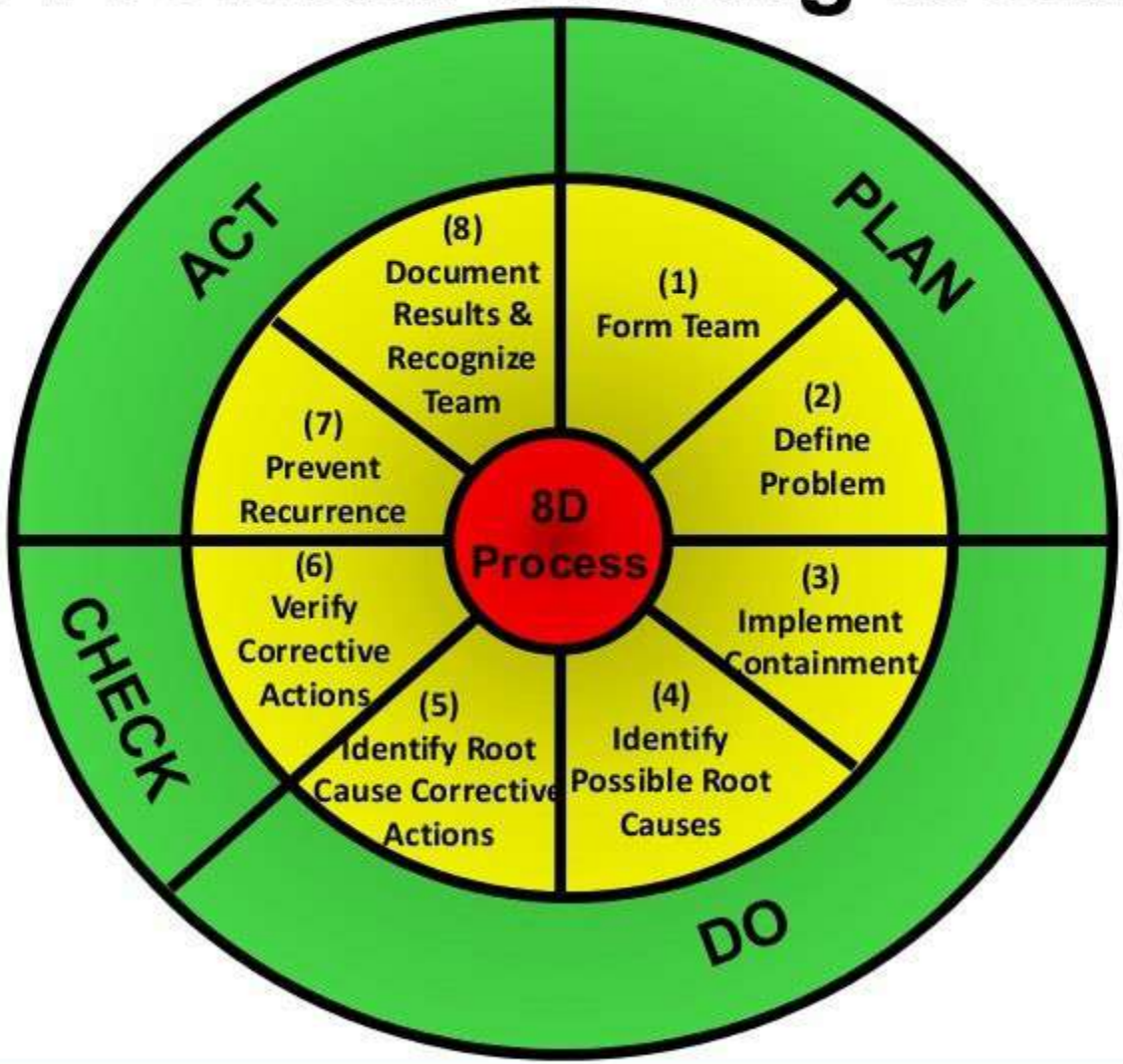
  Team Lead Says "As We Learned in Project X, If We Do Y … ." This Assumes That Solutions Used In Project X Will Work In a Similar Fashion on the New Project.

- **Time Constancy: Things Will Stay The Same Over Time**

  Assuming That Current Conditions are Representative of The Past or That Critical Variables Stay Constant Over Time are Examples of High Risk Assumption in Problem Solving

After Dennis Matthies

8D Problem Solving Method



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A.R. Alvarez

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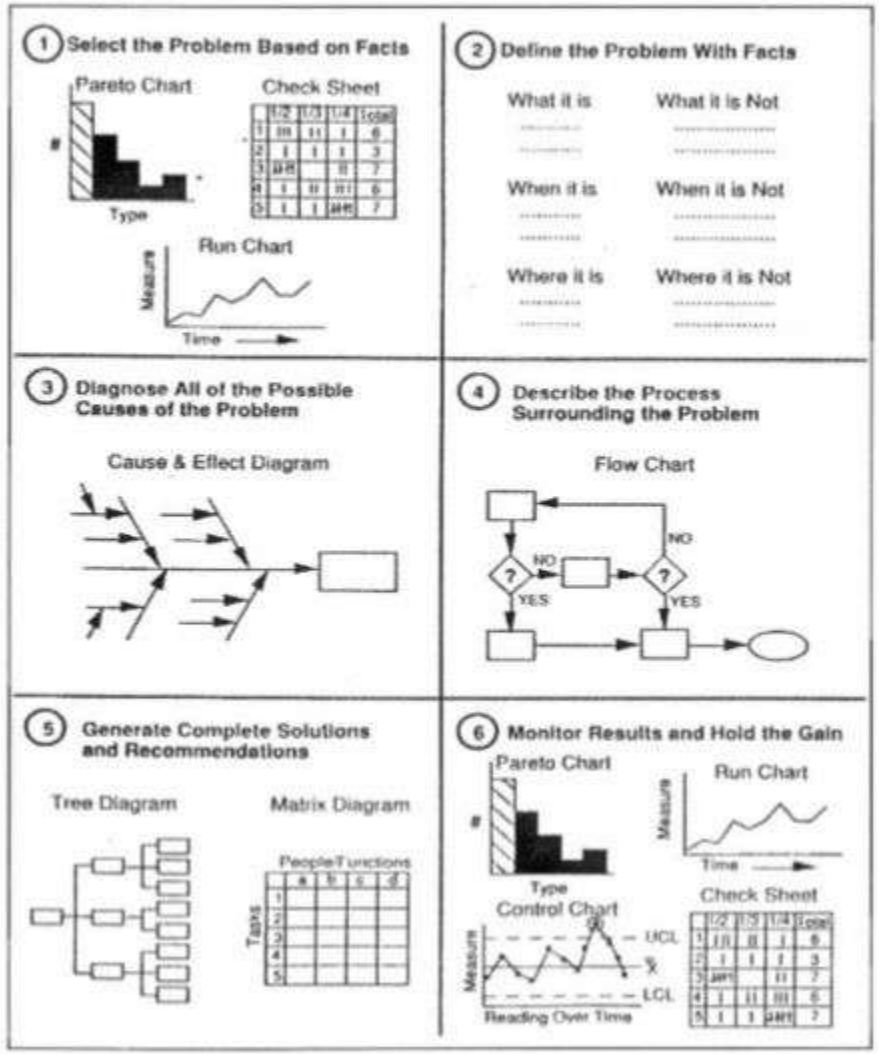

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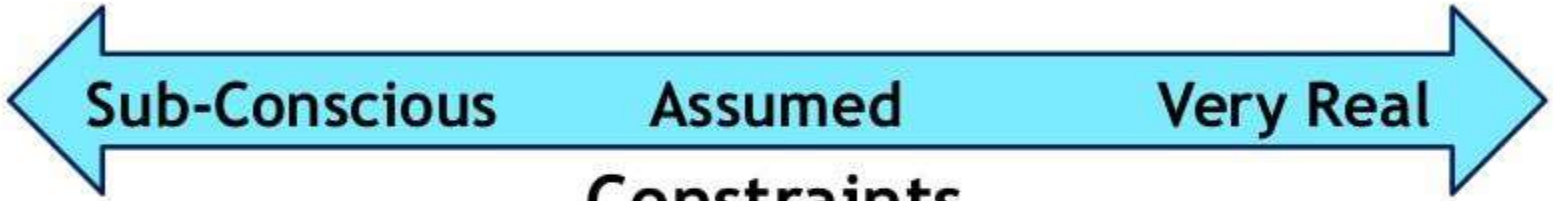
Get Tracked & Managed Like a Project

Avoid Artificial Constraints



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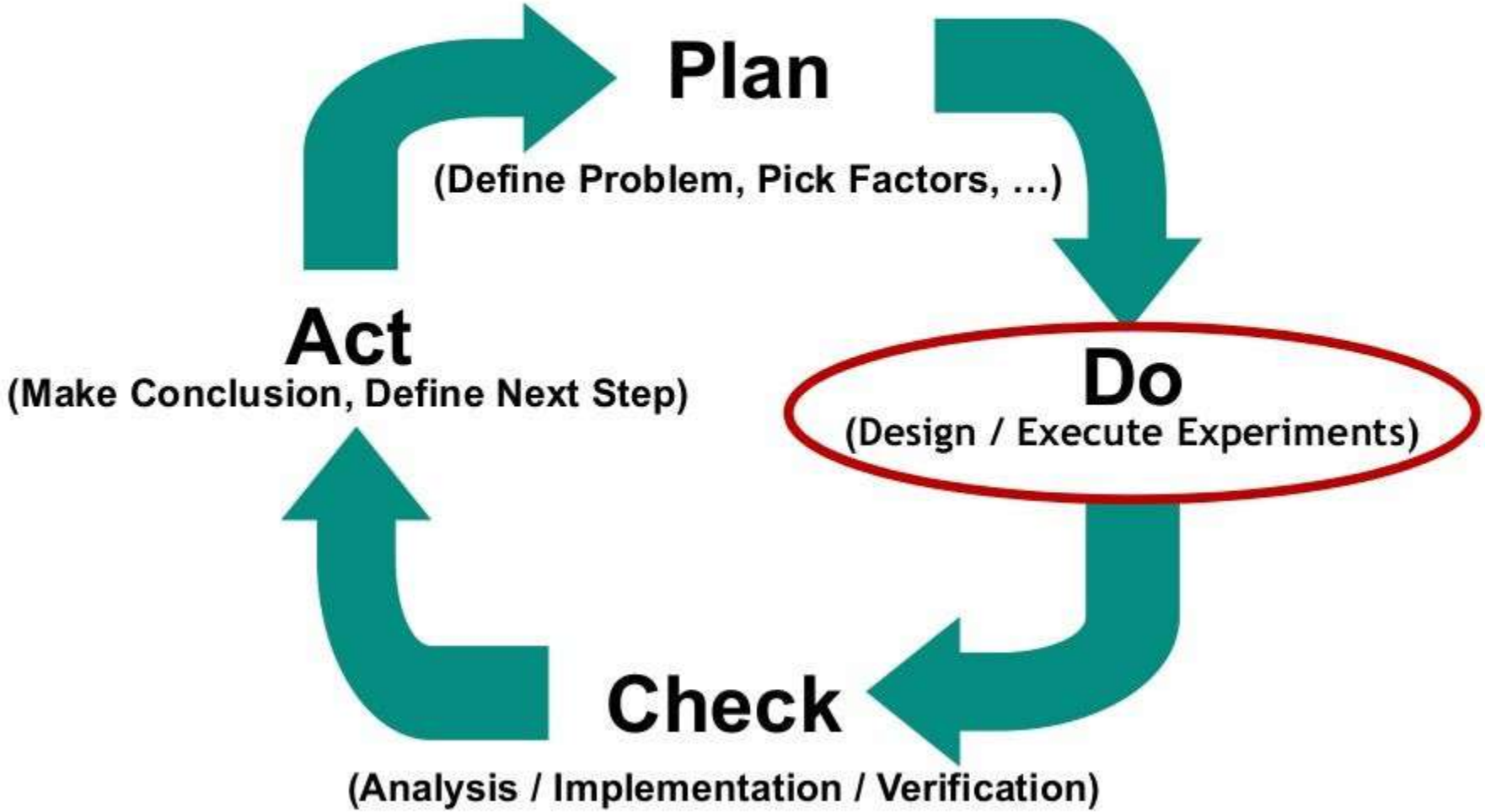
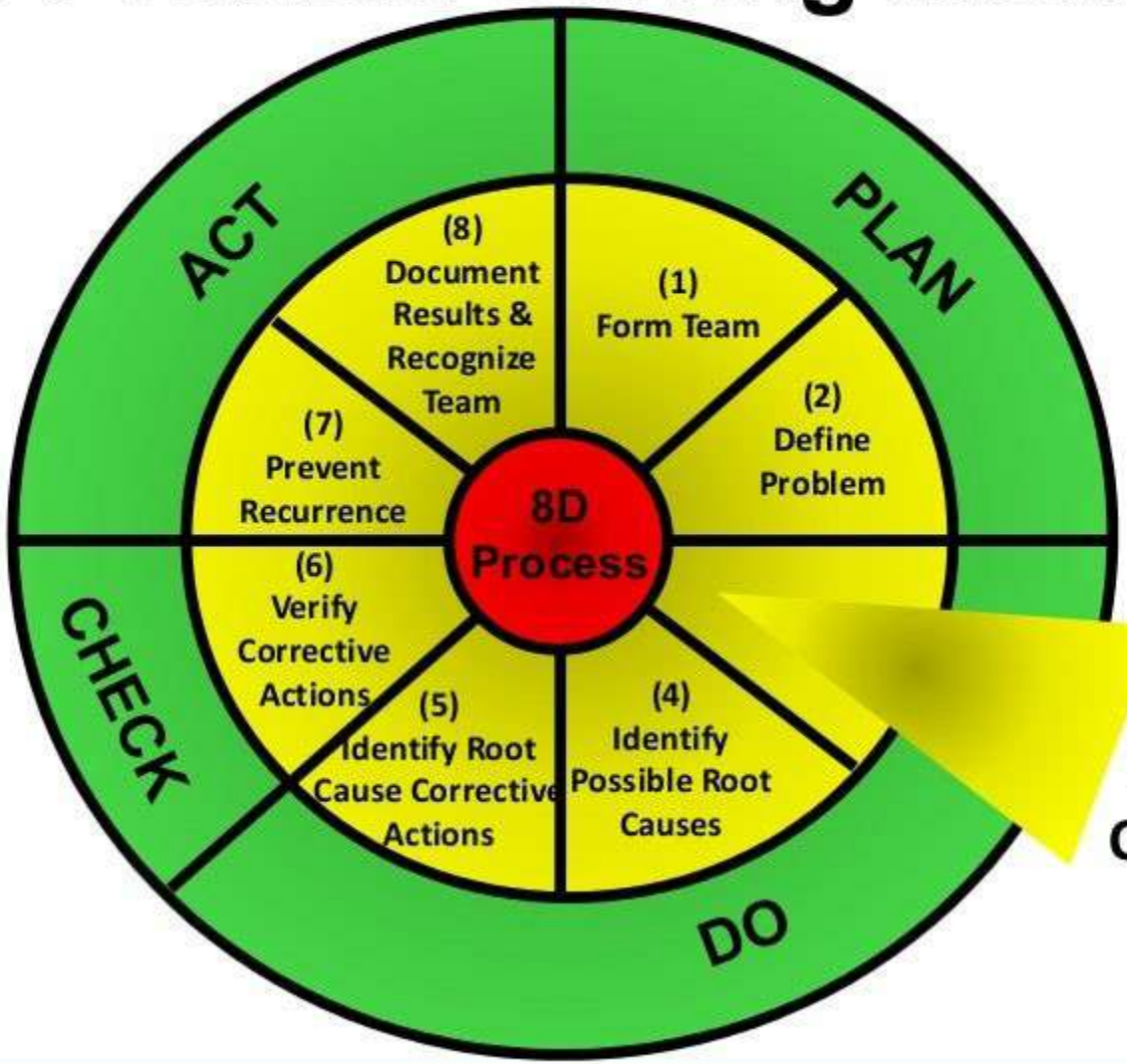
Use as Simple an Approach as Possible

PDCA: Problem Solving



8D Problem Solving Method



III. Containment (If Any)

- **Stop-Gap Measure - Triage; Not Root-Cause Fix**
- **Purpose: Minimize / Control / Isolate Problem; For Both Customers & Company**
  - Screen/Purge/Sequester Inventory/WIP?
  - Similar Devices/Flows?
  - Specify Anything That Has to Change to Make "Fix"
- **Timeline: "Fast"**
- **Implementation: "Quick and Easy"**
- **When is No Containment Required?**
- **Most of The Basic Tools Used in Subsequent Sections Applicable at This Step Too; Pick & Choose**

Containment Exercise

8D Problem Solving Method

IV. Identify Root Cause(s)

- **Hypothesis Generation** (Brainstorming/Fishbone)
- **Prioritize Which Hypotheses to Pursue** (Heuristic or Prioritization Tools)
- **Passive & Active Data Gathering** (Statistical Tools)
- **Can Root Cause Be Duplicated?**
- **What Allowed Failure?** (System, Spec, Procedure)

Problem Bug Matrix

Responsible:		Name			Fix Schedule			
Problem		Type (E / M / H)	Hypothesis	COL (Act/Fcst)	Confirm	Contain	Root Cause	Doc
1								
2								
3								
4								
5								

- Example of Work Breakdown
- Simple Way of:
  - Assigning Ownership
  - Defining Issue
  - Clarifying Hypothesis
  - Tracking Schedule
  - Efficient Communication
- How to Generate Hypothesis?
- How to Prioritize Which to Pursue?

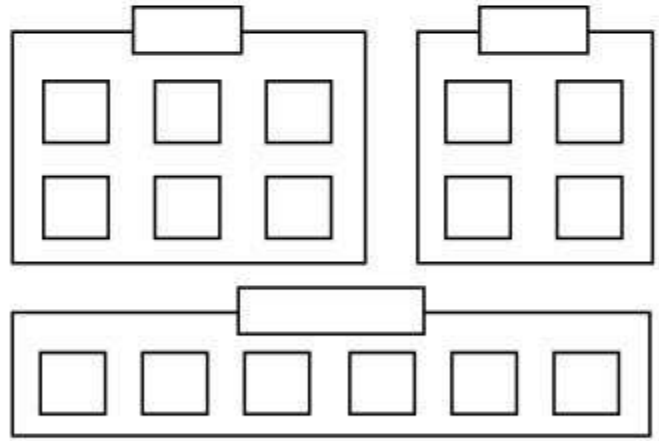
"Why", "What If", "How" Progression

- **"Why" Questions**
  - Catalyst in This Progression
  - Could Drive Potential Game Changers
  - "Why is This Happening?", Why are We Doing This?", "Why is This the Right Approach", ...
- **"What If" Questions**
  - Signals Beginning of The Search For Solutions
  - Prompts Unconstrained, Blue-sky Thinking
  - "What if We Could ...."
- **"How" Questions**
  - Get Down to Brass Tacks
  - "How Do We Get This Done?"

http://www.strategy-business.com/blog/Innovation-Begins-with-Three-Questions?gko=50d8a

Affinity Diagram

- **Optional, But Useful Step That Aids Brainstorming**
- **Often Used as Input to Fishbone or Tree Diagram**
- **Creative Thinking:**
  - Gathers Large Amounts of Language Data
  - Organizes it Into Groupings Based on Relations, and Defines Groups
  - Encourages True Participation.



