7-STEP
Structured Problem Solving Method Workshop Participant Guide

A fact based logical roadmap to improved results

TERADYNE

Part# 101-00 Revision 0445.1

Contents

7-Step Workshop
Participant Guide

TERADYNE

PREFACE

This Guide contains information required by participants to successfully complete the 7-Step Structured Problem Solving Workshop. The Guide is also an essential reference when using the 7-Step methodology.

The initial Companywide revision of this workshop was the result of contributions by 240 individual Teradyne employees who attended one of twelve Workshops conducted in the first half of 1991. These individuals shared their experiences and attempts at applying the 7-Step methodology through a series of workshop exercises. Cases were diagnosed and guidelines were developed based primarily on these experiences.

Subsequent revisions of the Workshop were based on feedback from many hundreds of workshops held throughout Teradyne by all divisions.

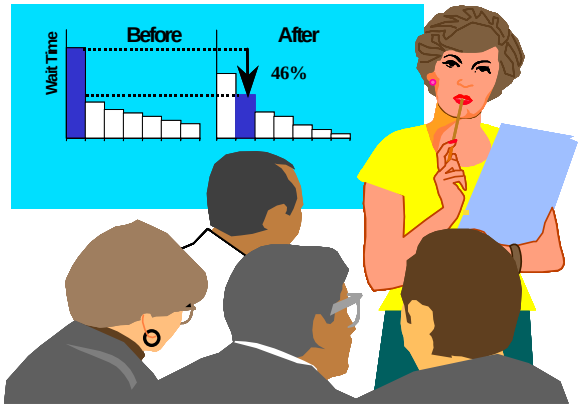
Teradyne owes a debt of gratitude to Professor Shoji Shiba of the University of Tsukuba, Tsukuba Japan. Much of the content and teaching methodology used in this workshop is based on Professor Shiba's teachings.

PLEASE HELP TO IMPROVE THESE MATERIALS

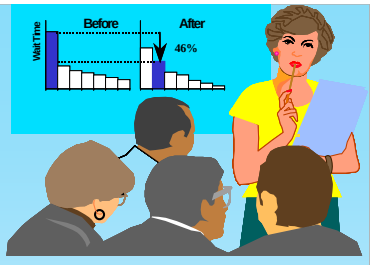
Please email suggestions for improving these materials to Companywide.TQMOffice@teradyne.com

TAB 1

Workshop Slides



Welcome to the …



7-Step Structured Problem Solving Workshop

Lots of shared learning …
and some fun

Are introductions in order?

Your 7-Step Workshop Groundrules

- ❑ Start / Resume on-time
- ❑ No external interruptions
- ❑ Phones / beepers off
- ❑ Work in teams with everyone contributing
- ❑ Use a Parking Lot
- ❑
- ❑
- ❑

The 3 Steps of Learning

Knowledge
Created through information
Reading the class slides

Understanding
Created by relating knowledge to your own experiences
Class exercises & discussion

Skill
Created thru' repetition and the will to use
Apply understanding to your daily work

Openness to Learning: *Put yourself in receive mode*

Workshop Agenda/Schedule

Day 1

- Module 1: Problems, Problems, Problems
- Module 2: Getting Started with the 7-Steps

Day 2 AM

- Completion of Module 2
- Module 3: Using the 7-Steps

Day 2 PM - Optional

- Action Learning Session
  - Use Your Own Data
  - Start to use the 7-Steps straight away
  - Get some practice with the commonly used tools

Short breaks will be taken as required

Workshop Objectives

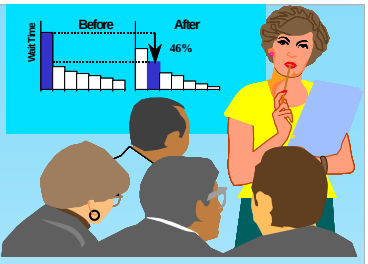
- For New Employees:
  - To prepare you for active participation in structured problem solving – specifically within a team setting
- For Longer Term Employees:
  - To refresh and recalibrate your existing 7-Step Knowledge & Understanding

You will:

- Learn and apply the 7-Step Logic & Thinking
- Understand the use and application of commonly used tools & techniques
- Use the common language associated with Structured Problem Solving
- Learn by doing

- Your challenge: As we progress through the workshop, relate what you learn to your own work situation and experience

Desired Outcome:
To *explore* the benefits, concepts, and logic flow of structured problem solving



Module 1 - Problems, Problems, Problems

Topics:

- The Focus of 7-Step Problem Solving
- 7-Step Logic / Thinking
- Two types of Action
- Systems Thinking
- Commonly used tools
- Setting up an Improvement Team

Are you a good problem solver?

For example: In an interview situation, how many of us would say we are good at solving problems?

So why do we need the 7-Steps?

There are many types of problems

Houston, we have a problem!

Getting out of bed

$Y = f(x)$

Should I authorize payment of this invoice?

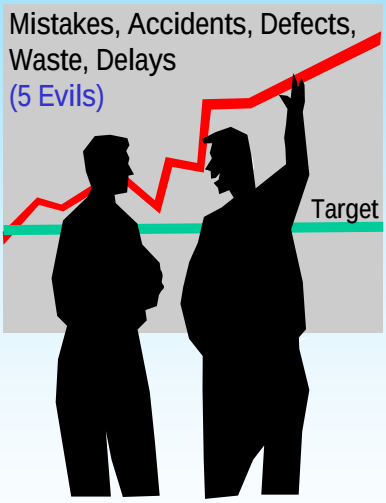
The last system we shipped took 3 days longer to install than usual

Customers are complaining. We need to improve customer satisfaction

Why doesn't the heating work properly?

What type of problems are we going to focus on?

Practical, work related, customer focused, problems in any department / function across the company



Gap / Weakness / problem

Where there is a gap between our current performance and our goal

Problems for which there is no obvious, or agreed, solution

Problems which we need the help of others to solve - or to implement a solution

Problems that are aligned to our Department / Division Business Goals

5 Element Table

Business Plan

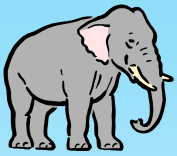
Division: .....

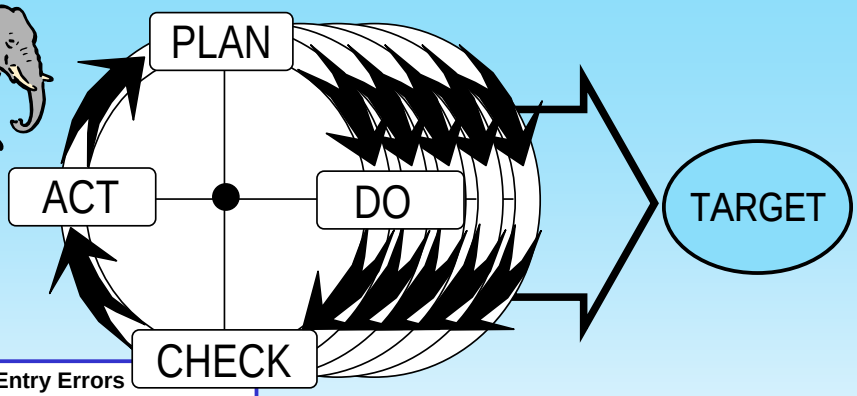
Owner: .....

Date: .....

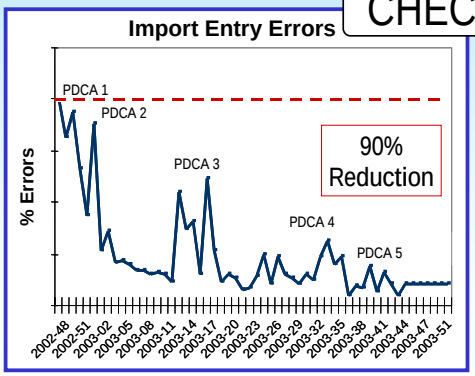
Statement of Desired Outcome	Metrics to Measure Progress	Target Value	Deadline Date	Focused Means
Improved results				7-Step Improvement Teams working on specific business problems

Problems come in Different Sizes





Deming's PDCA Cycle



Break down larger problems into bite sized chunks and

"Spin the wheel"

Fast spins = Rapid Improvements / Fast Response

More spins = Better Improvement Skills

Here's The 7 Steps

Plan	Step 1	Select a Theme (Gap)
	Step 2	Collect & Analyze Data
	Step 3	Identify & Verify the Root Cause
Do	Step 4	Plan & Implement a Solution (Test a Solution)
Check	Step 5	Confirm the Results
Act	Step 6	Standardize the Solution
	Step 7	Reflect on the Process

Here's the Logic

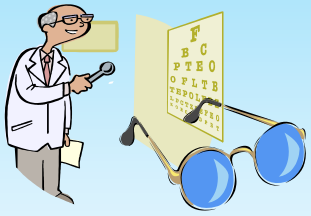
- Define & size the problem (**the symptoms**)
- Look wide then deep to find the underlying problem
- Find the root cause of the underlying problem (**the diagnosis**)
- Pilot a solution that targets the root cause
- Did the pilot solution work? (significantly reduce the underlying problem & the symptoms)
- If Yes – fully implement the solution (**the cure**)
- Lessons Learned (strengths & weaknesses)

The Scientific Method

The Thinking Process

An Everyday Example of 7-Step Logic/Thinking

Step 1	Define & size the problem (**the symptoms**)	Getting headaches two or three days a week recently. Having to take pain killers
Step 2	Look wide then deep to find the underlying problem	Headaches come on at work after prolonged usage of PC
Step 3	Find the root cause of the underlying problem (**the diagnosis**)	Most likely cause is eye strain. Verified by ophthalmic tests
Step 4	Pilot a solution that targets the root cause	Purchased a pair of glasses. Used them at work for two weeks when using the PC
Step 5	Did the pilot solution work?	Number of headaches significantly reduced
Step 6	If Yes, fully implement the solution (**the cure**)	Now always wear glasses when using a PC. Bought a second pair for home use. Scheduled regular eye tests
Step 7	Lessons learned (Strengths & Weaknesses)	Getting older is a pain! The 7-Steps worked for this problem!



A Teradyne Example of 7-Step Logic/Thinking

Step 1	Define & size the problem (**the symptoms**)	High failure rate of a specific power supply unit (PSU) in A565 testers at Infineon Indonesia – 7 failures for 5 testers over a period of one month.
Step 2	Look wide then deep to find the underlying problem	82% of Rider Boards type LA696 within the power supplies failed due to 50v relay problem
Step 3	Find the root cause of the underlying problem (**the diagnosis**)	Excessive (unnecessary) switching of 50v relays in the customer test program when testing the high volume 'Smart Power' device.
Step 4	Pilot a solution that targets the root cause	Worked with Infineon to pilot a modified test program. Monitored performance of the failing PSU over a 3 month period.
Step 5	Did the pilot solution work?	No failures when piloting the solution. 86% reduction in worldwide usage of the PSU.
Step 6	If Yes, fully implement the solution (**the cure**)	1. Infineon modified all existing test programs. 2. Sent the solution to all users of the PSU 3. Used the eknowledge Application Database to reach the widest possible audience.
Step 7	Lessons learned (Strengths & Weaknesses)	**Strength**: Working closely with the customer **Weakness**: Not analyzing data **Wide then Deep** initially - went down the wrong track

Why is the 7 Step Logic so important?

- It gives us a common language and thought process
  - Gets everyone on the same page as quickly as possible
  - Leads to faster and better decision making and responsiveness
- It can be used by everyone in the company
  - In teams (with a Leader and Sponsor)
  - Individually and with colleagues (with little or no team structure)
- Different terminology – but the same methodology / logic:
  - Business Planning
  - Gap Analysis
  - PDCAs
  - Project Assessments
  - Rapid 7-Step

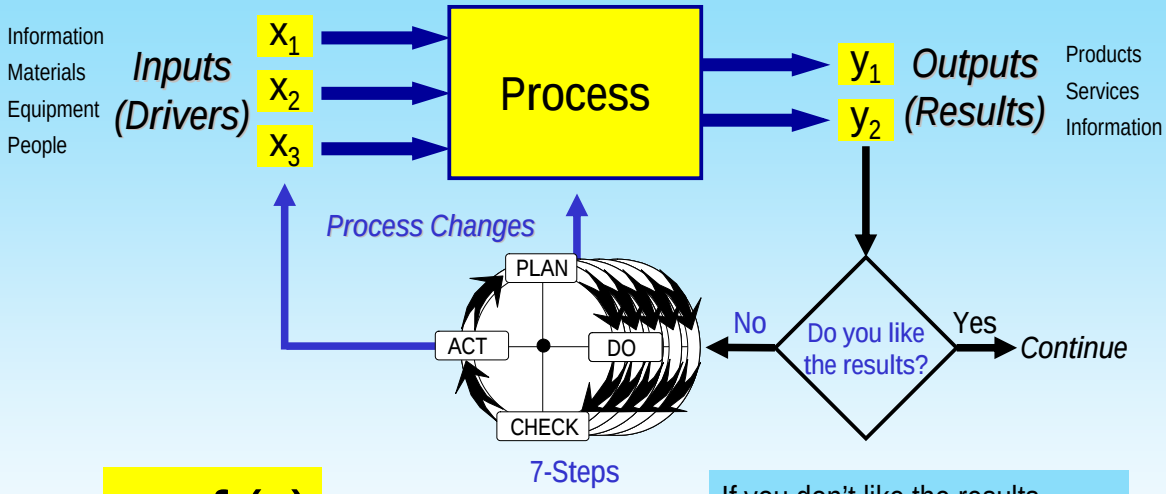
Because it's the way we continually improve the ***results*** of our work

Problem Solving Requires Two Types of Action

To prevent a problem from re-occurring you have to get to root cause – beyond containment to prevention

- Containment Action (*if required*)
  - A short term temporary fix (*pain killer for the symptoms*)
  - When we have to deal with the consequences of a problem while finding a solution
  - Protect the customer (*Internal & External*)
  - Don't forget to remove
- Preventative Action (*always*)
  - The 'long term' solution to the problem (*the cure*)
  - Focused on the root cause of the underlying problem
  - Should be "standardized" into the way we work (the process)

Systems Thinking



7-Steps

$y = f(x)$

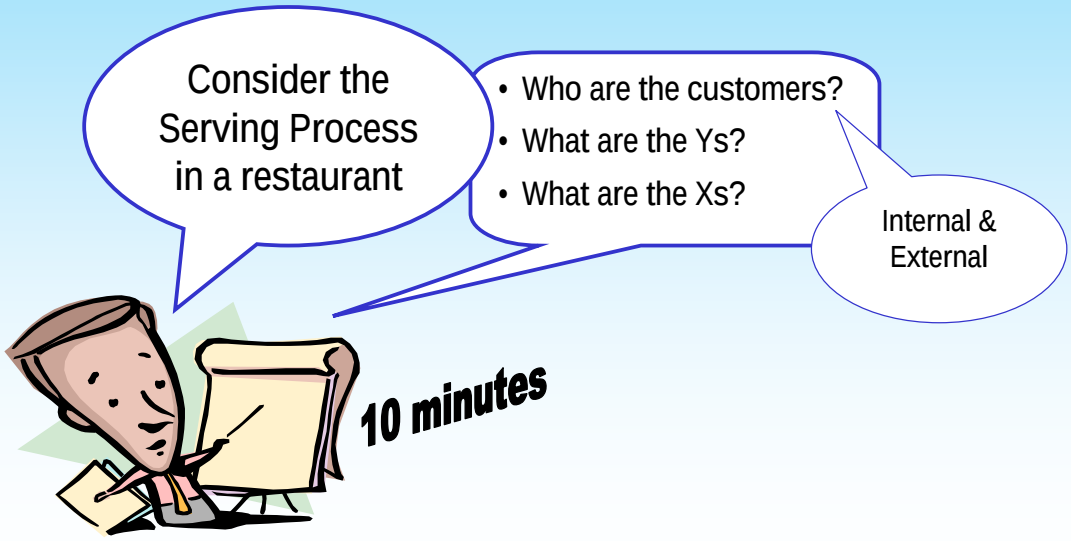
The output of a process (y) is controlled by a few critical inputs (Xs)

If you don't like the results,
You have to change the process

Two other ways change the results:

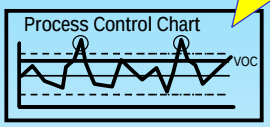
- Distort the data (self delusion)
- Distort the process (cut corners)

Systems Thinking – Team Exercise

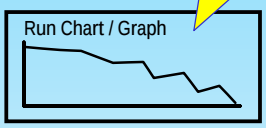


Commonly Used 'Simple but Powerful' Tools

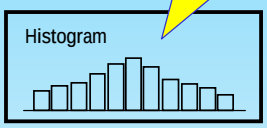
Shows the type & size of the problem



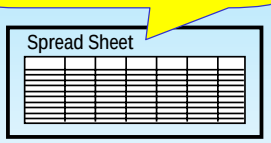
Summarizes the situation



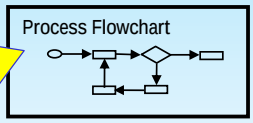
Shows the spread of the data



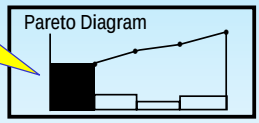
For collecting/formatting data

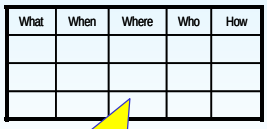


Maps the process that's causing the problem

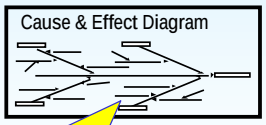


Helps find the "fat rabbit"

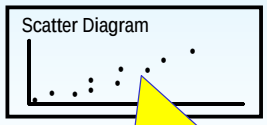




4W+1H Action Plan



Tool of choice when finding the Root Cause



Tests for a possible relationship between two things

Setting up an Improvement Team

Typically, how would a team get formed?

