Troubleshooting Techniques
Problem Solving and
Decision Making

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What do you need to do?

• Solve a Problem?
  • Find out what’s wrong.
  • Find a way to fix it.

• Make a Decision?
  • Who does it impact?
  • What is important?
  • What will it cost?
  • When can it be implemented?
You Dropped Food on the Floor
Do You Eat It?

Was it sticky? — No. — Did anyone see you? — YES.

Is it a boss/lover/parent? — No.

Was it a raw steak? — YES.

Was it expensive? — YES.

Did the cat lick it? — NO.

Are you a puma? — NO.

Is it bacon? — NO.

Can you cut off the part that touched the floor?

EAT IT.

EAT IT.

DON’T EAT IT

EAT IT.

DON’T EAT IT

YOUR CALL

EAT IT.

EAT IT.

EAT IT.

EAT IT.

EAT IT.

EAT IT.

EAT IT.
Why This Topic?

- Work in a team environment.
- Prevent Loss of $$$ / Time
- Reduce the Frustration Level
Who can use this?

• Managers and Directors
  • Values Timely Decisions
  • Systems oriented

• Engineers
  • Linear Thinkers, Problem Solvers
  • Optimize, Push Against Boundaries

• Reviewers
  • Spot the disparities, Adhere to Standards.

• Maintenance Shops / Skilled Trades
  • Get the job done.
  • See the real-world effects.
Problem Solving
TROUBLESHOOTING

• Utilizes all the K – T Methods
• Problem Statement – Important, but...
• Decision Making – also needed, but...
• Problem Analysis – Most Important
  • Researches the why of the issue.
  • How, why did it happen.
  • Finalize what needs to be done.
• Potential Problem Analysis.
  • Protect Your Actions and Decisions
Background

• Director, Engineering
• Project Manager
• Maintenance Supervisor
• Design Engineer
• Cambus Driver
• Farmer
K – T Methods:

• Situation Appraisal
• Decision Analysis
• Problem Analysis
• Potential Problem Analysis

Benjamin Kepner
Charles Treogoe
Worked at Rand Consulting 1950’s
Strategic Air Command
NASA
K – T Methods:

• Kepner – Tregoe methods are based on....
  • Conditioned Thought Process
  • Systematic Investigation
  • Rational Thinking
  • Unaffected by Politics, Emotions
    • (think Mr. Spock)

• You may already think this way ......
  • ...you might be an engun-near if.
What is K-T methodology?

Kepner Tregoe is used for decision making.

It is a structured methodology for gathering information and prioritizing and evaluating it.

It is very detailed and complex method applicable in many areas, which is much broader than just idea selection.

It is called also a root cause analysis and decision-making method.

It is a step-by-step approach for systematically solving problems, making decisions, and analyzing potential risks.
Situation Appraisal

• Identifies Issues Requiring Action
  • State the Problem
• Sets Priorities
• Determines Next Steps
• Plans Involvement of Key Personnel
Decision Analysis

• Clarifies Purpose
• Evaluates Alternatives
• Assesses Risks
• Makes Decision
Problem Analysis

• Defines the Problem
• Identifies Possible Causes
• Evaluates Possible Causes
• Confirms True Cause
Potential Problem Analysis

• Identifies Potential Problems
• Identifies Likely Causes
• Takes Preventive Action
• Plans Contingent Actions and Sets Triggers
• Protects the Decisions Made
Situation Appraisal

Where are we? What do we need to do?
Assess Situation (situation appraisal)

- Identify concerns (problems) by listing them
- Separate the level of concern (importance, magnitude, level of influence)
- Set the priority level to measure seriousness of impacts (influence), urgency and growth potential
- Decide what action to take next (step by step approach)
- Plan for who is involved, what they will be doing, where they will be involved, when it happened and the extent of involvement (magnitude)
Decision Analysis

For the more endearing (enduring???) situations.
Many options, No Perfect Solution.
Minimize Risk
Decision making process

- Problem definition
- Requirements identification
- Goal establishment
- Evaluation criteria development
- Select decision-making tool
- Apply tool (K & T, Pros-Cons, ...)
- Check
Make decision (A choice between two or more alternatives)

