RMS Supplier Quality

Quality Manager

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Prepared by

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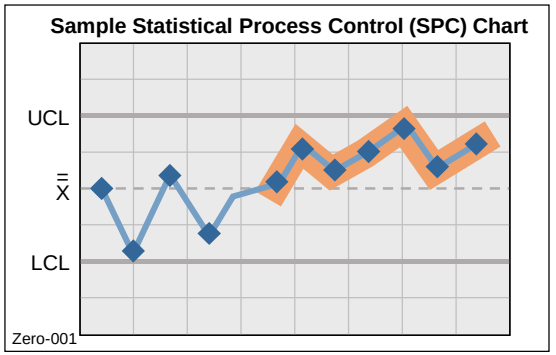
Supplier Partnerships — Quality Compliant Hardware, First Time, Every Time, Through Stable Predictable Processes.

Our commitment to our servicemen and servicewomen is to provide them an unfair advantage, ensuring that they complete their mission and come home safe to their families.

The Bottom Line: Where Good Quality Really Counts



Raytheon Missile Systems (RMS) knows good quality has a positive effect on the bottom line. We offer solutions on this website that we believe are best practices, but the important thing to remember is that this is a collective journey to learn and deploy methodologies that ensure not only Zero Escapes to Raytheon Operations, but ZERO escapes to our warfighting customers.

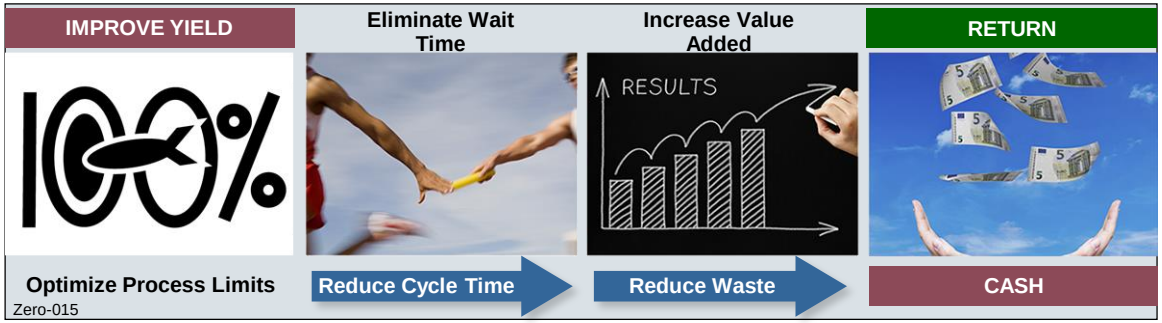
As the person leading Quality for your business, you are focused on preventing defects from occurring. Each defect costs money and erodes schedule. It may not be realistic to believe that every defect can be prevented, but then what can you do to cost effectively minimize risk and prevent escapes to your customers?

Taking sample measurements on special processes is highly recommended. Special processes are processes that can't be verified after point of manufacture. Capturing the resulting data and analyzing trends will likely result in determining out-of-family conditions and help prevent costly escapes. For example, RMS experienced an issue where a press fit pin fell out during vibe-at-next assembly. Upon investigation, we learned a subtier supplier was inserting the pin with an arbor press. The supplier's workers were not taking the time required to capture insertion pressure. Had they been, they would have seen an out-of-family condition and eliminated an escape to our end users, an escape that drove cost, damaged the Raytheon brand damage and caused customer concern that could have easily been avoided. A simple example, but highly impactful.

Do you monitor your factory yields? Many think yield is a good quality metric. It isn't if a failure is involved and true root cause is not understood. Let's say that a manufacturing process in your plant has a throughput of 85 percent. Sounds pretty good, right? It could be, but only if you understand what's keeping you from 100 percent (the true root cause of failures). Otherwise, the failures may be trying to tell you something about your process. It could be several of your processes are on the ragged edge of compliance. Over the life of the product, performance may erode to less-than-compliant when the hardware is in our warfighter's hands. If you know the root cause of your failures, a Quality manager (QM) can start communicating the financial trades between the cost of processing defects long term, and the cost of a nonrecurring corrective action to prevent the defects. Doing this analysis enables you to design a cost-effective system to control defects and reduce escapes.

Understanding critical characteristics and establishing process controls is key to minimizing variability. Being able to keep data trends and using that data in a meaningful way not only helps avoid defects, but indicates when variability is eroding your process. Do you understand the critical characteristics of your product? Are design for producibility analyses conducted during development to provide capable designs for production? Have you performed a process failure mode and effects analysis (PFMEA) in your factory? If not, you may not truly understand the cause(s) of variability. Stable, consistent processes contribute to the bottom line through defect reduction. Variability is the enemy of controlling escapes.

One can argue that good quality leads to affordability. You will often hear the argument that good quality drives cost. This does not have to be true. Smart, good quality drives affordability. A small amount of preventive expenditure will, most probably, save you and your company large amounts of costs associated with failure investigations, customer initiated actions, damage to brand and business erosion. How often are you "surprised" by the results of poor quality practices in your factories?



Separate from all other aspects of the problem are the branding issues that follow escapes to customers. RMS tracks escapes from our suppliers at the senior management level on a monthly basis and designs supplier engagement plans around poorer performers. Most of these engagements are designed around process control implementation that ensure you have understood and captured those critical characteristics that drive success in your manufacturing processes. Do you know and understand the escapes that your supply base is passing on to you? Do you know what defects you are passing through to RMS? Those escapes that get to your customers are detrimental to your brand and a direct threat to your business base; another example of negative effect to the bottom line. Conversely, RMS is always characterizing our supply base, and solid quality performance tends to lead to increased business. Are you the champion of variability reduction, process control and communicating what good quality looks like in your business? If so, feel free to share any success stories that you may have. By communicating often, we can reduce the journey we are on to achieve zero escapes.

Click on the links below to learn more about each subject.

Effective Metrics

Key Product Characteristics (KPC)/Key Control Characteristic (KCC)

What Does Good Process Control Look Like?

What Does Good Quality Look Like?

Effective Metrics

One of the most important aspects of being a good QM is the use of effective metrics. While there are hundreds of possible metrics and tools, listed below are some of the essential ones that every QM should know.

Quality Functional Deployment (QFD)

QFD is a system used to translate customer requirements into directly related engineering requirements.

Employing this "voice of the customer" helps to:

- Create a customer-driven environment.
- Ensure a methodical flow from the customer.
- Match requirements to product design.
- Establish priorities.
- Document the decision-making process.

QFD is a flexible tool that uses a system of interrelated matrices to help create a common ground between customer and supplier by prioritizing company activities/initiatives.