Discuss team roles and responsibilities

- Team Members
- Leader
- Sponsor
- Facilitator
- Expert Advisors / other contributors

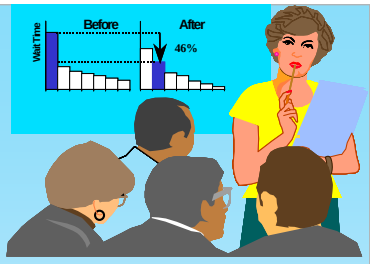
Key Take Aways from Module 1

- The 7-Step process is a fact based logical road map used throughout Teradyne for improving results
  (closing a gap between current performance and a goal)

- If you want to change results – change the process
  - Y = f (x)

- Effectiveness of the 7-Step Methodology is enhanced by the use of common tools, common language, and a common thought process

Desired Outcome:
To *ensure* you have a good understanding of each of the 7-Steps and the logic that links them together

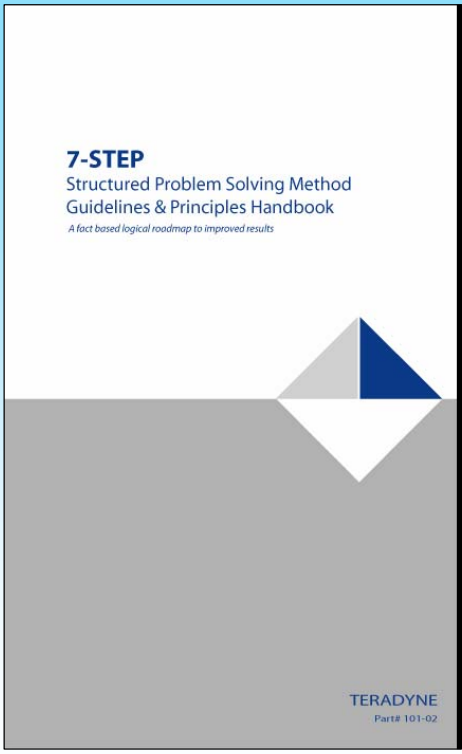


Module 2 - Getting Started with the 7-Steps

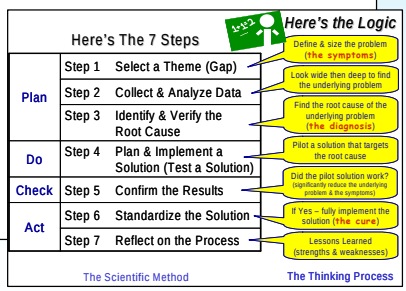
But first, let's take a short break

Topics

- 7-Step Guidelines & Principles Handbook
- The Case Study
- Typical Tools & Techniques



- Your essential guide as you learn to apply the 7-Step process
- Contains guidelines (*not rules*) which can improve the probability of a rapid and successful 7-Step spin
- Based on shared best practices by hundreds of Teradyne employees
- 7-Step Logic & Checklist on the back cover

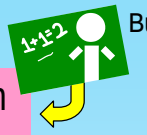


STEP 1

Select a Theme (Gap)

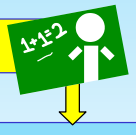
Desired Outcome:
Define and size the problem (the symptoms)

Step 1 Guidelines & Principles



Business Goal

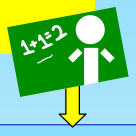
- The problem should be aligned to a business goal or an important business Issue
  - Refer to a 5 Element Business Plan or a Tree Diagram (Planning tools)
  - Customer complaints and business metrics are indicators of business performance gaps
- Develop a Theme Statement
- Support the Theme Statement with data showing the size and scope of the problem
  - Size of problem - use a Run Chart / Process Control Chart
  - Scope of problem - Use a Process Diagram to show boundaries
- Consider the need for immediate containment actions
  - 4W1H Action Plan



To Step 2 Focus for Data Collection

Develop A Theme Statement

- Develop a Theme Statement that clearly articulates the specific weakness (gap) that will be the focus of this 7-Step spin
  - The Theme Statement should be one complete sentence
  - It should be weakness orientated (describe a *gap*)
  - It should be measurable
  - At an appropriate "level"
  - Begin with an action word (typically *Reduce … the gap*)
  - Avoid the use of acronyms and location specific lingo
  - Avoid the use of absolutes (e.g. *Eliminate … the gap*)
  - Avoid stating a "perceived" root cause
  - Avoid stating a solution
  - May include a specific target (e.g. 30% reduction by end June 20xx)
- Theme Statement may be refined during Step 2



To Step 2 Focus for Data Collection

Scrub these Theme Statements against the Guidelines

Theme 1: Improve the time taken to process P.O.s

Theme 2: Decrease late deliveries caused by errors in manufacturing

Theme 3: Standardize software applications in order to reduce support costs

Theme 4: Mistakes in Order Entry

Theme 5: Improve the situation whereby too many input data errors are being made

Theme 6: Eliminate defects made by Engineering

Theme 7: Reduce customer frustration

Atlantic Avenue Restaurant Case Study

The Atlantic Avenue Restaurant is a popular restaurant in downtown Boston. Ten weeks ago, the owner installed an automated system for customers to record any complaints (via a menu driven screen) into all the restaurants in the chain. On average, customer complaints for the Atlantic Avenue are significantly higher than other restaurants in the chain.

The restaurant owner and staff are very aware of the likely negative impact that dissatisfied customers may have on the future of the business, so the owner has set the restaurant a goal to improve the level of customer satisfaction.

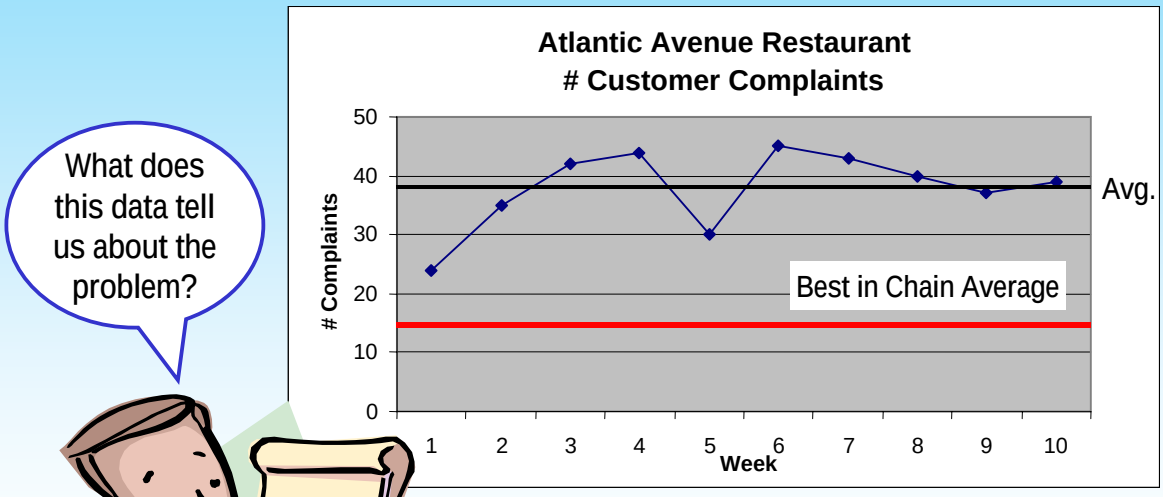
You and a group of other employees have immediately formed a 7-Step Team to work on the problem. Initial input from the restaurant manager is that the team should concentrate on waiting times because the manager thinks this is the biggest issue with customer complaints.

SOME FACTS ABOUT THE RESTAURANT:

- An average of 150 covers (customers) are served per day
- The restaurant serves Lunches and Dinners
- Open Monday to Friday
- Varying number of Waiters per shift
- Waiters work lunch and dinner shifts (not different staff for lunch and dinner)
- Experience of waiters varies considerably
- All restaurants in the chain are of a very similar size

Atlantic Avenue Restaurant Case Study

Supporting Data Showing the Size of the Problem



Average # Complaints per Week: 38
Range (variation): 23 to 46

RESTAURANT CASE
Step 1: Select A Theme

Step 1 Exercise (15 minutes)

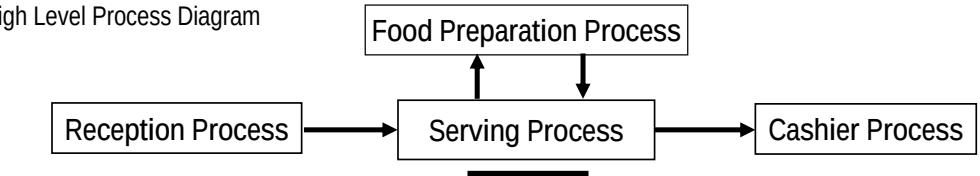
1. Develop your team's Theme Statement
2. Using the simple high level Process Diagram and template on the next slide, define the scope (boundaries) of the Serving Process by brainstorming Inputs and Outputs
3. Decide whether, in this particular case, your team would implement any immediate containment actions

- Use a flip chart to record your team's work
- Use the following page for your own records

Step 1 Exercise Record Sheet

Theme Statement: _____

High Level Process Diagram



Inputs - Xs Information, Materials, Equipment, People	Process	Outputs - Ys Products, Services, Information
	Start: Customer is seated	
	Process Description: Serving a meal in the Atlantic Avenue Restaurant	
	Finish: Customer pays the bill	

Does this problem require containment? Yes No

Step 1: Select a Theme (Gap) Checklist

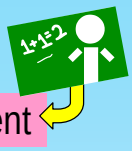
- ☑ The Theme (gap) is aligned to a business goal or important business issue
- ☑ A Theme Statement has been developed → To Step 2 Focus for Data Collection
- ☑ The Theme is supported with data showing the size and scope of the problem
- ☑ The need for immediate containment action has been considered

STEP 2

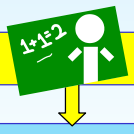
Collect & Analyze Data

Desired Outcome:
Look wide then deep to find the underlying problem

Step 2 Guidelines & Principles



- Focus data collection on the subject of the Theme Statement
- Draw a Flow Diagram of the process associated with the problem
  - Helps to identify possible data collection points / categories
- Show how the data was analyzed (stratified) **wide then deep** to discover the underlying problem
  - Pareto Diagrams help find the "fat rabbit" – opportunity for improvement
  - A Data Analysis Worksheet (**DAW**) is a great way to show Step 2 logic
- Develop a narrowed Step 2 Conclusion Statement



To Step 3
Focus for
Root Cause Analysis

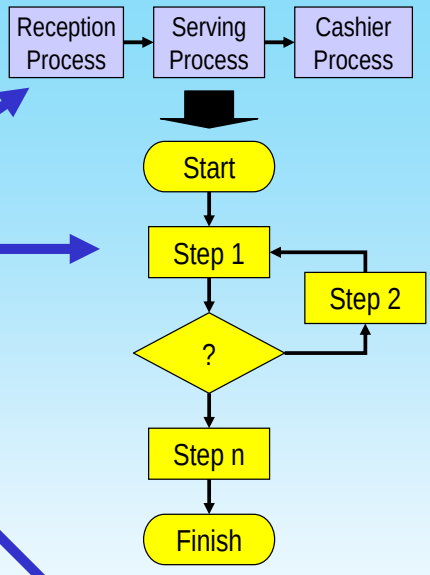
Data Collection Guidelines

Focus data collection on the subject of the Theme Statement

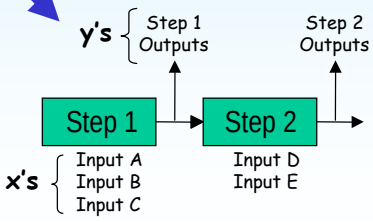
- Brainstorm WHAT data could be collected. Think about:
  - Possible causes / Contributing factors (the Xs)
  - Ways that the problem/data could be stratified. E.g.:
    - By Materials, By Method, By Machine, By Man, By Milieu
    - By Product, By Process, By Project, By People, By Place, By Period (Time)
- Drawing a Flow Diagram of the process associated with the problem can identify possible data collection categories
- Develop a Checksheet to collect data
  - Especially if more than one person will be collecting the same data
- Develop a 4W1H Data Collection Action Plan

Process Flow Diagram (Map)

- A High Level Process Diagram was used at Step 1 to "scope" the process associated with the problem
- At Step 2, a Process Flow Diagram is used to "map out" the flow/sequence of steps within the process
- If additional information is included on the diagram (e.g. Inputs & Outputs), it is referred to as a Detailed Process Diagram (or Map). This can be particularly helpful at Step 3

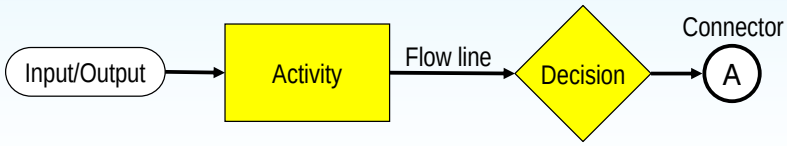


- Benefits
  - Excellent communication tool
  - Provides a visual overview of the process that needs to be improved
  - Helps to get a clearer understanding of what 'actually' happens versus what is documented or 'supposed' to happen



Flow Diagram Construction Hints

- Best done as a team activity
  - So as not to miss any details
- Use Post-it Notes
  - Easy to move around/change
- Show what happens when things go wrong
  - E.g. Rework
- Use “standard” symbols for Flow Charts (e.g., PowerPoint)



RESTAURANT CASE
Step 2: Collect & Analyze Data

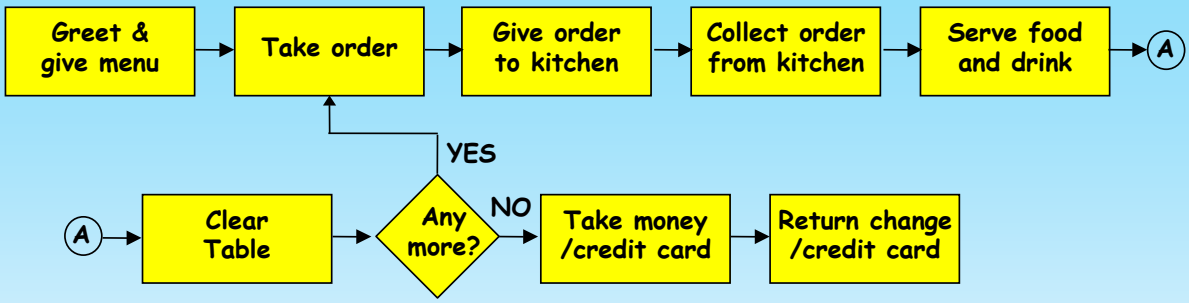
Data Collection Exercise (20 minutes)

An automated ‘Customer Complaints’ data collection system is already in place in the Atlantic Avenue Restaurant. But if your team had to devise such a system, what data would you want to collect?

1. Brainstorm a “long list” of possible data that could be collected to help analyze complaints widely and deeply. Refer to the Process Diagram developed for the Step 1 Exercise and the Flow Diagram on the following slide — 10 minutes
2. Given that data collection must be very quick and easy for customers to provide, use your brainstormed “long list” to select a “short list” of data that your team would actually collect. What criteria did you use for the selection? — 8 minutes

- Use a flip chart to record your team’s work — 2 minutes
- Use the following page for your own records

Process Flow Diagram for the Serving Process



Helpful Brainstorming Guidelines

- Choose an enthusiastic session leader
- List ideas on a flip chart
- Quantity not Quality of ideas
- No critiquing or analysis of ideas
- Create a fun atmosphere – silly ideas can spark a different line of thinking
- Don't force everyone to contribute in-turn
- Use one idea to develop another

Brainstormed "Long List" of Customer Complaints Data

Highlight the data that your team would actually collect (the "Short List")

Typical Tools Used at Step 2 for Data Analysis

1. Pareto Diagram
2. Data Analysis Worksheet (DAW)

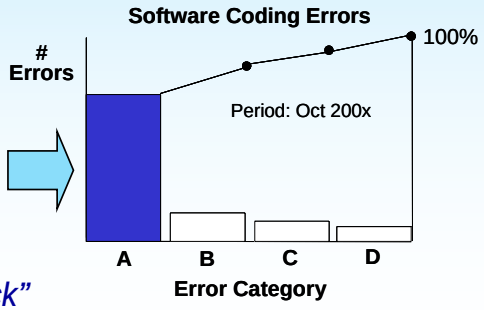
But first, let's have lunch

Step 2 Guideline:
Show how the data was analyzed (stratified) wide then deep to discover the underlying problem

Pareto Diagrams are a "tool of choice"

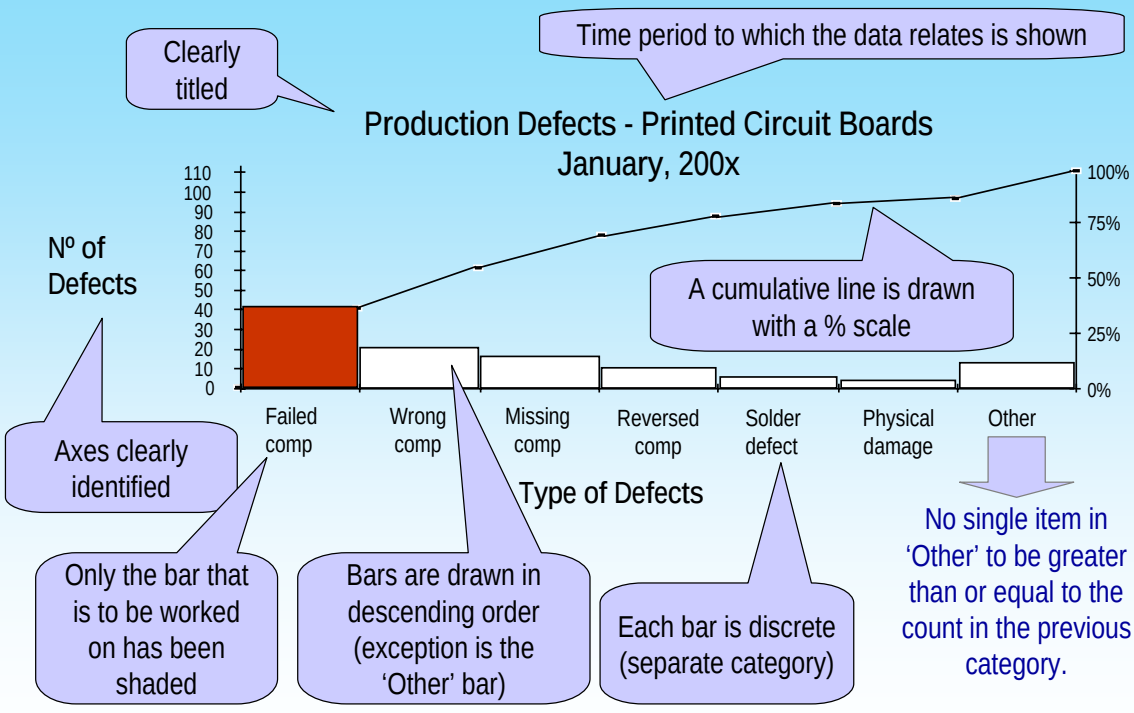
- Based on Vilfredo Pareto's (1848 - 1923) 80/20 Rule
- Identification of the "vital few" vs. the "trivial many"
- Most problems arise from a relatively small number of causes
- Pareto analysis is a technique to identify the "fat rabbit"

focus on the vital few issues



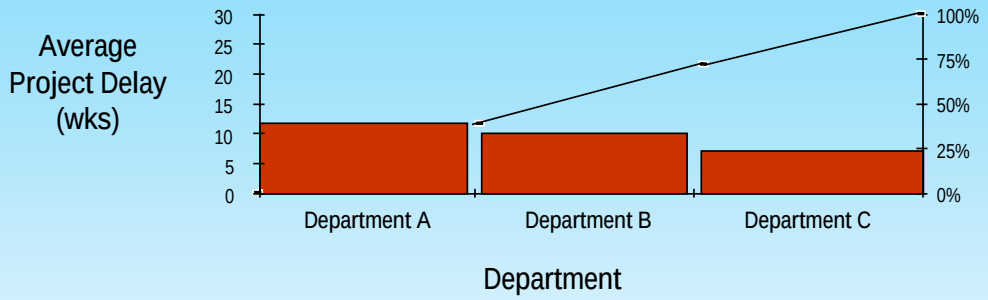
"Biggest bang for the buck"

Pareto Diagram Example 1



Let's look at other examples

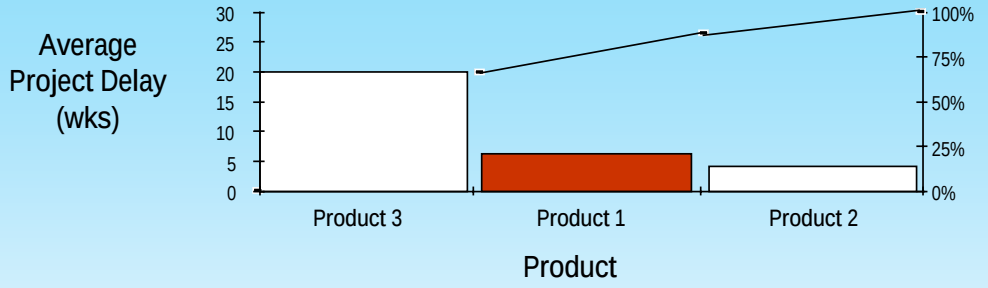
Pareto Diagram Example 2



Q1: What can we conclude from this pareto diagram?

