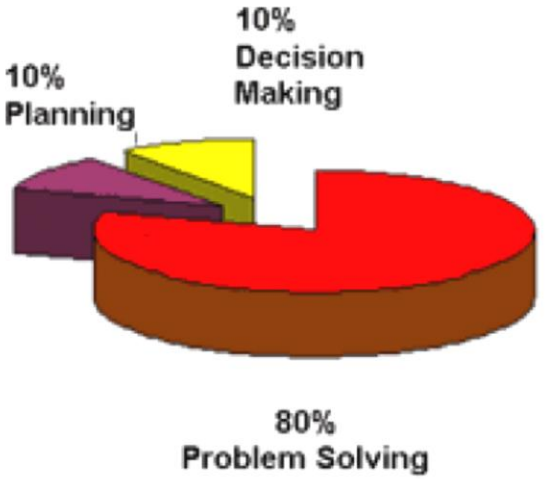
TOPS/8D's
DMAIC/DMADV

70 GLEN ROAD, CRANSTON, RI 02920 T: 401-461-1118 | F: 401-461-1119
www.tedco-inc.com

Problem Solving Techniques
TOPS
8D's
DMAIC/DMADV

Companies are often surprised to learn that as much as 80% of their resources are typically allocated to problem solving activities – sometimes better known as fire-fighting.



Everyone knows that prevention is better than cure, but finding a way of escaping the problem solving spiral has not been easy. Inevitably this infers a greater allocation of resources for more planning and better prevention. But how can more resources be allocated to prevention when they are being constantly used for putting out fires?

Originally developed at Ford Motor Company, 8D was introduced in 1987 in a manual titled "Team Oriented Problem Solving" (TOPS). As part of the Ford Lean Manufacturing initiative, this course was written at the request of senior management of the automaker's Power Train organization, which was facing growing frustration at the same problems that were recurring year after year.

The focus of this system was to use this approach in a team environment. Teams are to be cross-functional and include members from both the manufacturing organization as well as design engineering.

The 8D process evolved from Dr. Deming's Plan-Do-Check-Act (PDCA) cycle, and the Kepner Tregoe Problem Solving Decision Making (PSDM) process.

The common thread between all three techniques is the importance of focusing on finding the real reason for the problem (Root Cause Analysis) before looking for possible solutions.

Auto repair is a case in point. A "parts changer", if not told what to repair or replace, just starts replacing parts until the problem goes away, while a true auto mechanic knows how to analyze what is causing the problem before taking any corrective actions.

The Ford 8D’s (disciplines) process is most effective in dealing with chronic recurring problems, primarily defects or warranty issues. They were never intended to replace or stand as a systemic quality system. The 8Ds' focus was to deal with problems and discover the weaknesses in the management systems that allowed the problem to occur In the first place. In ISO terms, these are CAR’s and PAR’s.

The real benefit would come by changing how management decisions allowed the problem to happen. The problem is merely a symptom of a greater systemic management issue.

Global 8D problem solving is made up of a detection cycle and a prevention cycle. It defines a corrective action methodology. The 8D's are:

D#1 - Build the Team
D#2 - Describe the problem.
D#3 - Develop an Interim Containment Action
D#4 - Define / Verify Root Cause
D#5 - Verify Corrective Action
D#6 - Implement / Validate Permanent Corrective Action
D#7 - Prevent Recurrence
D#8 - Recognize the Team

Increasingly, these days, companies practicing lean manufacturing are requiring their employees to also understand the 8-Discipline approach (Eight D) to team-based problem solving. These essentially present a standard methodology for data analysis and statistical thinking and is a key lean tool.

Discipline 1 – Build The Team - Assemble a small team of people with the right mix of skills, experience and authority to resolve the problem and implement solutions. Ensure these people have the time and inclination to work towards the common goal. Get your people “on board” by using team building tools such as icebreakers and team activities.

Discipline 2 – Describe the Problem - How can you fix it if you don't know what's broken? The more clearly you describe the problem, the more likely you are to resolve it. Be specific and quantify the problem where possible. Clarify what, when, where and how much e.g. what is the impact to customers? Consider using checklists from professional 8d problem solving suppliers to stimulate and open up your thinking.