Key QFD benefits:

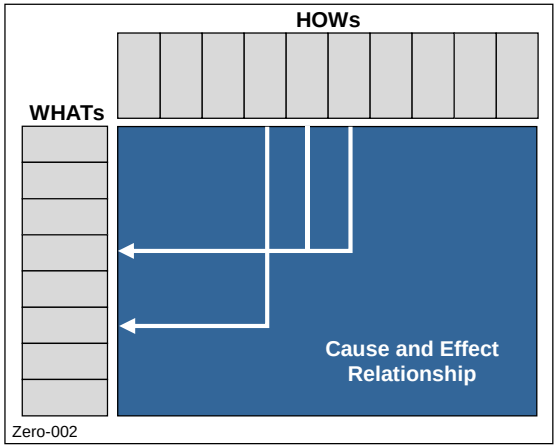
- Ensure that company activities are aligned with the customer mission, expectations and priorities.
- Helps expose and define "vague" or "unspoken" requirements.
- Enables evaluation of the risk and opportunity associated with alternative win strategies and technical approaches.
- Reduces overall cycle time and downstream changes.
- Promotes teamwork and increases organizational ownership.

The basic QFD House of Quality Matrix: What-How Concept

- The "hows": Critical parameters, design features, etc.
- The "whats" requirements, careabouts.

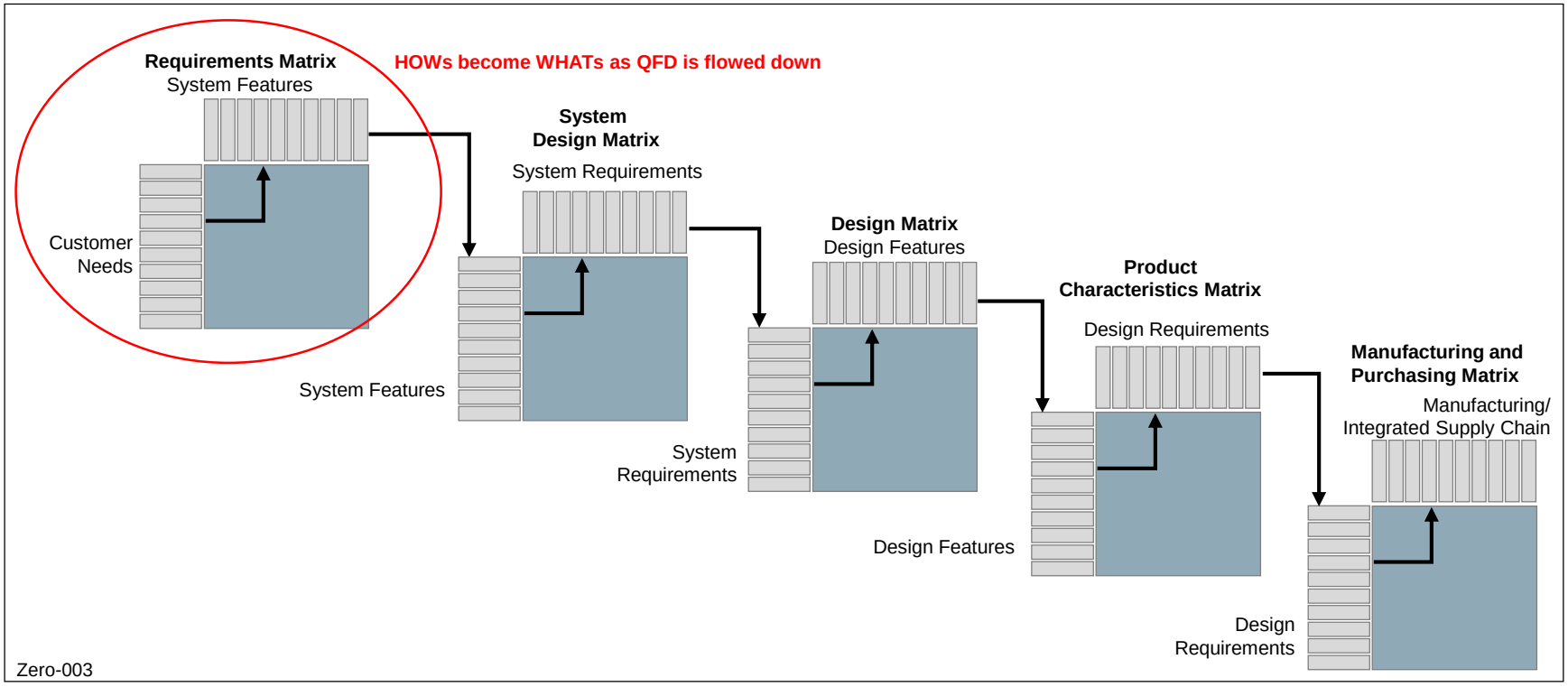
Completing the QFD Matrix:

- Relationship strength between each what and how is scored.
- "Hows" with highest total weighted scores are used to drive design decision.



Requirements Flowdown:

One method of determining the leverage points in a product or service that ensures your design addresses the features that drive customer satisfaction is the waterfall relationship, as shown:



The bottom line is that using QFD is a great way to flow down your customer's voice to every level of your design.

Fishbone Diagram

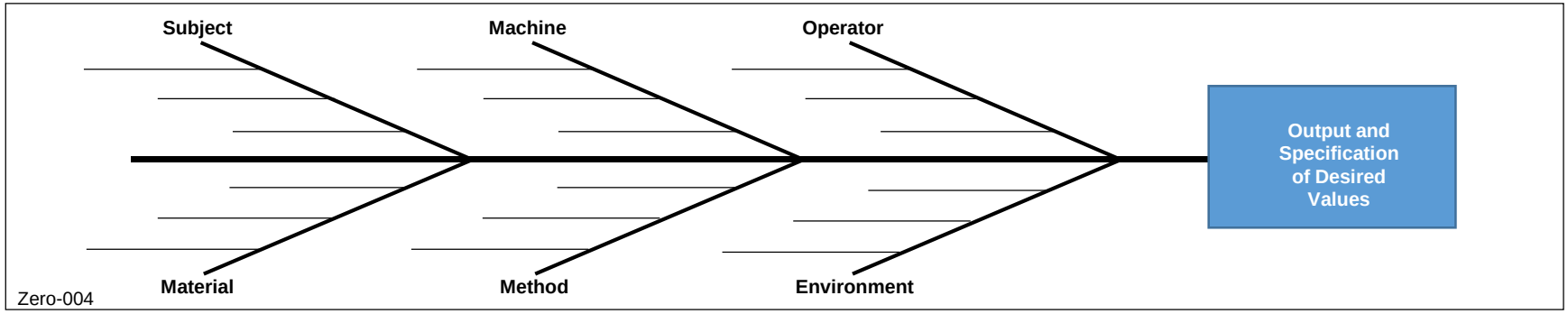
Fishbone diagrams (also called Ishikawa diagrams, herringbone diagrams, cause-and-effect diagrams, or Fishikawa) are causal diagrams created by Kaoru Ishikawa (1968) that show the causes of a specific event. Common uses of the fishbone diagram include product design, quality defect prevention, and identifying potential factors causing an overall effect. Each cause for imperfection is a source of variation. Causes are usually grouped into major categories to identify these sources of variation. The categories most often used are people, machine, measurement, method, environment and material. However, they should be set based on the individual process.