- **When To Use:**
  - Maps Geography: Facts/Thought Chaotic; Complex Issues To Grasp
  - Breakthroughs in Traditional Concepts Needed
  - Support For a Solution is Essential For Success

Construction of Affinity Diagram

I. Assemble Right Team: Interdisciplinary & Fresh

II. Problem Statement to Be Considered: Make Specific

- Problem Statement ⇨ Hypothesis of Cause? – Done in Step D4
- Problem Statement ⇨ Hypothesis of Fix? – Done in Step D5

III. Generate & Record Ideas: Everyone Participates

- No Criticism, Emphasize Large Quantity in Short Time
- Be Concise, Use Noun and Verb, Record Exactly, Post-It Notes

IV. Display Completed Cards: Mix Cards / Spread Randomly

V. Arrange Cards Into Related (6 – 10) Groups

- React (don't contemplate), Ok to disagree,
- Silent process, high energy

VI. Create Header Cards For Each Group

- Identify Card That Captures Central Idea; Ties Group Cards Together
- If No Such Card Exists, Create It (Be Concise)

VII. Draw Finished Affinity Diagram

- Draw Lines Around Each Grouping, Connecting All Items With Header Card

Affinity Diagram Example

- **Example:**

- **Pitfalls & Issues:**
  - Will Yield Both Jewels & Junk; Refine Latter
  - Doesn't Show Interrelationships
  - Organizes New Thoughts For Further Elaboration
  - Works Best in Conjunction With Fishbone or Tree Diagram
  - Can Be Overdone as Tries to Get Group to React From Gut Level
  - Encourages True Participation in Group Setting; Don’t Judge
  - Also Works as Individual Exercise

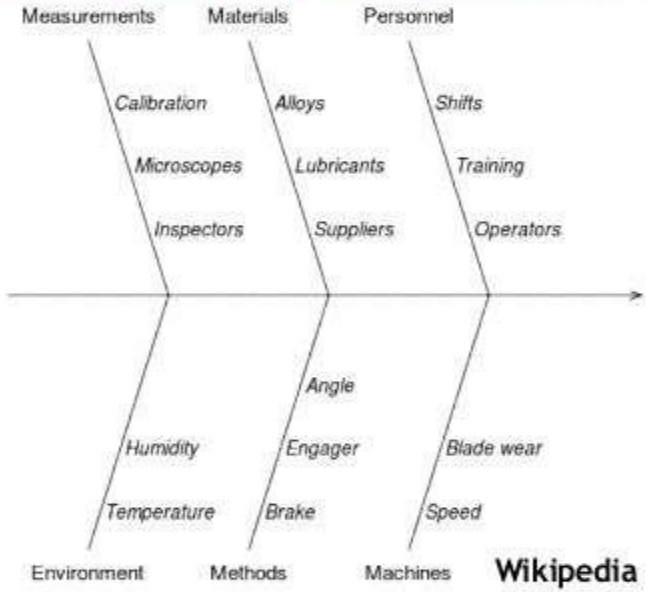
Fishbone Diagram

(Cause & Effect or Ishikawa Diagram)

Tool For Organizing Possible Root Causes of Problem

Two Possible Fishbones:

1) What Contributes to Problem?
2) How Did Defect Get Out?



Categories:

- **People**: Anyone Involved With Process
- **Methods**: How Process is Performed & Specific Requirements For Doing It; Policies, Procedures, Rules, Regulations and Laws
- **Machines**: Any Equipment, Computers, Tools, Etc. Required to Accomplish Job
- **Materials**: Raw Materials, Parts, Pens, Paper, Etc. Used to Produce Final Product
- **Measurements**: Data Generated From Process Used to Evaluate Quality
- **Environment**: Conditions Such as Location, Plant, Time, Temperature, and Culture

Fishbone Diagram

(Cause & Effect or Ishikawa Diagram)

Other Types:

- **4Ps (Generic)**: People, Procedures, Plant/Technology, Policies
- **6Ms (Manufacturing)**: Machine (technology), Method, Material, Manpower, Measurement/Metrics, Mother Nature (Environment)
- **7Ps (Marketing)**; Product/Service, Price, Place, Promotion, People, Process, Physical Evidence (or 4Ps – Underlined)
- **5Ss (Service)**: Surroundings, Suppliers, Systems, Skills, Safety

When To Use:

- Organize Result of Brainstorming or Affinity Diagram
- Need to Keep Track of Complex System of Input-Outputs
- Documentation of Organizational Learning Critical

Pitfalls:

- Doesn't Tell Where to Devote Resources
- Doesn't Show Interrelationships
- Can Be Overdone (Down to Atoms); Show Possible, Not Necessarily Actual

Fishbone Diagram Construction

I. Choose Goal or Problem Statement

- From D2; Insure Closed Loop With Original Problem Statement

II. Assemble Right Team

- Specialized Knowledge Required; Action Plan

III. Generate Major Fishbone Headings (Choose Template)

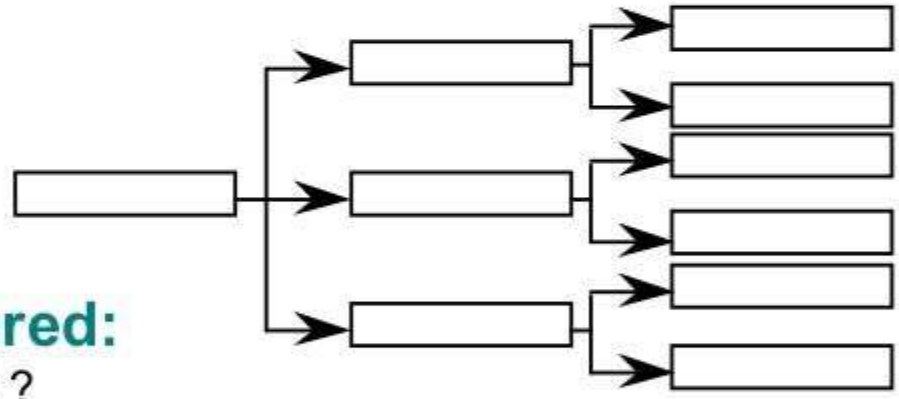
IV. Complete Fishbone Diagram

- Brainstorming or Affinity Diagram Details
- Focus is on Causes of / Contributors to Problem

V. Review Completed Fishbone for Completeness

Tree Diagram

- **Alternative to Fishbone Diagram**
- **Can Help Structure "Five Whys" Analysis**
- **Linear Thinking:**
  - Systematically Maps Detail For Paths & Tasks Needed



- **Key Questions Answered:**
  - What is Sequence of Tasks ?
  - What are Problem Components ?
  - What are Possible Hypotheses?
  - Does the Logic Hang Together?
  - How Complex Will Solution Be?
  - What are Assignable Tasks/Options ?

Tree Diagram Construction

I. Choose Goal or Problem Statement

- From D2; Insure Closed Loop With Original Problem Statement
- Original Issues

II. Assemble Right Team

- Specialized Knowledge Required; Action Plan

III. Generate Major Tree Headings

- First Level Can Often Be Alternative Hypotheses
- Second Level Can Then Be Ways to Test Hypotheses (Or Data to Get)

IV. Complete Tree Under Major Paths

- Continue Breaking Down Paths Until Have Actionable Items
- Direct Cause & Effect from Level to Level

V. Review Completed Tree For Logical Flow

- Works Only if Doing Each Level is Internally Consistent with Next Higher Level

Tree Diagram Example

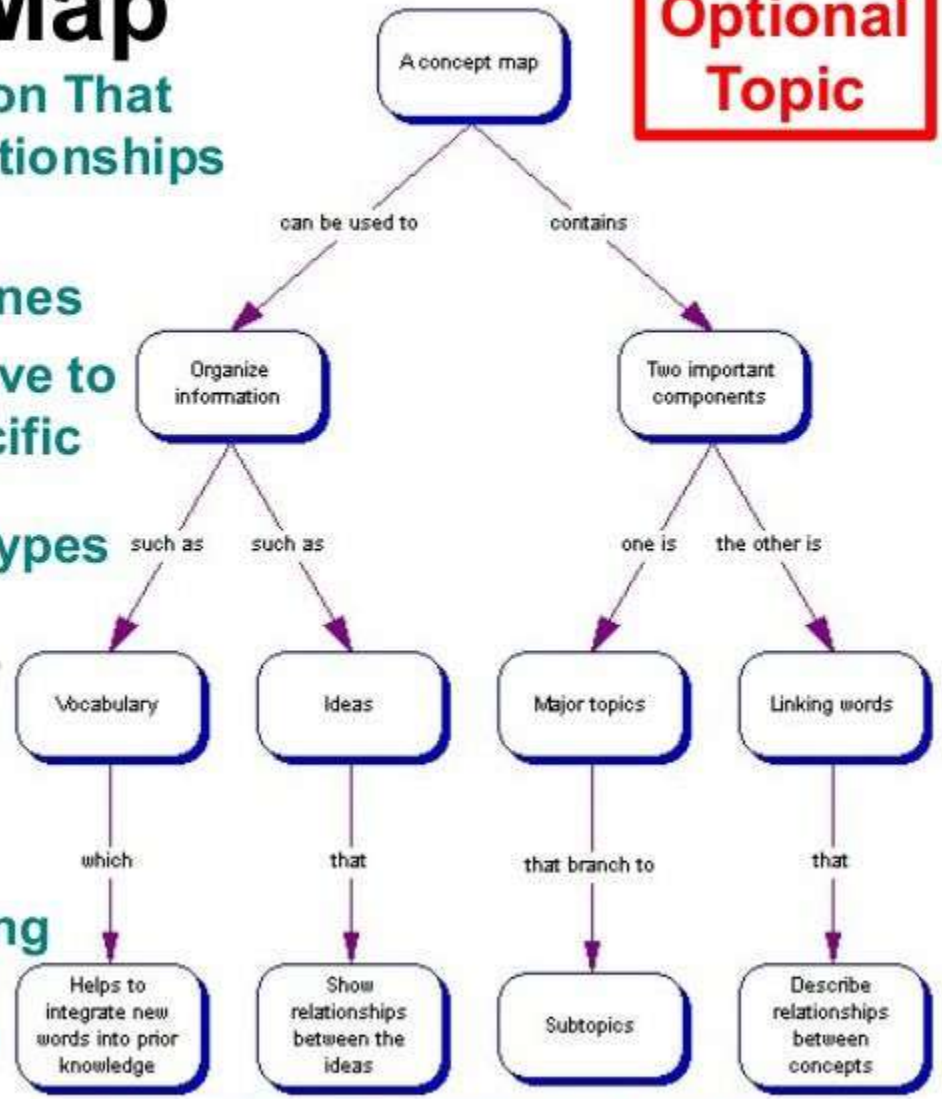
- **Example:**

- **When To Use:**
  - "Simple" Task Runs Into Repeated Roadblocks
  - Complex Implementation
  - Large Consequences for Missing Key Tasks
- **Pitfalls:**
  - Doesn't Tell Where To Devote Resources
  - Doesn't Show Interrelationships
  - Can Be Overdone (Down To Atoms)

Concept Map

Optional Topic

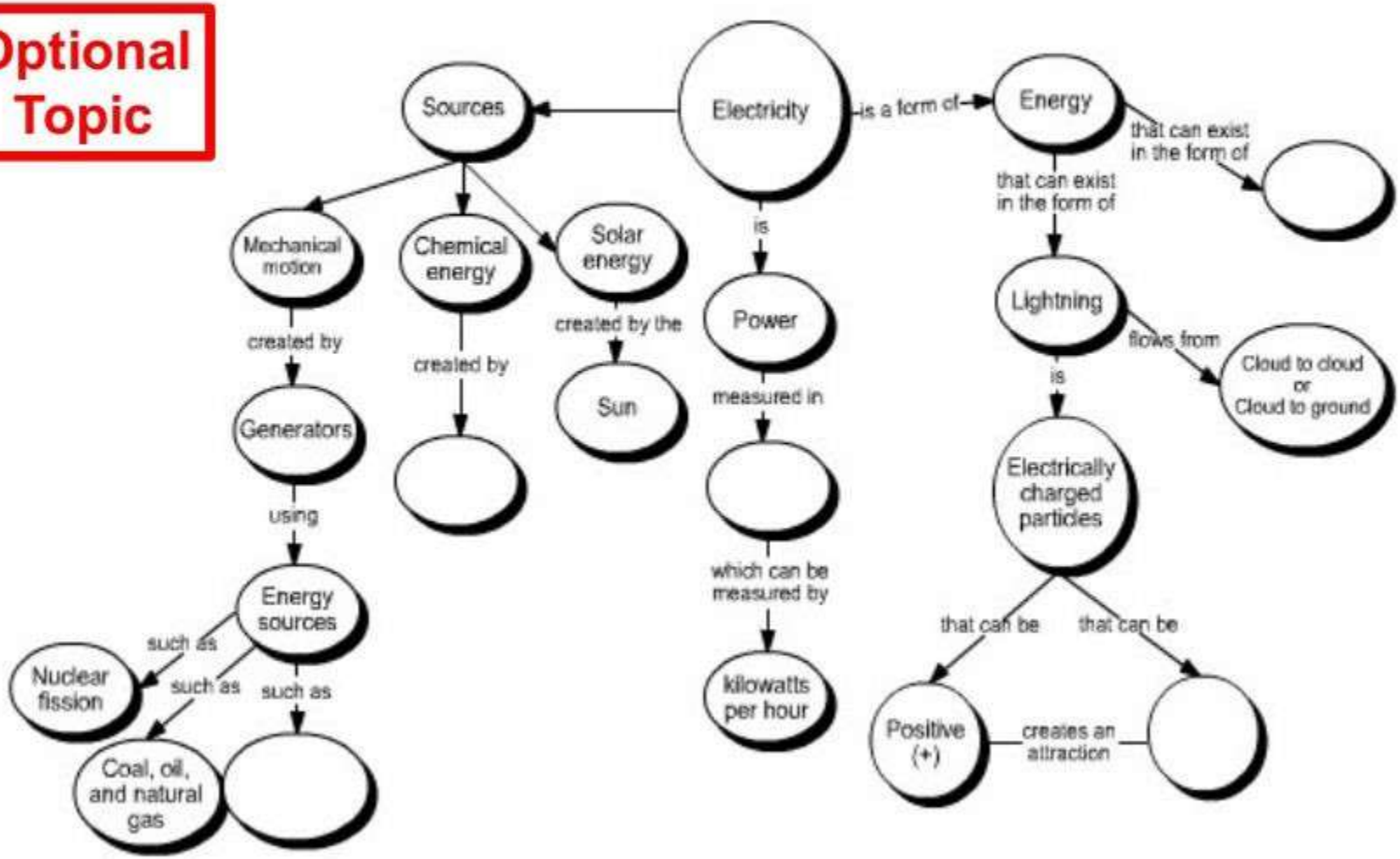
- **Visual, Schematic Representation That Illustrates Key Concepts & Relationships Between Those Concepts**
- **Consists of Nodes & Labeled Lines**
- **Hierarchically Arranged: Inclusive to Less Inclusive / General to Specific**
- **Useful in Organizing Different Types of Knowledge:**
  - Structural (Types & Numbers of Links)
  - Conceptual (Links &Concepts)
  - Declarative (Missing Nodes or Links)
- **Possible Follow-up Step After Affinity Diagram or Brainstorming**
- **Can Help Convey Broad Outline To Group**



http://tccl.rit.albany.edu/knilt/images/0/09/ConceptMapExample.gif

Electricity Concept Map

Optional Topic



https://upload.wikimedia.org/wikipedia/commons/c/c3/Electricity_Concept_Map.gif

Concept Map Construction

I. Assemble Right Team (Same as Before, Adjust as Necessary)

II. Problem Statement to Be Considered

- Problem Statement ⇨ Hypothesis of Cause? – Done in Step D4 (Tie to D2)
- Problem Statement ⇨ Hypothesis of Fix? – Done in Step D5

III. Generate & Record Ideas: Everyone Participates

- If Previously Created an Affinity Diagram, That is A Good Starting Point
- If Not Brainstorm to Generate Ideas & Group

IV. With Cards/Notes Arranged In Related (6 – 10) Groups

- Draw Lines Between Terms That are Related
- Most General/Inclusive Concepts Come First, The Links to More Specific Concepts
- On Lines Write Nature of Relationship Between Terms
- Once Basic Links Created, Add Cross-Links Which Connect Concepts in Different Areas

V. Review "Finished" Concept Map

- Examine Diagram to Look For Missing Terms and/or New Relationships;
- Adds as Appropriate

Optional Topic

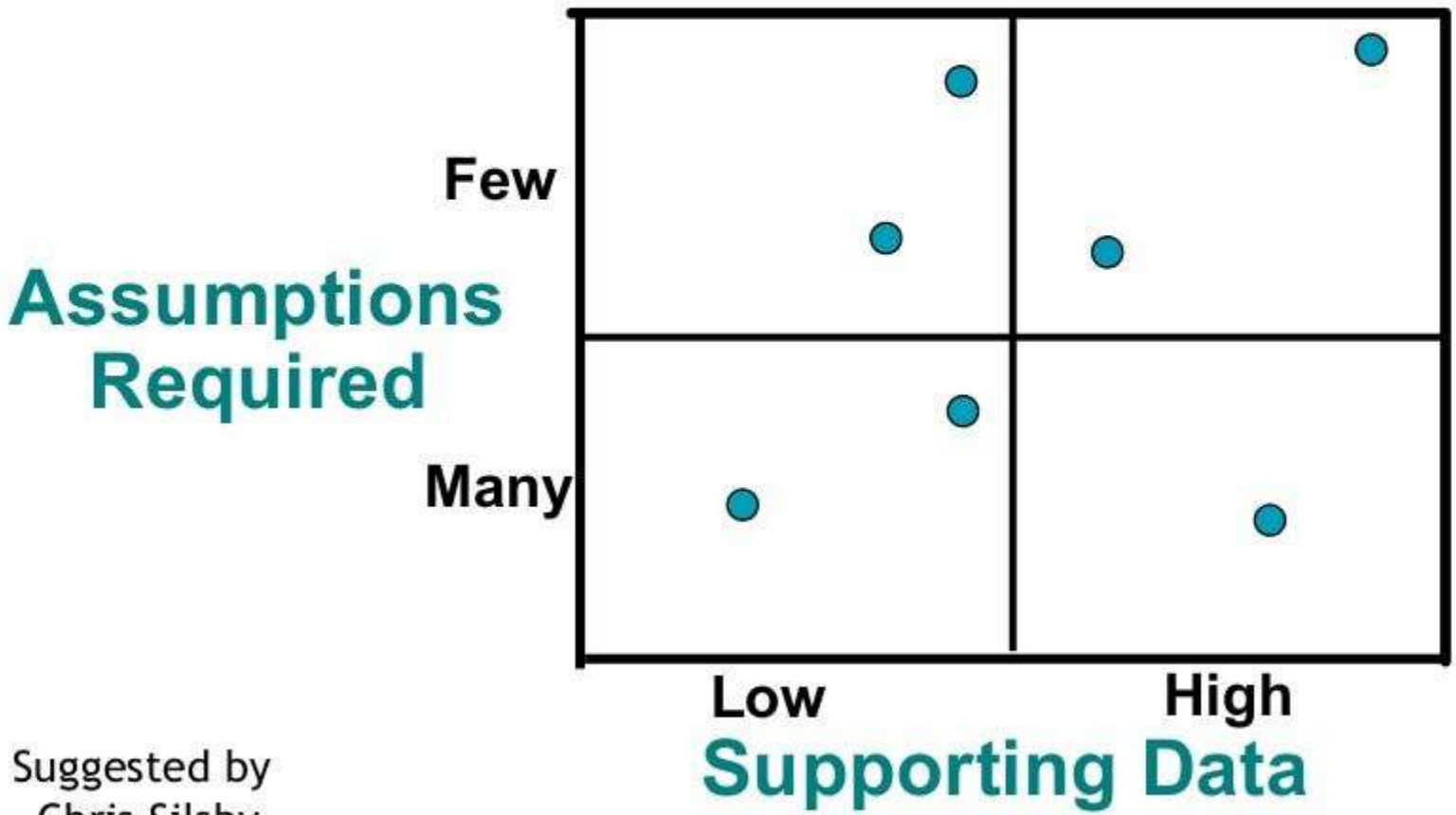
Prioritization Matrices

- **Decision Making Tool:**
  - Rationally Narrow Down Focus or Hypothesis to Pursue Before Detailed Implementation Planning
  - Prioritize Possible Solutions, Tasks, Issues, Product/Service Characteristics Based On Known Weighted Criteria

	Criteria					
	1	2	3	4	5	Total
1. Salary	△			●		
2. Cost of Living			○		△	
3. No Raise Policy		●				
4. Stock	○			△		
5. Quality of Life		△			○	
6. Earthquakes			△		●	
7. Cypress Rep	●					
8. Pressure				○		
9. Heavy workload		○			△	
10. Intensity			●			

- **Three Types:**
  - Simplified Matrix
  - Full Analytical Criteria Method
  - Consensus Method (Appendix)

Prioritizing Hypotheses to Pursue:
Simplest Approach – Data vs. Assumptions



Suggested by
Chris Silsby

Quantified Prioritization

- **Assign "Value" to Parts of Problem or Solutions**
- **Step 1: Decide Criteria & Category (Pick Scale)**
  - Big 3: Impact, Cost, Time
  - Use Log/Power (10X or 2^x …), Not Linear Scale
  - Separate Solution & Problem Source
- **Step 2: Complete Matrix & Calcs**
  - Fast Triage
  - Expose Bias (History, Data)
  - Resolve Conflict

Optional Topic

Criteria	$ Cost	Time	Measure	Frequency	Total
1. Method	16	1	8	4	29
2. Manpower	2	4	2	2	10
3. Materials	4	2	1	1	8
4. Machinery	8	16	16	16	56

Prioritization Matrix Example

- **Example:**

- **When To Use:**
  - Prioritization is Going to Happen By Design or Default - Hunch, Vote, Mandate, etc.
  - Implicit vs. Explicit Prioritization
  - Key Issues Identified; Must Narrow
  - Identified Key Relations; Not Strengths
  - Agreed Criteria for "Good" Solution; Need Consensus on Relative Importance (Boss/Team or Within Team Alignment)

Prioritization Matrices Guidelines

- Takes Time, Fit Tool to Problem; Doesn't Have to Be Used That Often (1 in 10?)
- Separate Possible Hypotheses / Problems to Evaluate vs. Possible Solutions to Implement (Clear Goals/Definitions)
- Value is in The Process, Not in Final Number
- Using Linear Instead of Log/Power Scale (No Differentiation)

Prioritization is Critical

Why are There So Many Slides on Prioritization?