Q2: What are the weaknesses in the format of this pareto?

Pareto Diagram Example 3

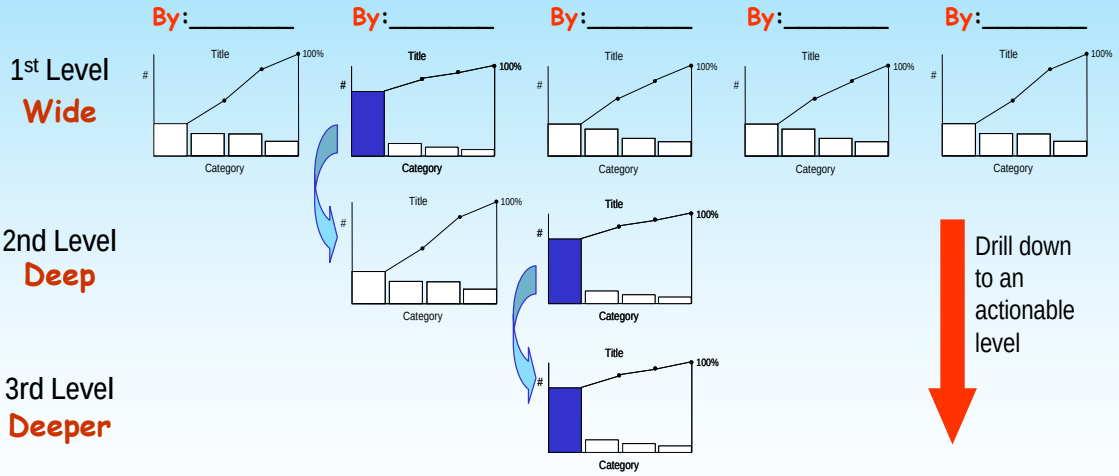


Q1: What can we conclude from this pareto diagram?

Q2: What are the weaknesses in the format of this pareto?

Analyzing the data wide then deep to discover the underlying problem

- Use the columns of a spreadsheet / Data Collection form to generate as many 1st Level Paretos as possible (take a **wide** view before digging deep)
- Use 1st Level Paretos to develop the 2nd and 3rd levels (**then deep**)

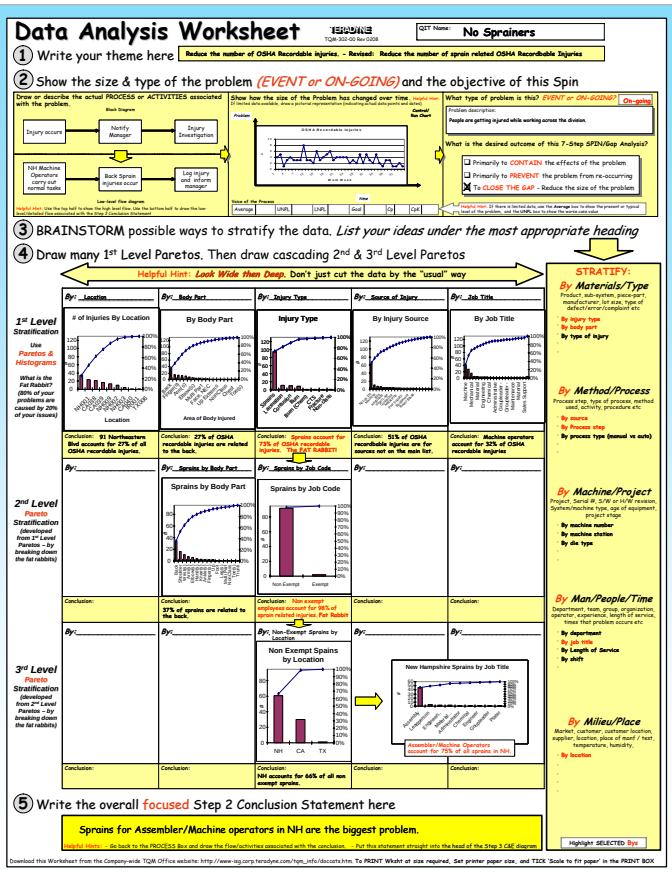


The DAW

- Is an aid to better understanding of the problem and thorough data stratification

  Wide then Deep

- Shows the data analysis logic flow (reasoning) from the Theme to the narrowed Step 2 Conclusion Statement
- Can be downloaded from the Teradyne Website
- Flipchart sized pads can be ordered (Part # 302-00)



RESTAURANT CASE
Step 2: Collect & Analyze Data

Data Analysis Exercise (25 minutes)

Your team have collated data from the customer complaints system for the last two weeks into a spreadsheet (see next page).

1. Individually, construct any one of the three possible 1st level Pareto diagrams. Teams to ensure that all three Paretos are drawn — 12 minutes
2. As a team, show how 2nd and 3rd level Paretos can be developed to come to a focused conclusion from the data — 10 minutes
3. Write a Conclusion Statement from your team's Pareto analysis — 3 minutes

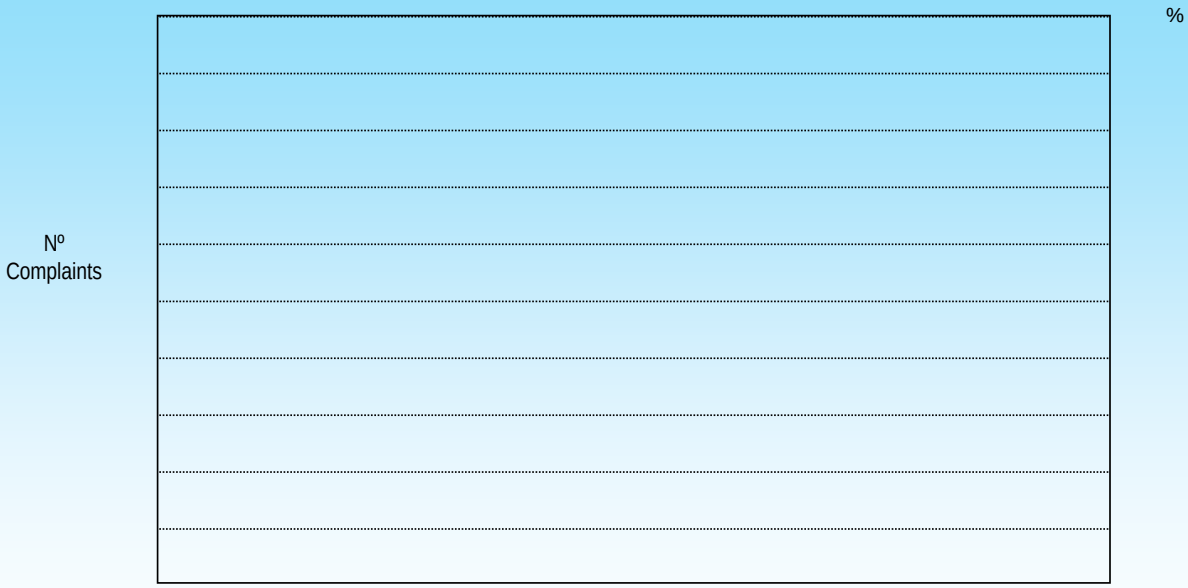
➢ Use the following pages to draw your Paretos

Restaurant Case – Data Collection Spreadsheet

	Monday		Tuesday		Wednesday		Thursday		Friday		Totals		
Reason for Complaint	Lunch	Dinner	Lunch	Dinner	Lunch	Dinner	Lunch	Dinner	Lunch	Dinner	Lunch	Dinner	Reason
Wait too long for food	5	0	7	0	3	0	3	1	17	1	35	2	37
Wrong food	1	0	2	0	1	0	1	0	8	0	13	0	13
Cold food	1	0	2	0	2	0	2	0	6	1	13	1	14
Room temperature	0	0	0	1	1	0	0	0	2	0	3	1	4
Waiter not friendly	1	0	2	0	2	0	2	0	6	0	13	0	13
Food not fresh	0	1	0	0	1	0	0	1	5	1	6	3	9
Seats too crowded	0	1	0	0	0	0	0	0	3	2	3	3	6
Other	0	0	0	0	0	0	0	1	2	1	2	2	4
Daily Lunch & Dinner Totals	8	2	13	1	10	0	8	3	49	6	88	12	100
Daily Totals	10		14		10		11		55		100		

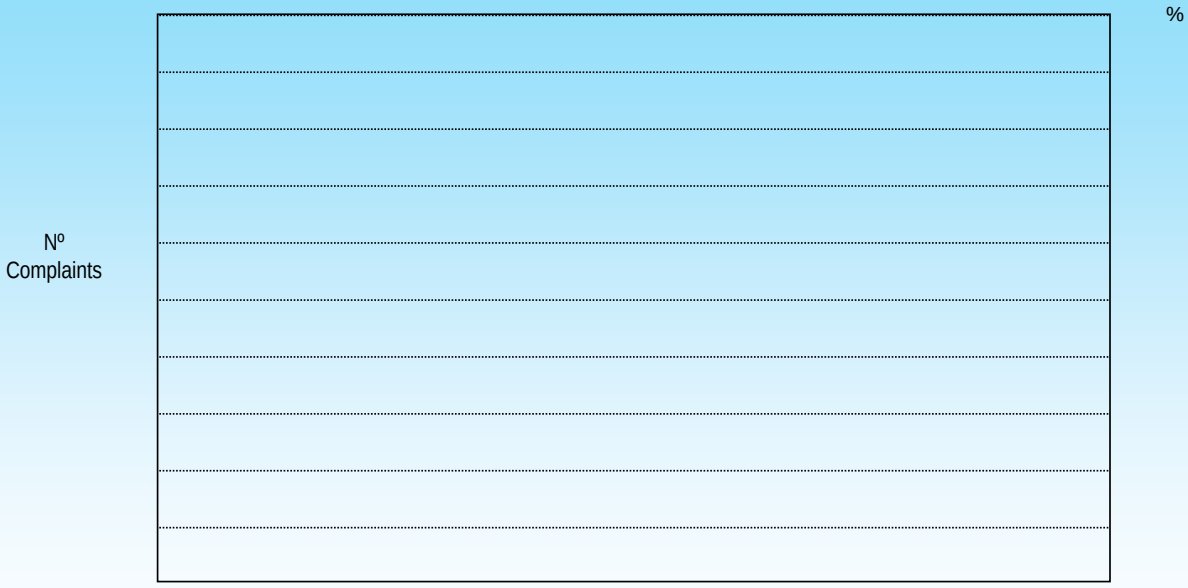
RESTAURANT CASE – Pareto Analysis Exercise

Before Pareto Title:



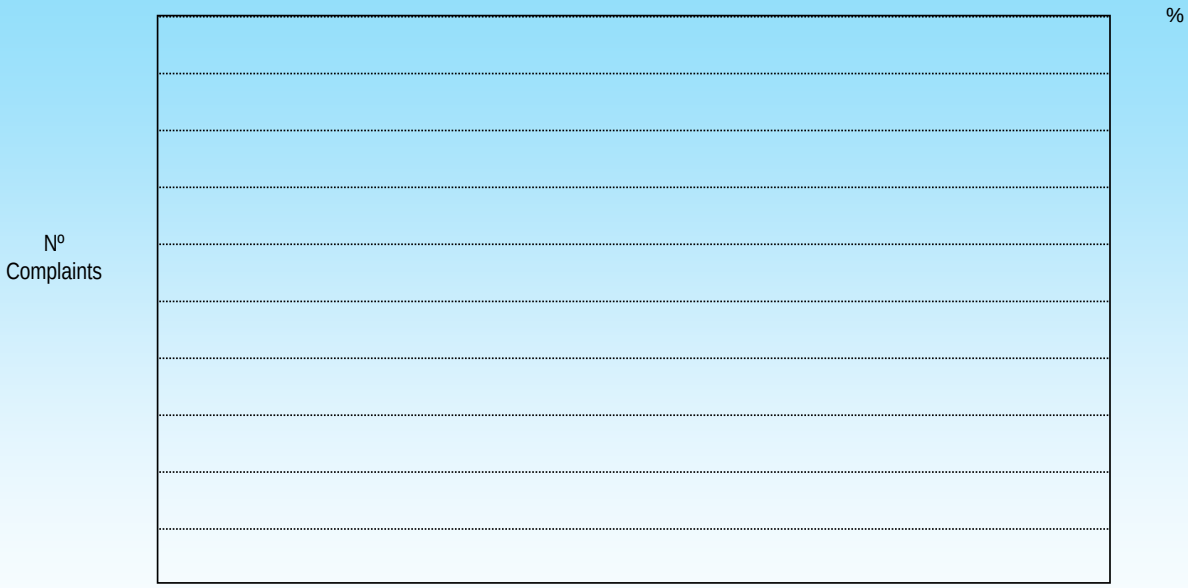
RESTAURANT CASE – Pareto Analysis Exercise

Before Pareto Title:



RESTAURANT CASE – Pareto Analysis Exercise

Before Pareto Title:



RESTAURANT CASE – Cascaded Paretos

1st Level Paretos

Title:

Title:

Title:

2nd Level Paretos

Title:

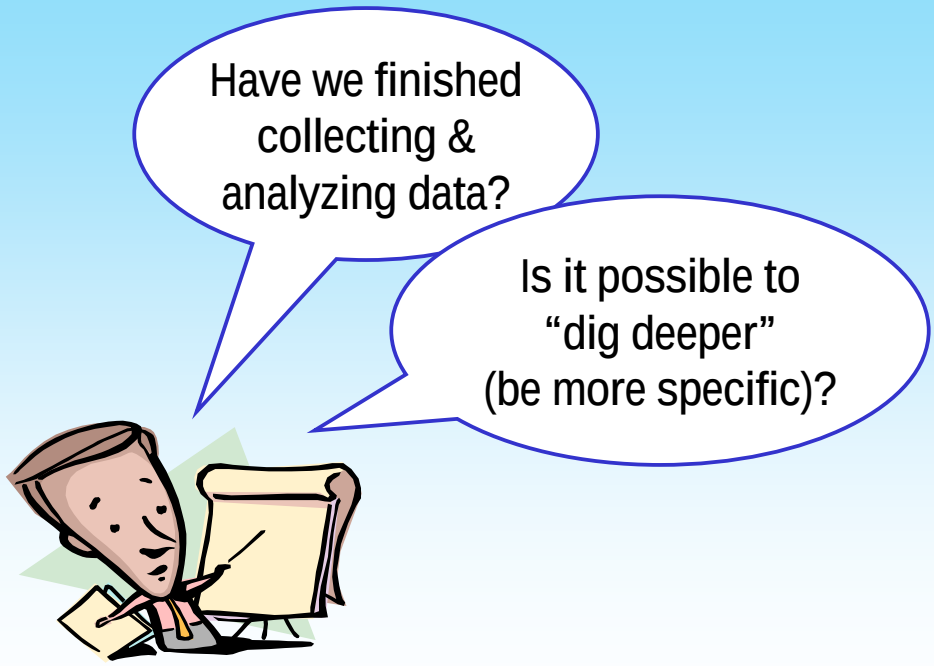
Title:

3rd Level Pareto

Title:

Conclusion from Pareto Analysis:

Restaurant Case - What's Next?



RESTAURANT CASE
Step 2: Collect & Analyze Data

"Waiting for Food" Run Chart

Your team has a count of the number of "wait too long for food" complaints. As this is the number one customer complaint, it was decided to measure how long customers are having to wait for their food – specifically at Friday lunchtime. This data is given below and plotted on a Run Chart on the next page.

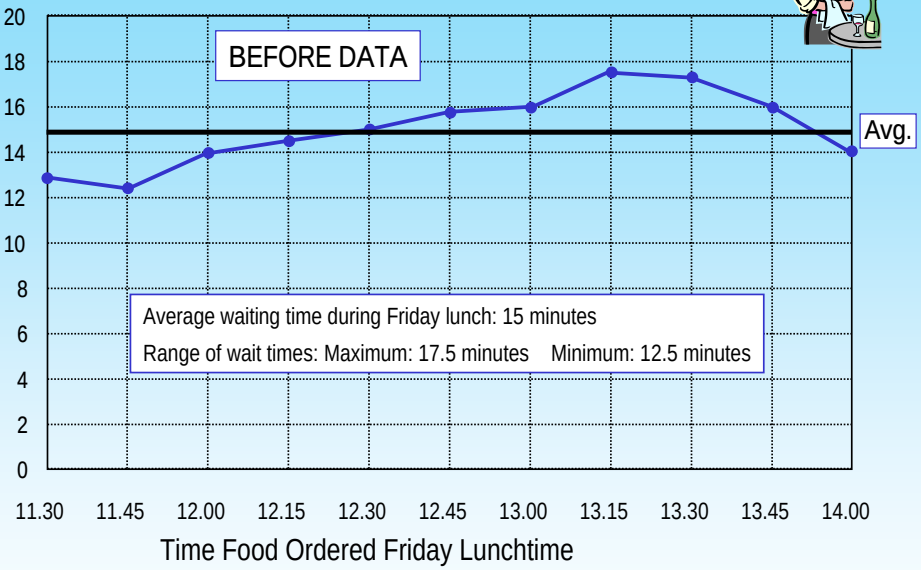
As a class, review the data and develop a narrowed Step 2 Conclusion Statement

Average waiting times for food at Friday lunch

Time Food Ordered	11.30	11.45	12.00	12.15	12.30	12.45	13.00	13.15	13.30	13.45	14.00
Waiting Time (mins)	12.8	12.5	14.0	14.5	14.8	15.7	16.0	17.5	17.2	16.0	14.0

'Wait for Food Friday Lunch' Run Chart

Avg. Waiting Time for food Friday Lunch (minutes)



Narrowed Step 2 Conclusion Statement

Restaurant Case - What's Next?