Discipline 3 – Develop an Interim Containment Action - What "sticking plaster" can you use until you figure out what's really causing the problem? Implement a temporary fix and monitor and measure the impact to ensure it's not making things worse. Remember to keep going, as a sticking plaster will never cure a broken leg!

Discipline 4 – Define / Verify Root Cause - There will be many suspects causing the problem, but usually only one culprit. The key is figuring out which one. This is where it can get a bit numerically challenging, as statistical tools are often used to get a deep understanding of what is going on in a process. Perform a Root Cause analysis by asking 5 Whys.

The 5 Whys is a technique used in the Analyze phase of the Six Sigma DMAIC methodology. It's a great Six Sigma tool that doesn't involve data segmentation, hypothesis testing, regression or other advanced statistical tools, and in many cases can be completed without a data collection plan.

By repeatedly asking the question "Why" (five is a good rule of thumb), you can peel away the layers of symptoms which can lead to the root cause of a problem. Very often the ostensible reason for a problem will lead you to another question. Although this technique is called "5 Whys," you may find that you will need to ask the question fewer or more times than five before you find the issue related to a problem.

Benefits Of The 5 Whys

- Help identify the root cause of a problem.
- Determine the relationship between different root causes of a problem.
- One of the simplest tools; easy to complete without statistical analysis.

When Is 5 Whys Most Useful?

- When problems involve human factors or interactions.
- In day-to-day business life; can be used within or without a Six Sigma project.

How To Complete The 5 Whys

1. Write down the specific problem. Writing the issue helps you formalize the problem and describe it completely. It also helps a team focus on the same problem.
2. Ask Why the problem happens and write the answer down below the problem.
3. If the answer you just provided doesn't identify the root cause of the problem that you wrote down in step 1, ask Why again and write that answer down.
4. Loop back to step 3 until the team is in agreement that the problem's root cause is identified. Again, this may take fewer or more times than five Whys.

5 Whys Examples

Problem Statement: Customers are unhappy because they are being shipped products that don't meet their specifications.

1. Why are customers being shipped bad products?

- Because manufacturing built the products to a specification that is different from what the customer and the sales person agreed to.

2. Why did manufacturing build the products to a different specification than that of sales?

- Because the sales person expedites work on the shop floor by calling the head of manufacturing directly to begin work. An error happened when the specifications were being communicated or written down.

3. Why does the sales person call the head of manufacturing directly to start work instead of following the procedure established in the company?

- Because the "start work" form requires the sales director's approval before work can begin and slows the manufacturing process (or stops it when the director is out of the office).

4. Why does the form contain an approval for the sales director?

- Because the sales director needs to be continually updated on sales for discussions with the CEO.

In this case only four Whys were required to find out that a non-value added signature authority is helping to cause a process breakdown.

Let's take a look at a slightly more humorous example modified from Marc R.'s posting of 5 Whys in the iSixSigma Dictionary.

Problem Statement: You are on your way home from work and your car stops in the middle of the road.

1. Why did your car stop?
- Because it ran out of gas.

2. Why did it run out of gas?
- Because I didn't buy any gas on my way to work.

3. Why didn't you buy any gas this morning?
- Because I didn't have any money.

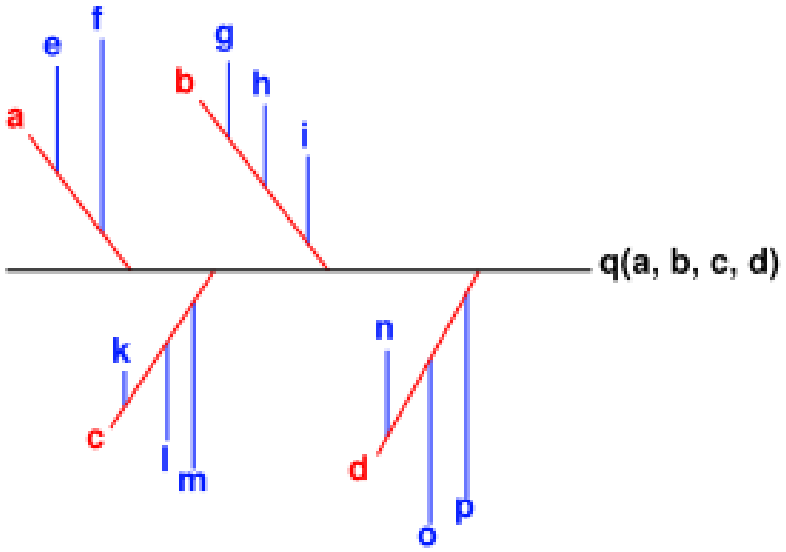
4. Why didn't you have any money?
- Because I lost it all last night in a poker game.