- Team Member Time Efficiency is Critical Resource to Rapid and Effective Problem Resolution
- Spending Time on The Right Hypothesis is Required to Know Root Cause; Don't Just Run Out and "Do"

Don't Confuse Motion With Progress

Don't Have a Fast Trigger, But a Slow Bullet

- Saves Company Time & Money (People, Yield, Customer Relationship, Etc.)

Do The Right Things, Not Just Do Things Right!

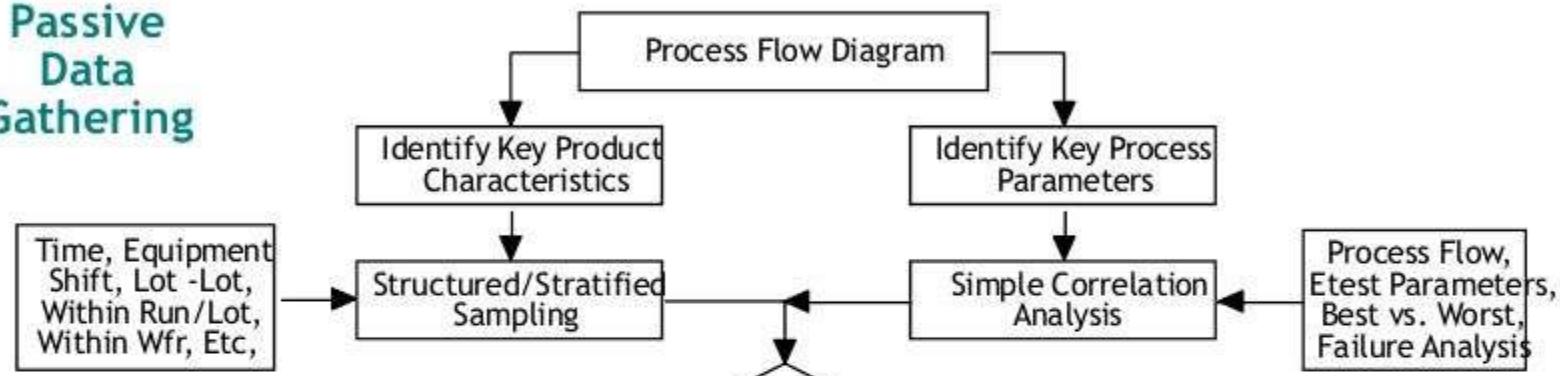
Root Cause Identification: Data

- What Data Do You Need at This Stage?
- How Much Data Do You Need?
- How are You Going to Get It?
- How Long is It Going to Take You to Get It?

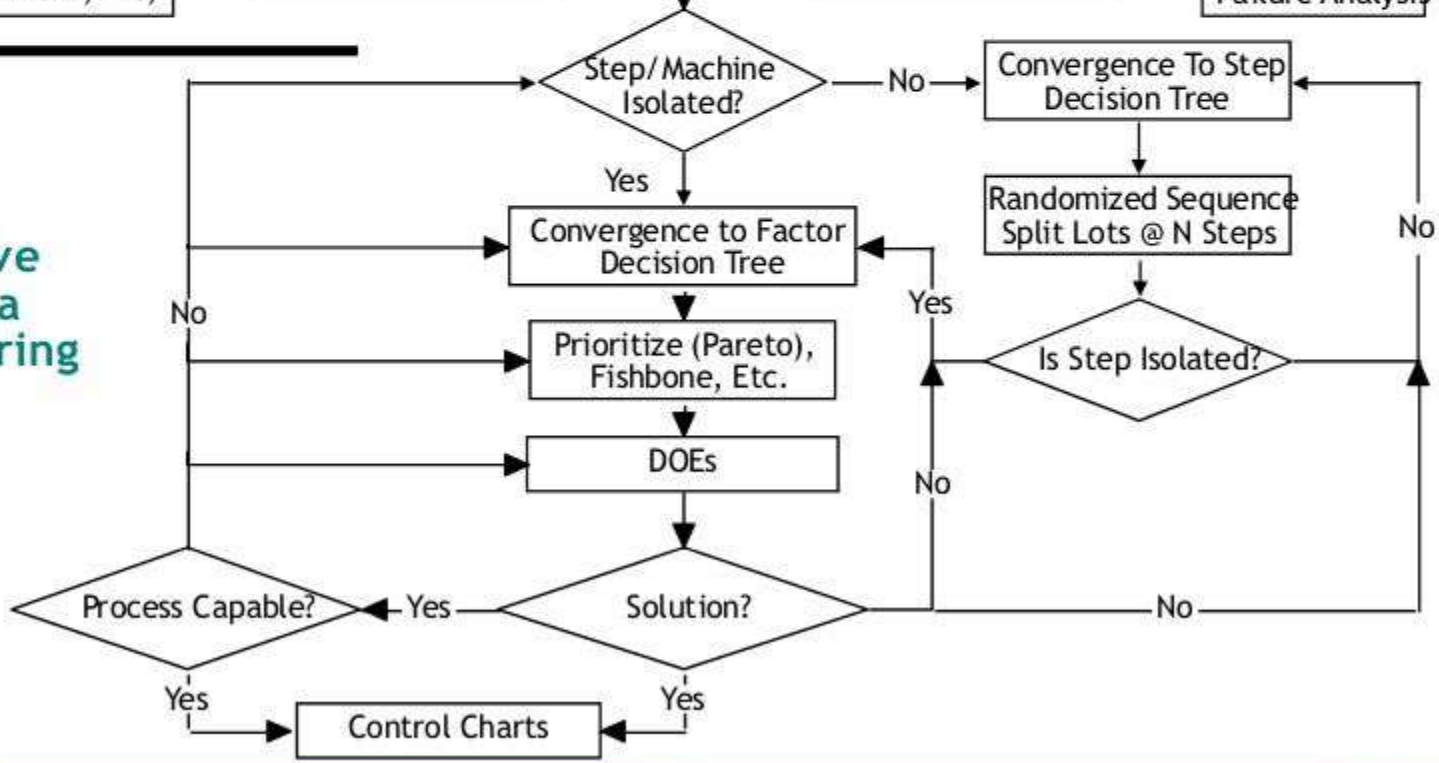
Acquiring Knowledge

- "Experts' & Peers
- Vendors
- Literature
- Experimentation: Machine / Si
- Rifleshot Experiments vs. Statistical DOEs

Passive Data Gathering



Active Data Gathering



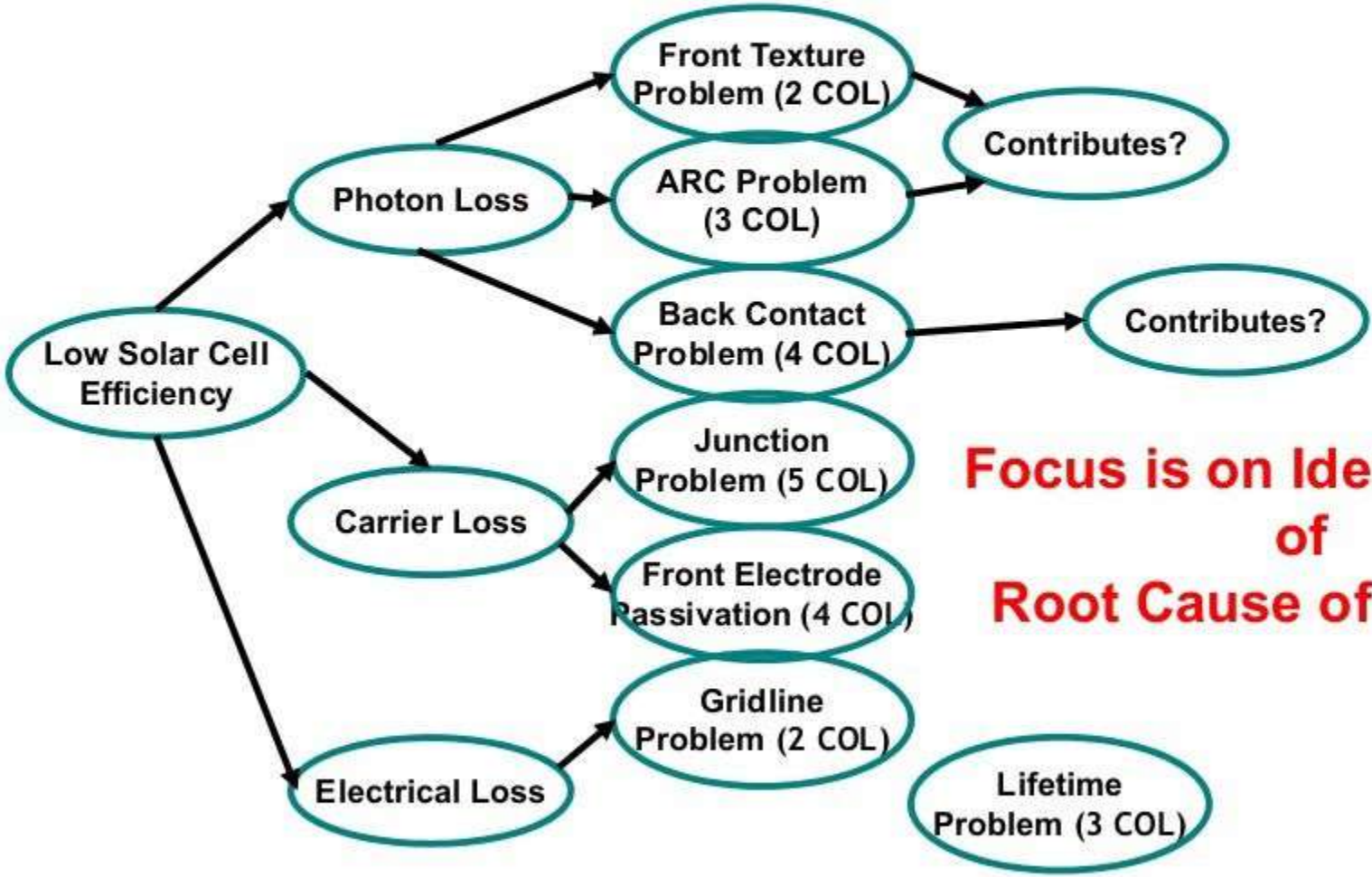
Experimental Factors

- **Picking Them**
- **How Many?**
- **Control & Noise Factors**
- **Continuous & Categorical**
  - Whenever Have Zero % of a Variable, a 'Continuous' Variable is Effectively Discontinuous; i.e. No vs. Yes (Jake)
- **Picking the Range**
  - Visual Hypothesis (Jake)
  - Equivalent Impacts
  - As You Open the Space, the Risk of Variables Going From Continuous to Categorical Increases
- **How Many Measurements (Memory)?**
  - Sources of Variation
  - Hierarchical & Directed Sampling

Experimental Design:
The Knowledge Line

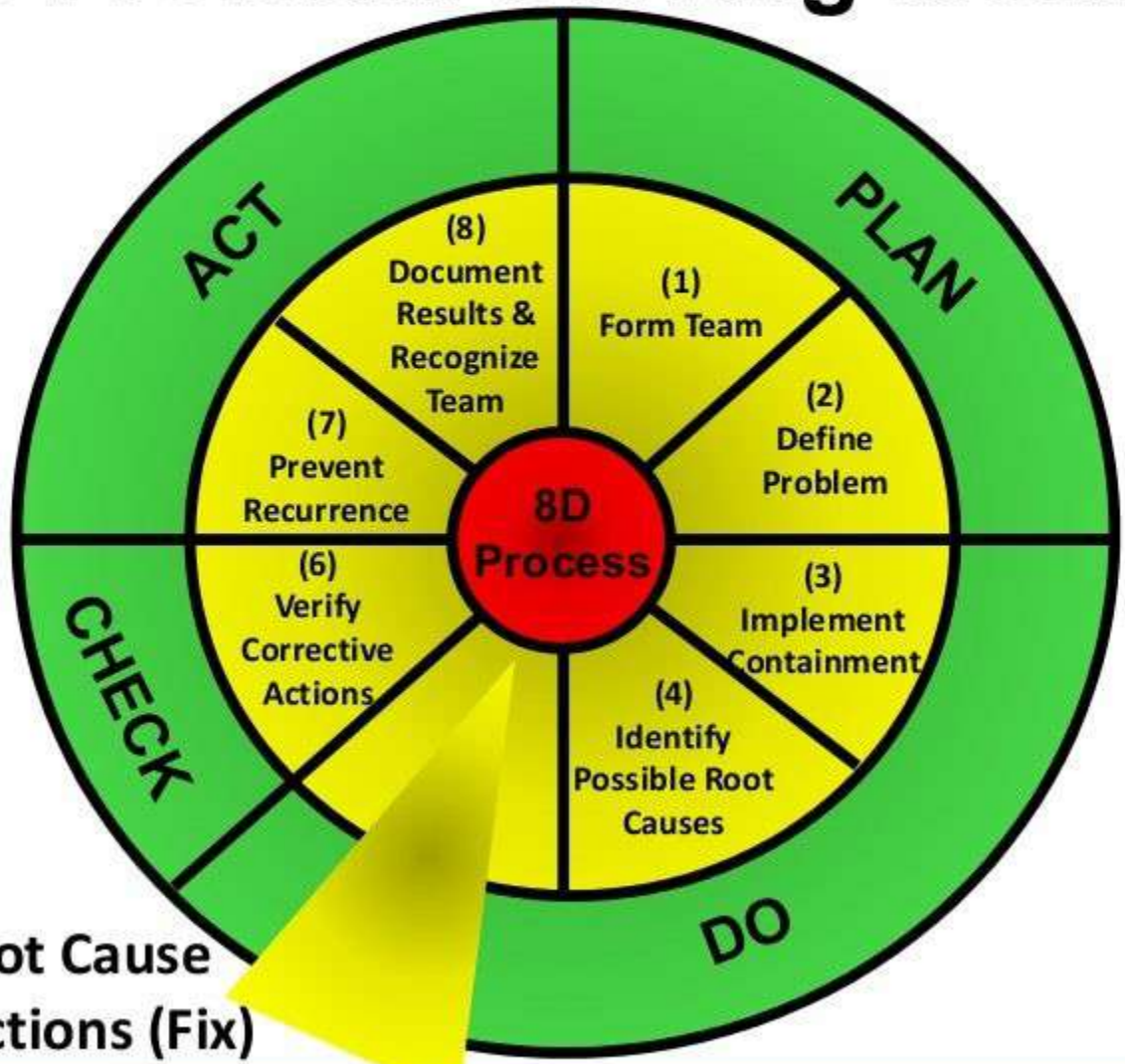
Statistical DOE Framework

COL Problem Solving Flowchart



Focus is on Identification of Root Cause of Problem

8D Problem Solving Method



V. Corrective Action(s) Plan

- **Once (Possible) Root Cause(s) of a Problem Are Identified – Need to Determine Solution(s)**
- **Plan:**
  - Best Solution Path(s) and Why: Root Cause Fix
  - Line Between Hypothesis Testing (Identifying Root Cause of Problem) and Determining Solution (Root Cause) Distinct But Blurs
  - Who Will Implement?
  - When Will It Be Done?
- **Verification of Fix**
  - Can Problem Be Turned Off & On?
  - Is Root Cause Controllable?
  - Will Not Cause Undesirable Effects (Unintended Consequences)
  - Verification is Proof **BEFORE** Implementation
  - Validation is Proof **AFTER** Implementation

Generating Possible Solutions

- In General Preferable to Start With Broad List of Possible Solutions; Seek Diversity of Options (Divergence)
- Can Use Same Brainstorming Tools Employed for Hypothesis Generation For Generating Possible Solutions
- Once Reasonable Set of Possible Solutions Generated, Same Prioritization Techniques Can Be Employed to Determine Which Solution(s) to Pursue (Convergence)
- Many of The Tools (In Particular Statistical Methods) Used to Identify Root Cause of Problem Can Be Reused to Determine Root Cause Fix
- As Before, Keep an Eye on Assumptions & Watch Out for False Constraints

Measures of Performance

- **In Any Problem Solving Methodology, Need Criteria to Which The Solution's Performance Can Be Measured:**

- **Efficacy (E_1):**
  - Indicates, Whether The Solution or Process Provides The Intended Outcome
  - That Intended Outcome May, However, Not Be What is Required for a Complete Soln

- **Efficiency (E_2):**
  - Resources: Indicates Whether The Least Possible Amount of Resources Are Being Used to Implement The Solution
  - Outcome: Indicates Whether the Simplest / Lowest Cost / Quickest (Pick Appropriate Criteria) is Being Used to Implement The Solution

- **Effectiveness (E_3):**
  - Indicates, Whether The Solution Provides a Root-Cause-Fix
  - And/Or Helps Realize a More Long-term Goal