- Identify what is being decided
- Establish and classify objectives (main ones, minor ones,..)
- Separate the objectives into **must** *(must have)* and **want** *(nice to have)* categories (assign **importance factors** from 1-10, where 10 is the most important **want** objective) and assign criterion rating (weights) or use H – M - L
- Generate the alternatives *(we can do it that way or we can take another way as well)*
- Evaluate the alternatives by scoring the **wants** against the main objective
- Review adverse (harmful) consequences of your corrective steps (risk evaluation, risk assessment)
- Make the best possible choice **what to do**
Problem Analysis

Most of the Troubleshooting Activity occurs here.
Problem Analysis

• Problem Statement
  • Simple one Sentence.
  • Set the Stage for what to Investigate.
  • Refine.
    • Exclude
    • Include
Problem Analysis

- Defines the Problem
- Identifies Possible Causes
- Evaluates Possible Causes
- Confirms True Cause
Problem Analysis

• What it is.  What it is not.
• When it happens.  When it doesn’t.
• Focus on the what, when, where, who
WHO WHAT WHEN WHERE EXTENT
Problem Analysis

• Did it work right before?
• Has a change occurred?
• What has changed?
• When did it occur?
Problem Analysis

• The majority of Problem Analyses never see Pen and Paper.
  • But the thoughts, talk and discussion happen all the time.
Problem Analysis - What

**Is**

- What specific object(s) has the deviation?
- What is the specific deviation?

**Is Not**

- What similar object(s) could have the deviation, but does not? (It did not happen)
- What other deviations could be reasonably observed, but are not? (It did not happen)

Example for **Is**:
1. What specific object **IS** related to the defect?
   - Inventory Valuation Objects in database A
2. What specifically is the defect (deviation)?
   - Inventory Adjustment does not work

Example for **Is Not**:
1. What specific object **IS NOT** related to the defect?
   - Inventory Valuation Objects in database B
2. What specifically is not the defect (deviation)?

1-> Setup has another parameters On
2-> Algorithm is used also for production where not error occurs
Problem Analysis - **What**

**Is**
- What specific object(s) has the deviation?
- What is the specific deviation? - bites on the neck

Example for *Is*:
1. Nice young girl’s neck and strange look of anemic person

**Is Not**
- What similar object(s) could have the deviation, but does not? (It did not happen)

What is the specific deviation? but does not? (It did not happen) – bites, anemia

Example of *Is Not*:
1. Girl with garlic in her hands
2. No bites
Another example for **WHAT** and **IS** and **IS NOT**

**Example I.**

IS girl visited Dracula lower castle without a bunch of garlic, but IS NOT not the one having bunch of garlic and visiting Špiberk castle in Brno
Uncover and handle problems
(problem analysis)

- State the problem *(definition and description of the problem)*
- Specify the problem by asking **what is** and **what is not**
- Develop **possible causes** of the problem
- Test and verify possible causes
- Determine the most probable cause *(root cause)*
- Verify any assumptions
- Try the best possible solution and monitor what will be a situation after applied correctives step
Problem Analysis - Where

**Is**
- Where is the object when the deviation is observed? (geographically)
- Where is the deviation on the object?

**Example for Is**:
1. Old castle in the mountains (Romania)

**Where IS**: Romanian Carpathian mountains where it is very easy to meet a lot of vampires there

**Is Not**
- Where else could the object be when the deviation is observed, but is not?
- Where else could the deviation be located on the object, but is not?

**Example for Is Not**
1. Brno castle Spilberk

Where **IS NOT** possible to meet vampires (only lovers and children and seniors)
Problem Analysis - When

Is

• When was the deviation observed first (clock and calendar time)?

• When since that time has the deviation been observed?

• When, in the object’s history or life cycle, was the deviation observed first?

Is Not

• When else could the deviation have been observed first, but was not?

• When since that time could the deviation have been observed, but was not?