Let's review a hardcopy **DAW** for the Restaurant Case

Restaurant Case

DAW

Hit Esc key to return to Workshop presentation

Data Analysis Worksheet

TERADYNE
Part # 302-00 Rev 0208

QIT Name: Complaint Busters

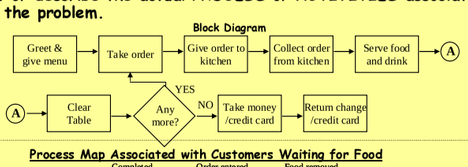
1 Write your theme here

Reduce the number of Customer Complaints in the Atlantic Avenue Restaurant

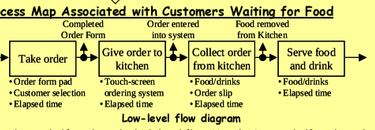
2 Show the size & type of the problem *(EVENT or ON-GOING)* and the objective of this Spin

Draw or describe the actual PROCESS or ACTIVITIES associated with the problem.

Block Diagram



Process Map Associated with Customers Waiting for Food

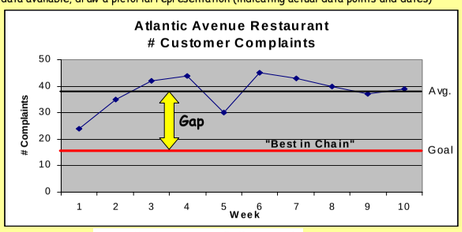


Low-level flow diagram

Helpful Hint: Use the top half to show the high level flow. Use the bottom half to draw the low-level/detailed flow associated with the Step 2 Conclusion Statement

Show how the size of the Problem has changed over time. Helpful Hint: If limited data available, draw a pictorial representation (indicating actual data points and dates)

Problem



Avg # Customers/Wk = 774

Voice of the Process

Average	38 per Wk		LNPL		Goal	15 per Wk	CpK	

What type of problem is this? *EVENT or ON-GOING?* On-going

Problem description: **The restaurant has a higher number of customer complaints per week than other restaurants in the chain - averaging 21 customers per complaint over the last 10 weeks against a "Best in Chain" of 52 customers per complaint.**

What is the desired outcome of this 7-Step SPIN/Gap Analysis?

- ☐ Primarily to CONTAIN the effects of the problem
- ☐ Primarily to PREVENT the problem from re-occurring
- ☒ To CLOSE THE GAP - Reduce the size of the problem

Helpful Hint: If there is limited data, use the **Average** box to show the present or typical level of the problem, and the **UNPL** box to show the worse case value

3 BRAINSTORM possible ways to stratify the data. *List your ideas under the most appropriate heading*

4 Draw many 1st Level Paretos. Then draw cascading 2nd & 3rd Level Paretos

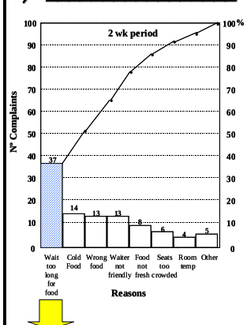
Helpful Hint: ***Look Wide then Deep.*** Don't just cut the data by the "usual" way

1st Level Stratification

Use ***Paretos & Histograms***

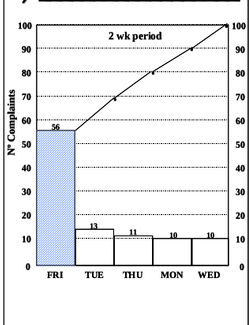
What is the Fat Rabbit? (80% of your problems are caused by 20% of your issues)

By: Reason for Complaint



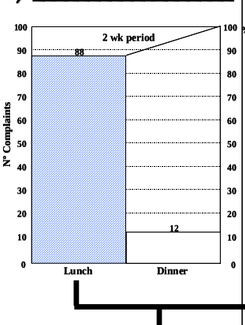
Conclusion: 37% of all complaints are for "Waiting too long for food"

By: Day



Conclusion: 56% of all complaints are on a Friday

By: Time of Meal



Conclusion: 88% of all complaints are at Lunchtime

By: _____

Conclusion:

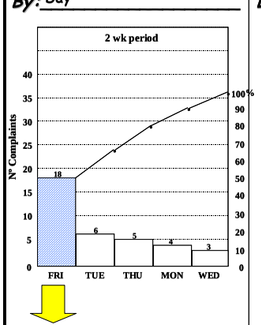
By: _____

Conclusion:

2nd Level Pareto Stratification

(developed from 1st Level Paretos - by breaking down the fat rabbits)

By: Day

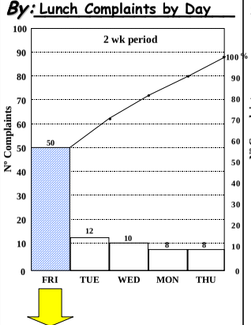


Conclusion: 50% of 'Wait too long for food' complaints are received on Fridays

By: _____

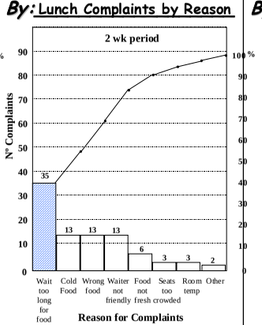
Conclusion:

By: Lunch Complaints by Day



Conclusion: 57% of complaints at lunch are on Fridays

By: Lunch Complaints by Reason



Conclusion: 40% of lunchtime complaints are 'Wait too long for food'

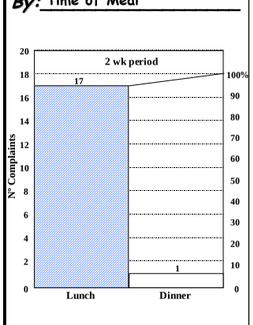
By: _____

Conclusion:

3rd Level Pareto Stratification

(developed from 2nd Level Paretos - by breaking down the fat rabbits)

By: Time of Meal

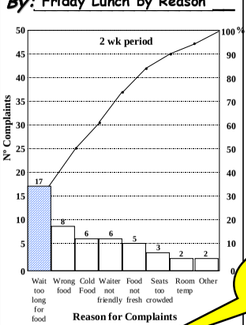


Conclusion: 94% of 'Waiting too long for food on Friday' complaints are received at lunchtime

By: _____

Conclusion:

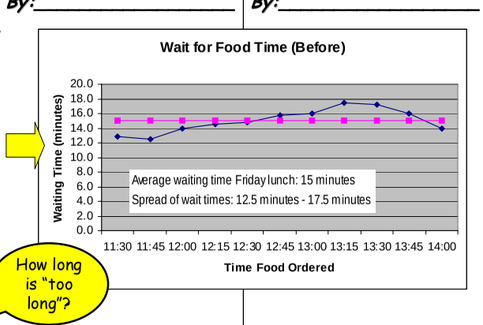
By: Friday Lunch by Reason



How long is "too long"?

Conclusion: 'Wait too long for food' at Friday lunch is the biggest problem

By: _____



Conclusion: Customers are waiting on Avg. 15 minutes for food Friday lunch time

By: _____

Conclusion:

STRATIFY:

By *Materials/Type*

Product, sub-system, piece-part, manufacturer, lot size, type of defect/error/complaint etc

- Reason for (type of) complaint
-
-
-
-

By *Method/Process*

Process step, type of process, method used, activity, procedure etc

-
-
-
-
-

By *Machine/Project*

Project, Serial #, S/W or H/W revision, System/machine type, age of equipment, project stage

-
-
-
-
-

By *Man/People/Time*

Department, team, group, organization, operator, experience, length of service, times that problem occurs etc

- Time of complaint (Lunch/dinner)
- Day of complaint
- Server
-
-

By *Milieu/Place*

Market, customer, customer location, supplier, location, place of manf / test, temperature, humidity,

-
-
-
-
-

Highlight SELECTED Bys

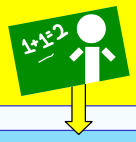
5 Write the overall focused Step 2 Conclusion Statement here

Our biggest problem is: Customers have to wait an average of 15 minutes for food at Friday lunchtime

Helpful Hints: ▪ Go back to the PROCESS Box and draw the flow/activities associated with the conclusion ▪ Put this statement straight into the head of the Step 3 C&E diagram

Step 2: Collect & Analyze Data Checklist

- ☑ Data collection was focused on the Theme Statement
- ☑ A Flow Diagram of the process associated with the problem was drawn
- ☑ Can clearly show how the data was analyzed wide then deep to discover the underlying problem
- ☑ A narrowed Step 2 Conclusion Statement has been developed



To Step 3
Focus for
Root Cause Analysis

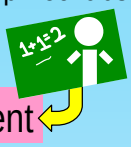
STEP 3

Identify & Verify the Root Cause

Desired Outcome:
To find the root cause of the underlying problem (the diagnosis)

Step 3 Guidelines & Principles

Step 2 Conclusion



- Focus root cause analysis on the Step 2 Conclusion Statement
  - Ask "5 Whys" against the Step 2 Conclusion Statement
- Develop a Detailed Process Flow Diagram of the process steps associated with the underlying problem
  - Will assist in highlighting potential causes
- Show how facts (data) were used to identify and verify the selected root cause
  - The Root Cause Analysis (**RCA**) Method, using a C&E Diagram, is the best practice technique
- Develop a conclusion statement that clearly articulates the root cause of the underlying problem

To Step 4
Focus for the Pilot Solution

RESTAURANT CASE

Step 3: Identify & Verify the Root Cause

Detailed Process Flow Exercise (15 minutes)

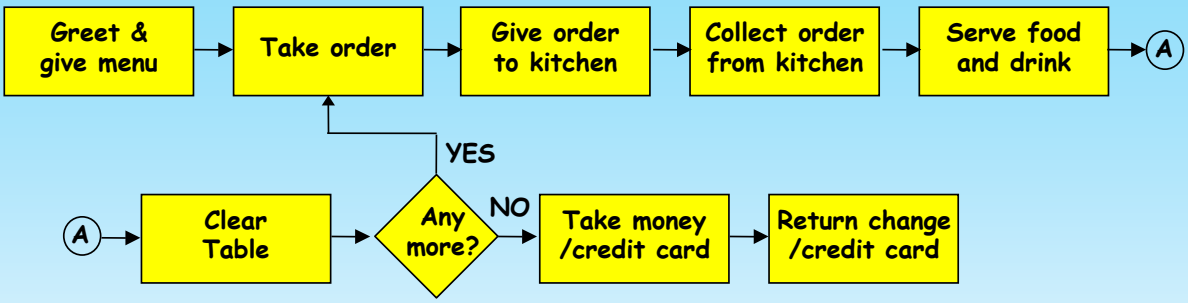
Following the process of focusing on the area of greatest concern, your team has decided to get a better understanding of the work practises that are associated with the narrowed Step 2 Conclusion Statement

1. Using the Worksheet on the next page, identify which of the process steps are likely to have a direct effect on the Narrowed Step 2 Conclusion Statement — 3 minutes
2. For each of these process steps, identify critical input variables (Xs) and the outputs (Ys) — 10 minutes

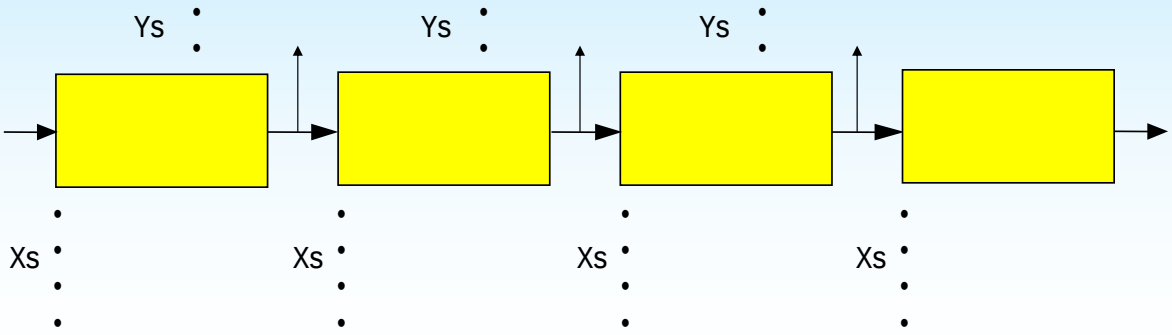
- Use a flip chart to record your team's work — 2 minutes
- Use the Worksheet for your own records

Restaurant Case – Step 3 Flow Diagram Worksheet

Process Flow Diagram of the Serving Process



Detailed Process Flow Diagram (Map) for Steps Associated with Customers Waiting for Food



Inputs (Xs): Information, Materials, Equipment, People **Outputs** (Ys): Products, Services, Information

Typical Tools / Techniques Used During Step 3

1. Cause & Effect (C&E) Diagram
2. The RCA Method
3. Scatter Diagrams

Cause & Effect (C&E) Diagram

- Organizes and displays THEORIES (hypotheses) of what might be causing the underlying problem identified at Step 2
- Encourages innovative thinking (brainstorming)
- Shows all the logic paths explored in the search for the root cause
  - **5 Whys Logic**
- Excellent communication tool
- Very easy to read ….. but needs practise to develop

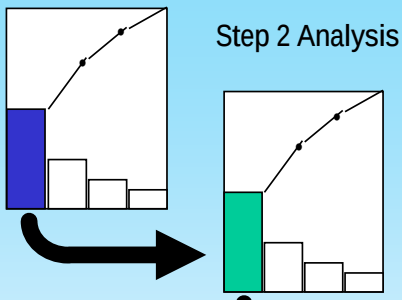
Alternative names:
- Ishikawa diagram
- Fishbone diagram
- WHY diagram

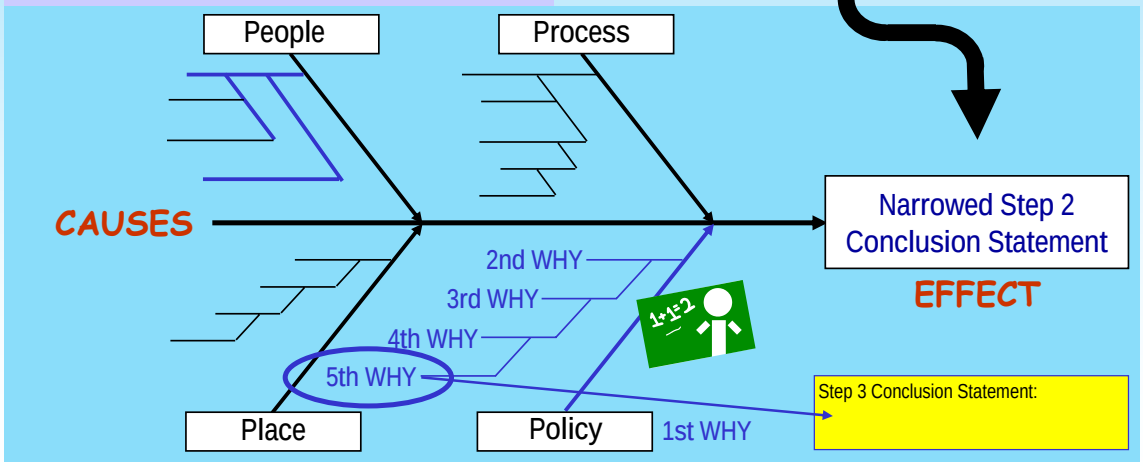
Basic types:
- Dispersion
- Process

Focuses Root Cause Analysis on the Underlying Problem

Main Branch Headings

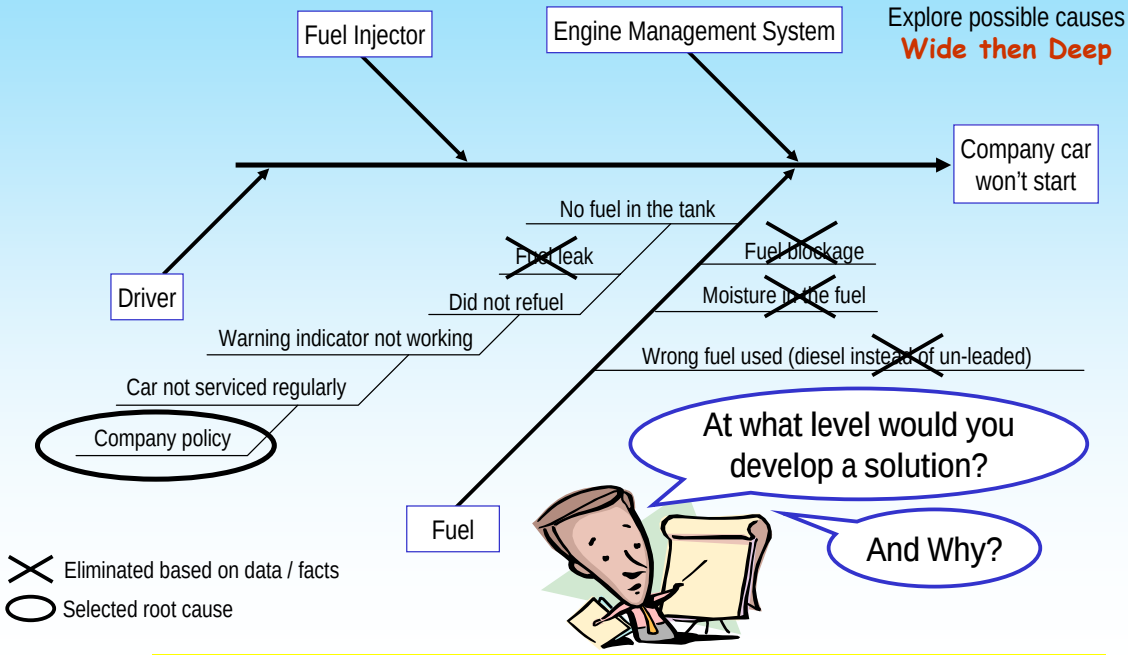
Ms	Ps
Manpower	People
Materials	Provisions
Methods	Procedures
Machines	Place
Measurements	Patrons
Milieu (environment)	Policies