The concept was first used in the 1920s and is considered one of the seven basic tools of quality control. It is known as a fishbone diagram because of its shape, similar to the side view of a fish skeleton.

So when should you use a fishbone diagram? Use it to explore all the possible or root causes of a problem, uncover bottlenecks in your processes, and identify where and why a process isn't working.

A simple "how-to" follows:

1. Prepare a flip chart or an overhead transparency of the following fishbone format sample:



2. List the problem/issue to be studied as the "head of the fish" (the right side of the diagram).
3. Label each "bone" with an identified major cause category. These (or others) may be used or combined. Major cause categories to consider:
   - Four M's: methods, machines, materials and manpower.
   - Four P's: place, procedure, people and policies.
   - Four S's: surroundings, suppliers, systems and skills.
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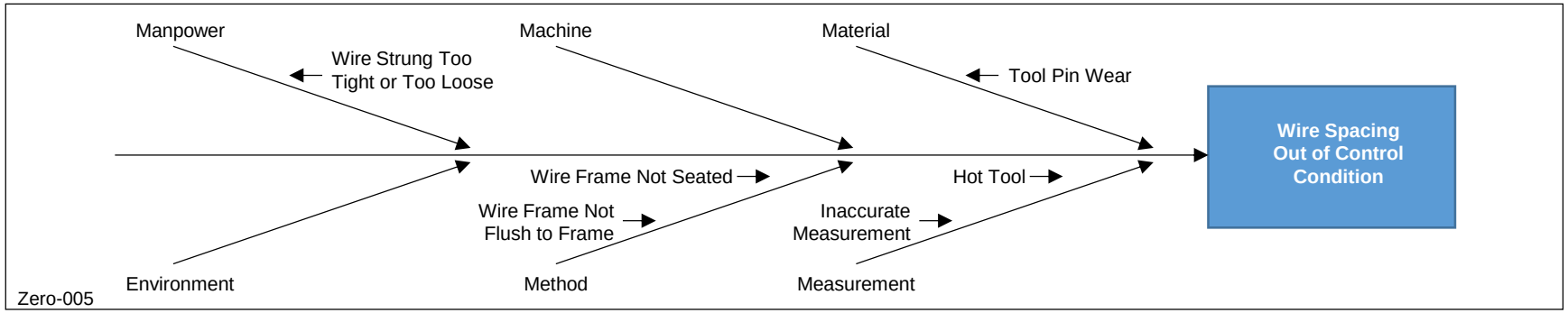
   - Four M's: methods, machines, materials and manpower.
   - Four P's: place, procedure, people and policies.
   - Four S's: surroundings, suppliers, systems and skills.
6. Brainstorm potential causes of the problem. As possible causes are provided, decide as a group where to place them on the diagram. It is acceptable to list a possible cause under more than one major cause category.
   - Consider combining small branches onto larger ones.
   - Consider splitting up large branches into smaller ones.
7. Review each major cause category. Circle the most likely causes on the diagram.
8. Review the causes that are circled and pursue each line to root cause.
9. Reach an agreement on the most probable cause(s).

An example of a wiring issue is shown below:



The fishbone diagram can reveal key relationships among variables, and the possible causes provide additional insight into process behavior. Causes can be derived from brainstorming sessions. These groups can then be labeled as categories of the fishbone. They will typically be one of the traditional categories mentioned above, but may be something unique to the application in a specific case. Causes can be traced back to root causes using the "Five Whys" technique (or similar).

The bottom line is that a fishbone diagram helps to visually display the many potential causes for a specific problem or effect. It is particularly useful in a group setting and for situations in which little quantitative data is available for analysis.

Failure Modes and Effects Analysis (FMEA)

FMEA was one of the first systematic techniques for failure analysis. It was developed by reliability engineers in the 1950s to study problems that might arise from malfunctions of military systems. A FMEA is often the first step of a system reliability study. It involves reviewing as many components, assemblies and subsystems as possible to identify failure modes and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded in a specific FMEA worksheet. There are numerous variations of such worksheets. A FMEA is mainly a qualitative analysis.

A few different types of FMEA analysis exist, including functional, design and process. Additionally, a FMEA can be called a FMECA to indicate that criticality analysis is performed.

When should you use a FMEA?

Some potential targets for a FMEA application:

- When a new processes is being designed.
- When new systems, products and processes are being designed.
- When existing product designs or processes are being changed.
- When carry-over designs are used in new applications.
- After system, product or process functions are defined, but before specific hardware is selected or released to manufacturing (ideally).

How to perform a FMEA

This example illustrates how to use a FMEA to create a risk-mitigation plan:

- Step 1: Brainstorm potential process risks, sources of variation, and potential causes.
- Step 2: Rate potential risks (1= low probability, 10 = high probability).
- Step 3: Prioritize risks and define mitigation actions.
- Step 4: Continuously update and review project.

Failure Mode Effects Analysis (FEMA)

Process:
Subsystem:

Prepared By:
FMEA Date:
Revision Level:
Revision Date:
Page 1 of

S	=	(S)everity of the effects of the Failure (1=low, 10=high)
O	=	Probability of Failure (O)ccurring (1=low, 10=high)
D	=	Liklihood Failure is (D)etected (1=low, 10=high)
RPN	=	Risk Priority Number (S x O x D)

													New			
Process Function	**Potential Failure Mode**	**Potential Effects of Failure Mode**	**S**	**C**	**Potential Cause of Failure**	**O**	**Current Controls**	**D**	**RPN**	**Recommended Actions**	**Resp**	**Actions Taken**	**S**	**O**	**D**	**New RPN**
What is the process step?	In what ways can this process step fail to meet requirements?	What will happen as a result of the failure described?			What causes the failure to occur?		What are the existing controls that either prevent the failure mode from occurring or detect the failure mode should it occur?		Risk Priority Number (S*O*D)	What are the actions that will control or eliminate the cause of failure?	Who is responsible for the action?	What are the completed actions taken? Be sure to note date completed.				