5. Why did you lose your money in last night's poker game?
- Because I'm not very good at "bluffing" when I don't have a good hand.

As you can see, in both examples the final Why leads the team to a statement (root cause) that the team can take action upon. It is much quicker to come up with a system that keeps the sales director updated on recent sales or teach a person to "bluff" a hand than it is to try to directly solve the stated problems above without further investigation.

5 Whys And The Fishbone Diagram

The 5 Whys can be used individually or as a part of the fishbone (also known as the cause and effect or Ishikawa) diagram. The fishbone diagram helps you explore all potential or real causes that result in a single defect or failure. Once all inputs are established on the fishbone, you can use the 5 Whys technique to drill down to the root causes.



"If you don't ask the right questions, you don't get the right answers. A question asked in the right way often points to its own answer. Asking questions is the ABC of diagnosis. Only the inquiring mind solves problems."

Discipline 5 – Verify Corrective Action - You know what's causing the problem – how are you going to fix it? Test to make sure that your planned fixes have no undesirable side effects. If so, are there complementary fixes that eliminate side effects? If your solution just isn't feasible, you can still change your mind before you move to the next "go live" stage.

Discipline 6 – Implement Permanent Fix - Go for it! Implement your permanent and complementary fixes and monitor to make sure it's working. Usually you will get it right, but if not, go back a few steps and try again – the culprit is there to be caught!

Discipline 7 – Stop It Happening Again - If you've gone to all this trouble, you don't want the problem to sneak up on you again! Prevent recurrence of the problem by updating everything related to the process e.g. specifications, training manuals, or "mistake proofing" the process.

Discipline 8 – Celebrate Success - Teamwork got you this far, so put on your collective party shoes and celebrate your success. Going public with success spreads knowledge and learning across your organization, and let's face it, we all like a little recognition now and again.

8D Response Report

WHO IS EFFECTED BY THE PROBLEM?		Date Open:		8D No.:	
Company:		Initial Response:		Customer Complaint No.:	
Address:		Target Close Date:			
Location:		Revision Date(s):			
Part No./Code		8D Initiator:			
Product Name:		8D Initiator's Spvr:			
☐ INTERNAL or ☐ EXTERNAL		Actual Close Date:			

D1 TEAM MEMBER NAMES/TITLES:		D2 PROBLEM STATEMENT/DESCRIPTION (quantify) (one defect per 8D)
Champion:		
Team Leader:		
Team Members:		

D3 CHOOSE AND VERIFY INTERIM CONTAINMENT ACTION(S) (ICA):	% Effective:	Target Date:	Actual Date:
HOW DID YOU VERIFY THE EFFECTIVENESS OF THE ICA?			

D4 DEFINE AND VERIFY ROOT CAUSE(S):	% Contribution:
HOW DID YOU VERIFY THE ROOT CAUSE(S)?	

D5 CHOOSE AND VERIFY PERMANENT CORRECTIVE ACTION(S) (PCA):	% Effective:
HOW DID YOU VERIFY THE EFFECTIVENESS OF THE PCA?:	

D6 IMPLEMENT AND VALIDATE PERMANENT CORRECTIVE ACTION(S) (PCA):	Target Date:	Actual Date:
HOW WILL YOU VALIDATE THE PCA?		

D7 SYSTEM PREVENTION ACTIONS TO PREVENT RECURRENCE: Mistake Proofing: How are you going to ensure it can't happen again?	Target Date:	Actual Date:

HAS CORRECTIVE ACTION/IMPLEMENTATION BEEN REVIEWED AGAINST DOCUMENTS?:

Check boxes that apply: ☐ Control Plan ☐ FMEA ☐ Flowchart ☐ Proc./Work Instr. ☐ Add to Internal Audit

D8 TEAM AND INDIVIDUAL RECOGNITION: Recognize the collective efforts of the team.