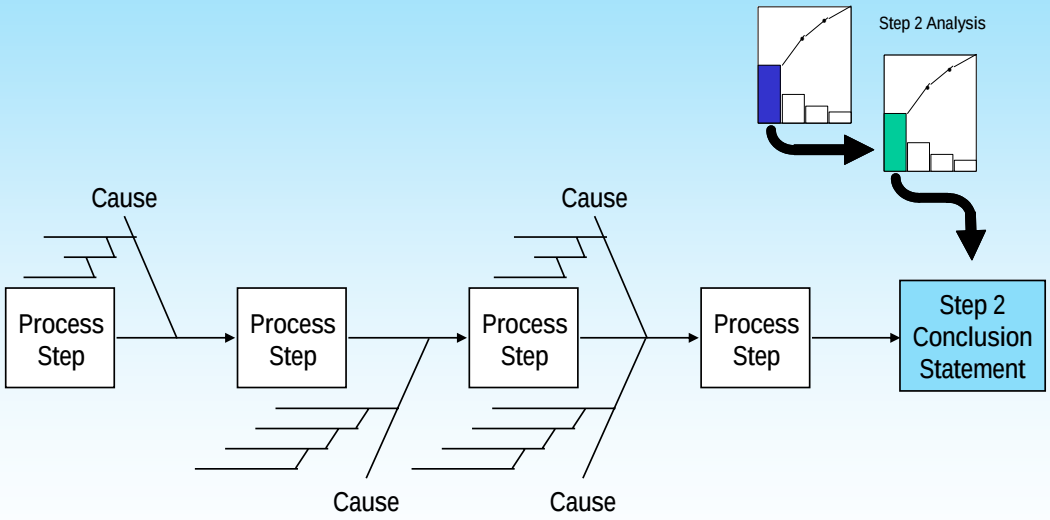
5 Whys Logic

- Ask "Why" repeatedly (rule of thumb is 5 times) until you reach the root cause – i.e., can't sensibly go any deeper / an actionable level



'Process' C&E Diagram

- Causes are developed for each step in the process
- Easy to understand because it follows the process

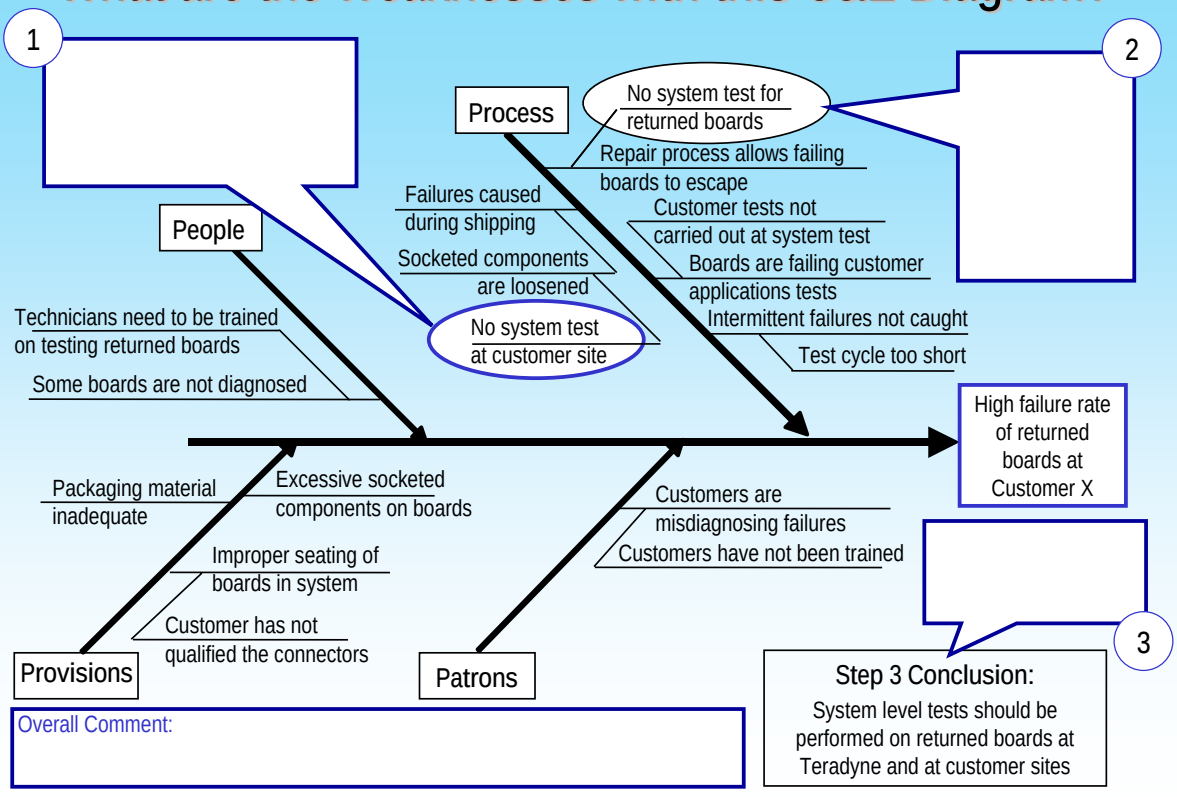


Some common problems to look out for:

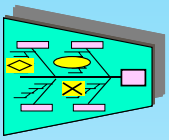
- The Theme Statement is put into the effect box – instead of the narrowed Step 2 Conclusion Statement
- Solutions (not causes) are shown on the diagram
- The logic doesn't "hang together"
- Only one or two main branches are shown

- Does not go down 5 Why's on the most likely causes
- Ambiguous wording (e.g. Communication)
- The selected root cause is not identified
- Data has not been used to select and test the root cause

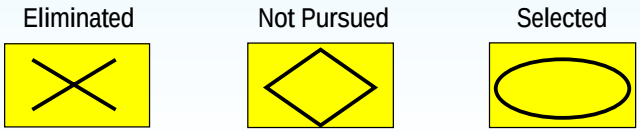
What are the Weaknesses with this C&E Diagram?



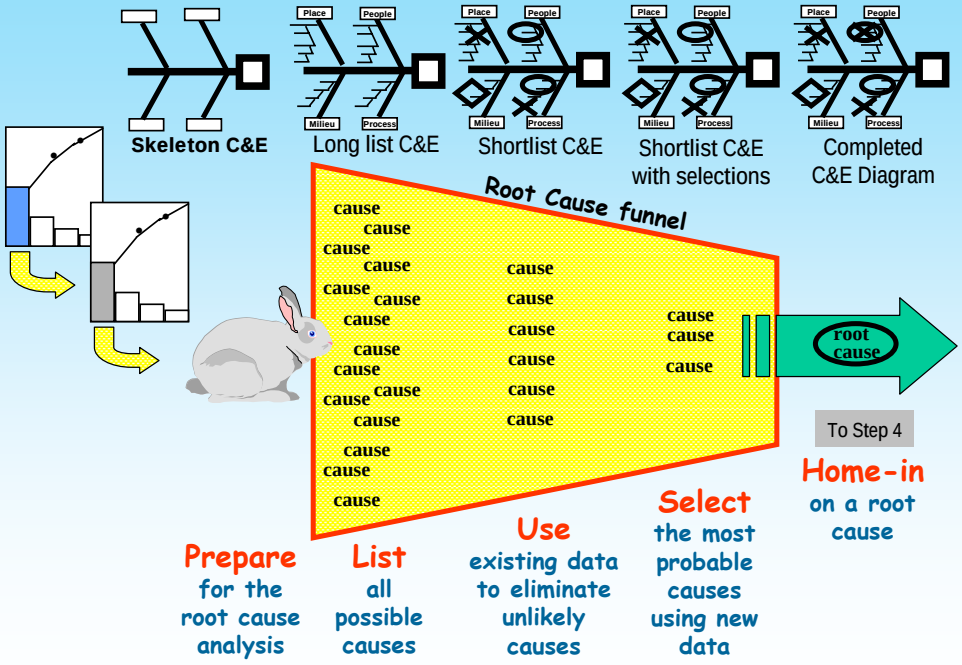
THE RCA METHOD



- Uses the Cause & Effect (C&E) Diagram
- Incorporates a Root Cause Funnel
- Addresses some of the common weaknesses
  - Only get to “containment” level
  - Root cause selected on the basis of opinion not facts
  - No consensus on the selected root cause
- Standard symbols are used on the diagram

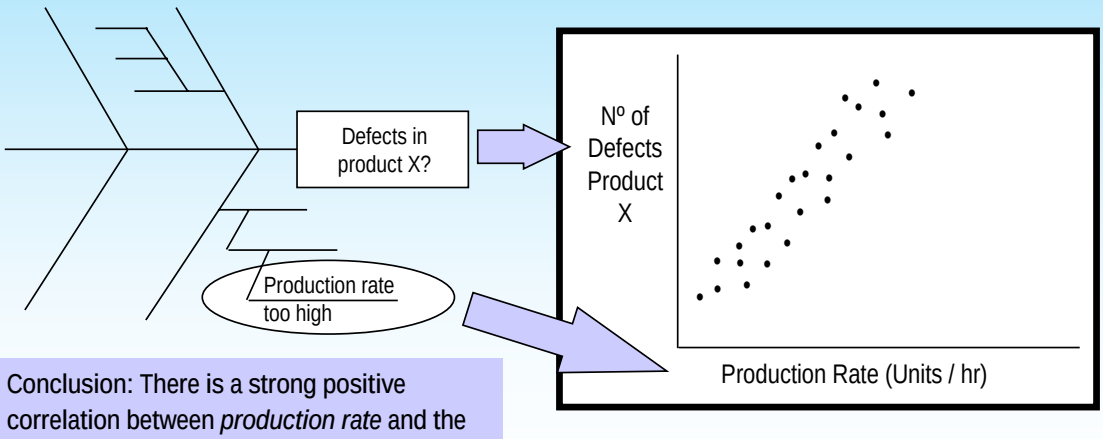


THE RCA METHOD (PLUSH)



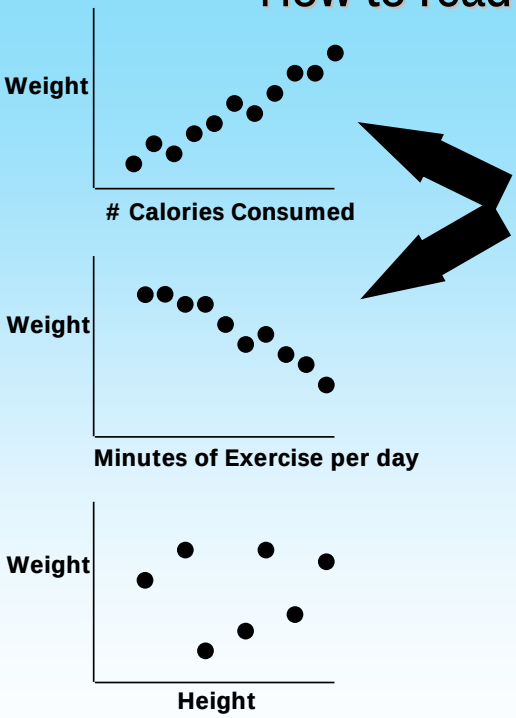
Scatter Diagram

- Used to study the relationship between two variables (possible CAUSE and EFFECT relationship)
- Is a standard Excel chart



Conclusion: There is a strong positive correlation between *production rate* and the number of defects for Product X

How to read Scatter Diagrams



Positive Correlation

Definite relationship between the potential root cause (X) and the effect (Y)

Negative Correlation

No Correlation

between the potential root cause (X) and the effect (Y)

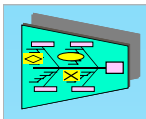
The strength of correlation (Strong, Weak, None) is determined by the spread of the data points from a 'Best Fit' (Regression) line drawn through all the data points

RESTAURANT CASE
Step 3: Select & Verify the Root cause

Root Cause Analysis Exercise
(30 minutes)

1. Brainstorm possible causes for the Step 2 Conclusion Statement
   - Refer to your Detailed Flow Diagram (the Xs)
   - Refer to Pareto analysis
2. List the possible causes under appropriate main Branch Headings
3. Develop a "5 Whys" logic chain for one of the possible causes
4. Identify what data would be required to verify the root cause

- Use an RCA Template and Post-it Notes
- Use the following page for your own records



Part# 304 - 00

RESTAURANT CASE C&E Diagram

RCA Template
downloadable from the
Teradyne website

Notes

Date:
Participants:

Conclusion Statement

Eliminated | Not pursued | Selected

RESTAURANT CASE
Step 3: Identify & verify the Root Cause

Scatter Diagrams Exercise (10 minutes)

Your team reviewed additional data and used Excel to construct scatter diagrams to find possible correlations between the factors influencing 'waiting for food' complaints:

- Number of Customers
- Customer / Waiter Ratio
- Food Preparation Time
- Waiter Experience

1. Write a conclusion statement (type & strength of correlation) for each of the scatter diagrams on the next page
2. Write your team's Step 3 Conclusion Statement on a flip chart (use the page following the scatter diagrams for your own records)

Scatter Diagram Data (Only 3 rows of data shown)

50 rows of data available

Day	# Customers	# Waiters	Cust/Waiter Ratio	Avg. Food Prep. Time (minutes)	# Complaints
1	93	5	18.6	6	1
2	96	5	19.2	4	4
3	133	8	16.6	5	3

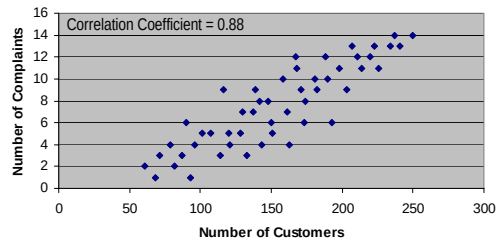
25 rows of data available

Waiter Experience (Years)	# Complaints
5.7	3
5.6	5
2.7	3

Day	Avg. # Customers
Mon	105
Tues	122
Wed	152
Thur	185
Fri	211

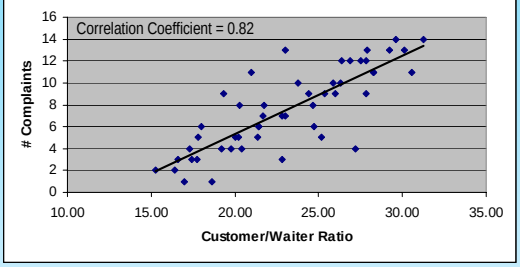
Step 3 Scatter Diagrams

#1 **# Customer Complaints vs # Customers**



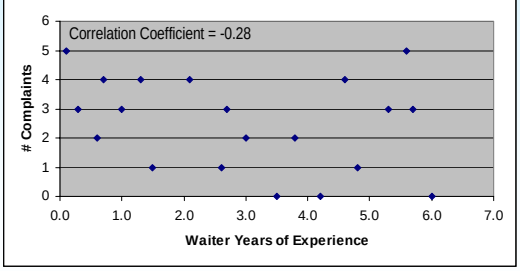
Conclusion: _____

#2 **# Customer Complaints vs Customer/Waiter Ratio**



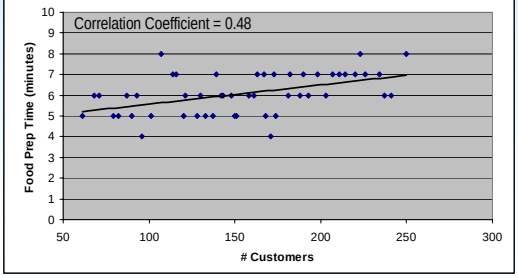
Conclusion: _____

#3 **# Complaints vs waiter Experience**



Conclusion: _____

#4 **Avg Food Preparation Time**



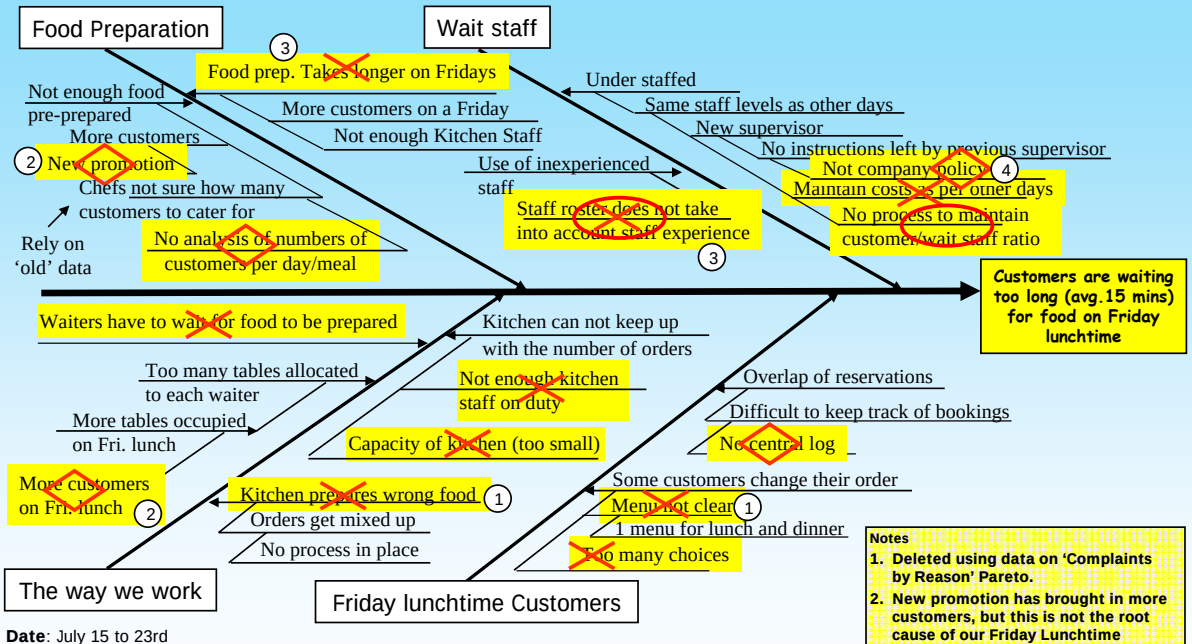
Conclusion: _____

RESTAURANT CASE - Step 3 Conclusion

Now that you have completed a *C&E diagram* and analyzed more data to support/eliminate your potential root causes, what is your team's Step 3 conclusion?