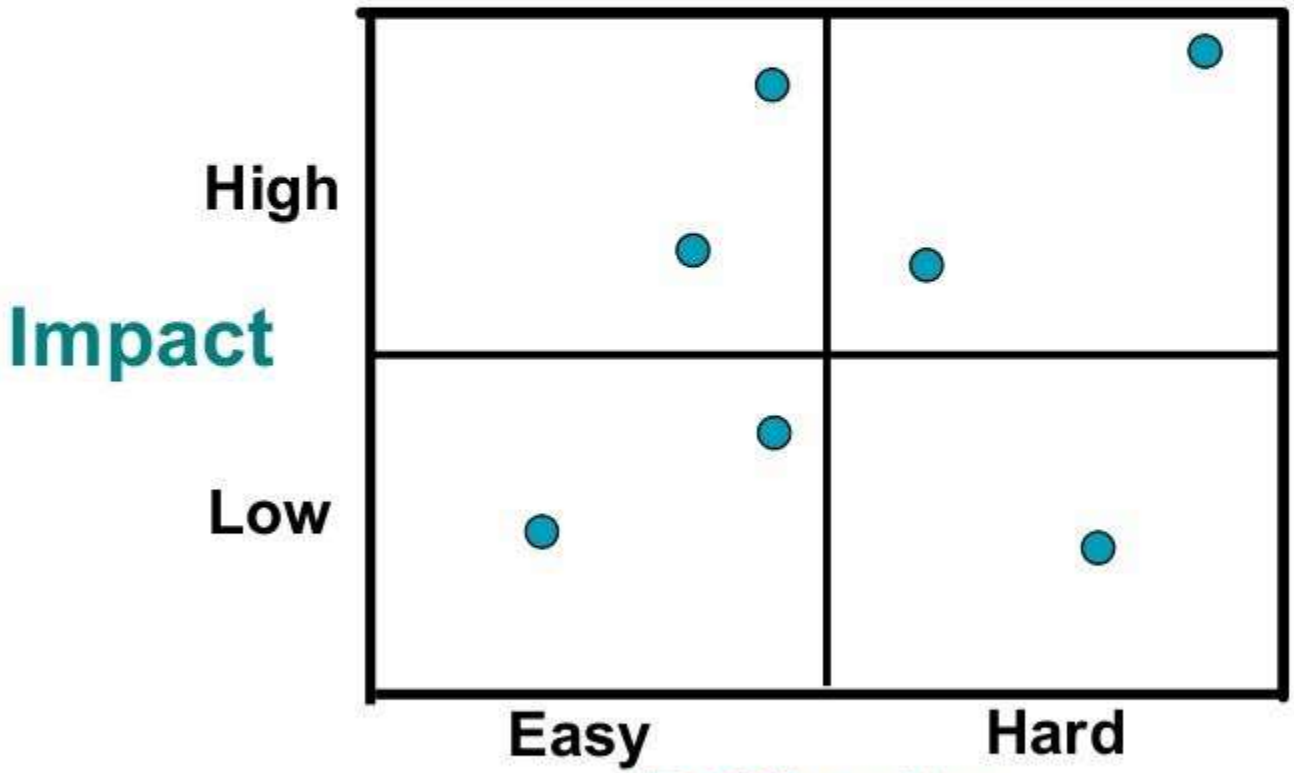
http://en.wikipedia.org/wiki/CATWOE#CATWOE

Re-Purpose Problem Solving Tools

- Previously Tools Employed to Find Root Cause of Problem
- Now Tools Employed to Determine Root Cause Fix
- Re-Focused Affinity Diagram
- Re-Focused and Expanded Tree (or Fishbone) Diagram
- Need to Prioritize Possible Solution Paths
- Choice of Factors & Ranges Re-Set; Experimental Techniques Less Exploratory, More Directive
- Need to to Estimate Cycles of Learning/Schedule for Solution(s)
- Flowchart Solution Paths to Track Convergence

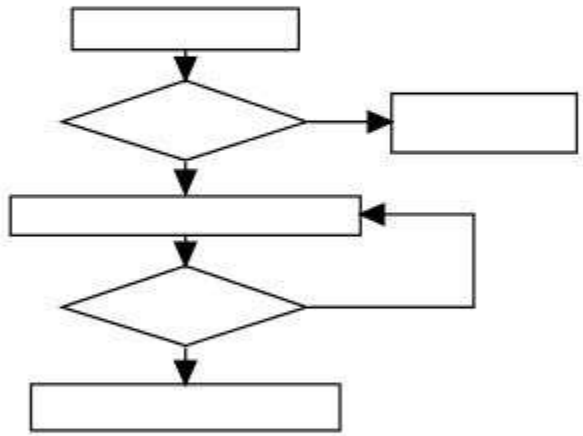
Prioritizing Actions to Take:

Simplest Approach - Impact vs. Difficulty



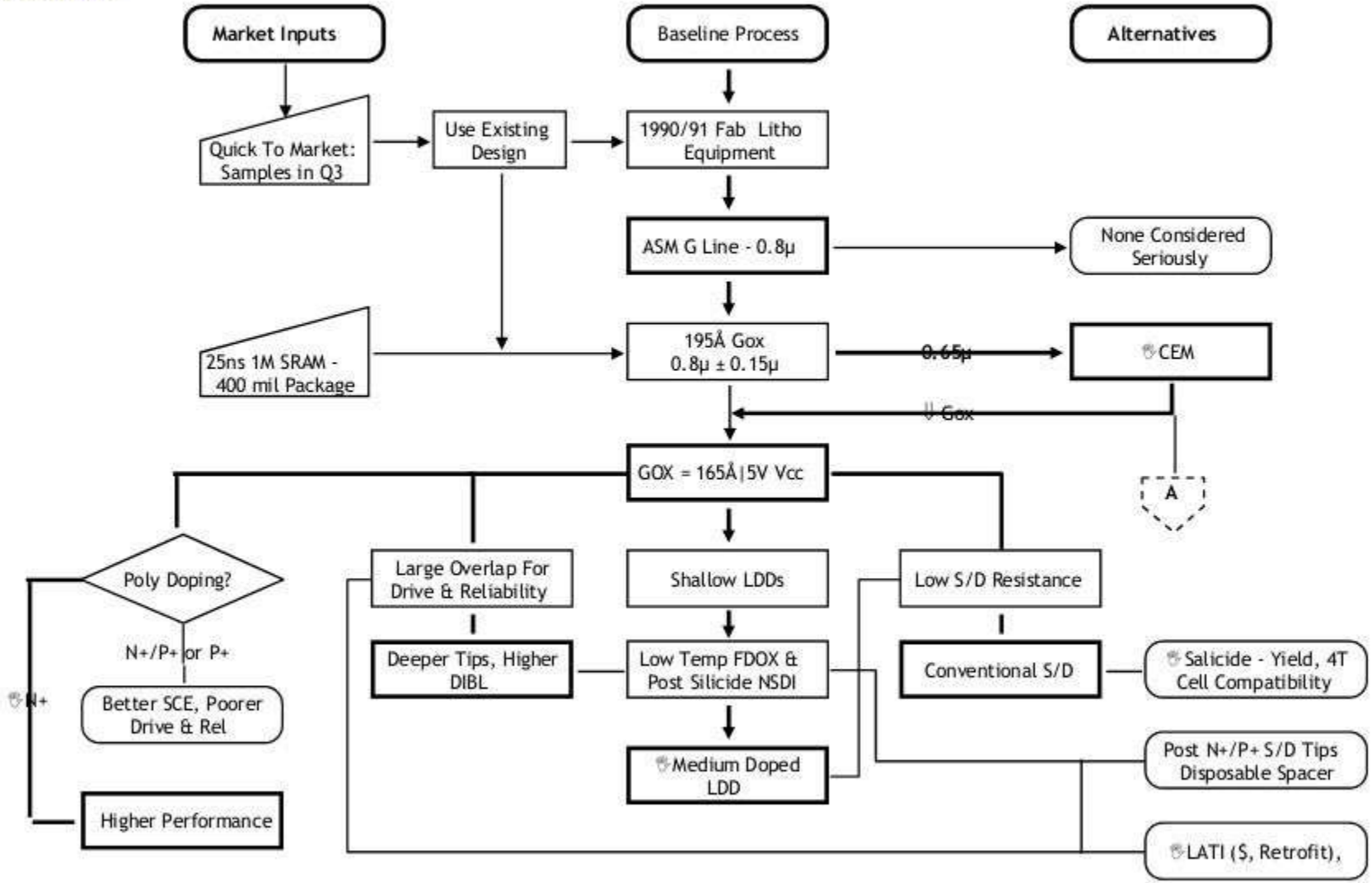
Flow Charts

- **Implementation Planning Tool:**
  - Maps Out Conceivable Events & Contingencies. Identifies Counter-Measures to Problems



- **When To Use:**
  - Compare Actual & Ideal Paths in Order to Identify Deviations
  - Task is New, Unique, or Complex
  - High Stakes & Efficient Implementation Critical
  - Contingencies are Plausible

Basic Problem Solving



Flowchart Example

- **Example:**

- **Flowchart Themes:**
  - Implementation Path With Fewest or Least Serious "What Ifs" is Best Alternative
  - Weigh Risk vs. Reward
  - Define Boundaries of Process Clearly
  - Every Feedback Loop Needs an Escape
  - Clearly Shows Holes in Plans
  - Good Communication Tool
  - Can Also Be Extremely Useful in Analyzing Past History

Flowchart Construction

I. Assemble Right Team (Must Know Details of Problem)

II. Determine Basic Flow of Proposed Activities

- Start Broad, Add Detail in Layers Later
- Think Straight Line

III. Choose Chart Format (Graphical or Outline)

IV. Construct PDPC

- Place Branches in Sequential Order of Implementation
- Layers:
  - Implementation Steps
  - "What Ifs"
  - Countermeasures
- "What Could Go Wrong?", "What Are Options?"
- Pick Countermeasure And/Or Alternatives
- Evaluate Feasibility/Necessity (Label)

V. Review: Sanity Check Flow, Compare to Ideal; Check Completeness

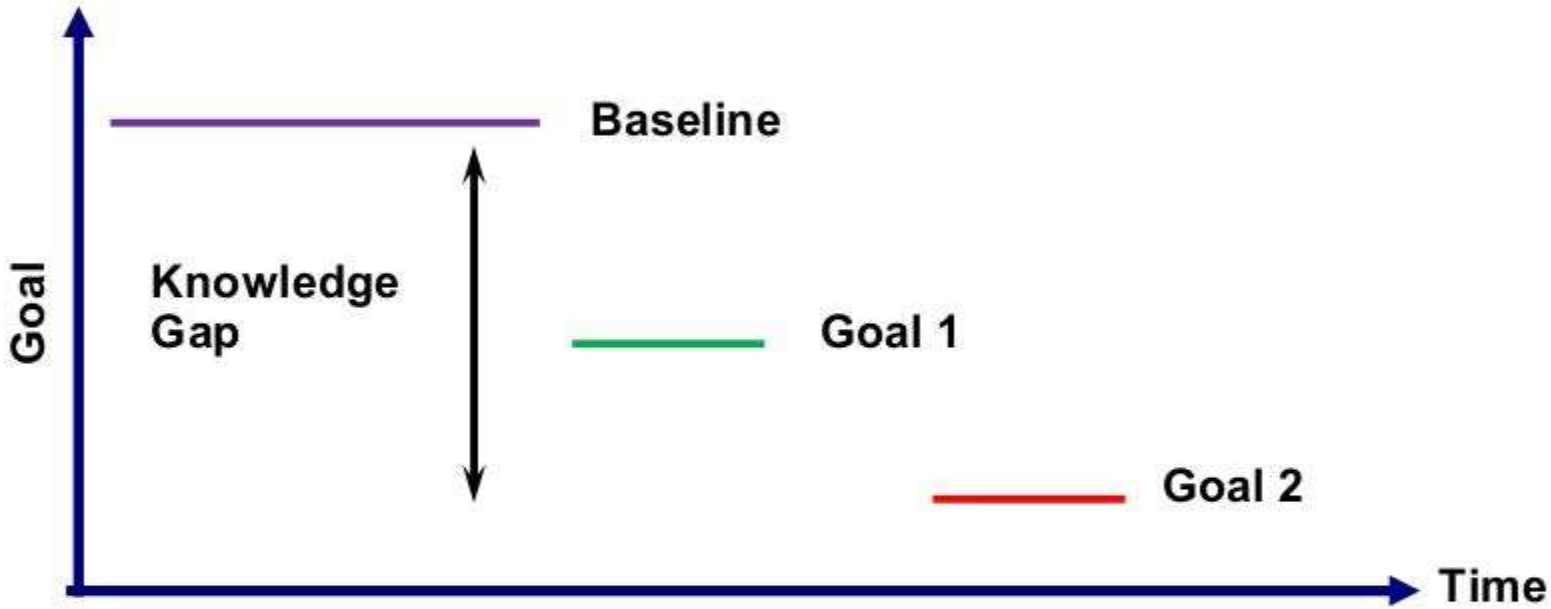
Scheduling Problem Solving

- Gantt Diagrams
- Pert Charts
- Spreadsheet W3s
- Other

But….

… These are All "Linear" Tools That Breakdown in a "Non-Deterministic" World

The Knowledge "Gap"



Baseline vs. Goal:

The Larger The Gap, The Less You Know

Goal "Gap" = Knowledge "Gap"

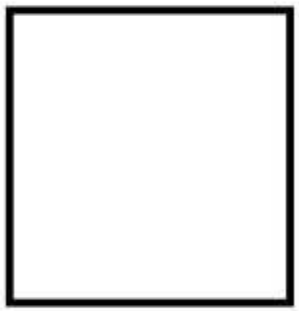
To Close the Knowledge "Gap" Need Cycles of Learning (COL)

Beware of Overconfidence

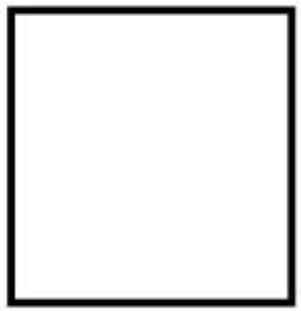
(How Much Do You Really Know?)

Knowledge Gap & Cycles of Learning

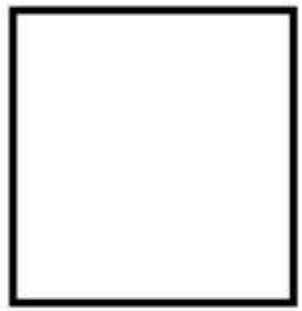
Define Your Problem
Which Bucket ?



Easy
 # COLs ?
Time/Cycle



Medium
 # COLs ?
Time/Cycle



Hard
 # COLs ?
Time/Cycle

What's Your Batting Average ?
What Did You Learn ?

What is a Cycle of Learning?

Plan	1. Problem Identification/Hypothesis 2. Specify Desired Outcome 3. Prioritized Input / Output
Do	4. Data Collection & Analysis 5. Perform Work/Experiment
Check	6. Confirmation of Effects
Act	7. Process Standardization (if Done) 8. Planning Next Step (Learning Cycle)

Deming's PDCA Cycle

Scheduling Problem Solving

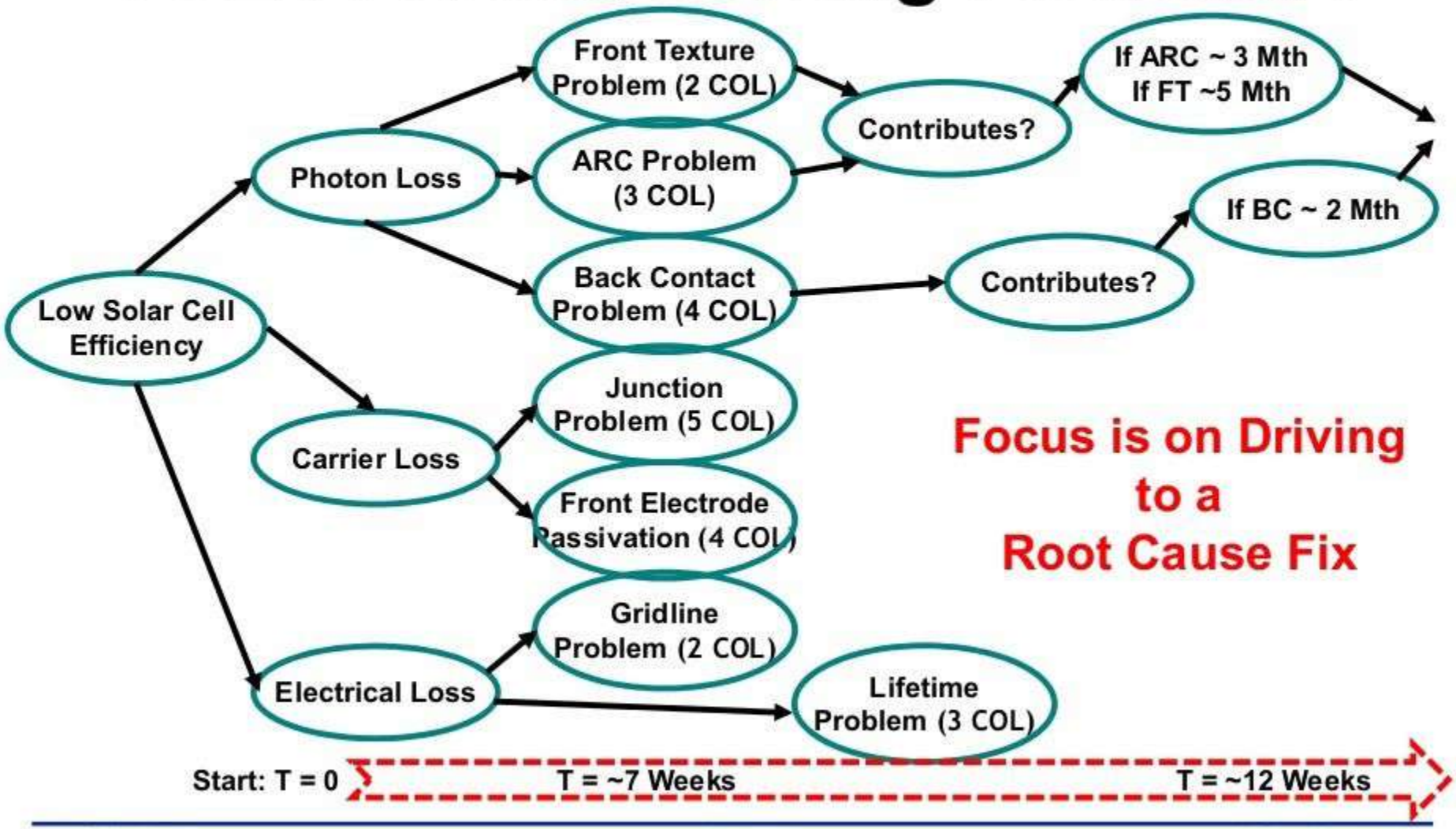
- **Point 1: Complexity is Not Your Friend**
  - Save Invention For Where it Adds Value
  - Eliminate it Everywhere Else
  - "Buy" Knowledge
- **Point 2: What Are You Doing?**
  - Two Parts:
    - How Many (PDCA) Cycles?
    - Time Per Cycle
  - What Impacts # of Cycles?
  - What Impacts Time Per Cycle?