• When else, in the object’s history or life cycle, could the deviation have been observed first, but was not?
Example for WHEN and IS and IS NOT

Customer X and Customer Y both use product B but only customer X was sent the wrong product if Salesman Tony was on holiday in this time and Salesman Mustafa was in charge, so the object IS Salesman Mustafa, but IS NOT Salesman Tony.
Example for **WHEN** and **IS** and **IS NOT**

Customer X and Customer Y both use product B but only customer X was sent the wrong product if Salesman Tony was on holiday in this time and Salesman Mustafa was in charge, so the object **IS** Salesman Mustafa, but **IS NOT** Salesman Tony.
Problem Analysis - **Extent**

**Is**

- How many objects have the deviation?
- What is the size of a single deviation?
- How many deviations are on each object?
- What is the trend?
  - Occurrences?
  - Size?

**Is Not**

- How many objects could have the deviation, but don’t?
- What other size could a deviation be, but isn’t?
- How many deviations could there be on each object, but are not?
- What could be the trend, but isn’t?
  - Occurrences?
  - Size?
Problem Analysis
Evaluate Possible Causes

• *Determine the most probable cause*
  • Which possible cause best explains the IS and IS NOT information?
  • Which possible cause has the fewest, simplest, and most reasonable assumptions?
Problem Analysis
Confirm True Cause

• What can be done to verify any assumptions made?
• How can this cause be observed at work?
• How can we demonstrate the cause-and-effect relationship (e.g. Current Reality Tree or Ishikawa Fishbone Diagram)?
• When corrective action is taken, how will results be checked?
Planning the Next Steps

• Problem Analysis
  • Do we have a deviation?
  • Is the cause unknown?
  • Is it important to know the cause to take effective action?

• If the answer is YES to ALL three, than you have a big problem, Huston !!!
Example of problem manifestation
(decrease of performance)

What do we see, hear, feel, taste, or smell that tells us there is a deviation?

Final effect of the = PROBLEM (e.g. server crashed)
<table>
<thead>
<tr>
<th>What</th>
<th>Identify:</th>
<th>IS</th>
<th>IS NOT</th>
<th>Distinction</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>What is problem?</td>
<td>What is not problem?</td>
<td>What difference between is and is not?</td>
<td>What is possible cause?</td>
</tr>
<tr>
<td>Where</td>
<td>Locate:</td>
<td>Where is problem found?</td>
<td>Where is problem not found?</td>
<td>What difference in locations?</td>
<td>What cause?</td>
</tr>
<tr>
<td>When</td>
<td>Timing:</td>
<td>When does problem occur?</td>
<td>When does problem not occur?</td>
<td>What difference in timing?</td>
<td>What cause?</td>
</tr>
<tr>
<td>Extent</td>
<td>Magnitude:</td>
<td>How far does problem extend?</td>
<td>How localized is problem?</td>
<td>What is the distinction?</td>
<td>What cause?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How many units are affected?</td>
<td>How many not affected?</td>
<td>What is the distinction?</td>
<td>What cause?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How much of any one unit is affected?</td>
<td>How much of any one unit is not affected?</td>
<td>What is the distinction?</td>
<td>What cause?</td>
</tr>
</tbody>
</table>
Test the Most Probable Cause

Clarifying problem Analysis (example)

<table>
<thead>
<tr>
<th>Potential root cause:</th>
<th>True if:</th>
<th>Probable root cause?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange Server 123 has something wrong with it</td>
<td>Only Exchange Server 123 has this problem</td>
<td>Maybe</td>
</tr>
<tr>
<td>Procedure incorrect</td>
<td>Same procedure crashes another server</td>
<td>Probably</td>
</tr>
<tr>
<td>Technician error</td>
<td>Problem did not always reoccur</td>
<td>Probably not</td>
</tr>
</tbody>
</table>

We have to ask

<table>
<thead>
<tr>
<th>Question</th>
<th>IS</th>
<th>IS NOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>What (identify)</td>
<td>Q1</td>
<td>Q2</td>
</tr>
<tr>
<td>Where (locate)</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>When (timing)</td>
<td>Q5</td>
<td>Q6</td>
</tr>
<tr>
<td>Extent (magnitude)</td>
<td>Q7</td>
<td>Q8</td>
</tr>
</tbody>
</table>
Problem description (example)

• On a new model of airplane, flight attendants develop rash on arms, hands, face (only those places). It only occurs on flights over water.