The 8d problem solving process is used by big businesses such as Ford, Shell and Toyota. The key is focusing on facts and not opinion, being disciplined enough to follow the process and remembering that a good team are worth more than the sum of the individuals. Do that, and you'll save time, money and lift your employees

For most manufacturing organizations, routine problem solving will not improve the product and/or process. A more systemic overall quality initiative, such as the Six Sigma DMAIC or DMADV process is still required.

DMAIC is used to improve an existing process that is not performing as expected.

Define the goals of the improvement activity. The most important goals are obtained from customers. At the top level the goals will be the strategic objectives of the organization, such as greater customer loyalty, a higher ROI, increased market share, or greater employee satisfaction. At the operations level, a goal might be to increase the throughput of a production department. At the project level goals might be to reduce the defect level and increase throughput for a particular process.

Measure the existing system. Establish valid and reliable metrics to help monitor progress towards the goal(s) defined at the previous step. Begin by determining the current baseline. Use exploratory and descriptive data analysis to help you understand the data.

Analyze the system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal. Use statistical tools to guide the analysis.

Improve the system. Be creative in finding new ways to do things better, cheaper, or faster. Use project management and other planning and management tools to implement the new approach. Use statistical methods to validate the improvement.

Control the new system. Institutionalize the improved system by modifying compensation and incentive systems, policies, procedures, MRP, budgets, operating instructions and other management systems. You may wish to utilize standardization such as ISO 9000 to assure that documentation is correct. Use statistical tools to monitor stability of the new systems.

DMAIC Problem-Solving Worksheet

Project Tracking Number: _____ **Date Initiated:** _____ **Date Closed:** _____

Phase	0	D	M	A	I	C
	Identify the Problem	Define	Measure	Analyze	Improve	Control

0: Identify the Problem

We can learn of problems from many sources, including: internal metrics used to monitor the health of processes and the organization, feedback from customers and employees and results of audits against standards and regulations. Use data, not emotions, to prioritize the order of problems to work on.

Questions & Considerations:	Responses:
How was the problem identified?	
Are "real" data available to confirm and diagnose the problem?	
Is a team needed to tackle the problem or can one person handle the job working alone?	
What is the level of urgency and impact of the problem?	

D: Define

When setting up a problem-solving team, consider team membership, roles of the members, boundaries of freedom for the team and the team start-up process. Describing the problem starts with a well-thought-out Problem Statement. The Problem Statement communicates the scope of the problem that the team is working on and gets the team focused. A complete Problem Statement should also provide information relevant to the problem to help the team get started and clarify what is expected of the team.

Questions & Considerations:	Responses:
Who are the project team members?	
What is the role of each team member?	
Have a Team Champion and SME (Subject Matter Expert) been identified?	
What are the boundaries of freedom for the team?	
How will team activities be documented and communicated?	
Has a Team Start-Up Worksheet been used?	
Has a Problem Statement been developed? Note: The Problem Statement communicates the nature of the problem to the team, focuses the team on the scope of the problem, provides data and information on what the problem is AND what it isn't and lets the team know what they are expected to do.)	
Do the expectations clarify the role the team should play (determine root cause(s) and implement or recommend a solution(s)), specify the deadline and include monetary limits for the team?	
Does the Problem Statement communicate a problem to be studied or assign a task to be carried out?	

M: Measure

In the Measure phase, set up measurement systems so that the data needed to determine the root cause of the problem can be collected and the effectiveness of DMAIC efforts can be demonstrated.

Questions & Considerations:	Responses:
▸ Have quality characteristics that are critical to customers (CTQ or Critical to Quality) been defined? How are they measured? Have baseline measurements been made?	
▸ Is the variation in the CTQ characteristics understood? What measures (histograms, process capability) are used?	
▸ Has a detailed process flowchart or SIPOC flowchart been used to identify where data are generated and where more data may be needed to fully understand what process steps impact the CTQ characteristics?	
▸ Part of capturing measurements from the process is ensuring that the measurements represent good, valid data. Has a Gage Repeatability and Reproducibility (GR&R) Study been conducted on measurement devices that the DMAIC team will rely upon?	
▸ What graphical display methods (concentration diagrams, histograms, timeline analysis and workflow diagrams) and exploratory data collection techniques (failure analysis, simulations, design of experiments, control charts and correlation, regression or multivariate analysis) have been used to help analyze data?	
▸ Consider use of macro-measures and a balanced scoreboard of the process to monitor the DMAIC effort.	