Solution

Combine COL Forecasting With Conventional Scheduling Methods

- Use COL Methodology to Forecast Non-Deterministic Steps
- Use PERT (or Favorite Method) to Keep Track of Tasks
- Apply Best Practices (Scrubbing, Schedule Monitoring, etc.) to Minimize Deviations
- Suggest Separately Estimating COL/Time For Determining Root Cause vs. Root Cause Fix (Overlap)

COL Problem Solving Flowchart

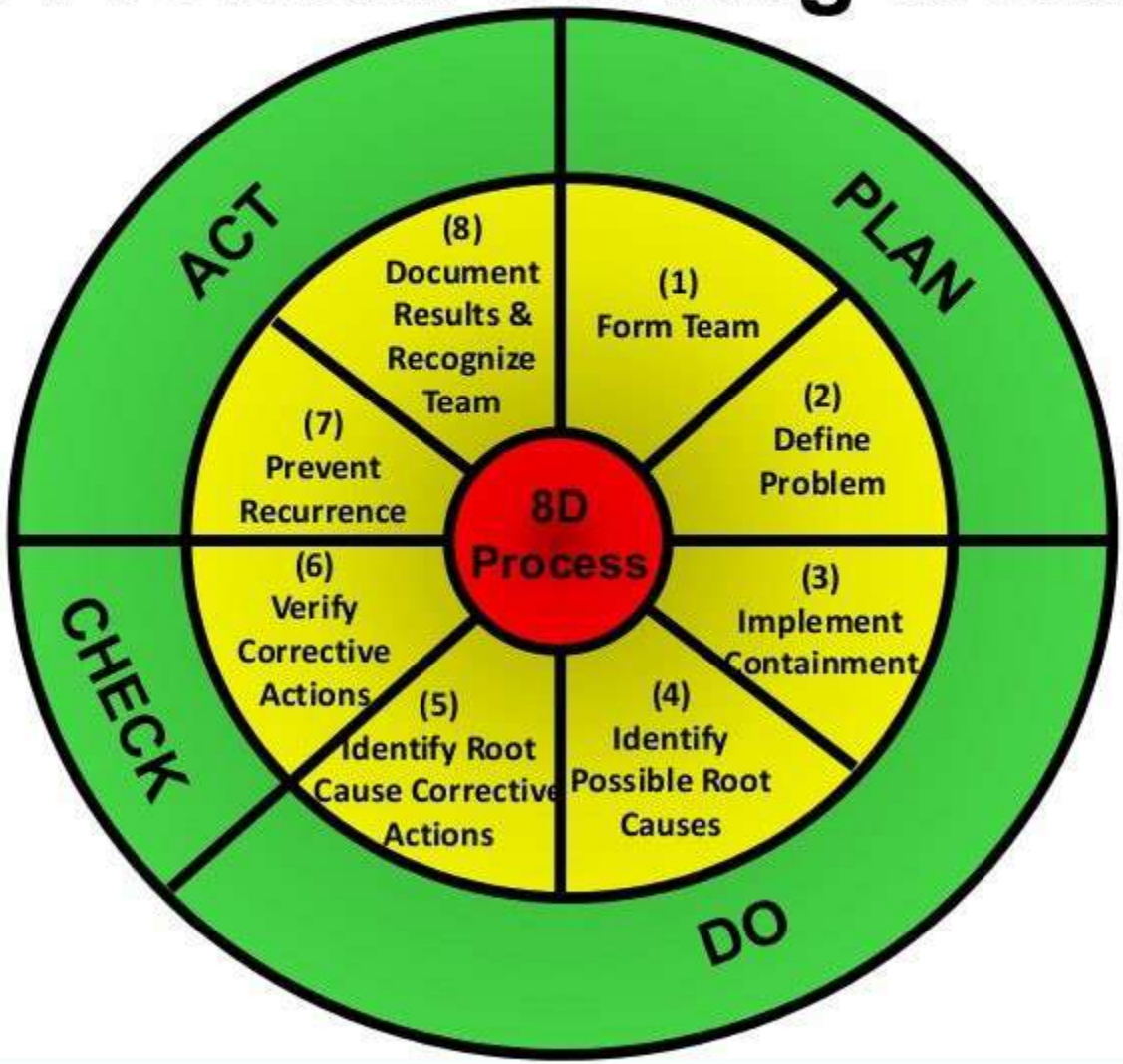


Ultimate Test: Right Direction?

- **Progress or Motion ?**
  - Entropy vs. Convergent
  - Consistent
  - Kill or Move Forward?
- **Repeated Slips ?**
  - Step Back and Diagnose Issue(s)
  - Typical: Excess AIPs, Capability, Subject Matter Knowledge, Team Dynamics, Outside Interference, …

Its OK (Good) to Get Help if Project is In Trouble

8D Problem Solving Method



Basic 8D Problem Solving: Tools & Methods

A.R. Alvarez

Part 3

Problem Solving Outline

- **Part 1: Overview of Methods (Plan)**
  - Problem Solving Principles
  - Contrasting Different Approaches
  - PDCA / 4D & 8D Framework
  - D1 – D2: Form Team & Define Problem
- **Part 2: Step-By-Step Problem Solving (Do)**
  - D3: Implement Containment
  - D4: Identify Possible Root Causes
  - D5: Identify Root Cause Corrective Actions
- **Part 3: Problem Solving Wrap-Up (Check & Act)**
  - D6 – D8: Verify Corrective Actions, Prevent Recurrence, Document Results & Recognize Team
  - Appendix

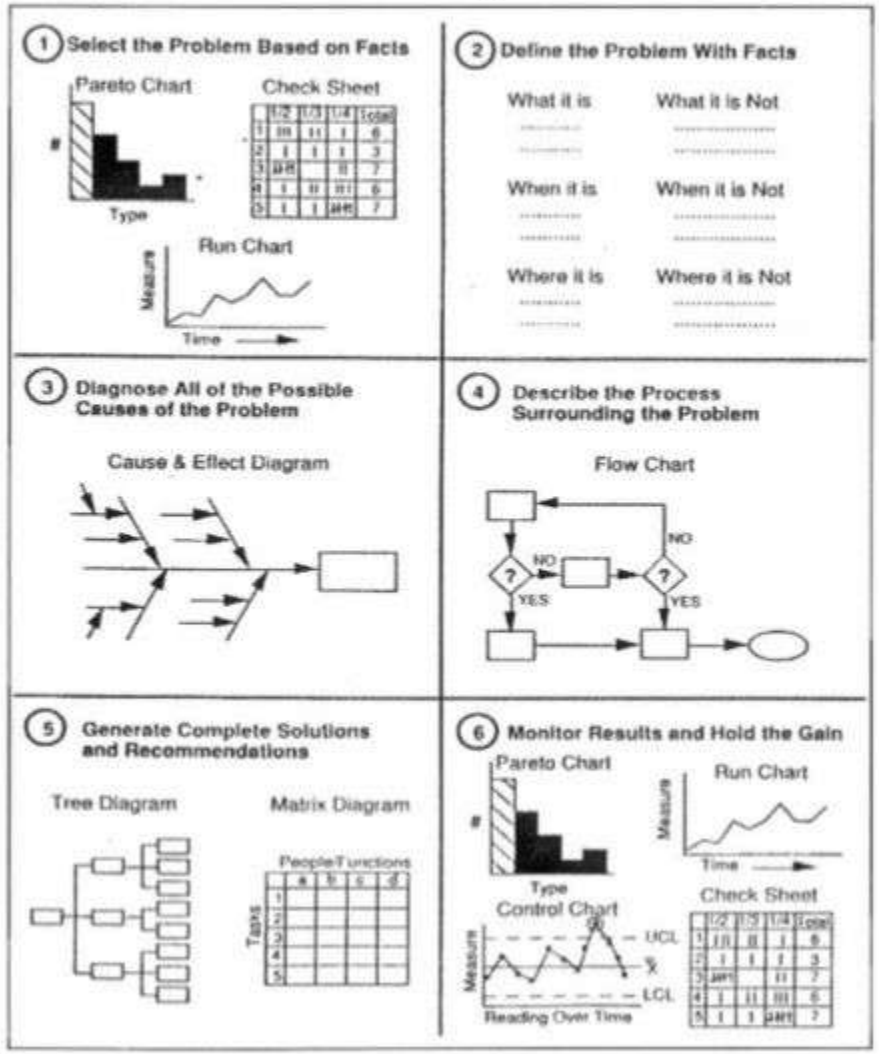
No One Way to Problem Solving Success

But Some Are Better Than Others

Good Ones Have Many Common Elements

Integrate Different Perspective

Utilize Simple Tools

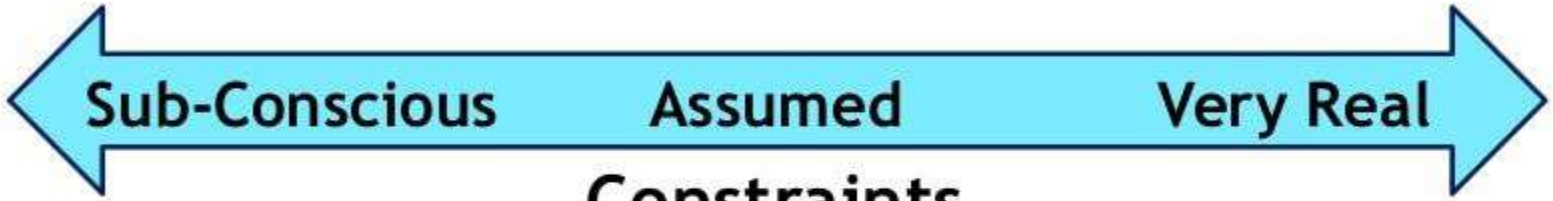


Ask & Answer Simple Questions

- **What is The Problem?**
- **Why is it a Problem?**
- **What Are The Goals?**
- **How Long Will it Take to Solve?**
- **How Much Will it Cost to Solve?**

Get Tracked & Managed Like a Project

Avoid Artificial Constraints



Constraints

- Constraints Will Always Exist
- Real Constraints Need to Be Respected, But Also Challenged
- Where Can Constraints Appear During Problem Solving?
- How Do You Become Aware & Overcome Constraints?

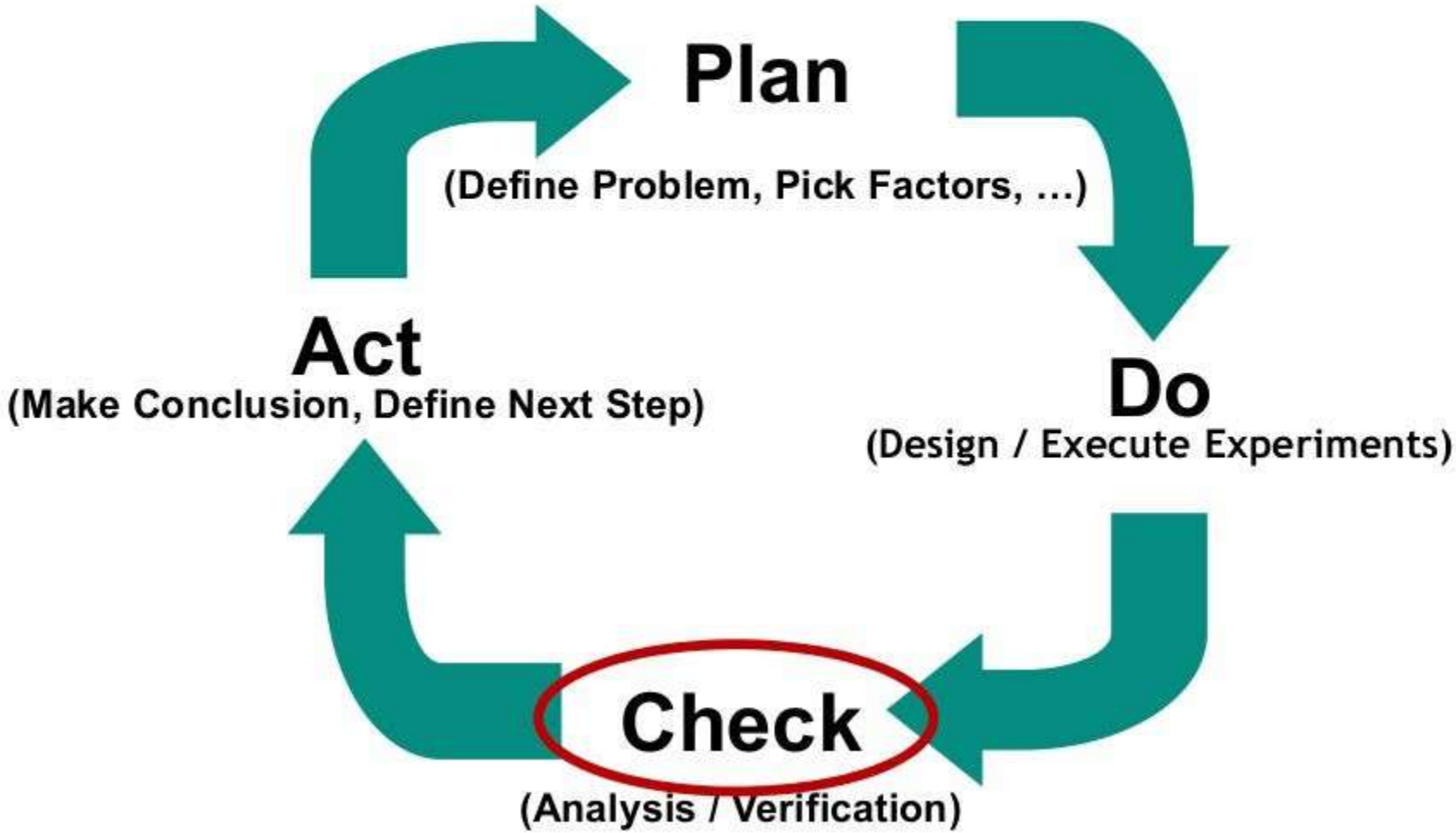
Fit Method to Problem

Different Problems May Require Different Approaches

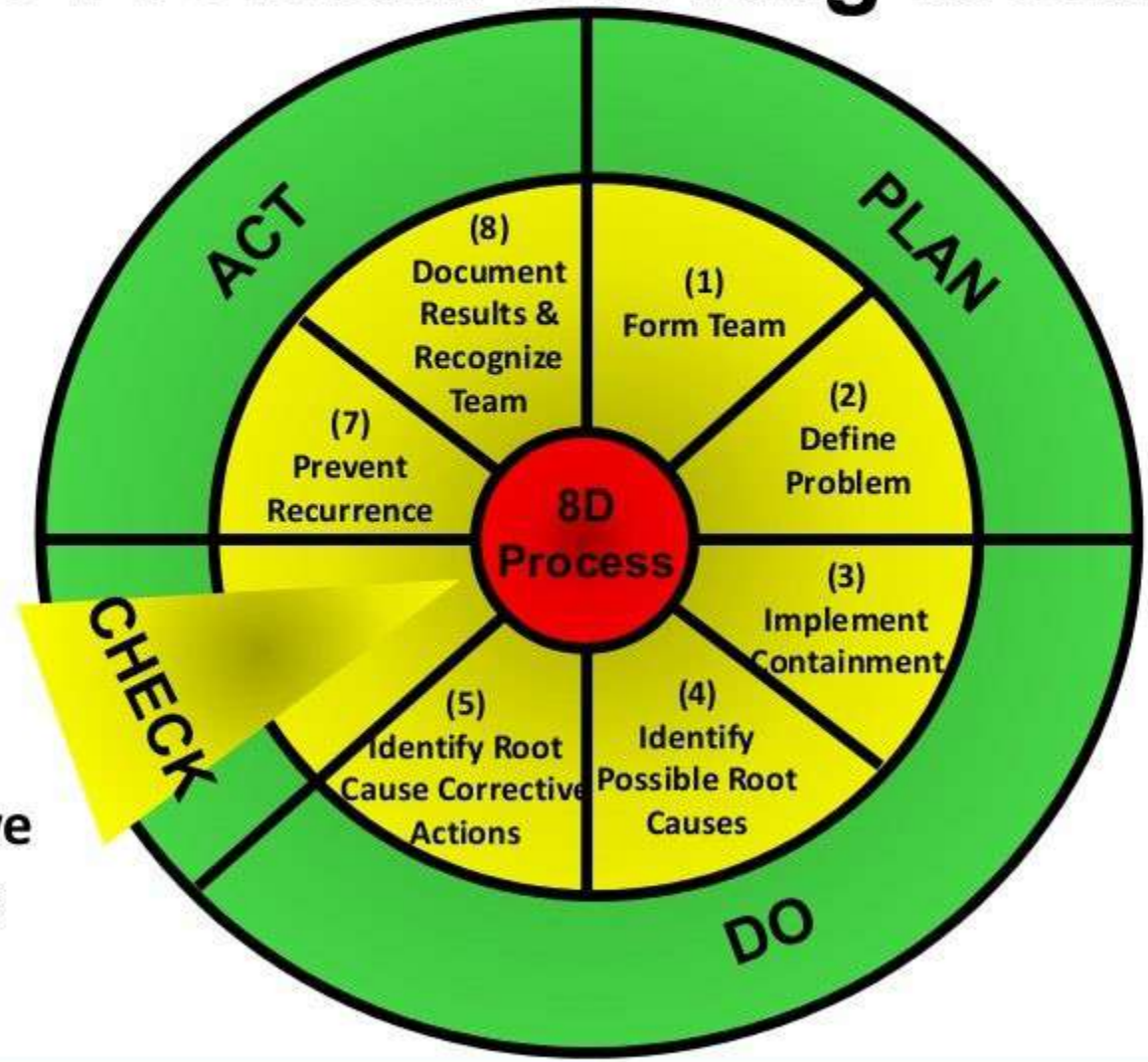
Be Adaptive

Use as Simple an Approach as Possible

PDCA: Problem Solving



8D Problem Solving Method



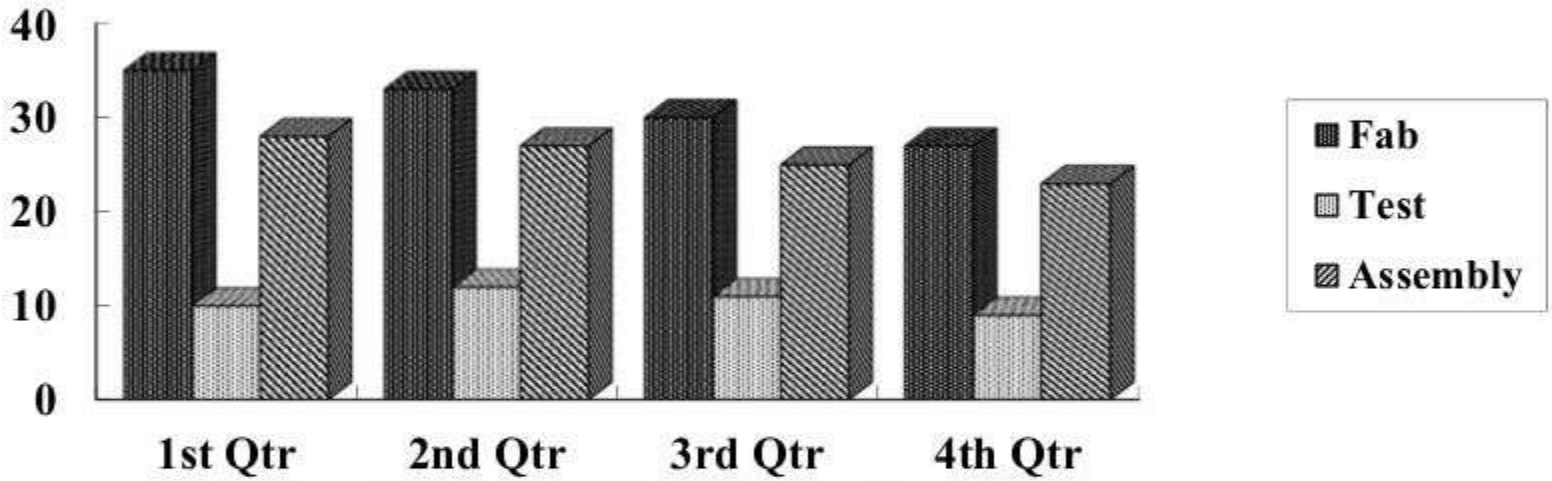
VI. Verify Corrective Actions

- Demonstrate Effectiveness of Root Cause Fix (Data)
- Validate Effectiveness
- Other Actions to Ensure Solution Stability: Equip Mod, Spec Change, PM, Inspection, Audits . . .
- Monitor Implementation (SPC Control as Appropriate)
- Eliminate Containment Actions (If Used)
- Update Specs or Procedures?