• Usually disappears after 24 hours. No problems on old planes over those routes.

• Does not affect all attendants on these flights, but same number of attendants get it on each flight. Those who get rash have no other ill effects.

• No measurable chemicals, etc., in cabin air.

• Rash arm ->
## Problem analysis real table

<table>
<thead>
<tr>
<th></th>
<th>IS</th>
<th>IS NOT</th>
<th>DISTINCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHAT:</td>
<td>Rash</td>
<td>Other illness</td>
<td>External contact</td>
</tr>
<tr>
<td>WHEN:</td>
<td>New planes used</td>
<td>Old planes used</td>
<td>Different materials</td>
</tr>
<tr>
<td>WHERE:</td>
<td>Flights over water</td>
<td>Flights over land</td>
<td>Different crew procedures</td>
</tr>
<tr>
<td>EXTENT:</td>
<td>Face, hands, arms</td>
<td>Other parts</td>
<td>Something contacting face, hands and arms</td>
</tr>
<tr>
<td></td>
<td>Only some attendants</td>
<td>All attendants</td>
<td>Crew duties</td>
</tr>
</tbody>
</table>
Results ????
Potential Problem Analysis

Protect your decisions!!!
Potential Problem Analysis

• Identifies Potential Problems
• Identifies Likely Causes
• Takes Preventive Action
• Plans Contingent Actions and Sets Triggers
• Protects the Decisions Made
See the Upcoming \((\text{approaching, next to come})\) and Potential Opportunity -Solutions

- State the action
- List the potential opportunities,
- Consider the possible solutions
- Take the action to address the likely cause/solution
- Prepare actions to enhance likely \((\text{possible})\) effects
Let’s Look At Some Problems!
Apollo XIII

- On it’s way to Moon
  - Under-volt Main Bus B
  - Loud Boom
  - Under-volt Main Bus A
  - Venting gas into space
- NASA puts Problem Analysis to work.
- Contingency Actions Taken.
- True Cause not found until weeks later.
CRCE Pipe Break

• Water leaking through ceiling.
• Quickly found the Pipe Break
• Why did it happen?
• How do we prevent this in the future?
• What was true cause?
Let’s Look At Some Problems again!

I’VE SOLVED YOUR PARKING PROBLEM....
...I’M TAKE AWAY YOUR COMPANY CAR!
Server crashed !!!! (home study !!!)

- **Server crashed** *(this is a very poor problem definition)*
- The e-mail system crashed after the 3rd shift support engineer applied hot-fix XYZ to Exchange Server 123 *(better definition of the problem)*

<table>
<thead>
<tr>
<th>IS</th>
<th>COULD BE but IS NOT</th>
<th>DIFFERENCES</th>
<th>CHANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHAT</td>
<td>System failure</td>
<td>Similar systems/situations not failed</td>
<td>?</td>
</tr>
<tr>
<td>WHERE</td>
<td>Failure location</td>
<td>Other locations that did not fail</td>
<td>?</td>
</tr>
<tr>
<td>WHEN</td>
<td>Failure time</td>
<td>Other times where failure did not occur</td>
<td>?</td>
</tr>
<tr>
<td>EXTENT</td>
<td>Other failed systems</td>
<td>Other systems without failure</td>
<td>?</td>
</tr>
</tbody>
</table>

History (and best practice) says that the root cause of the problem is probably due to some recent change. **WHAT, WHERE, WHEN and EXTENT** will be shown on next slides.
K – T Methods:

- Comparative Management Ideologies:
  - Root Cause Analysis
  - Brainstorming
  - Scenario Planning
  - Groupthink
  - Gestalt Framework Theory
  - Six Thinking Hats
Systematic Problem Solving and Decision making Overview

**Problem Definition Process**
- Problem Recognition
- Compare the actual to the desirable = Deviation
- Specify the Deviation
- Develop Potential Causes
- Test for Cause
- Cause Determined

**Decision Making Process**
- Establish Musts & Wants
- Generate Alternatives
- Compare Alternatives & Select
- Decision Made
Summary

• State the Problem
• Identify Possible Causes
• Test for True Cause
• Implement the Required Action
Thanks for Your attention
QUESTIONS?