Step 3 Conclusion Statement:

The RCA Method: The Atlantic Avenue Restaurant



Date: July 15 to 23rd

Participants: Judy, Greg, Bill, Sally, Fred, Stan (Head Chef), Meg (Manager)

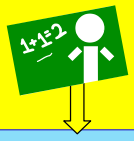
Conclusion: The team have identified 'No process to maintain customer/wait staff ratio' as the most dominant root cause

Notes

1. **Deleted using data on 'Complaints by Reason' Pareto.**
2. **New promotion has brought in more customers, but this is not the root cause of our Friday Lunchtime problems**
3. **Deleted on the basis of new data (see scatter diagrams)**
4. **Reviewed with Sponsor July 22nd**

Step 3: Identify & Verify the Root Cause Checklist

- ☑ The Root Cause Analysis was focused on the narrowed Step 2 Conclusion Statement
- ☑ A Detailed Flow Chart was developed for the process steps associated with the underlying problem
- ☑ Can clearly show how facts (data) were used to identify and verify the selected root cause
- ☑ A Step 3 Conclusion Statement that clearly articulates the root cause of the underlying problem was developed

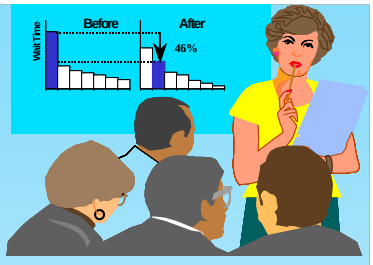


To Step 4
Focus for
The Pilot solution

Review of first 3 Steps – The logic so far

Step	Key Deliverables	Comments
1	A Theme Statement Reduce the number of customer complaints in the Atlantic Avenue Restaurant	➢ Aligned to business goal set by the Restaurant owner ➢ Run chart used to show the type and size of the problem over time
	4W1H Containment Action Plan	➢ Not required
2	A Narrowed Step 2 Conclusion Statement Customers are waiting 15 minutes (avg.) for food Friday lunchtimes	➢ See DAW for logic
	A Process Flow Diagram	➢ Flow diagram for the Serving Process
3	A Detailed Process Flow Diagram	➢ Flow diagram showing critical Xs and Ys for the steps associated with 'waiting for food'
	A concise statement of the root cause Customer / Waiter ratio not being maintained	➢ Used The RCA Method ➢ See C&E Diagram and scatter diagrams

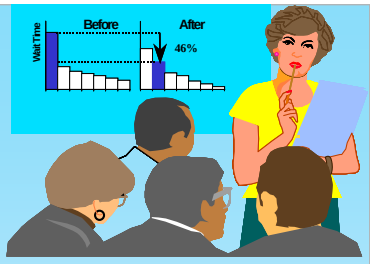
Close of Day 1



7-Step Structured Problem Solving Workshop

- Review any outstanding Parking Lot issues
- Feedback on Day 1
  - Any issues that can be addressed in advance of Day 2?

Welcome to Day 2 of the …



7-Step Structured Problem Solving Workshop

AM

- Completion of Module 2 (Steps 4 to 7)
- Module 3: Using the 7-Steps

  Enhancing your understanding of the practical application of the 7-Steps and the common language

PM

- Optional Action Learning Session

  Bring your own problem / data

Click the Yellow bar for a reminder of the Steps and the logic

The Restaurant Case Study – The logic so far

Step	Key Deliverables	Comments
1	A Theme Statement Reduce the number of customer complaints in the Atlantic Avenue Restaurant	➢ Aligned to business goal set by the Restaurant owner ➢ Run chart used to show the type and size of the problem over time
	4W1H Containment Action Plan	➢ Not required
2	A Narrowed Step 2 Conclusion Statement Customers are waiting 15 minutes (avg.) for food Friday lunchtimes	➢ See DAW for logic
	A Process Flow Diagram	➢ Flow diagram for the Serving Process
3	A Detailed Process Flow Diagram	➢ Flow diagram showing critical Xs and Ys for the steps associated with 'waiting for food'
	A concise statement of the root cause Customer / Waiter ratio not being maintained	➢ Used The RCA Method ➢ See C&E Diagram and scatter diagrams

STEP 4

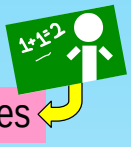
Plan & Implement a Solution (Test a Solution)

Desired Outcome:
Pilot a solution that targets the root cause

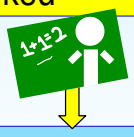
"Don't jump to Step 4"

Step 4 Guidelines & Principles

Step 3 Conclusion



- The solution should target the root cause – not peripheral issues
  - Can confuse the results
- Develop a 4W1H Action Plan - monitor regularly, modify as required
  - Step 4 is a trial / experiment to test the likely results if fully deployed
  - Consider improving the existing process before re-engineering
  - Get knowledgeable and affected individuals involved in the planning stage
  - Establish the duration of the pilot
- Identify the measurements to confirm that the solution worked
  - The measurements will need to show a 'significant'* reduction in:
    1. The underlying problem identified in the Step 2 conclusion
    2. The problem identified in the Theme Statement



To Step 5
Confirm the Results

*Statistical significance is outside the scope of this workshop

RESTAURANT CASE
Step 4: Test a Solution

Step 4 Exercise (20 minutes)

Now your team understands the cause of customers complaining about waiting too long for food Friday lunchtime:

1. Develop a 4W1H Action Plan to pilot your solution — 15 minutes
   - Consider improving the existing Serving process
   - Determine the duration of the pilot
2. Describe the measurements your team will use to confirm whether the solution has worked. — 3 minutes

- Use a flip chart to record your plan — 2 minutes
- Use the 4W1H matrix on the following page for your own records

RESTAURANT CASE
Step 4: Plan & Implement a Solution (Test a Solution)

Nº	WHAT	Who	When	Where	How
	Confirmation Measurements				

Generated by: _____ Date: _____

Step 4: Test a Solution Checklist

- ☑ The solution targets the root cause – not peripheral issues
- ☑ A 4W1H Action Plan was developed and implemented
- ☑ Measurements that will be used to confirm the solution worked have been identified

To Step 5
Confirm the Results

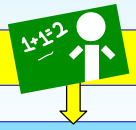
STEP 5

Confirm the Results

Desired Outcome:
To confirm whether the pilot solution worked (the desired results were achieved)

Step 5 Guidelines & Principles

- Compare data from before and after pilot implementation
  - Consider whether the data need to be normalized
  - Confirm the results using Comparative Paretos and Run Charts
    - Impact on the problem stated in the Theme
    - Impact on the underlying problem
    - Identify potential Positive and Negative side effects
  - Confirm results with the customer if practical to do so
- Assess Lessons Learned during pilot implementation
  - What lessons were learned when piloting the solution?
- Develop a Results Statement
  - Summarizing the results and lessons learned

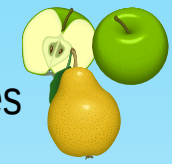


To Step 6
Standardize the Solution

Typical Tools/Techniques Used During Step 5

1. Normalizing Data
2. Comparative Paretos
3. Run Chart

Normalizing Data



Why normalize data? To compare apples with apples

- Data must be normalized if:
  - The NUMBER OF SAMPLES before the change is different from the number of samples evaluated after the change. *OR*
  - The TIME PERIOD used for Before data is different from After data.

Example: Number of Samples:

Before # Samples 100 / After # Samples 200	Normalization factor = 0.5	Multiply AFTER data by 0.5

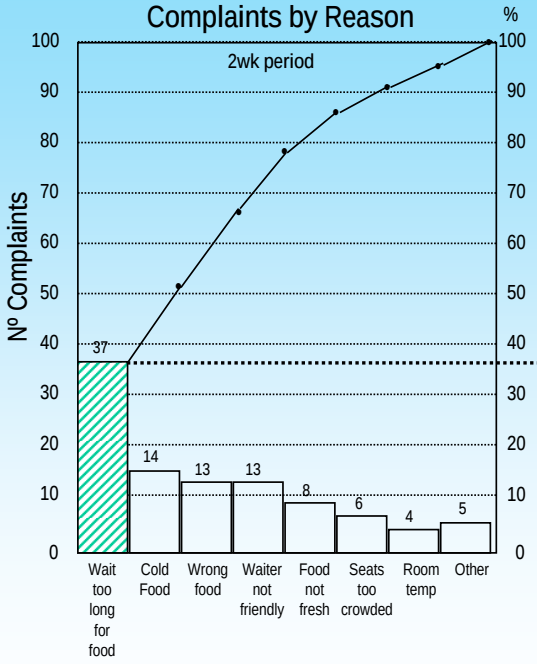
Example: Time Period:

Before Time Period - 2 months / After Time Period - 1 month	Normalization factor = 2	Multiply AFTER data by 2

Comparative Paretos

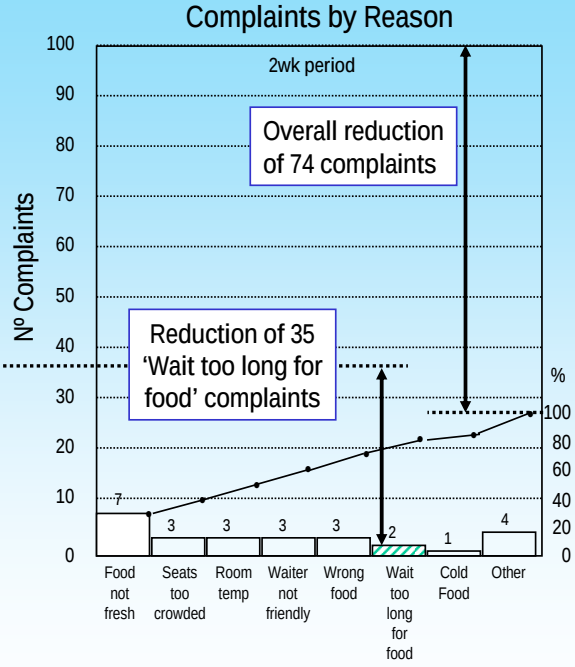
BEFORE (From Step 2)

Complaints by Reason



AFTER

Complaints by Reason



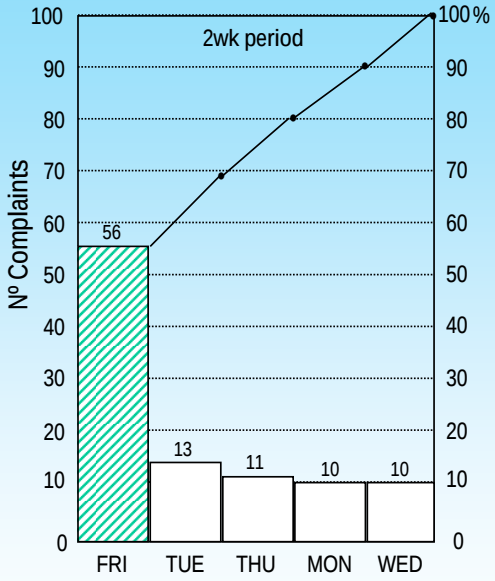
- Before & After diagrams are Paretos in their own right
- Y axes must be the same scale

Positive Side Effects:

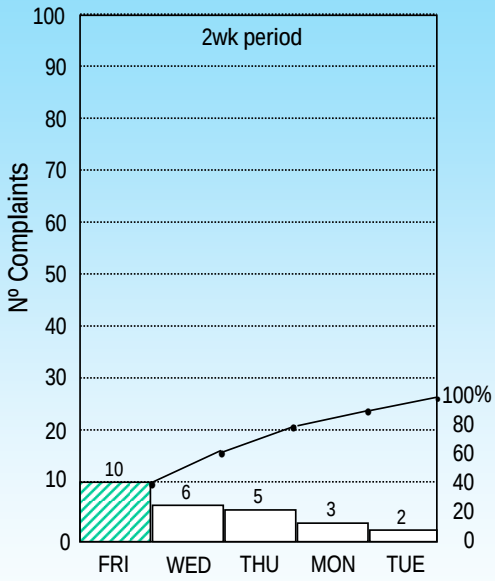
Negative Side Effects:

Complaints by Day Comparative Paretos

BEFORE



AFTER



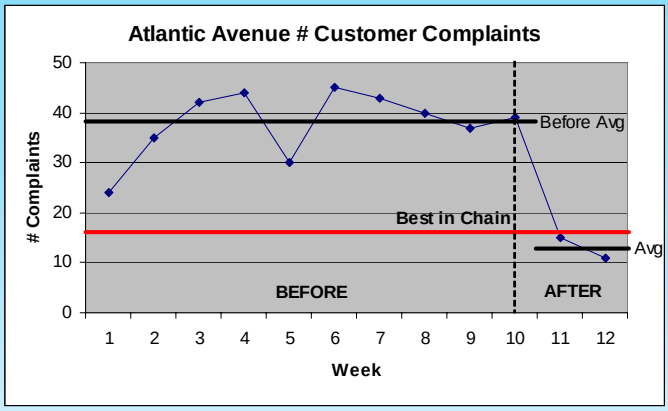
Overall Reduction in # Complaints

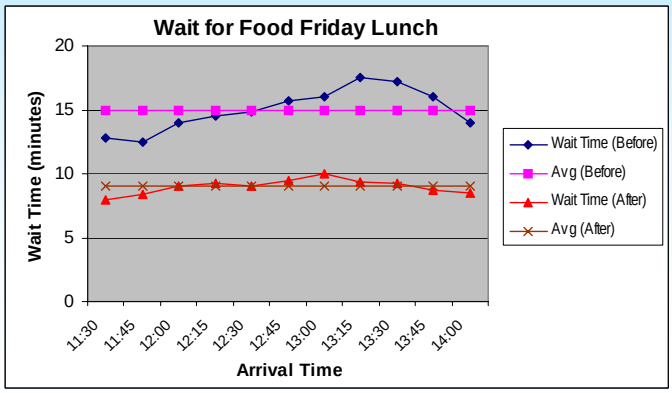
Reduction in the # Complaints on Friday

Potential Side Effects

Positive:

Negative:





Run Charts

1. The Problem Identified in the Theme

Before

Avg: 38 complaints per week

Range: 24 to 44 complaints

After

Avg: _____ complaints per week

Range: _____ to _____ complaints

2. The Underlying Problem

Before

Avg: 15 minute wait for food

Range: 12.5 to 17.5 minutes

After

Avg: _____ minute wait for food

Range: _____ to _____ minutes

RESTAURANT CASE
Step 5: Confirm the Results

Step 5 Exercise (12 minutes)

In your teams, use the Comparative Paretos and Run Charts on the previous pages to develop a Step 5 Results Statement. Write your Statement on a flip chart

Results Statement

- Effect on the Theme:
- Effect on the underlying problem:
- Potential Side Effects
  Positive:
  Negative:
- Customer Feedback:
- Lessons Learned During Pilot Implementation
  -
  -

Step 5: Confirm the Results Checklist

- ☑ Data from before and after pilot implementation has been compared
- ☑ Lessons learned during the pilot implementation have been assessed
- ☑ A Results Statement summarizing results and lessons learned has been developed

To Step 6
Standardize the Solution

STEP 6

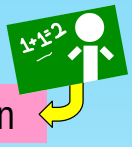
Standardize the Solution

Desired Outcome

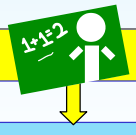
To fully implement the solution piloted at Step 4

Step 6 Guidelines & Principles

Results Statement



- Develop a 4W1H Action Plan to fully implement the solution
  - Plan to get the maximum possible benefit from the solution
  - Don't forget the lessons learned during pilot implementation
  - Include actions to prevent continued use of the "old" way of working (Remove out of date documentation, software, jigs/fixtures, databases etc.)
  - Where actions extend beyond the life of a team, establish a review schedule to ensure the actions get fully implemented
- Document & Maintain the revised process
  - Use existing divisional/department documentation system where appropriate
  - Update the existing Process Flow Diagram
  - Train, inform, and involve affected individuals
- Continue to monitor Results over time
  - To ensure the results don't deteriorate
  - Standardize, Do, Check, Act (SDCA) process



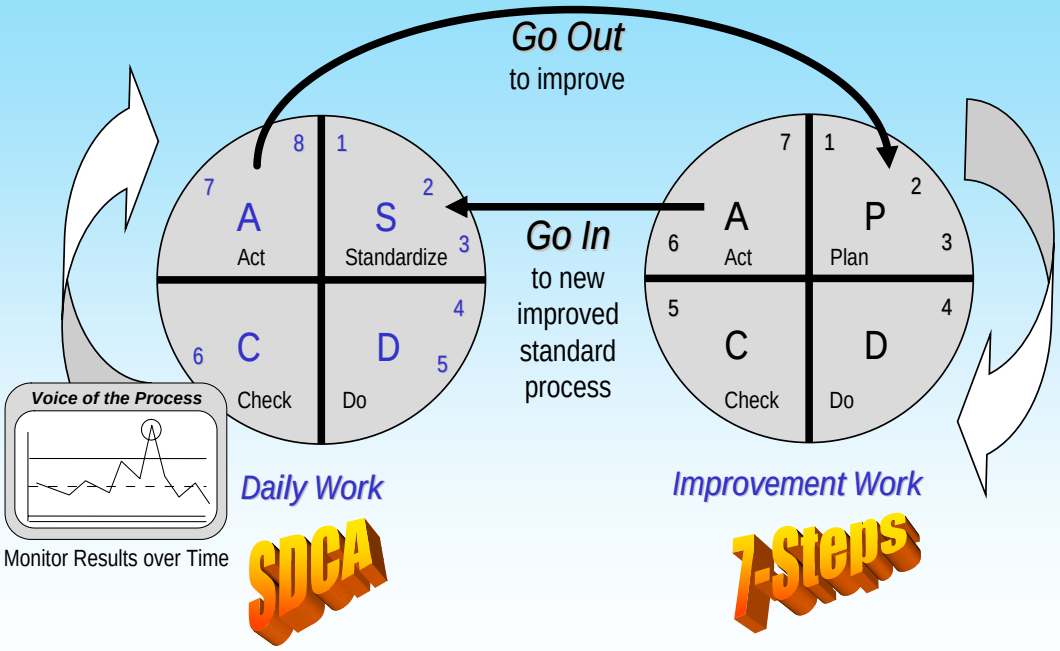
Improved results to the customer

Standardization Guidelines

- Document & Maintain the revised process

  Everyone needs to know:
  - **What** needs to be done
  - **Who** needs to do it
  - **When** it needs to be done
  - **Where** to find the information, equipment, materials
  - **How** to do it (Detailed Instructions)
- 5 Key areas of Standardization
  - Training
  - Communication
  - Monitoring
  - Standardization across like processes
  - Documentation

Relationship Between Daily Work & Improvement Work



RESTAURANT CASE
Step 6: Standardize the Solution

Step 6 Exercise (15 minutes)

Using the Step 6 Guidelines, develop a 4W1H Action Plan to describe how your team would standardize your solution. Include:

- Actions to prevent continued use of the 'old' way of working
- Metrics to be monitored over time

- Use a flip chart to record your team's work
- Use the following page for your own records

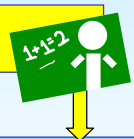
Restaurant Case Step 6: Standardize the Solution

Nº	WHAT	Who	When	Where	How
	Specific Action(s) to Prevent continued use of the 'Old' Way of Working				
	Metrics to be Monitored Over Time				

Generated by: _____ Date: _____

Step 6: Standardize the Solution Checklist

- ☑ A 4W1H Action Plan to fully implement the solution and "spread the word" has been developed
- ☑ The revised process has been documented and will be maintained
- ☑ Results will continue to be measured



Improved results to the customer

STEP 7

Reflect on the Process

Desired Outcomes

1. Lessons learned from this spin are used to improve your 7-Step skills
2. Decide “What next”
3. Complete the Improvement Story

Step 7 Guidelines & Principles

- Consider how the 7-Step process could have been better executed
  - Summarize Lessons Learned (what worked well; what slowed progress)
  - Review “Plan vs. Actual” against your timeline or initial expectations
- Decide, “What next”
  - Recommend the next problem (fat rabbit) needing attention
  - A team may decide to work on the next problem or may disband
- Complete the Improvement Story and review with your Sponsor
  - Use a suitable Story format to show the logic and summarize achievements