How (S)evere is the effect to the customer? (1-10)
Is this component or system classified as (C)ritical, (K)ey, or (S)ignificant?
How often does the cause of the failure (O)ccur? (1-10)
How likely are you to (D)etect a failure before the part leaves this location? (1-10)

Zero-006

Key FMEA terms:

- **Failure mode** – The way in which a process can fail.
- **Effect** – The impact on the process or customer requirements as a result of the failure.
- **Severity** – The impact of the effect on the customer or process.
- **Root cause** – The initiating source of the failure mode.
- **Occurrence (or frequency)** – How often the failure is likely to occur.
- **Detection** – The likelihood that the failure is discovered in a timely manner, or before it reaches the customer.
- **Risk Priority Number (RPN)** – The value computed by multiplying the values assigned to Severity, Occurrence and Detection: RPN = Severity x Occurrence x Detection.

The bottom lines is that FMEA is a systematic technique to identify potential failures; prioritize the failures according to the risk; provide information to impact the product design, process design and mistake proofing, and identify actions that can reduce/eliminate failures. The effort that goes into doing a FMEA represents upfront planning that ensures you have considered all possible ways that a failure could happen. By doing so, you minimize the chances that those failures could occur.

Statistical Process Control (SPC)

SPC is a methodology that uses graphical and statistical tools to analyze, control, and reduce variability within a process. SPC is a fundamental aspect of quantitative management that focuses on understanding variation of data. SPC uses data to understand and control processes with a goal of more effective management via fact-based techniques.

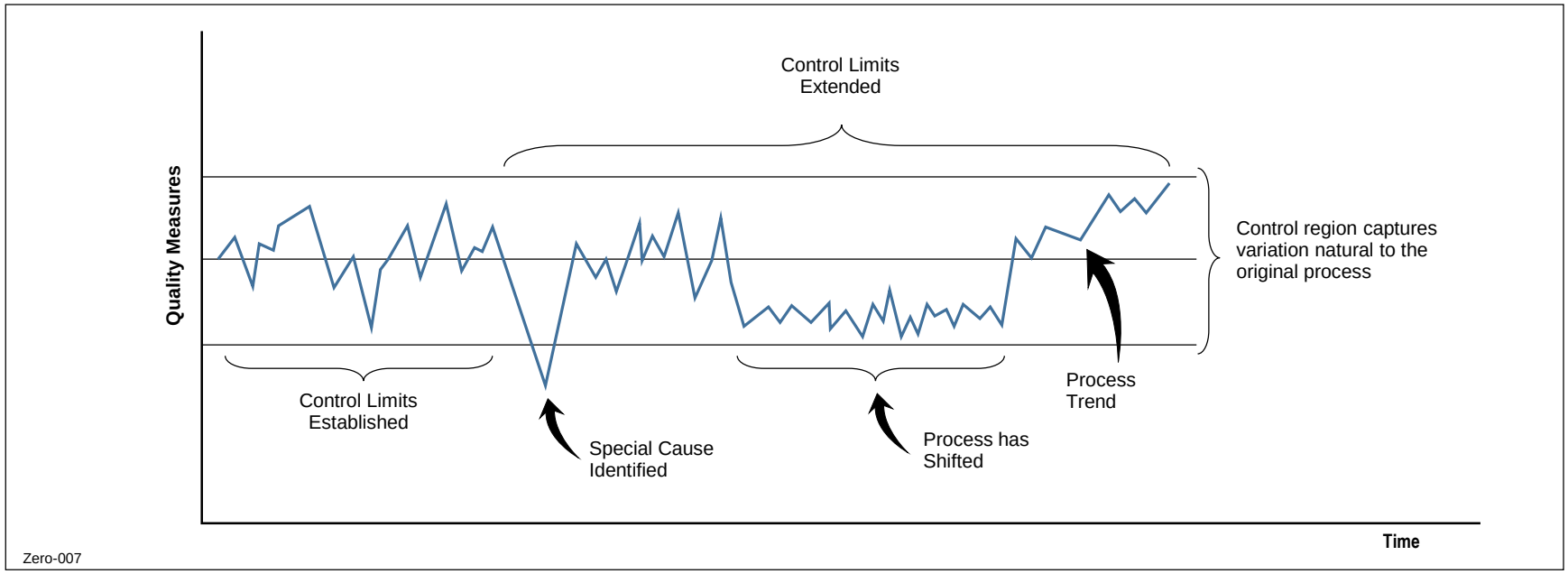
What are the benefits of SPC?

SPC offers the ability to:

- Monitor and control a process in real time.
- Make statistically valid decisions.
- Determine when and when not to take action on the process.
- Quantify and reduce variation.
- Improve understanding of products and processes.
- Determine the type of action to take (e.g., actions to eliminate special causes, actions to improve the overall process).

SPC uses many tools such as run charts, control charts, histograms, distributions, capability studies and measurement studies.

One of the main SPC tools is a control chart. Control charts provide a method of tracking process parameters over time to identify changes. Upper and lower control limits are established with initial data. These limits are extended to monitor the process over time. If a point goes outside the control limits, or if there is a different indicator like a mean shift or process trend, then special cause of variation has been identified that needs to be investigated.