Analysis

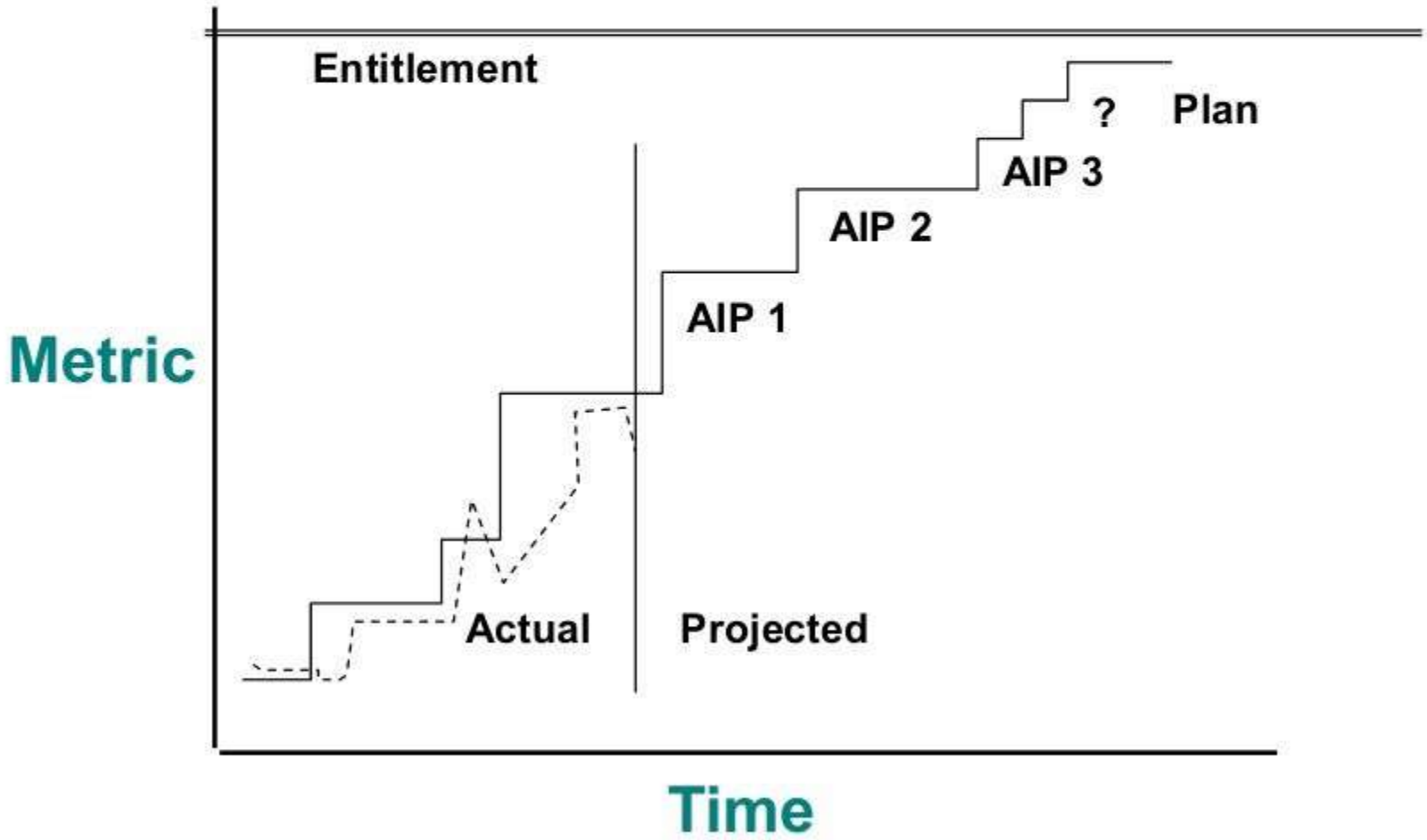
- Simple Graphics
- Statistical Tests
- Engineering Interpretation
- SPC

Data Presentation: Problems & Results

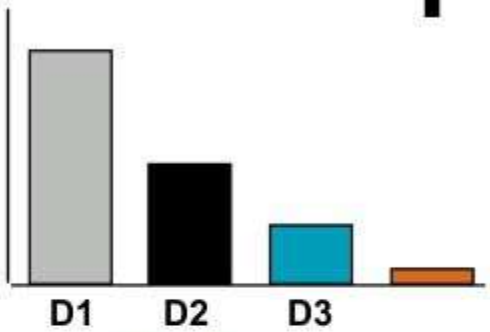


- What Does This Mean?
  - ....
  - ....
- What Should We Do?
  - ....
  - ....

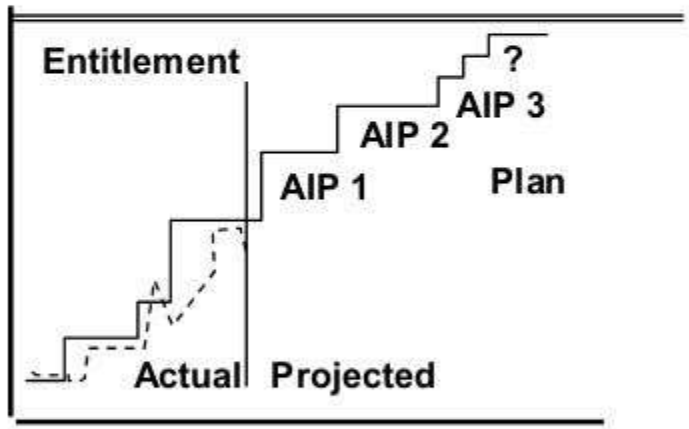
Data Presentation: Plans



Putting It Together



Pareto



Time-Phased Plan

W3s

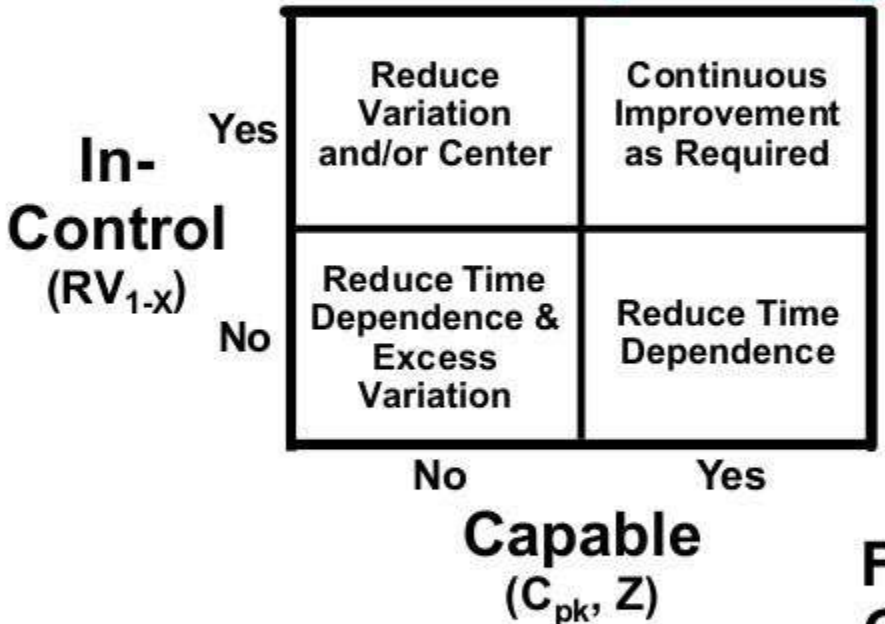
Problem	What (Soln)	Who	When OS	When CS
D1	AIP 1.1		39	43
	AIP 1.2		44	
D2	AIP 2.1		43	
.	AIP 2.2		32	41
.				
DX	AIP X.1		51	

SPC Overview

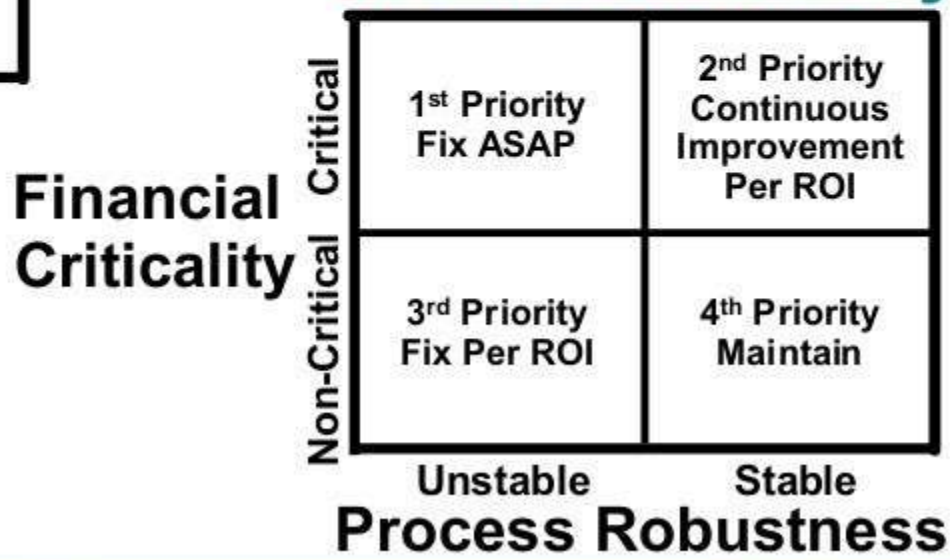
- Process Flow Documentation (Use and/or Expand Flowchart From Problem Solving Work)
- Critical Process Node Matrix ⇨ Prioritized Nodes
- Gauge Capability Study ⇨ Capable & Controlled Gauges
- Process Capability Study ⇨ Capable & Controlled Process Steps
- Control Chart & Decision Rule Implementation ⇨ Optimized SPC Charts With Appropriate Responses
- Maintenance & Feedback System ⇨ ROI Driven Continuous Improvement

Capability & Critical Node Matrices

Nodal Capability

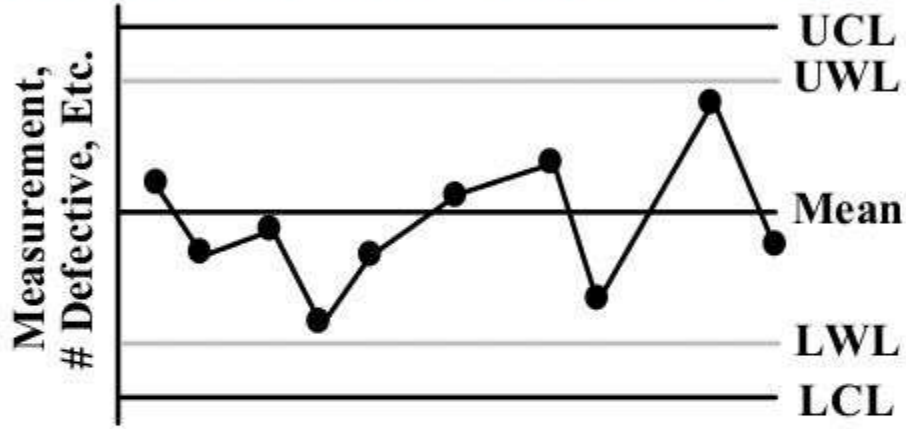


Nodal Criticality



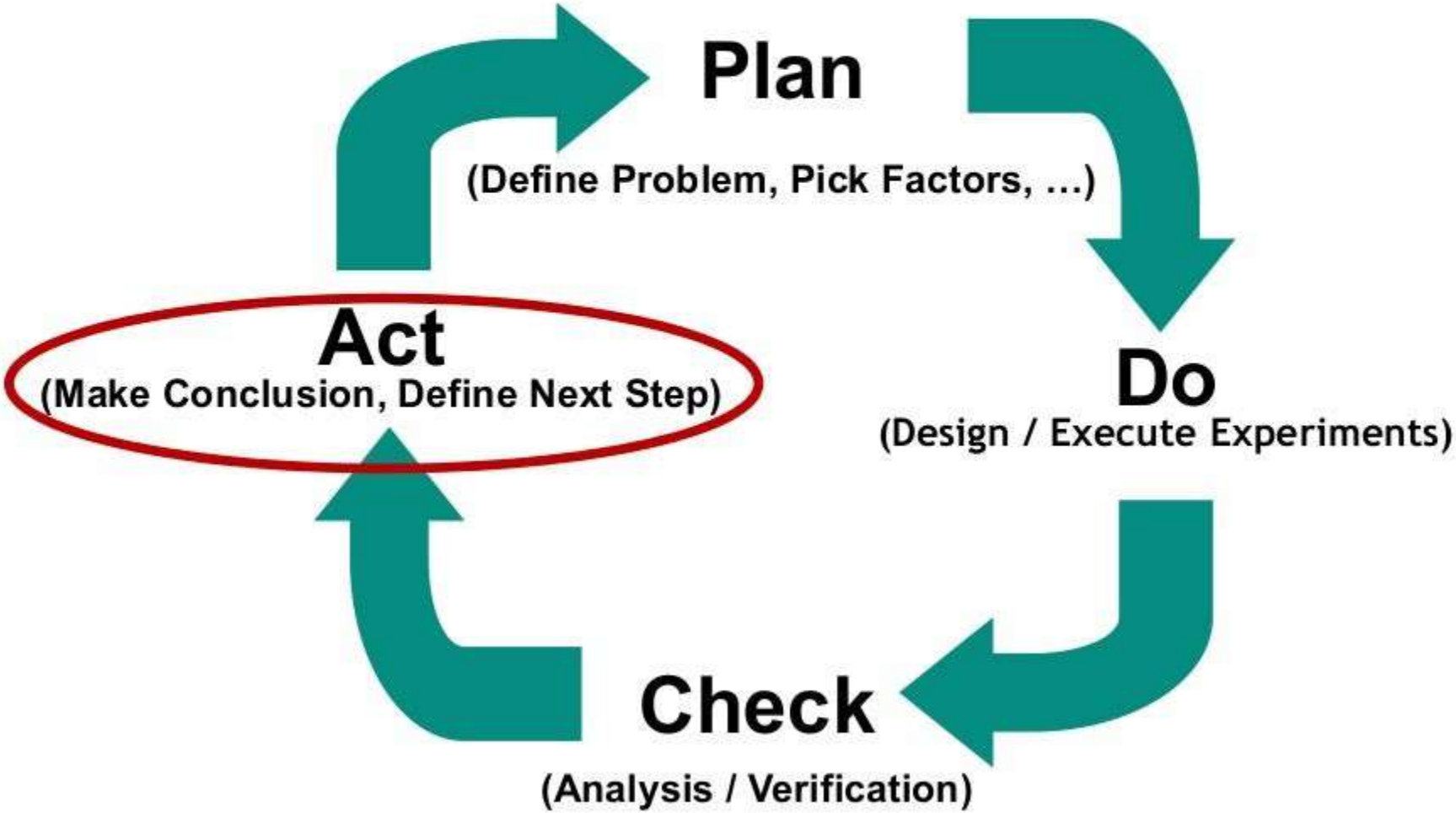
Control Charts

- Run Chart with Statistically Determined Control Limits

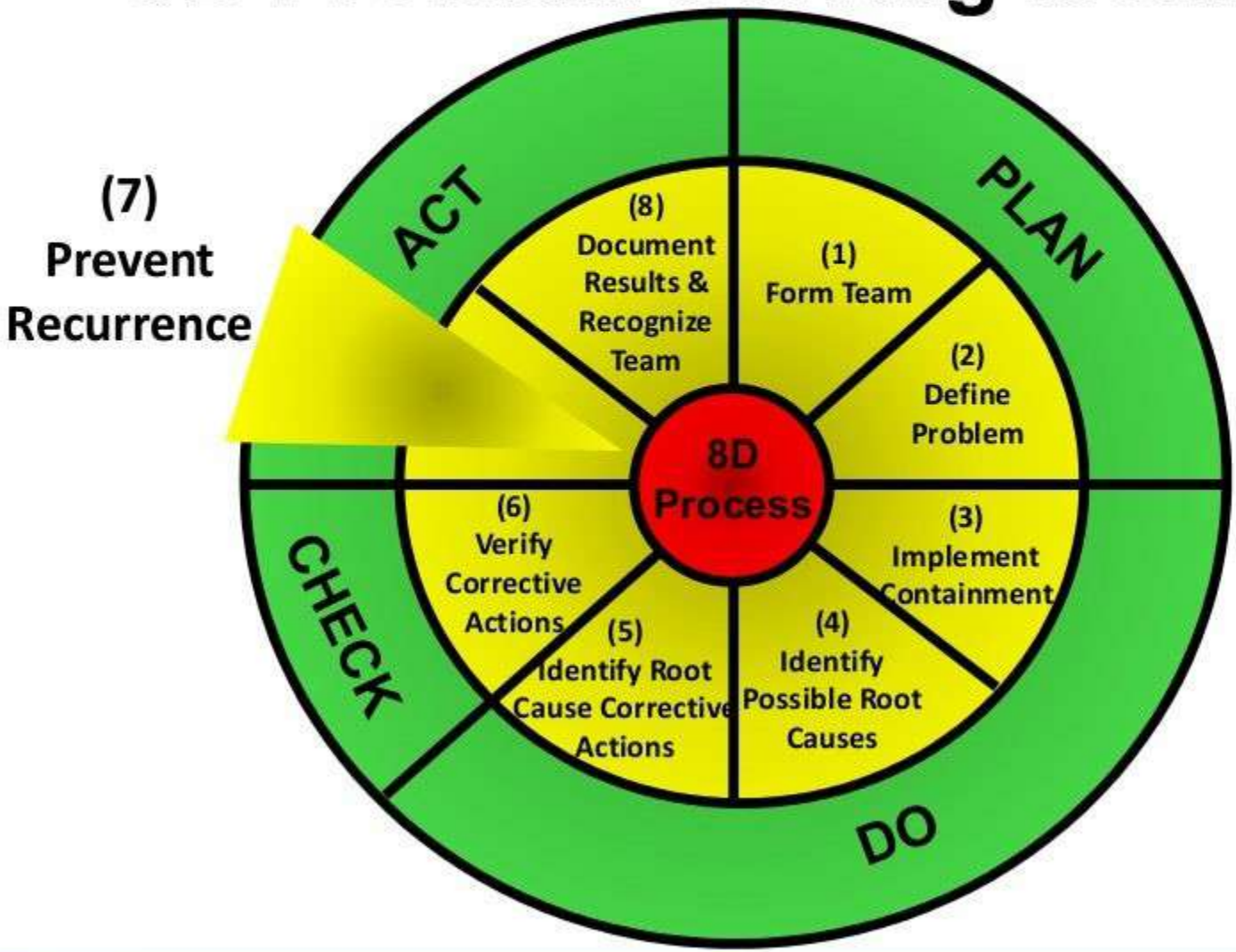


- Reflects Ability of Monitored Process to Remain in State of Statistical Control; i.e. Aids in Identification of Assignable (Special) or Excess Variation
- Process Can Be in Control, But Not Capable
- If Set Up Properly, What Can Be Said About Points Falling Outside Limits?