3 Tips on Developing a 7-Step Improvement Story

1. Build the Story As You Go
   - Highlight the ***logic trail*** in the form of a story. ***From***:
     "This is the problem" to …
     "Our solution has been tested and will reduce the problem by X% (saving $y)"
   - Should concisely communicate how you went about the improvement work – and the benefits achieved
   - Review with the sponsor "As you go" (helps to keep 'on-track')

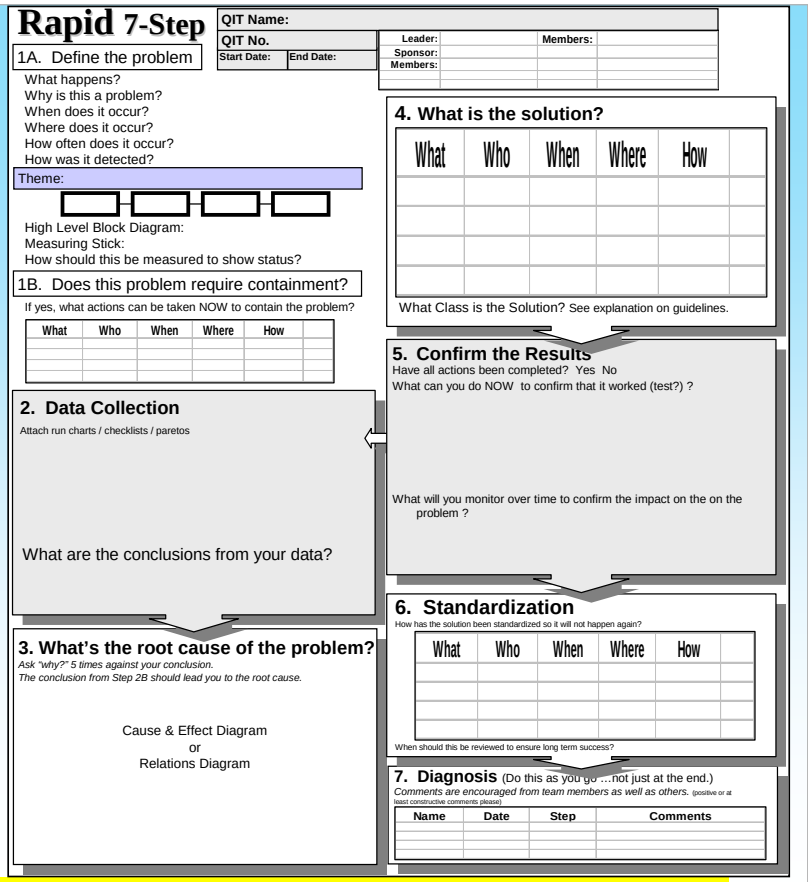
2. Capture Each Step in 1-2 Pages
   - Focus on the logic and the conclusions
   - Should be short and concise - not be a 'hefty tome'
   - In some cases a one page hand written overview may suffice

3. Easier to use existing Formats, Tools, and Software
   - See the Teradyne website
   - *Rapid 7-Step Storyboard*

Rapid 7-Step

A One page Storyboard

- Flipchart sized pads
- Or download from Teradyne website
- Posted for all to see
- Complete "as you go"
- Write on the form
- Stick & paste graphs / diagrams / photos etc.
- Do some work on the problem every day



Step 7: Reflect on the Process

Reflection Exercise (10 minutes)

An Affinity Diagram is a very simple but powerful tool to capture lessons learned

1. Individually, write two labels (Post-it Notes) answering the question, "What lessons will you take away from this workshop" — 3 minutes
   - One thought per label
   - Use a Black pen or pencil
2. In your team, at a flip chart — 7 minutes
   - Scrub and group the labels
   - Write a RED 'Header' label for each grouping (encapsulating the thoughts expressed in the labels)
   - Not all labels need to be grouped - 'Lone Wolves' are allowable

➢ Use the following page for your own records

Step 7: Reflect on the Process

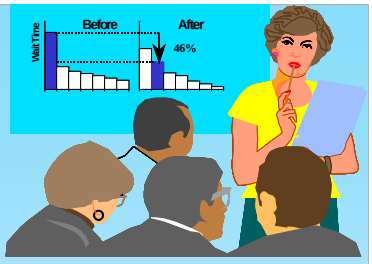
What lessons will you take away from this workshop?

"Jump up" Take Aways from Module 2

- You don't need to be a tools expert to use the 'Simple but Powerful' common tools
- The tools are helpful, but it's the logic that really matters

- The effectiveness of the 7-Step Methodology is enhanced by the use of the common language and the common thought process

Desired Outcome:
To *enhance* your understanding of the practical application of the 7-Step Methodology



Module 3 - Using the 7-Steps

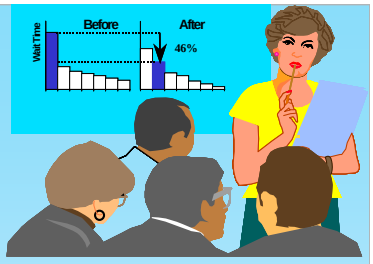
Topics

- Using Structured Problem Solving in Different Situations
- A Teradyne Example
- Critical Success Factors Checklist
- 10 Minute 7-Step Quiz

Using Structured Problem Solving in Different Situations

All follow the same 7-Step methodology. The logic is never compromised

Daily Problem (PDCA)	Rapid 7-Step	Classic 7-Step	Business Problem (Gap Analysis)
Supervisor / individual identifies a problem which can be solved locally	Time sensitive problem – important to solve quickly	A problem that is aligned to a business goal or important business issue	Typically defined by a Business Level 5 Element Table
Quick analysis by one or two people.	Local team set to work on the problem	Department or Cross Functional Teams formed	Several teams working against a business agenda
Need clear logical thinking to set out the case for a solution that targets the root cause – not just a quick fix	Very specific problem / narrowed low level Theme (e.g. bar of a Pareto)	Problem cannot be resolved immediately (e.g. Department / product defect rate)	Business Review Table used to monitor progress / performance. A "PDCA" is performed on gaps in performance
EXAMPLES			
Department not meeting a specific performance standard	Product/Service failures. Customer demands immediate action.	Product line is currently not meeting yield projections.	Performance of Parts Return Process needs significant improvement
Solving a problem raised at a departmental meeting	An In-flight Project Assessment	A Post Mortem Project Assessment	Specific goals identified by a Customer Team



Click on the icon to review an

Example Teradyne 7-Step Story

'Classic'
7-Step Story

Alternatively review 'own-choice' examples:

(E.g., Rapid format, Single page report, Stories shown on Incremental Improvement Posters, a Project Assessment)

Some Critical Success Factors for Effective Use of 7-Step Methodology in an Organization

- Continuous Improvement Culture in place
  - Common language and methodology used throughout the organization
- Organizational Support Available
  - Quality Councils, Sponsors, Training, Managers / supervisors coach teams and individuals
- Getting the "right" individuals involved for a given problem
  - Enthusiastic, willing to put in the effort, stakeholders in wanting improved results
- Working on problems that are aligned to business goals / issues
- Teams use "Clock Management"
  - Set a schedule that fits the problem – and try to stick to it

7-Steps

The 10 minute *Quiz*

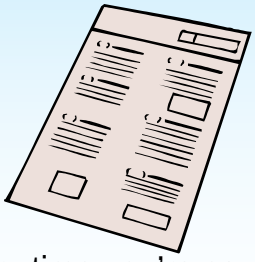
……let's have some fun

QUIZ Preparation

- This is a lighthearted quiz to see how much you've picked up from the Workshop
- It's a bit of fun for *you* – and useful info for *us* (to PDCA the workshop material and Instructor delivery)
- The quiz is team based – see which team scores the most points *against the clock*
- Please close your manuals and put away all other materials before the Quiz Questions are handed out.

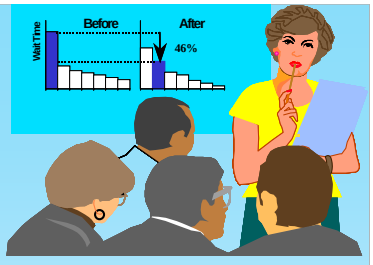
Here's how the *QUIZ* works

- In your teams, use *one* quiz sheet to record your team's answers
- You'll have exactly *10 minutes* to answer as many questions as possible:
  - Don't get stuck on a question. If you don't know the answer move on
- When the time is up, pass your quiz sheet to another team for marking
- We'll go through the answers as a class – scoring the sheets as we go
- The team with the most points wins!



Rules:

1. In cases of dispute - the Instructor rules OK
2. The Instructor is *always* right
3. No peeking at manuals – 1 point deducted every time you're caught



Workshop Wrap Up

To what extent have the objectives of the Workshop been achieved?

The Workshop Objectives were:

- For New Employees:
  - To prepare you for active participation in structured problem solving – specifically within a team setting
- For Longer Term Employees:
  - To refresh and recalibrate your existing 7-Step Knowledge & Understanding

You should now be able to:

- Apply the 7-Step Logic & Thinking
- Understand the use and application of commonly used tools & techniques
- Use the common language associated with Structured Problem Solving

- Your challenge was: As we progress through the workshop, relate what you learn to your own work situation and experience

Help is On-Hand

- Additional 7-Step Related Classes
  - Root Cause Analysis (RCA) Workshop
  - Voice Of the Process (a.k.a. Basic Tools 2) Workshop
  - SDCA Workshop
  - Getting Maximum Benefit from Process Behavior Charts
  - Project Assessment Workshop (RPD Series)
- Division / Local Managers & colleagues
- Teradyne Website – for materials, templates, tools, training, links
  - Companywide & Divisional information (via IN-SITE, Teradyne's internal corporate web site at www.corp.teradyne.com)

Click here to go to IN-SITE

7 Step Checklist

Business Goal / Issue

Step 1: Select a Theme (Gap)
- ❑ The Theme (gap) is aligned to a business goal or important business issue
- ❑ A Theme Statement has been developed
- ❑ The Theme is supported with data showing the size and scope of the problem
- ❑ The need for immediate containment action has been considered

Step 2: Collect & Analyze Data
- ❑ Data collection was focused on the Theme Statement
- ❑ A Flow Diagram of the process associated with the problem was drawn
- ❑ Can clearly show that the data was analyzed wide then deep to discover the underlying problem
- ❑ A narrowed Step 2 Conclusion Statement was developed

Step 3: Select & Verify the Root Cause
- ❑ Root Cause Analysis was focused on the narrowed Step 2 Conclusion Statement
- ❑ A Detailed Process Flow Diagram was developed for the process steps associated with the underlying problem
- ❑ Can clearly show how facts (data) were used to identify and verify the selected root cause
- ❑ A narrowed Step 3 Conclusion Statement that clearly articulates the root cause was developed

Step 4: Plan & Implement a Solution (Test a Solution)
- ❑ The solution targets the root cause – not peripheral issues
- ❑ A 4W1H Action Plan was developed and implemented
- ❑ Measurements that will be used to confirm the solution worked have been identified

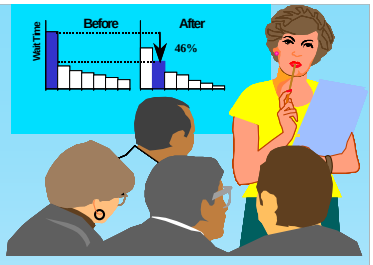
Step 5: Confirm the Results
- ❑ Data from before and after pilot implementation has been compared
- ❑ Lessons learned from the pilot implementation have been assessed
- ❑ A Results Statement summarizing results and lessons learned has been developed

Step 6: Standardize the Solution
- ❑ A 4W1H Action Plan to fully implement the solution and "spread the word" has been developed
- ❑ The revised process has been documented and will be maintained
- ❑ Results will continue to be measured

Step 7: Reflect on the process
- ❑ Lessons Learned relative to the use of the 7-Step process have been documented
- ❑ 'What next" decision has been taken
- ❑ QI Report completed and reviewed with the Sponsor

Improved results to customer

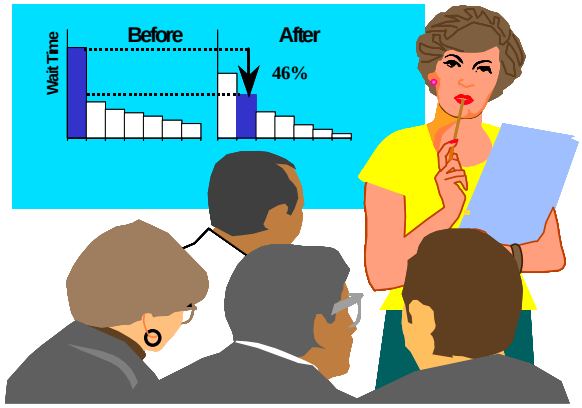
Thanks for your participation



- Any remaining **Parking Lot** issues?
- Please complete your feedback forms
- Action Learning Session

TAB 2

Example Teradyne 7-Step Story



The Infineon Indonesia OVI Power Supply QIT

This team used the 7-Step Structured Problem Solving Process to make measurable benefits for their customer and for Teradyne

Learn from the Key Strengths *of their 7-Step Story*

Click on your Options:

1. ***See the team video*** (6 minutes 25 seconds)
2. ***Read the Story***
3. ***Q&A***

TERADYNE

Hit Esc at anytime to come out of the presentation

The Infineon Team

Left to right: Back row: Mark Wai Heng, Henriyanto, Saw Bok Wu, Saw Biing Huei, Guenther Liebl, T. Kannan, Wilson Ong, ***Second row:*** Yosep, Achmad Cholis, Sukandi, Abdul Razak, Hary Widodo, LS Khew. ***Front:*** Suharnoko

Infineon Indonesia test over 350 million devices a year for use in a wide variety of consumer products. They had a problem with high failure rate of a power supply in their A565 testers – reducing testing capacity.

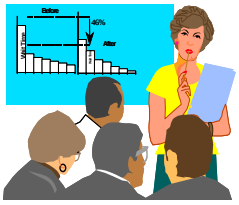
Left to right: Larry Itzkowitz, John Curran, Michael Kelly

The Team set themselves an aggressive goal to reduce failures by 60%. They actually achieved an 88% reduction – improving both system reliability and customer satisfaction.

Back to the beginning

Semiconductor Test Field Organization

QUALITY IMPROVEMENT REPORT



TERADYNE

7-Step QI Report

QIT Name: *Infineon Indonesia OVI Power Supply High Failure*

Division: *Semiconductor Test Group (STG)*

Department/Function: *Sales/TAG/GCS. Infineon Indonesia Customer Team*

Start Date: *Mid September 2001*
End Date: *15 June 2002*

Evil: *Defect and Mistake*

Corporate Goal (MC^2 + C.I): *Cost and Continuous Improvement*

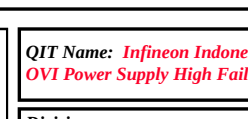
QIT Members:
Biing Saw (Sales)
Wilson Ang (GCS)
Sombat Jimnayim (GCS)
Chris Tan (C.C.C.)
Harjit Singh (TAG)
Mirah Nafi (TAG)
Kannan (Infineon Indonesia)

Leader: Wilson Ong (GCS)
Sponsor: Guenther Liebl (Sales)

Resource :
Larry Itzkowitz (Teradyne PSG)
John Curran (Teradyne Eng.)
Michael Kelly (Teradyne Eng.)

Charter: Infineon Indonesia customer, Kannan, escalated the high usage of the OVI (Octal Voltage Current) Power Supplies in Teradyne A565 test systems. This problem has reduced testing capacity for Smart Power Devices and is especially alarming because he requested 7 Sets of OVI Power Supply in Sept 2001 for 2 of the 5 A565 testers.

The objective of this QIT is to find out the root cause of the problem and implement corrective action to prevent its occurrence.

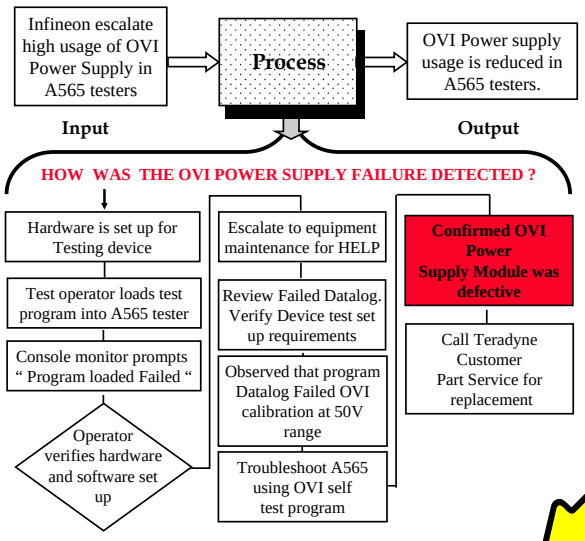


1. The front sheet captures essential information about:
   - *The team*
   - *The problem they faced, and how it was aligned to an important business issue*
   - *The desired outcome of this spin of the QIT (i.e. prevent reoccurrence of the problem)*
2. The customer was a member of the team

Back to the beginning

STEP 1: SELECT A THEME

DESCRIPTION OF PROCESS:



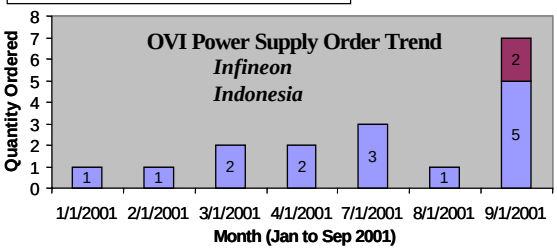
Initial Theme: **Reduce OVI Power Supply usage for Infineon Indonesia's A565 testers**

Benefits:
- Reduced OVI power supply repair costs.
- Increased tester up-time and utilization.
- Increased tester reliability (Mean Time Between Board Failure)

1. Process diagrams were used to show the area being addressed
2. The team recognized that the theme may need to be refined when they had more data … *but this did not hold them up*

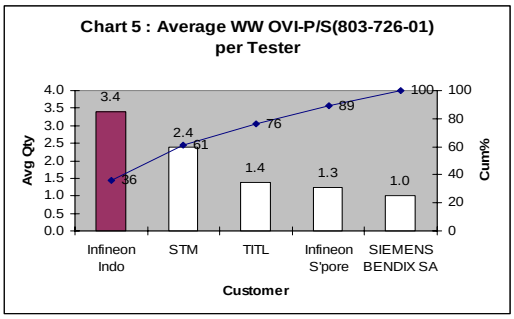
Back to the beginning

STEP 1: SELECT A THEME *HISTORICAL DATA*



A total of 17 parts were requested from Jan to Sept 2001

How does Infineon Indonesia's usage of OVI Power Supplies compare with other customers?