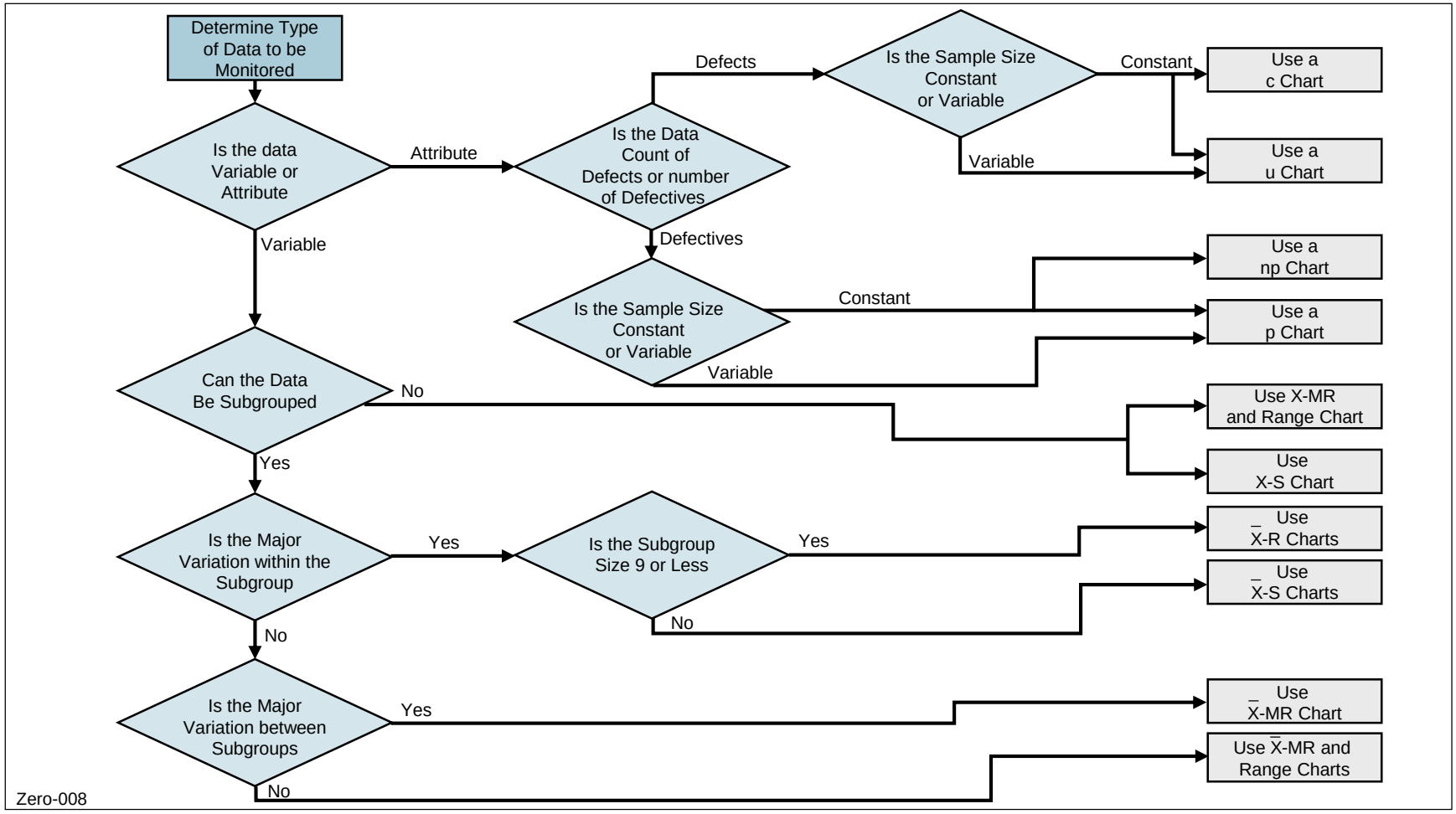
The centerline is usually the average or the goal. The control limits are the centerline, plus or minus three standard deviations. The limits are calculated by running the process untouched (i.e., according to standard procedures but without any extra tweaking or adjustments), taking samples and plugging the sample averages into the appropriate formula. Those sample averages can then be plotted onto a chart to determine whether any of the points fall between or outside of the limits or form unlikely patterns. If either of these things happens, the process is considered "out of control."

When should I use a control chart?

Statistical process control is used to monitor and control a process by those who have local responsibility for the process. Statistical control charts require process owners to take measurements of their process, plot data, interpret data and take action on the process as necessary. This enables process owners to see the effects of changes in systems, workers, policies, overtime, etc. A compilation of the data also enables one to determine the capability of the process to meet specifications and customer requirements. It does not tell the user what is wrong, but it does indicate when to look for problems. It is also used to assess and improve process capability.

What type of control chart should I use?

There are many different kinds of control charts depending on what type of data you have. You can use the flowchart for a generic guide:



What should I do if I have a process that is out of control? While there is not a "one-size-fits-all" answer to this, there are some general questions and paths to investigate. Below is a list of common questions to ask when investigating an out of control process:

1. Are there differences in the measurement accuracy of the instruments used?
2. Are there differences in the methods used by different operators?
3. Is the process affected by the environment (e.g., humidity, temperature)?
4. Has there been a significant change in the environment?
5. Is the process affected by tool wear?
6. Were any untrained operators involved in the process at the time?
7. Has there been a change in the source for raw materials?
8. Is the process affected by operator fatigue?
9. Has there been a change in maintenance procedures?
10. Is the machine being adjusted frequently?
11. Did the samples come from different machines, shifts, or operators?
12. Are operators afraid to report bad news?

Key Product Characteristics (KPC)/Key Control Characteristic (KCC)

If you could control just one thing, what would it be?

A KPC is a feature of a material, component, product or system whose variation has significant influence on safety, performance, fit, service life or producibility and cannot easily be controlled to its specified tolerances. A good KPC is the link between your customer's functional needs and the physical realization of those needs at the assembly level.

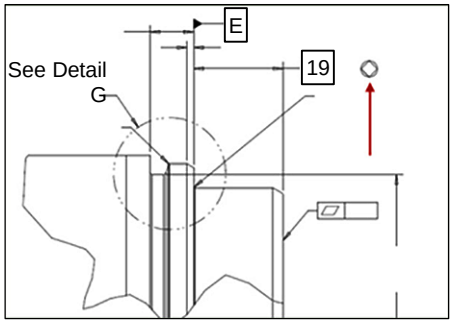
A KCC is a process parameter (such as temperature, line speed, pressure, viscosity, concentration, etc.) for which variation should be controlled around its target value to ensure that variation in a key product characteristic is maintained or minimized around its target value.

A good KCC is easy to capture, easy to analyze and monitor and is a direct input to the process.

How do KPC and KCC relate? The KPC is an attribute found on, within, or about the product. If the machine (or other process feature) of the verification is monitored and adjusted as necessary, it's a control characteristic. KCCs govern KPCs.

This is how KPCs typically appear on a drawing.

18 ◇ Denotes a Safety Key Product Characteristic (KPC)
19 Changing or Failure to Meet Indicated Dimension Can Result In Catastrophic Failure.



Zero-009

Knowing and identifying KPCs is critical to mission success! Why? Let's examine what happens when you don't.

Not identifying KPCs and the impact on design reuse

During a new product development effort that included design reuse, the engineering team made a change to dimensions from a previous design. This dimension was a KPC, but was not identified as such in the original drawing. This small change resulted in a catastrophic failure of the product during testing with the customer. The schedule was delayed and retesting was required.

Importance of identifying and flowing KPCs to your suppliers

A program was experiencing high fallout of parts from a specific supplier. The parts were failing during acceptance testing for the same characteristic. Upon investigation, it was discovered that the supplier was never flowed a requirement to meet the one KPC that most affected the performance of the produced part. Once the KPC was communicated to the supplier, it was able to produce compliant parts cheaper, faster and with higher quality. The yield for the part shifted from wildly inconsistent (80 percent for one lot, 10 percent for the next) to steady (close to 100 percent every lot). This was accomplished by eliminating the root cause and variation so we could realize true yield versus unverified variability failures.