A: Analyze

Defining the root causes is the core of the problem-solving process. This is normally the toughest aspect of the problem-solving process; if the root causes of the problem were obvious, then the problem would have been solved already. There are usually two families of causes at work when we know there is a problem. The first, the causes that appear to be the problem, are frequently symptoms, not root causes. The specific causes that allowed the apparent causes or symptoms to occur are the root causes, often buried deep in the process. Often, once the root causes are known, the solutions becomes obvious.

Questions & Considerations:	Responses:
▸ What techniques have been used to discover the root cause(s)? (e.g.: The 5-Whys, What is—What isn't Analysis, Timeline Analysis, Failure Analysis, Simulations and Statistical Analysis)	
▸ Have you asked the Root Cause Question: "Do these causes explain all that is known about what the problem is, as well as all that is known about what the problem isn't?" This is really a two-part question: make sure the root causes found fit both the "is" and the "isn't" sections of the question. If the causes being tested don't fit both, then they are probably not the root causes.	
▸ Have the root causes identified been verified? (Verification may require a series of confirmation runs.	

I: Improve

Sometimes a systematic approach is needed to use the root cause analysis to develop a solution. If the solution(s) is obvious, select the best solution or mix of solutions that will lead to a robust, yet cost-effective, solution. If solutions are not yet evident, follow the data trail. When solutions are not obvious, often the root cause has not been found. Once the solution and its implementation are approved, the next step is to create an Action Plan. The Action Plan outlines what steps are needed to implement the solution, who will do them, and when they will be completed. A Simple Action Plan merely documents what needs to be done, who will do it, and when will it be done by. A complex solution needs more thorough planning and documentation.

Questions & Considerations:	Responses:
▸ Has the solution passed the tests of practicality, feasibility and cost-effectiveness?	
▸ Is the solution robust and capable of preventing a recurrence of the problem?	
▸ Does the ROI (return on investment) or the payback of the solution justify the cost of implementing the solution?	
▸ Can the solution be implemented within the required deadline?	
▸ Is a Simple Action Plan (who will do what by when) adequate or will a Complex Action Plan be needed?	
▸ If a Complex Action Plan is needed, have Activity Plans, Gantt Charts and PERT Charts been developed?	
▸ Part of implementing a solution is to document new procedures or changes to procedures as well as any changes that relate to the organization's quality system; has this been done?	
▸ Has training to support the new systems been developed and provided?	
▸ After people use the new or revised process a few times, they most likely will have some improvement ideas. Have the suggestions been assessed and have corresponding adjustments made to the process, has the documentation been updated and has retraining been provided?	

C: Control

The job of a problem-solving team is not complete once the solution is implemented. Preventing recurrence is an important part of a problem solution. To prevent recurrence of the problem, the team must verify that the outcome of their Action Plan works and validate that the outcome is on-target. Verification is testing that the solution produces the desired outcome; validation is ensuring that the outcome really solves the problem. Once a team has completed implementing the solution and ensured that the solution works, all team members deserve to be congratulated. Team members need to know that their efforts are appreciated and that the organization knows about their accomplishments.

Questions & Considerations:	Responses:
▸ Has the outcome of the Action Plan been verified to work?	
▸ Has the outcome been validated to be on-target?	
▸ Have Action Plan results been documented, have related procedures been updated and have corresponding changes to affected quality system elements been made?	
▸ Have audits been establish to assess the use and effectiveness of the solution to ensure the gains are held?	
▸ Have the results been leveraged to prevent occurrences of like problems in all similar operations?	
▸ Has the organization (leadership group) recognized the team for their efforts in a timely manner?	
▸ Has the project team recognized those that have provided the team with support and assistance?	

DMADV is used when developing new processes or correcting existing processes requiring more than incremental improvement.

Define the goals of the design activity. What is being designed? Why? Use Quality Function Deployment (QFD) or Analytic Hierarchical Process to assure that the goals are consistent with customer demands.