PDCA: Problem Solving



8D Problem Solving Method



VII. Prevent Re-Occurrence

- **Verify That Corrective Action Was Implemented Correctly & is Being Used**
- **Insure Proper Control Systems are In Place**
- **Would Self-Audit Discover Similar Problems?**
- **Is an Audit Team Necessary?**

Fix Not Just The Root Cause of The Problem, But Also The Practices That Led to The Problem in The First Place

- **What Modification to Business Process: Systems, Specs, . . . Are Required?**

Prevention Checklist

- Application to Other Areas?
- Audit Work Procedures, SPC Charts, etc.
- Update FMEA
- Upgrade Mistake Proof System as Appropriate
- Track Results Closely For Appropriate Time Period to Insure Remains in control
- Document / Specification Update

FMEA

- **Planning / Prevention Tool:**
  - Systematic Method of Identifying & Preventing System, Product and/ or Process Problems Before They Occur
  - Focused on Preventing Problems, Enhancing Safety, & Increasing Customer Satisfaction
  - Ideally Conducted in Product Design or Process Development Stages, Although Can Be Applicable to Existing Products or Processes
- **Applications:**
  - Product Development: Design, Software, Technology, Test/Product Eng, …
  - Manufacturing: Operations, Process, Equipment, Quality, . . .
- **Specific Types:**
  - System FMEA: Applied to Interaction of Parts
  - Design FMEA: Applied to Product Design/Development
  - Process FMEA: Applied to Process Design/Operations
  - Machinery FMEA: Applied to Machinery / Equipment (Ref: Sematech Guide)

Optional Topic

Use Judiciously, It's Easy to Overdo FMEA

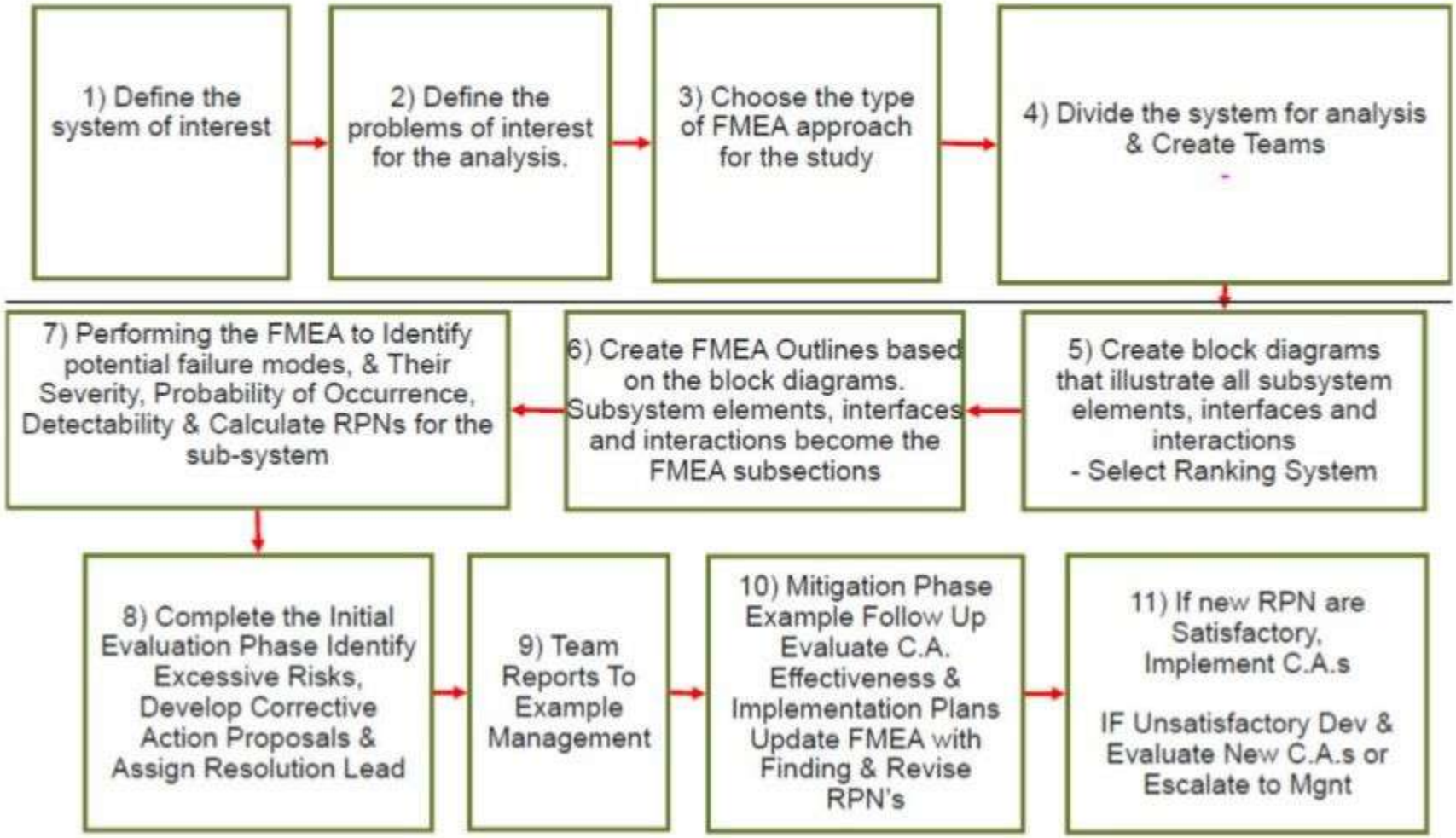
FMEA Implementation

Utilize The Basic Problem Solving Tools in FMEA Process

- List Potential Failure Modes
- Identify Effects of Failure Modes
- Severity of Failure
- List Potential Causes of Failure
- Occurrence: How Many, Where, . . .
- Recommendation Actions (Capture W3s) & Results
- Controls

Note: In All Cases Important to Document Assumptions

FMEA Process Flow



DfR Solutions 2011

FMEA Form

Procedure Product Name:		Prepared by:	Page ___ of ___
Responsible:		FMEA Date (Orig) _____ (Rev) _____	

Process Step / Input	Potential Failure Mode	Potential Failure Effects	SEVERITY	Potential Causes	OCCURRENCE	Current Controls	DETECTION	RPN	Actions Recommended	Resp.	Actions Taken	SEVERITY	OCCURRENCE	DETECTION	RPN
What is the process step and Input under investigation?	In what ways does the Key Input go wrong?	What is the impact on the Key Output Variables (Customer Requirements)?		What causes the Key Input to go wrong?		What are the existing controls and procedures (inspection and test) that prevent either the cause or the Failure Mode?			What are the actions for reducing the occurrence of the cause, or improving detection?		What are the completed actions taken with the recalculated RPN?				
								0							0
								0							0
								0							0
								0							0
								0							0

Identify Failure Modes &Their Effects

Identify Causes of Failure Modes & Controls

Prioritize

Determine & Assess Actions

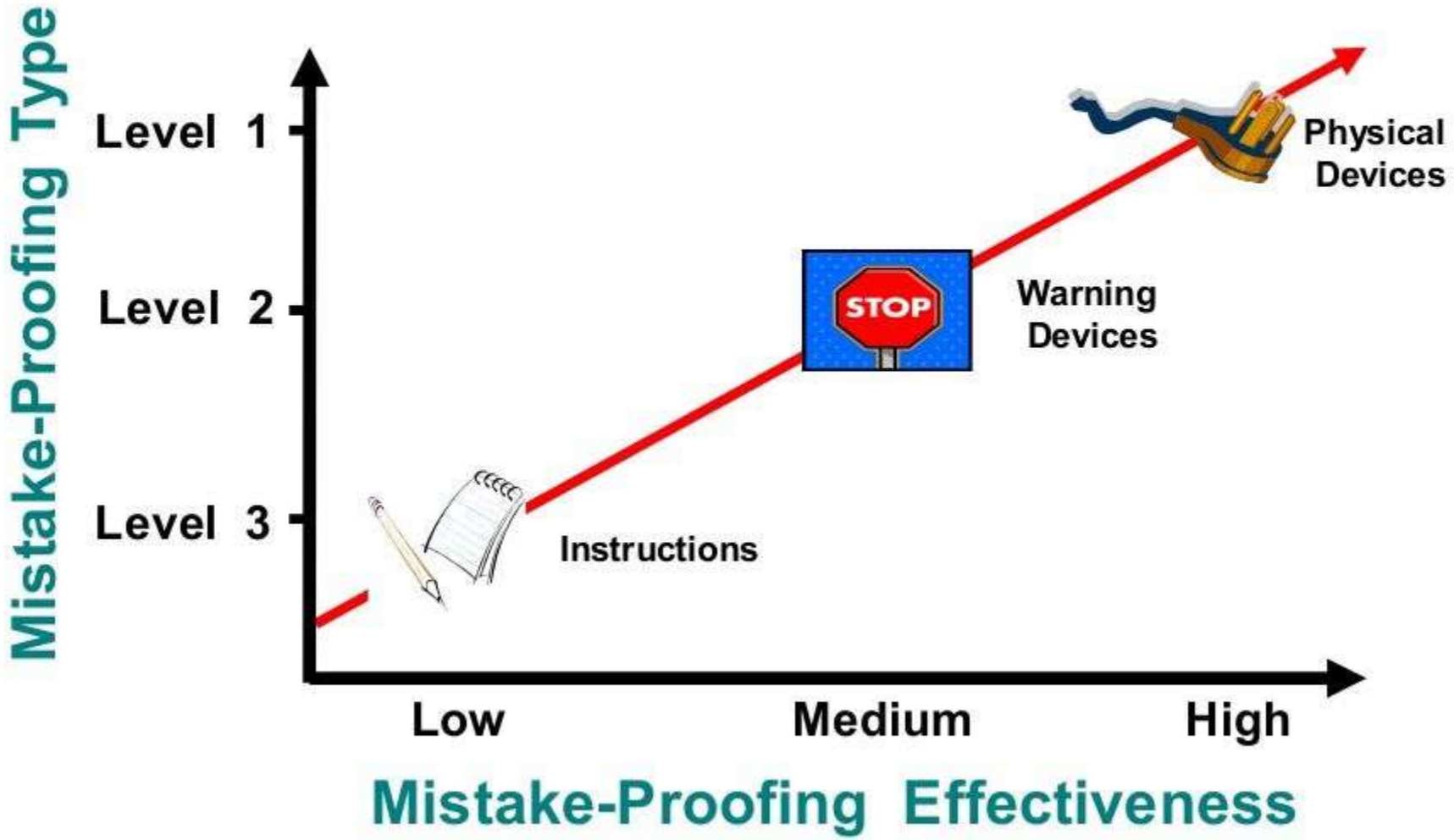
RPN = Severity X Occurrence X Detection

FMEA Resource Matrix

	Customer	Program Management	Integration Responsible Individuals	Service Operations and Warranty	Safety	Manufacturing and Assembly	Materials, Packaging, and Logistics	Engineering and Statistical Analysis	Quality and Reliability	Equipment Manufacturer	Plant Maintenance
Scope	■	■	■								
Functions, Requirements, Expectations	■	■	■	■	■	■	■				
Potential Failure Mode – how the process might fail	■	■	■	■	■	■	■		■		
Effects or Consequences of the Failure	■	■	■	■	■	■	■		■		
Causes of the Failure	■					■	■	■	■	■	■
Current Controls - Prevention						■	■		■	■	■
Current Controls - Detection	■					■	■		■		■
Severity, Occurrence, Detection, RPN	■					■	■	■	■	■	■
Recommended Actions Required	■	■	■			■	■	■	■	■	■

- What Might Go Wrong?
- How Bad Might The Effect Be?
- How Might Effect be Prevented, Mitigate or Detected at Earliest Possible Moment …
- With Lowest Possible Cost & Risk

Mistake Proofing



Mistake Proof Principles & Tools

Mistake Proofing Principles

1. Elimination
2. Prevention
3. Replacement
4. Facilitation
5. Detection
6. Mitigation

Mistake Proofing Methods

1. Variation Control
2. Workplace Organization
3. Identification
4. Process Checks
5. Poka-Yoke Devices

Mistake Proofing Devices

1. Guide Pins
2. Error Detection & Alarms
3. Limit Switches
4. Sensors
5. Vision Systems
6. Counters & Timers
7. Checklists

After F.G. Adler, Operational Excellence Consulting, "8D Problem Solving Process ASQ Clinic Feb 2013

Document Mgt Systems

	Who is Responsible	Completion Date	
		Planned	Actual
Management System Manual			
Mfg Work Instructions			
Inspection Work Instructions			
Process Flow Charts			
Process Control Plans			
Design FMEA			
Process FMEA			
Gages & Gate Study/Capability Doc			
Production Part Approval Process (PPAP)			
Engineering Change Approval			

Which Document Systems are Appropriate for Situation?

8D Problem Solving Method

Document Results & Recognize Team (8)

VIII. Summary / Conclusion

- Final Report
- Communicate Results (Internal & External)
- Preserve Organizational Learning
- Learning Post-Mortem?
- Celebrate Success

Technical (or Quality or …) Report Template

I. Problem Definition:

Performance Gap, Temporal Effects, "Geography", Impact, Priority, …
Objective of Current Step/Report

II. Summary / Conclusion:

What Was Done: (Containment vs. Root Cause, Did we fix problem?)

What It Means / Impact:

- Technical Implications:
- Business Implications:

What We're Going to Do About It: (Include Appropriate ARs/W3s)

- Containment:
- Root Cause:

What is Left:

- How Much More Work Required:
- How Much Longer it Will Take
- How Much it Will Cost (as Appropriate):

Technical (or Quality or …) Report Template

III. Schedule (Cycle of Learning, Time/Cycle, Calendar Time)

IV. Background

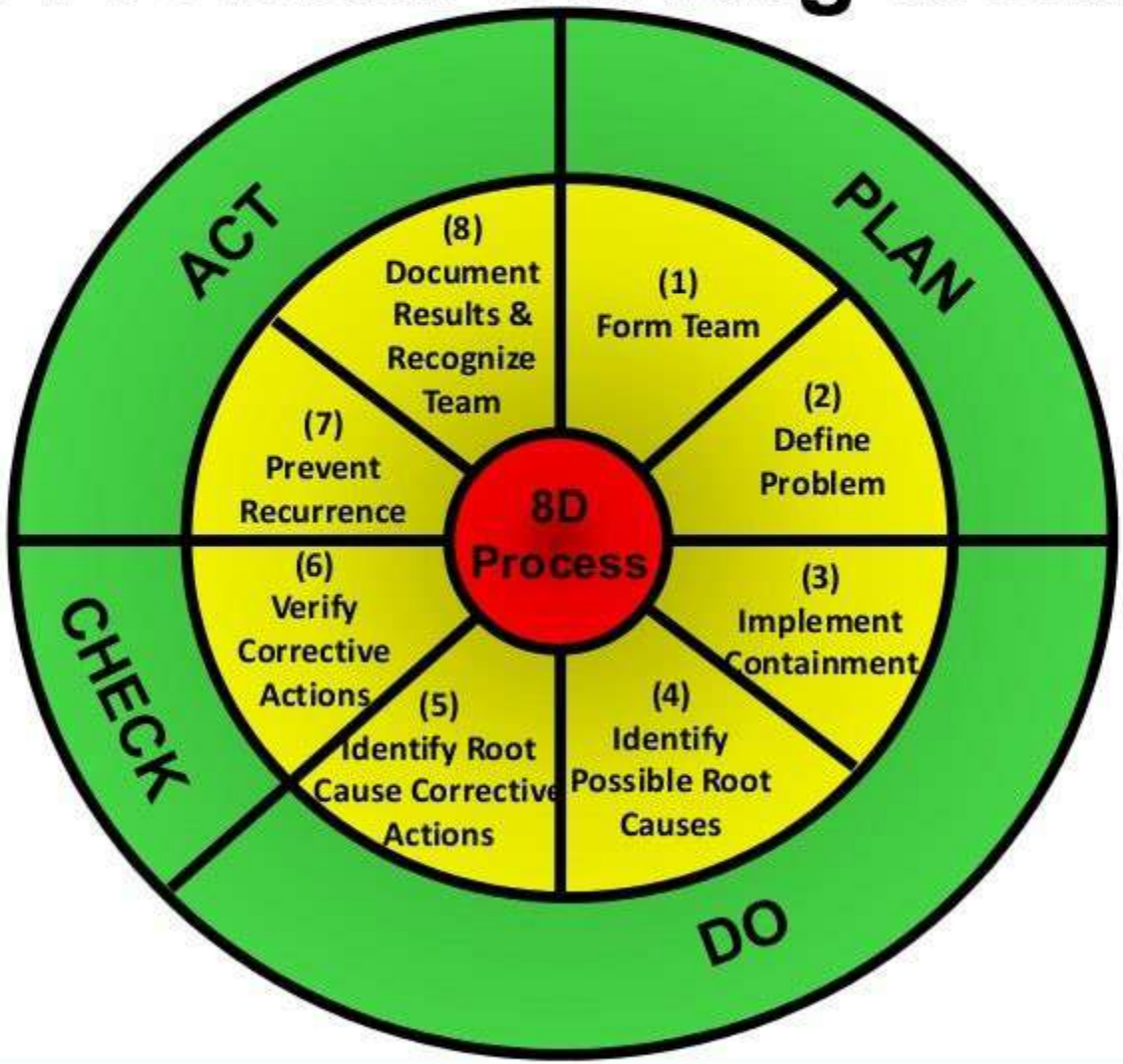
History: (As Appropriate)
Alternatives Considered: (Which ones were tried, not tried, why; tradeoffs)
Solution Path: (As Appropriate)
Etc.:

V. Experimental Description: (As required; Design, Execution, Expectation)

VI. Results & Discussion:

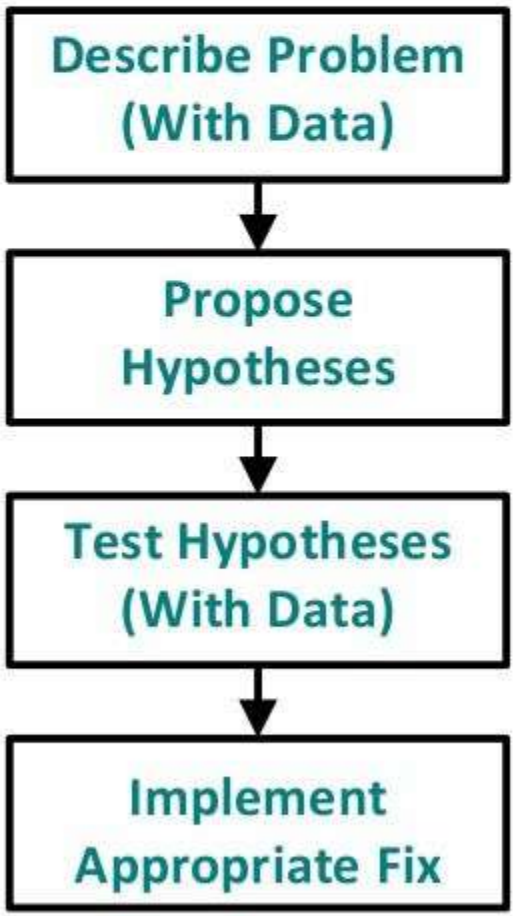
VII. Appendix: (Data as Appropriate)

8D Problem Solving Method



Best Practices in Problem Solving

(It Really Isn't That Complicated)



- Clear, Concise Problem Definition
- Starts With Broad Perspective
- Gets Alignment Across Organizations
- Breaks Down Problem
- Questions Data, Knowledge Base, Assumptions
- Critically Focuses Data
- Eliminates Artificial Constraints
- Drives Convergence & Critical Path
- Is Self-Correcting
- Balances Planning & Doing
- Balances Root Cause Fix & Containment
- Is Properly Tracked & Progress Communicated
- Appropriately Documented

Appendix

Plans That Get Approved

- What is The Plan?
- Why is it Recommended?
- What Alternatives Were Considered?
- What are The Goals?
- How Long Will it Take?
- How Much Will it Cost?

CATWOE

- **Clients**: Who Are The Beneficiaries or Victims of This Particular System/Problem? (Who Benefits or Suffer From its Operation/Solution?)
- **Actors**: Who Are Responsible For Implementation? (Who Would Carry Out The Activities Which Make The System Work / Solve the Problem?)
- **Transformation**: What Transformation Does This System Bring About? (What Are The Inputs & What Transformation Do They Go Through to Become Outputs?)
- **Worldview**: What Particular Worldview Justifies The Existence of This System/Problem? (What Point of View Makes This System Meaningful?)
- **Owner**: Who Has The Authority to Abolish This System or Change Its Measures of Performance or Owns the Problem?
- **Environmental Constraints**: Which External Constraints Does This System Take as a Given?

http://en.wikipedia.org/wiki/CATWOE#CATWOE

Edmond's Creative Problem Solving Checklist

Stages or Ingredients of SM-14	Method or Guide keeps thoughts en route to new reliable knowledge *click **here** to print worksheet* Space for Comments & Notes Provided Below
1. Curious Observation 	Be alert - What is needed? Be skeptical - Prevent trouble. Discover problems. Ask why?
2. Is there a problem? 	Analyze problem carefully, as Einstein stated, "A problem properly defined is often half solved."
3. Goals & Planning 	Break problem down into sub problems. Consider any solutions as tentative till complete Stage 6.
4. Search, Explore, & Gather the Evidence 	Search internet, books, and other sources. Follow leads. Explore all angles. Build files.

One of Three

http://www.problemsolving.net/wrksheet.html

ARA TRAINING

Edmond's Creative Problem Solving Checklist

5. Generate Creative & Logical Alternataive Solutions 	Search for ideas, read publications to trigger your imagination. think reflectively.
6. Evaluate the Evidence 	If possible, chart evaluations of your tentative solutions or theories. Compare and test.
7. Make the Educated Guess (Hypothesis) 	State your working hypothesis explicitly. Make predictions for testing.
8. Challenge the Hypothesis 	Test. Experiment. Control variables. Attempt to falsify.
9. Reach a Conclusion 	Can others test and confirm your conclusions?