Infineon Indonesia's A565 testers have the highest usage of OVI P/S
- 36% of worldwide usage
- 3.4 parts per tester in the last 9 month period
- Avg repair cost per month for 5 A565 testers is US$4021

1. Historical data was used to show the size of the problem
2. The Theme:
   - *is customer focused*
   - *is weakness orientated*
   - *is measurable*
   - *does not state or imply the root cause or solution*
   - *sets a clear objective for the team*

Final Theme: **Reduce OVI power supply usage for A565 testers at Infineon Indonesia by 60% by 15th June 2002.**

Back to the beginning

STEP 1B: Does this problem require Containment Action?

To ensure that Infineon Indonesia have sufficient on-site spares for immediate repair of their A565 testers, and will get replacement parts within 24 hours

CONTAINMENT PLAN

	What	Who	When	How	Check
1	Ensure local Parts Center's stocking level is able to meet Infineon Indo. failure rate.	Chris Tan	9/20	Review part usage trend for customers using OVI Power Supply option and plan for adjustment	☑
2	Consignment of Spare in Infineon Indo while troubleshooting this high failure rate	Biing Saw	9/20	See item 3	☑
3	Get 2 brand new OVI PS from factory and install on a system to monitor mtbf of these 2 OVI PS. These also serve as a consignment spare.	Guenther	11/20	Consumer division agreed to send 2 OVI Power supply and "on loan" to IFX Batam till problem is resolved.	☑

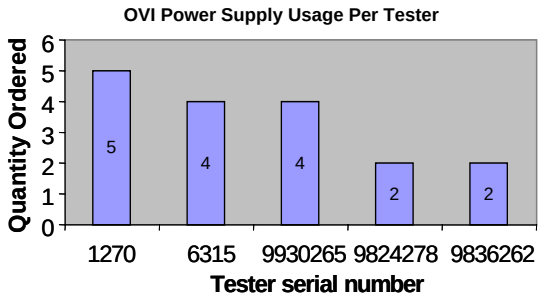
IFX = Infineon Worldwide

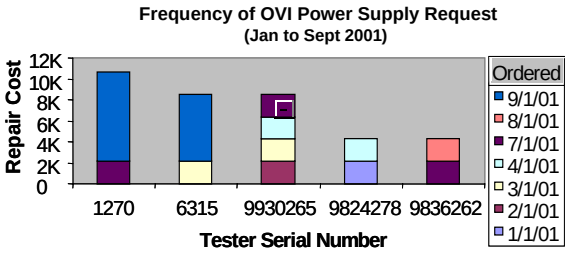
Immediate **Containment** action was taken to improve customer satisfaction
- *It mitigated the effects (symptoms) of the problem for the customer*
- *It showed the customer that Teradyne was responding quickly to the problem … whilst the QIT investigated the root cause and found a solution that would prevent the problem from reoccurring*

Back to the beginning

STEP 2: COLLECT AND ANALYZE DATA

Data Stratified by: A565 Tester Serial Number





OBSERVATION: All five A565 testers needed replacement OVI power supplies at least twice within the last 9 months

CONCLUSION: This problem is not related to a specific tester – all testers are experiencing the problem

The QIT brainstormed many possible ways to cut the data.

Here you can see they decided to see if the problem was related to a specific tester.

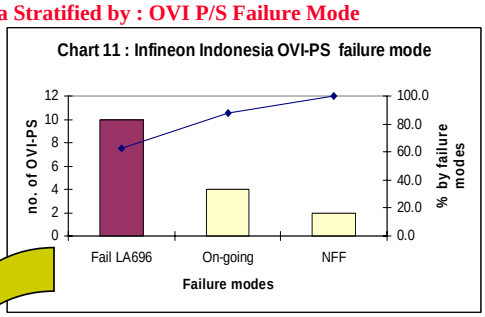
Stratifying the data by Tester Serial number gave them the answer …

Nor did stratifying the data by 'Device Type' and 'Tester Usage' help to uncover the "fat rabbit" (Paretos not shown)

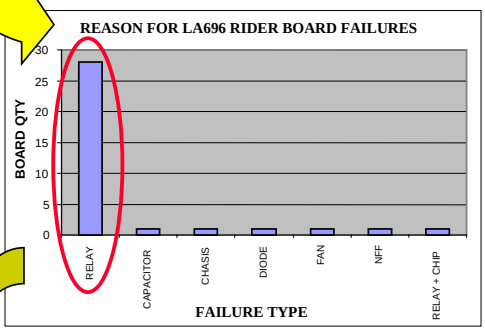
Back to the beginning

STEP 2: COLLECT AND ANALYZE DATA

Data Stratified by : OVI P/S Failure Mode



Observation: Part's repair data shows that 10 out of 16 (63%) of OVI P/Ss failures were the result of LA696 Rider Board failures



STEP 2 CONCLUSION:
82% of LA 696 Rider Boards within OVI Power Supplies fail due to relay problems

1. The team cut the data *Wide then Deep* to find the "fat rabbit"
   - *By* Tester Serial Number ✗
   - *By* Device type ✗
   - *By* Tester usage ✗
   - *By* Power Supply failure mode ✓

Then went down another level to find that the problem was related to relay failures

2. A narrowed Step 2 Conclusion was reached and clearly articulated to focus the Step 3 root cause analysis

Back to the beginning

Step 2: Key Learning Points

- The team used Pareto analysis techniques and diagrams to stratify the data multiple ways. They cut the data

  Wide then Deep to reach a narrowed conclusion

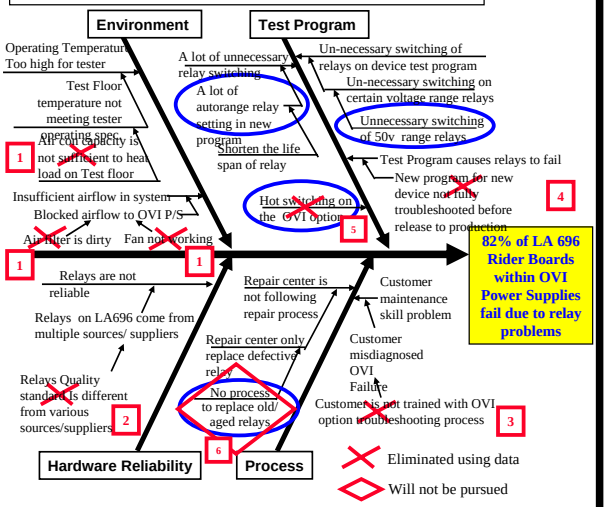
- The next page shows how the team took the narrowed conclusion statement and placed it **verbatim** in the head of a Cause & Effect (C&E) diagram

To focus their Root Cause Analysis work on the Step 2 narrowed conclusion rather than the broader Theme statement

Did you know there's a tool that helps you work through the logic of data stratification – *Wide then Deep*? It's called the **Data Analysis Worksheet (DAW)**. You can download it, together with worked examples, from the Companywide TQM Office website at:
http://eit.corp.teradyne.com/tqm_info/doccats.htm

Back to the beginning

STEP 3: IDENTIFY THE ROOT CAUSE



Notes for the RCA Method – Prepare, List, Use, Select, Home-in

1. Temperature and Ventilation are within tester operating specs.
2. Relays are from a single supplier - NEC part number 581-345-00
3. Repair center found two NFF (No Fault Found) which is16% (2 out of the 12) of OVI Power Supplies received. Team decided not to focus on this possible cause.
4. Device Program has been used since in January .ie BT77XX device family.
5. Probable causes were further eliminated by observation and conclusion drawn from **SELECT** Step
6. Requires repair center to follow ECO. Has been re-enforced in Wk46' 2001. This is beyond direct control of QIT.

The team used

The RCA Method

PREPARE for the Root Cause Analysis

LIST all possible causes

USE existing data to eliminate unlikely causes

SELECT the most probable root causes using new data

HOME-IN on a root cause

RCA = Root Cause Analysis

STEP 3 RCA CONCLUSION

The QIT decided to work on a single root cause – unnecessary switching of 50V range relays in device program

Back to the beginning

Animation finished

Step 3: Key Learning Points

- **The RCA Method is the "Best Practice" root cause analysis technique**
- Use ***brainstorming*** to **LIST** as many possible causes of the problem as practical. The team asked:

  "Why do 82% of LA696 Rider Boards within OVI Power Supplies fail due to Relay problems?"
- Arrange all the brainstormed possible causes (**no solutions**) on the branches of the C&E diagram and then ask the '5 Whys' to logically complete the diagram

- **USE** known facts to eliminate or discount as many of the brainstormed causes as possible
- At the **SELECT** and **HOME-IN** Steps use **new data** and conduct tests to try to **verify** the remaining causes
- **PLUSH** ***is an easy way to remember the Steps of***

  The RCA Method

  Prepare List Use Select Home-in

Did you know
there's a Root Cause Analysis (RCA) Workshop?

Contact your TQM Manager or TQM Administrator for class information

Back to the beginning

STEP 4 : PLAN & IMPLEMENT A SOLUTION (TEST A SOLUTION)

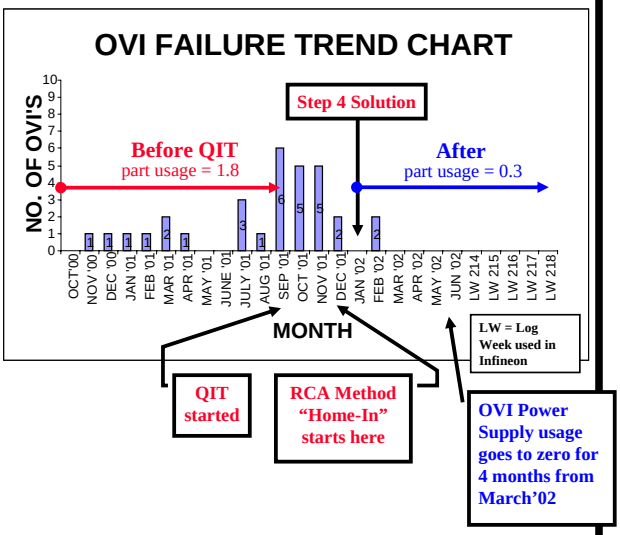
ACTION PLAN

	What	Who	When	How	Check
1	Continue monitoring the MTBBF for A565-02 after installing two new OVI Power supplies	Kannan & Wilson Ong	11/23/2001	Kannan will call Wilson for failure.	On-going throughout Step 4 ☑
2	Propose program change to Infineon Indonesia	Harjit	11/27/2001	Meeting with Infineon customer	☑
3	Modify and Install L2791 device program of BT77XX Family for A565-4	Harjit	12/19/2001	Work with Infineon Customer.	Monitoring OVI power supply performance ☑
4.	Modify other test programs for BT77XX Family running at other A565s	Kannan	Jan' 2002	Harjit to provide coaching for customer in implementation to other A565s.	☑

1. **The team ran an experiment to test a possible solution to the root cause**
   - ***The experiment was under the team's control***
   - ***If it did not yield the desired results it could be reversed quickly and easily***
2. **The team used a 3W+1H action plan so that all team members knew "who was doing what"**

Back to the beginning

STEP 5: CONFIRM THE RESULTS



Conclusion

Monthly OVI power supply usage had gone down from 1.8 (17 parts in 9 month) to 0.3 (2 parts in 6 month since Jan '2002). The magnitude of the problem has been reduced by 88% .

1. Results were confirmed by comparison of before and after date
2. The team used customer data which:
   - *Reinforced the market-in philosophy*
   - *Validated internal results*
   - *Communicated to the customer the progress they had made towards problem resolution*

Back to the beginning

STEP 6: STANDARDIZE THE SOLUTION

	What	Who	When	How	Check
1	Update Infineon Munich Engineering Team on affected program changes on 50V compliance range in device program	Harjit	02/15/2002	Email sent to IFX (Batam, Munich,Malacca)	Done
2	Document and distribute (to OVI users) Engineering Notes describing proper programming techniques	Murali Nair	02/15/2002	Email for OVI users. Site meeting as necessary	Done
3	Produce an Application Note to reach wider audience of OVI users	Murali and Harjit	03/01/2002	Murali to find out from Consumer Business Unit person-in -charge	Done

IFX = Infineon Worldwide

The team took a three pronged approach to standardizing the solution

1. Informed Infineon Worldwide Engineering & Production teams so that they could fix all existing programs
2. Proliferated the solution to all OVI users by distributing an Engineering Note
3. Used the eKnowledge Application Database to reach the widest possible audience for their solution

Back to the beginning

STEP 7: REFLECT ON THE PROCESS

STRENGTHS:

1. Right members, active support from Factory Engineering team especially in providing OVI Power Supply for experimentation done in 'Home-In' of Root Cause Analysis.
2. User friendly tools available in GCSSA website looking for historical data for part usage for OVI customers world-wide. This was especially helpful in Step 2 data collection and analysis.
3. Infineon very supportive and understanding. Worked jointly until completion.

WEAKNESSES:

1. Rhythm of meeting insufficient – Guenther
2. Difficult to input action items as data collected, root cause analysis and action items are done concurrently if QIT is on-going.

CORRECTIVE ACTIONS:

For Weakness #1:
GFS manager to allow more time for GFS service engineer to participate QIT/CTP.

For Weakness #2:
TQM Manager to facilitate team leader

NEXT SPIN:
None identified

1. Lessons learned related to the 7-Step process were summarized
2. The QI Report was reviewed with Guenther (the team sponsor)
3. This QI Report has been communicated to help other teams and individuals learn from their experience

See the next page for the "jump-up" Lessons Learned

Back to the beginning

The Infineon Team

Used the 7-Steps to improve system reliability and increase customer satisfaction

"Jump-up" Lessons Learned

- Analyze the data *Wide then Deep*
- Come to a narrow conclusion at the end of Step 2
- Use known facts to eliminate possible root causes

The End except for Q&A

All these materials and much more can be viewed/downloaded from Teradyne's Companywide TQM website at
http://eit.corp.teradyne.com/tqm_info/index.htm

The Infineon Team – Q&A

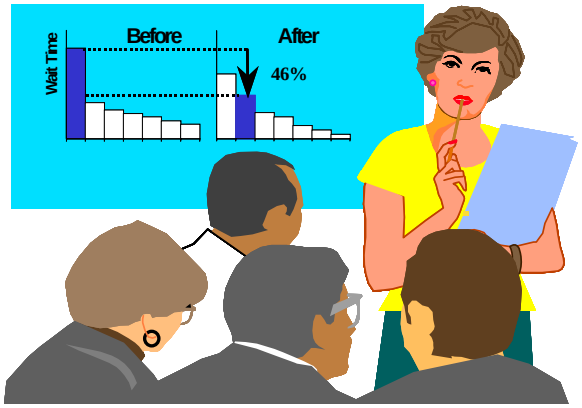
Question	Answer
Why wait for the customer to **tell us** they were experiencing a high failure rate of OVI Power Supplies? Would it not have been better for us to have proactively realized that Infineon had a problem?	You're right. But it's not so simple. Returns are monitored, but as in this case, the data for an individual customer can get masked by worldwide data (which did not show a statistically significant upturn in failures). Having a close relationship with the customer meant that we got to hear of the problem quickly.
Why did you include containment actions in your QIT Story? We normally only do that when using the Rapid 7-Step format.	Once Infineon informed us of their concerns, it was very important to react quickly. At TCS they say **"Never let the sun set on a problem"**. In the past we have been criticized by customers for saying "We'll form a QIT – but it'll take some time to find a solution". The customer thinks we're not racing to solve the problem. Containment action can be very important.
Some people I've spoken to think they have seen this type of problem before. Any comment?	If you're right, it only reinforces the importance of Step 6. The **7-Step Guidelines & Principles** says that the purpose of Step 6 is twofold: 1) to ensure that the gains will be maintained over time, and 2) to get the widest possible benefit from the solution. We tried to do this with our three-pronged approach.
Congratulations on a job well done. What was the key to success of this QIT? And … Any final recommendations?	Active participation of the customer and using the expertise of a cross functional team were both very important. But the key to success in this QIT was using **The RCA Method** at Step 3. As for a recommendation? If you haven't already done so – **sign up for the RCA Workshop as soon as possible!**

Infineon Indonesia OVI Power Supply QIT

Video will loop until stopped. LEFT MOUSE CLICK on the video to STOP and RESTART.

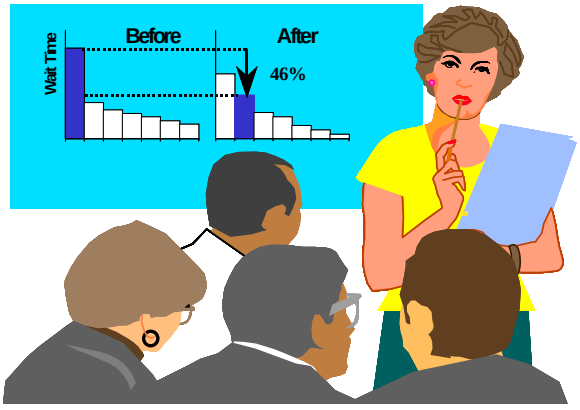
TAB 3

Division / Instructor Specific Information



TAB 4

Workshop Evaluation Form



Student Feedback Form

Course Name: **7-Step Structured Problem Solving Workshop** Course Code: **230059**

Instructor(s): _____ Date of Workshop: _____

Site Location: _____

Name *& Phone Number (Optional):* _____

Please circle the appropriate number below:

4 = Strongly Agree 3 = Agree 2 = Disagree 1 = Strongly Disagree

COURSE CONTENT

1.	The material was well organized	4	3	2	1
2.	The course objectives were clear	4	3	2	1
3.	The course met all of its stated objectives	4	3	2	1
4.	The information provided in the course material was adequate	4	3	2	1
5.	My knowledge has increased as a result of this course	4	3	2	1

COURSE EXPERIENCE

1.	It was easy to register for this workshop	4	3	2	1
2.	Received course preparation material in a timely manner *(if applicable)*	4	3	2	1
3.	Material/handouts easy to follow	4	3	2	1
4.	Training exercises were useful in explaining information	4	3	2	1
5.	Time allocated was sufficient for course delivery & all components	4	3	2	1
6.	The course met my expectations	4	3	2	1
7.	I will use what I have learned today in my daily work	4	3	2	1
8.	Training facility was adequate	4	3	2	1

INSTRUCTORS

1.	Instructor was knowledgeable about the course material	4	3	2	1
2.	Instructor communicated the training information well	4	3	2	1
3.	Instructor was prepared for the class	4	3	2	1

Overall Comments_____

_____

_____

Strengths of this workshop:_____

_____

_____

Weaknesses of the workshop:_____

_____

_____

OVERALL

	Excellent	Very good	Fair	Poor
I would rate this workshop:	4	3	2	1

Revision Date: 081904

7-STEP Structured Problem Solving Method Workshop Participant Guide

Part# 101-00 Revision 0445.1

TERADYNE