Key Product Characteristics Question to Consider:

1. Regardless of the maturity of your design, do you understand the safety critical/key product characteristics of your design? If you don't have KPCs identified, who can help you?
2. Have KPCs been captured on your drawings?
3. Have you incorporated inspection/verification activities into your build process to ensure KPCs meet the drawing requirements?
4. Do you monitor and analyze the data generated by your KCCs for variability?
5. Have you communicated what ramifications occur if the KPCs do not meet the requirements?

Zero-010

Cost of Poor Quality

Cost of poor quality is the total cost of producing a defective product. Cost of poor quality can also be viewed as the cost associated with a product and/or systems that are not meeting quality objectives.

Why would you want to monitor and reduce the cost of poor quality?

- To increase profits.
- To increase customer satisfaction.
- As a method of prioritizing issues.
- To gain information that leads to improvement and quality planning.

What are your costs of poor quality? Here are some examples:

Known Cost of Poor Quality	
Reprocessing/rework	Rejects
Sorting inspection	Customer returns
Warranty expenses	Downgrading for product

Hidden Cost of Poor Quality	
Lost sales	Overtime to correct errors
Process downtime	Loss of goodwill
Extra inventory	Paperwork errors
Lost discounts	Delays
Damaged goods	Obsolete inventory
Premium freight costs	Incorrect orders shipped
Customer allowances	Extra process capacity

Zero-011

What Does Good Process Control Look Like?

There are many processes in your factory that have an impact on your productivity. While the complete list is wide and varied, we would like to highlight two common processes in any factory: electrostatic discharge (ESD) and foreign object debris (FOD).

Let's start with ESD. Why is it important?

Most humans cannot feel an electrostatic discharge unless it is 3,500 volts or more. Parts, assemblies and equipment can be damaged at levels lower than this. This means that damaging ESD events can occur without being felt. Employees are capable of charging and discharging tens of thousands of times a day, and may not ever feel it. Unfortunately, sensitive electrical and electronic hardware may not be as lucky.

ESD events can have results ranging from no damage to immediately detected catastrophic damage to the most harmful latent failures. Catastrophic failures occur when an ESD item no longer performs its intended function. These failures usually result in an assembly or equipment functional failure and are typically caught during in-house testing. Latent failures are the result of undetectable damage. They usually occur after a period of normal operation. Latent ESD damage is either partial or a failure that can reduce the life of the deliverable product.

What are the impacts?

- In-house failure costs:
  - The cost of replacing the failed item.
  - Costs associated with material reviews and disposition.
  - Manufacturing throughput reduction, delivery delays and cost increases.
  - Customer dissatisfaction with schedule slips.
- Field failure costs:
  - Customer dissatisfaction with quality and performance.
  - Costly field service and replacement.
  - Diminished reputation and reduced customer confidence.
  - Possible loss of follow-on or future sales.
  - Critical strategic mission failure.

ESD is an important process to understand. For more information on ESD control program requirements, refer to MIL-STD-1686C.

Another important process in your factory is FOD. FOD is sometimes referred to as foreign object elimination (FOE).

A foreign object (FO) is a substance or article alien to the product or assembly that could cause damage.

FOD is any damage attributed to a foreign object that can be expressed in physical or economic terms that has the potential to degrade the product's required safety and/or performance characteristics.

Sources of FOs include:

- People
  - Misplaced items.
  - Accountability.
- Processes
  - Inherently these generate FO.
- Continual inspection.
- Item accountability.

Common types of FOs:

- Hardware and material
  - Screws, nuts, bolts, O-rings, wires, components.
- Process by-products
  - Excess sealant, solder balls, metal clips, paint chips, wire clippings.
- Tools
  - Pliers, wrenches, screwdrivers.
- Personal items
  - Jewelry, sunglasses, food, money, keys.
- Other items
  - Labels, pen caps, pencil lead, wipes, batteries.

What are some ways to combat FO?

Proper hardware control is one preventive method. Make sure production hardware is accounted for during assembly, storage and production, using content labels that state the amount of items enclosed in a container. Also, ensure accountability by only using consumables based on their immediate need, and cover hardware when not in use.

Another way to prevent FO is to practice good housekeeping. Don't allow work stations or surrounding area to become cluttered with unnecessary items. A good way to do this is by utilizing the "clean as you go" approach.

Eliminating FOD and its causes helps reduce defects and escapes to your customers.

What Does Good Process Control Look Like — Special Processes

What are special processes?

Process control saves both you and Raytheon money. We share an end goal of delivering a quality product, on time and within budget.

When looking at process control within your organization, certain processes cannot be verified as easily as others. If a process cannot be verified in its final state without destructive testing, it is considered a special process.

These special processes have a tendency to add cost if not dealt with at the planning phase of production.

Special processes are referenced in AS 9100, 7.5.2 Validation of Processes for Production and Service Provision, which states the following:

"The organization shall validate any processes for production and service provision where the resulting output cannot be verified by subsequent monitoring or measurement and, as a consequence, deficiencies become apparent only after the product is in use or the service has been delivered."

NOTE: These processes are often referred to as special processes.

Validation demonstrates the ability of these processes to achieve planned results.

The organization shall establish arrangements for these processes including, as applicable:

a) defined criteria for review and approval of the processes.

b) approval of equipment and qualification of personnel.

c) use of specific methods and procedures.

d) requirements for records (see 4.2.4).

e) revalidation.

Quality Management Influence

As a QM in your company, it is your responsibility to flow down best practices and assure controlled and capable production processes of your programs. The goal of your business is to deliver a high quality product on time, within budget. We understand that and want you to succeed. Because, in the end, your success is our success.

To address special processes in a way that allows you to accomplish that goal, RMS recommends Nadcap as a source of information. In the end, process control is what your company needs to fully verify and validate your product prior to delivery to your customer.

When addressing special processes, it's important to fully use both process control and process capability methods. ISO 11462-2:2010(E): Guidelines for implementation of statistical process control (SPC). Several books offered on the ASQ bookstore and/or Amazon.com may be helpful.

Nadcap Audit Guidance

Nadcap defines the following topics as special processes and ensures compliance through accreditation. Audit checklists are available through its eAuditNet link. Registration is free and may help in verifying where your company stands with your quality system.

Chemical Processing (SAE AC7108): Anodizing, chemical cleaning, chemical milling, conversion/phosphate coating, etching, laboratory evaluation, paint/dry film coatings, plating, stripping, surface prep prior to metal bond and surface treatment/passivation.

Coatings (AC7109): Thermal spray, vapor deposition, diffusion coating process, stripping of coated parts, coatings evaluation, plating of coated parts and heat treating of coated parts.

Composites (AC7118): Prepreg/adhesive bonding/resin film infusion, metal bonding, core processing and liquid resin processing.

Conventional Machining as a Special Process (AC7126): Hole-making, turning, grinding, broaching, milling, and edge treatment.