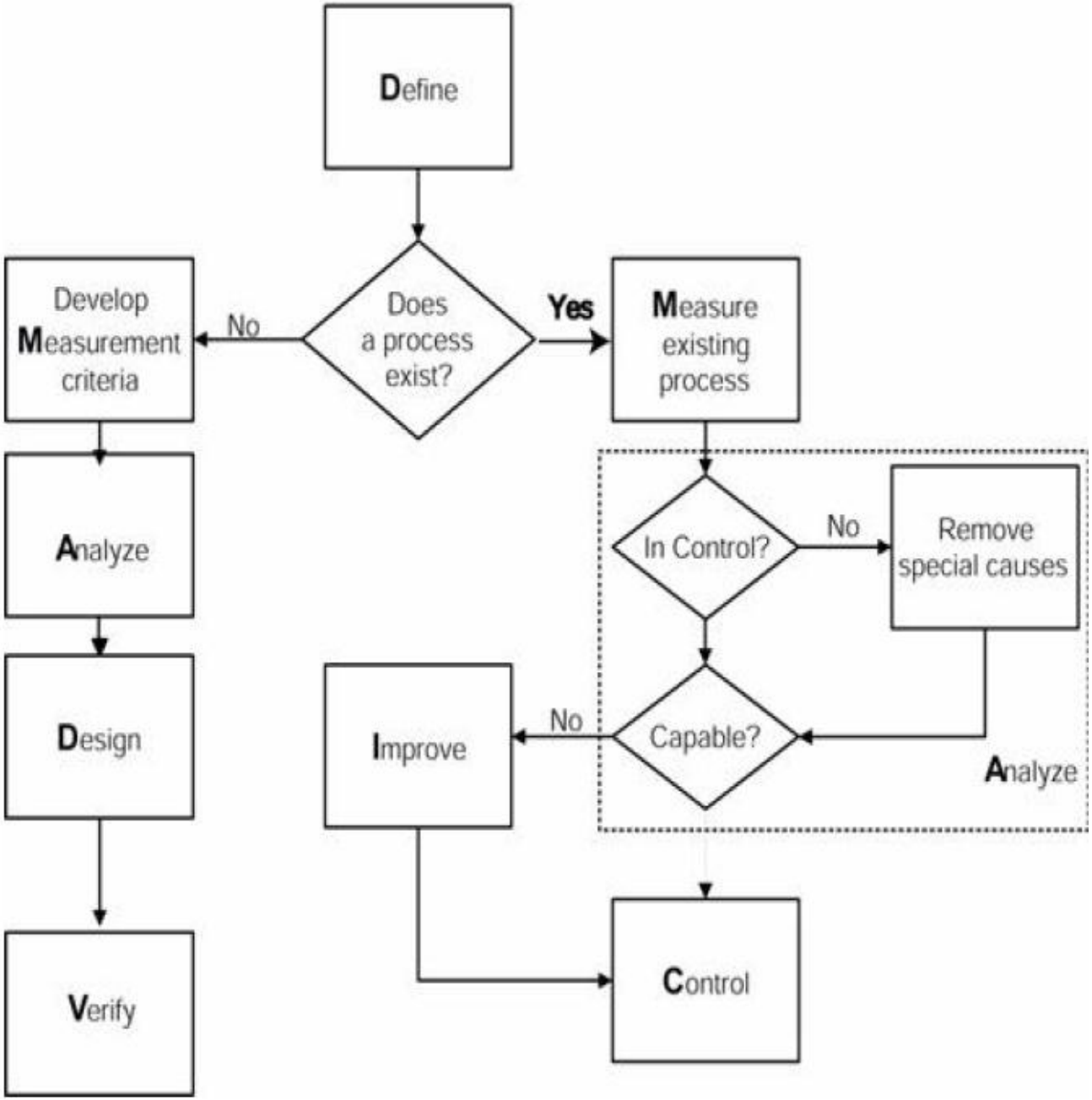
Measure the performance metrics critical to stakeholder's. Translate customer requirements into project goals.

Analyze the design options available for meeting the goals. Determine the performance of similar best-in-class designs.

Design the new product, service or process. Use predictive models, simulation, prototypes, pilot runs, etc. to validate the design concept's effectiveness in meeting goals.

Verify the design's effectiveness in actual use.

DMAIC versus DMADV



KAIZEN
TOPS/8D's
DMAIC/DMADV

70 GLEN ROAD, CRANSTON, RI 02920 T: 401-461-1118 | F: 401-461-1119
www.tedco-inc.com