Two of Three

http://www.problemsolving.net/wrksheet.html

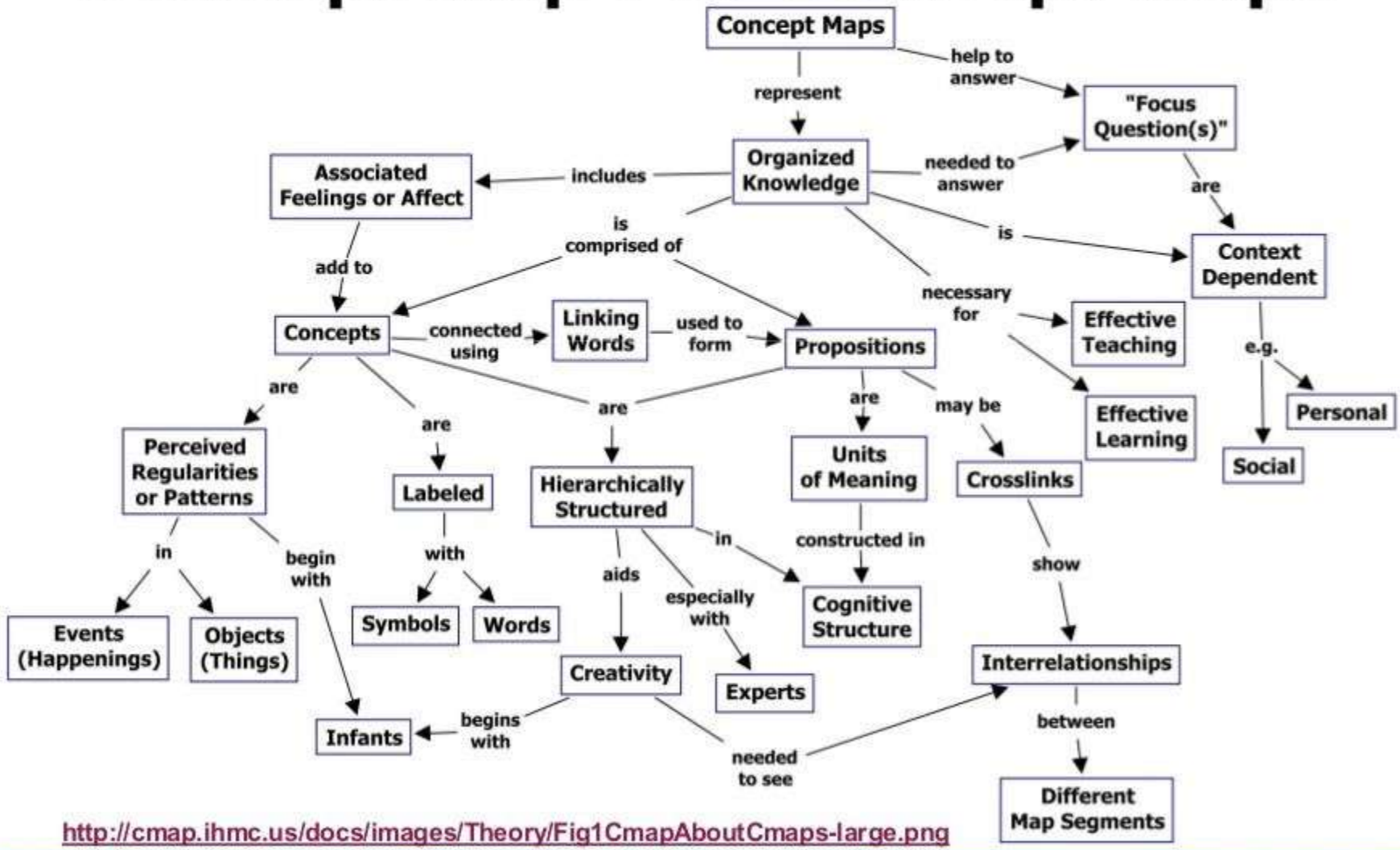
ARA TRAINING

Edmond's Creative Problem Solving Checklist

10. Suspend Judgement 	Keep an open mind and be ready to accept new evidence. Knowledge is forever changing.
11. Take Action 	
Below are the Supporting Ingredients used at all the preceeding stages of SM-14	
12. Creative, Non-Logical, Logical, & Technical Methods 	Use all types of action methods at all stages to actually accomplish results.
13. Procedural Principles & Theories 	Follow those used by researchers everywhere but "anything goes" (if ethical).
14. Attributes & Thinking Skills 	Be honest, team worker, communicator, etc. Use creativity - reason .logically.

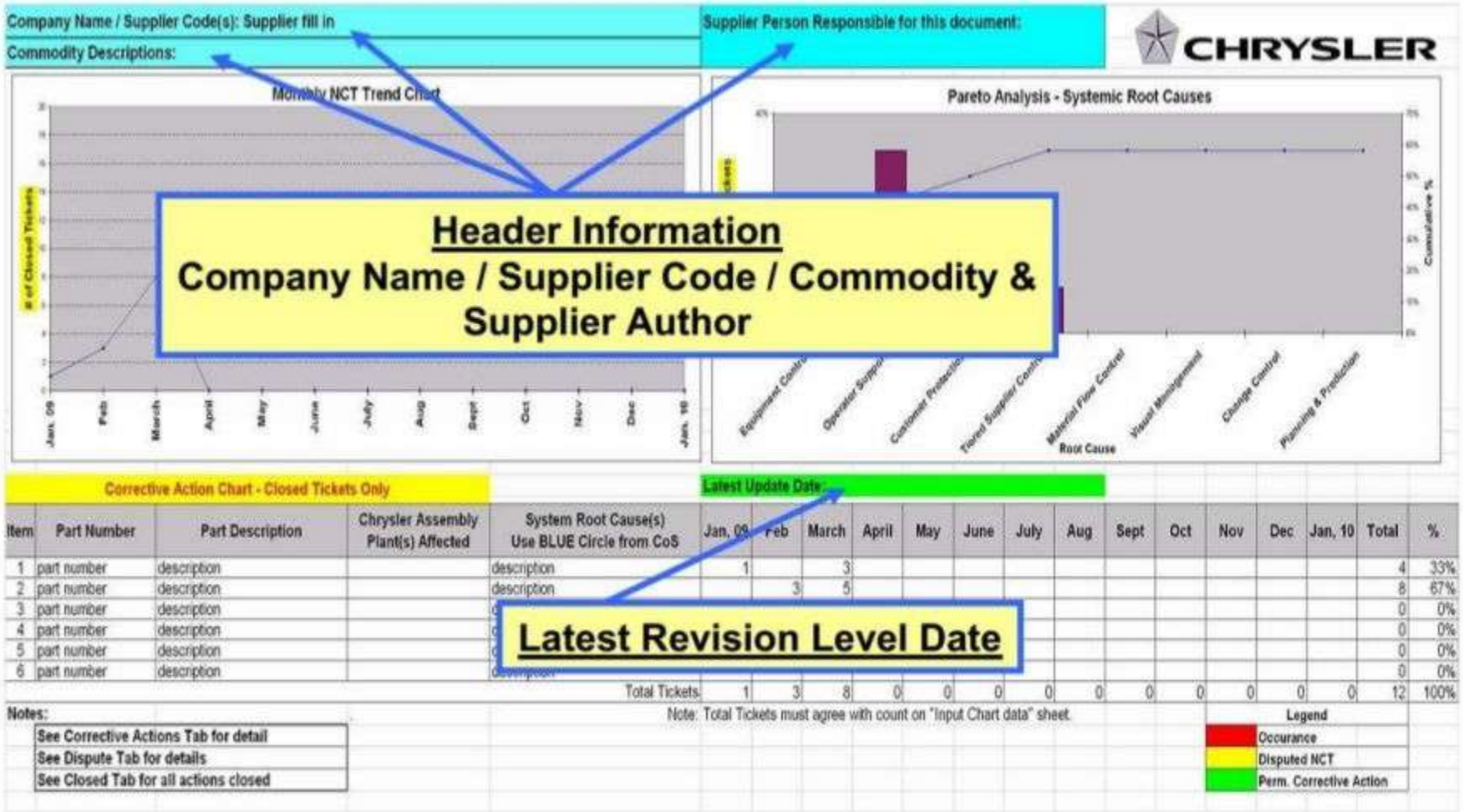
Three of Three

Concept Map For Concept Maps



http://cmap.ihmc.us/docs/images/Theory/Fig1CmapAboutCmaps-large.png

Paynter Chart Analysis Guidelines



What If

Have So Many Problems,

Not Sure Which

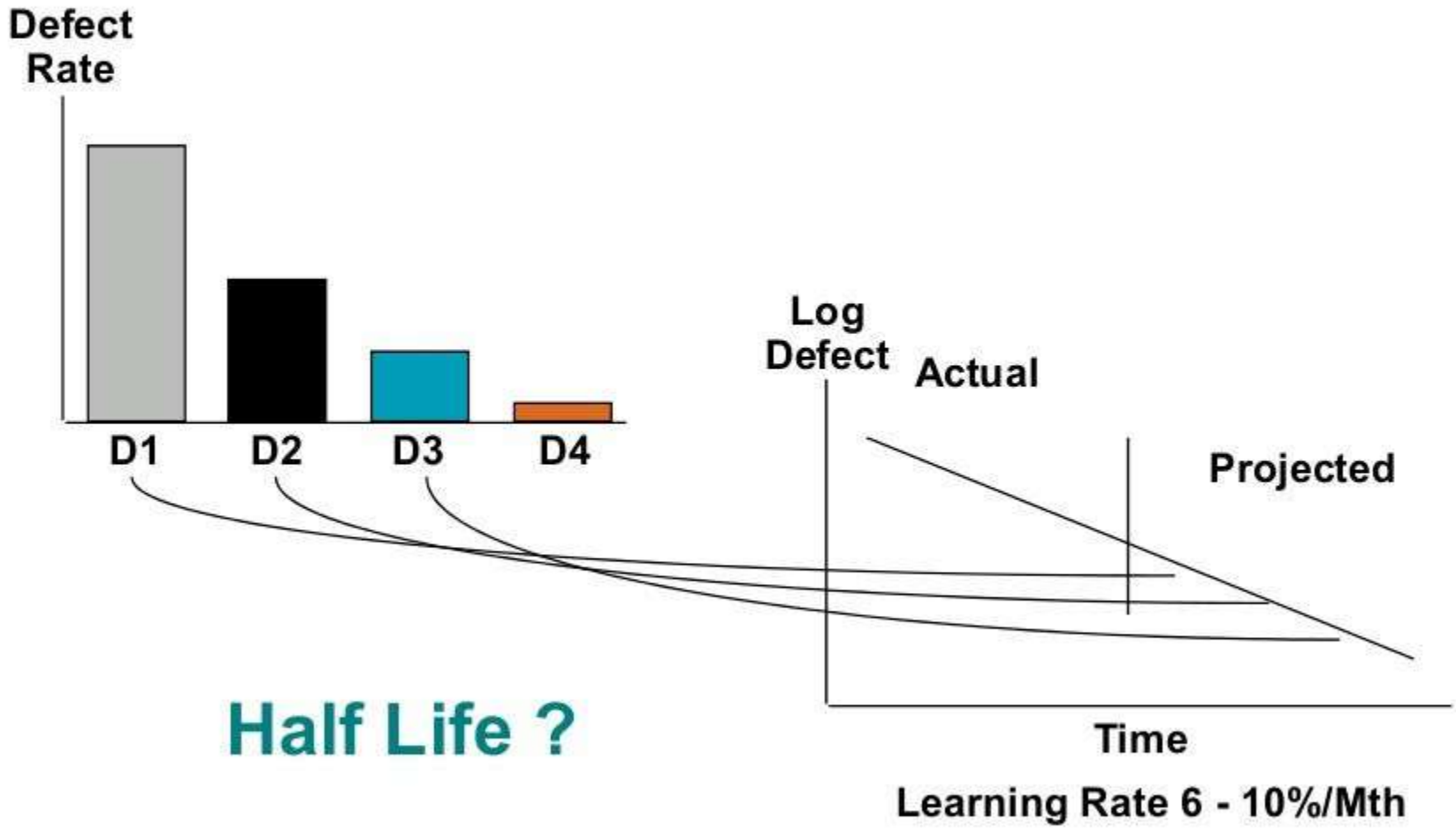
To Work on First?

Different Type of Pareto Charts

- Fit Measurement Scale to Problem
- Get the Time Scale Right
- Break Down Broad Causes Into Specific Parts
- Analyze Groupings: Product, Machine, Shift, etc.
- Measure Impact of Changes: Before & After

What Do Different Charts Tell?

Pareto & Learning Rates



Half Life ?

Consensus Criteria Prioritization Method

I. Agree Upon Goal to Be Achieved

- Confirmation Step if Using Tree Diagram
- Clarify: Prioritizing Problem to Work On or Solution to Problem

II. Create List of Criteria to Be Applied to Options

- Each criterion should reflect desired outcome:
  - Low Cost To Implement
  - Quick Implementation
  - Impact $
  - Self- Contained
  - Low Risk
  - Others ???
  - Resources
  - Pain
  - ROI
  - Effectiveness (Complete?)
  - Sustainable

III. Construct Matrix

- Record Options on Matrix Y, Criteria on X

Consensus Criteria Method

IV. Prioritize Criteria (X-Axis)

- Determine Scale: 10X, 2^x, etc.; High Being "Important" or "Good"
- Determine Weight For Each Criteria (Insure High = "Good")
- Review For Consistency of Criteria Weights

V. Score Options Based on a Criteria (Y-Axis)

- Determine Scale: 10X, 2^x, etc.; High Being "Important" or "Good"
- Determine Weight For Each Option (Insure High = "Good")
- Review For Consistency of Option Rankings

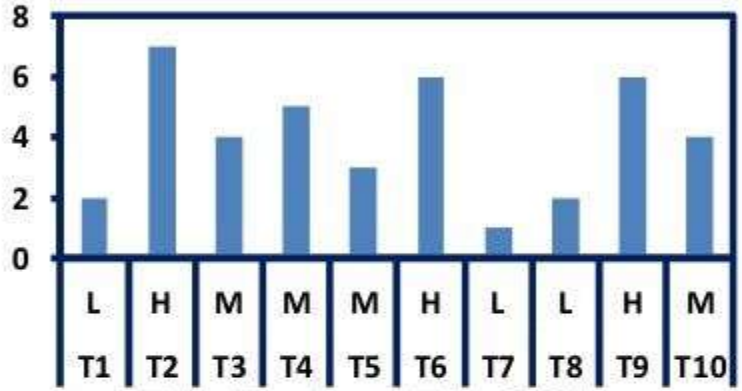
VI. Compute Option Score

- Multiply Option Score By Criteria Weight

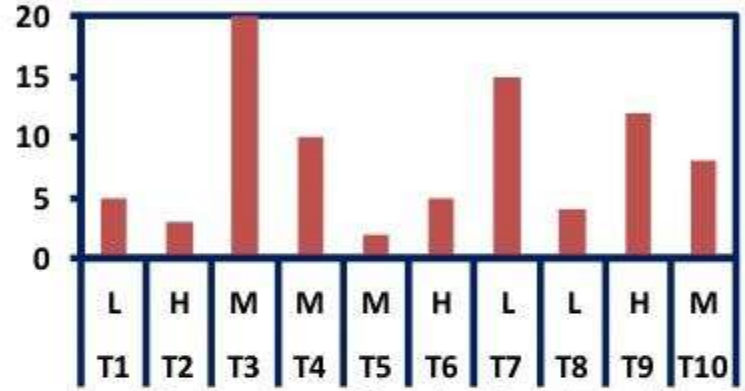
VII. Compute Total Option Ranking Scores

- Repeat Steps V and VI For Each Criteria
- Sum Scores for Each Option
- Review For Consistency of Option Rankings

COL: Handling Multiple Tasks

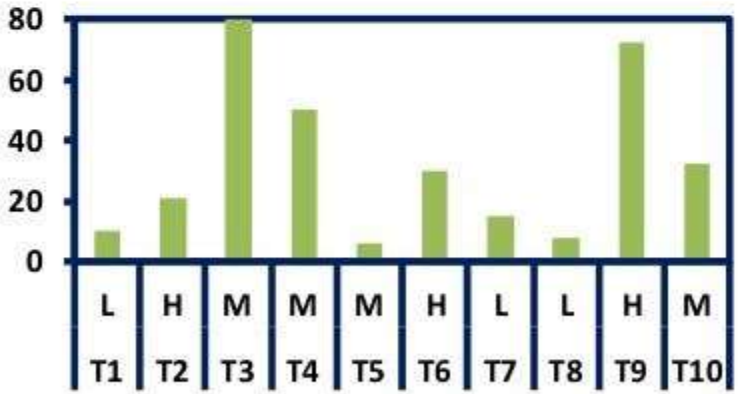


Ten Tasks – Ten COLs



Days Per Cycle Per Task

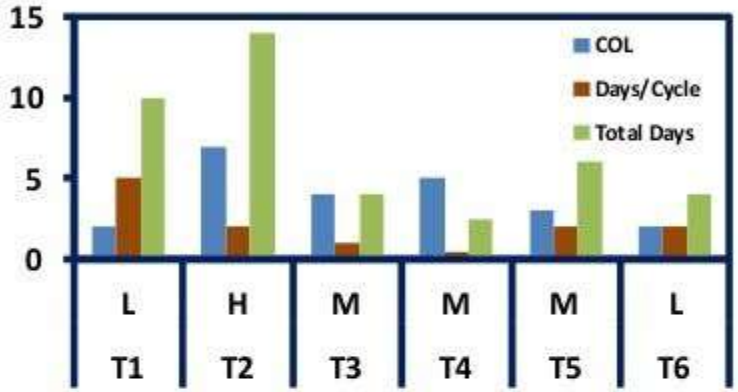
Batting Average?



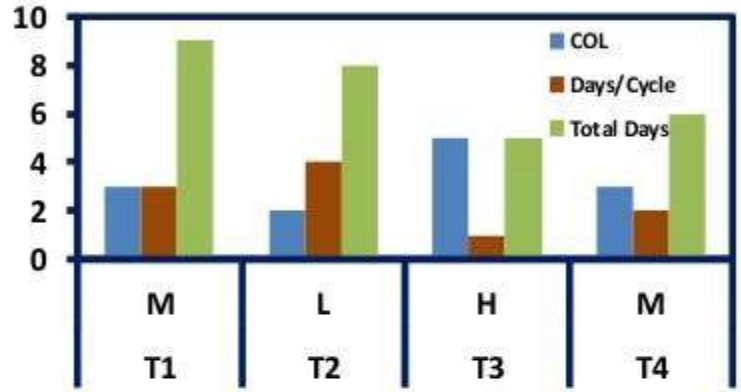
Temporal Budget Per Task

10 Sub-Tasks (or Threads) Require Resolution to Complete Task

COL: Multi-Level Problem

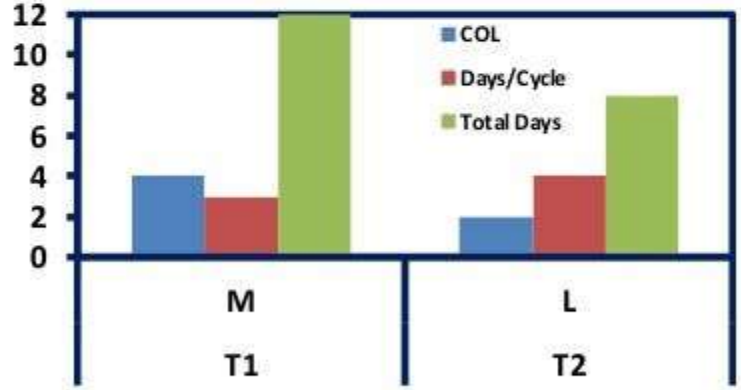


Six Tasks in 1st Level



Four Tasks in 2nd Level

'Knowledge Gap' Reduced Incrementally at Each level



Two Tasks in Final Level

Three Level Problem, Multiple Tasks Per Level

A BUNCH OF THANKS TO

Tony Alvarez

Reference:

https://www.slideshare.net/ARAlvarez?utm_campaign=profiletracking&utm_medium=sssite&utm_source=ssslideview