Elastomer Seals (AC7115): O-rings, plate seals/rubber bonded to substrates, molded shapes, compression seals and compounding

Electronics (AC7119, AC7119/1, AC7119/2, AC7119/3, AC7120, AC7121): Printed boards, circuit card assemblies and cable and harness assemblies

Fluids Distribution (SAE AS7112): F-Hose manufacturing, fittings and other machined components, couplings, hose assembly, value added hose assembly distributors and titanium tubing manufacturers.

Heat Treating (AC7102): Metal systems, heat treating process, heat treating, equipment, brazing, and hot forming.

Materials Testing Laboratories (AC7101, AC7101/11, AC7006): ISO/IEC 17025 Equivalency (AC7006), chemical testing, mechanical testing, metallography (micro and macro), hardness, corrosion, microhardness, DTA, test specimen preparation.

Measurement and Inspection (AC7130): Coordinate measuring machine (CMM), airflow, laser trackers and articulated arms

Nondestructive Testing (AC7114): Magnetic particle, liquid penetrant, ultrasonic and radiography.

Nonconventional Machining and Surface Enhancement (AC7116, AC7117): Electrochemical machining (ECM), electrochemical grinding (ECG), electrical discharge machining (EDM), laser beam machining (LBM) and shot peening.

Sealants (AE AS7200/01, SAE AS7202): Polysulfide, polythioether, silicones, polyurethanes and adhesion promoters.

Welding (AC7110): Diffusion welding, electron beam welding, flash welding, friction/inertia welding, fusion welding (including foundry in-process/casting repair), laser welding, percussion stud welding, resistance welding and torch/induction brazing, welder/welding operator qualification and metallographic evaluation of welds.

Nonmetallic Materials Testing: Mechanical testing, physical testing, chemical testing, thermal testing and flammability testing for Class A composites and Class B: adhesive/adhesive primers

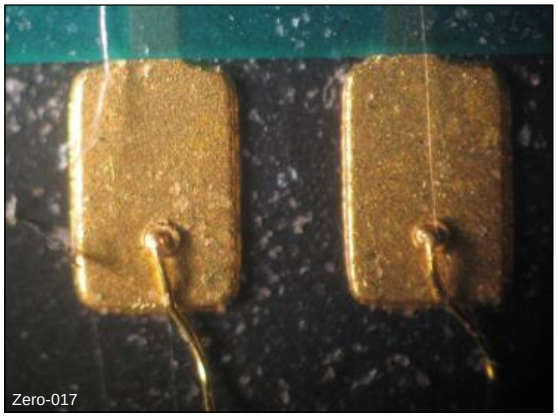
Nonmetallic Materials Manufacturing: Raw material manufacturing of resin, prepreg and adhesive film.

Example: Composite — Bonding

Supplier A was depending on inspection and automatic optical inspection (AOI) to catch bonding defects.

- Ball and wedge bonding had high levels of defects.
  - Bonding was manually sighted.
  - Needed bond count per job was tracked by humans.
  - Inspection and AOI assessed quality at next operation.
  - High defect levels required unnecessary material movement of WIP.

After reviewing the data, Supplier A embraced process control methodologies and created a plan of attack to deal with its special processes.



Short Term:

- Collected targeted SPC metrics on inspection effectiveness.
- Implemented Kaizen C-Is after process gembas to find obvious improvement opportunities.

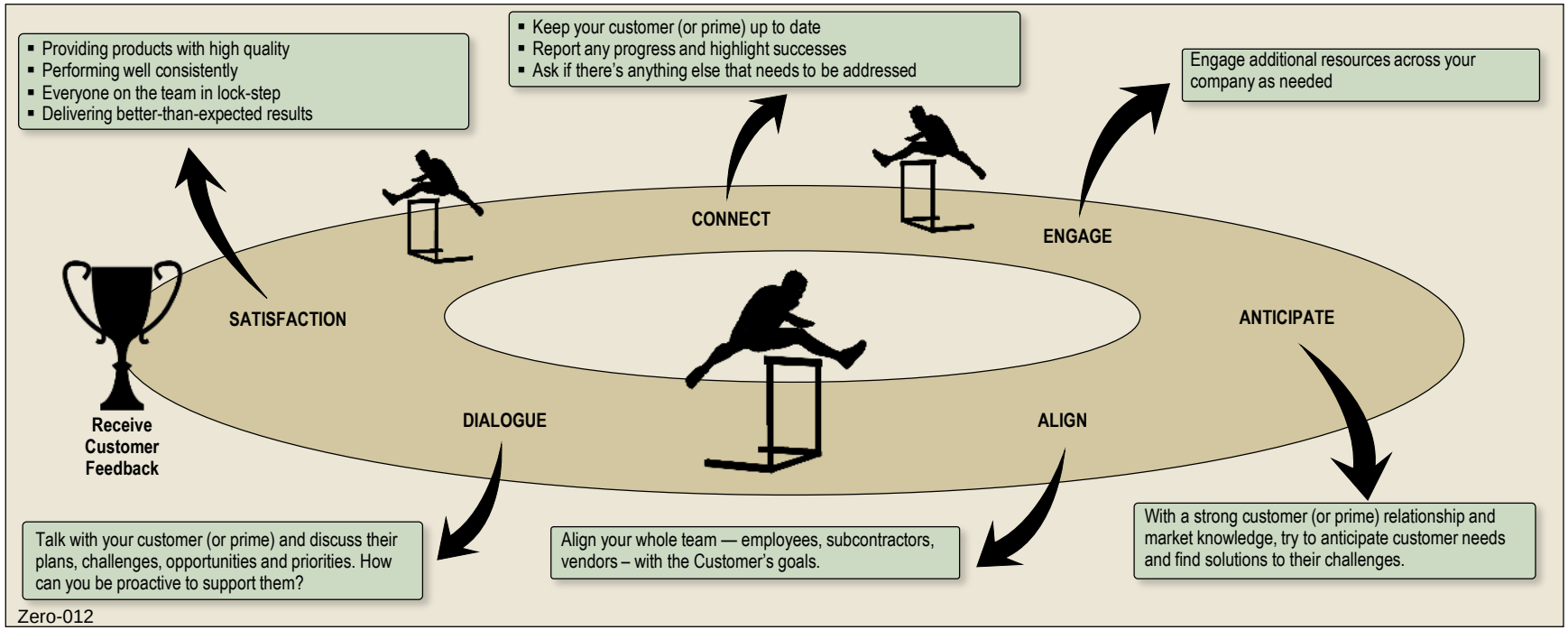
Long Term:

- Use internal "smarts" in wedge-bonder to detect correct amount of wire deflection in a good bond.
- Used computer to count how many good bonds occurred.
- Upgrade ball-bonding equipment for similar in-phase inspection capability, leaving AOI as process double check.

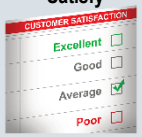
Outcome:

Since July of 2013 work volume has doubled, while defects have dropped by two-thirds compared with original baseline performance. Supplier A leaned operation, minimized movement, and raised quality that combined let to an increased satisfaction level from the customer and better profit margin for the supplier.

What Does Good Quality Look Like?



Each customer is unique. Tailor your approach based on the risk and size of the effort.

Dialogue 	**Things to consider:** ▪ Discuss plans, challenges, opportunities and priorities – What is keeping them up at night? – What are the barriers to their success? – Do you understand the customer's goals – short term and long term? ▪ How can you proactively support them? ▪ Highlight the good things that you are doing. Leaders often fail to market the good things that they are doing with their customers. It is important to communicate successes. ▪ If the customer is pressuring you, then the odds are the customer is getting pressure from someone else. Consider what you can do to help relieve the pressure from the customer.
Align 	**Things to consider:** ▪ What are your customer's agency/organization goals? ▪ Engage teammates, subcontractors and vendors ▪ Communication between all stakeholders, including subcontractors is very important, expecially when the effort includes multiple locations. Regular face-to-face meeting with team members from different locations is highly recommended; this reduces the chance of miscommunication, increases work productivity, increases accountability, and produces a better working relationship within the team.
Anticipate 	**Things to consider:** ▪ Don't be hesitant to ask! Meet with your customer and ask them about their plans for the next year, three years, five years. ▪ Conduct quality function deployment (QFD) exercise, or equivalent, with the customer and subcontractors to help determine which program requirements are most important to the customer. Periodically review and update. Be aware of trends in their industry. Industry news can help you predict what your customers might be working on and how you can help them. ▪ Use any available resources to keep up on your customers' industries and competitive information so you can properly position yourself to anticipate their needs. ▪ Maintain customer "wish list" to bring out when funding becomes available.
Engage 	**Things to consider:** ▪ Focus on customer interactions. When you interact with your customers, your aim should be to ensure that the interaction is a satisfying one. Going the extra mile to make your customers feel respected and valued will have a significant impact in how they regard doing business with your company. ▪ Have a goal in mind. Keeping the lines of communication open with your customer is an on-going activity but it should involve more than just staying in touch or idle chit-chat. Use these opportunities to pursue new product ideas or grow customer loyalty. ▪ Capitalize on social media. Social media can be a powerful tool to engage with your customers. Numerous social networking channels are available and they present endless opportunities to engage your customers. However, understand that each of these social media sites is different and requires a different strategy. Use social media to form strong relationships that involve frequent online interactions.
Connect 	**Things to consider:** ▪ Show your customers respect. Don't just talk about respect, demonstrate it. ▪ When engaging with your customers, listen to hear and not to respond. ▪ Make your customers feel as if they are your top priority. ▪ Seek ways to establish an emotional connection with your customers. Having empathy towards your customers and their expectations will help you form an emotional bond with them. ▪ Make a list of your customers by name and role. List something specific that demonstrates you know them personally.
Satisfy 	**Things to consider:** ▪ Focus on performing well consistently, with everyone in the team aligned. ▪ Design margin into your product where it counts. "Excite" your customer by exceeding expectations. ▪ Quality improvement activities that can lead to increased customer satisfaction include developing new product features, reducing cycle time for providing service and centralizing operations. ▪ Process quality improvements can improve customer satisfaction. Invest in identifying where your processes are failing to meet customer expectations. Some signals to look for include complaints, defects, process deficiencies and other costs related to poor quality.

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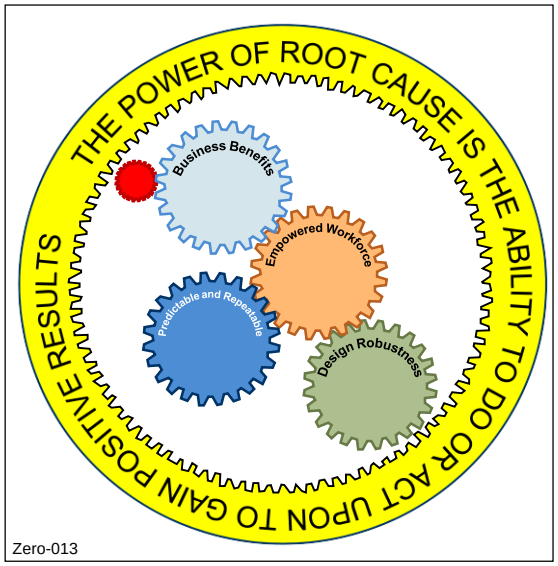
What Does Good Quality Look Like — Power of Root Cause



Nonconformances are seldom traced to a single contributing factor. They are usually the result of interconnected effects from processes, systems and materials. To successfully mitigate and prevent escapes from reaching our customer, it is vital that we understand all the contributing interrelated relationships, layers and factors.

Quality professionals must investigate the facts and data to discover the systemic root cause and device corrective action of the nonconformance. It is imperative to gain an understanding of the mechanics of the parameters, manufacturing processes, engineering support, materials and detection-testing/inspection involved in the failure mode and develop a strategy of continual improvement to prevent escapes to customers and elimination recurrence.

A culture of quality drives continual improvement and a never-ending pursuit of quality perfection, resulting in customer satisfaction, increase in profit margins, and an empowered workforce.

Gears in the Power of Root Cause Wheel Business Benefits:

- Higher profits.
- Cost competitive.
- Highest-performing cost and quality.
- Customer satisfaction.
- Quality culture.

Empowered Workforce:

- Focused on zero escapes.
- Proactive.
- Lessons learned.
- Enlightened.

Predictable and Repeatable:

- Process control.
- Predictable quality.
- Predictable on-time delivery.
- Problem elimination.
- Proactive.

Design Robustness:

- Easier to produce.
- Applicable to other products.
- Applicable to other processes.
- Creation of Quality culture.

Why bother investing the resources to drive to true root cause? If you take the time and analyze any data for three months straight, you are more than likely going to find that the majority of the defects you see are repetitive. Why choose to live with the defects rather than investing the resources to correct the root cause? In the end, you can wind up "dying the death of a thousand cuts" financially. Quality professionals can help change this paradigm. Help people understand that spending a relatively small amount up front is better than suffering the cost and schedule delays caused by defects.

For example, one company decided to implement the use of bar coded dispositions to allow for faster processing of defects. While this increased their ability to process defects faster, it did nothing to reduce the number of defects they were having to process! They never truly understood the true root cause of the defects they were seeing.

What Does Good Quality Look Like – Effective Quality Management System

“QMS, we have one of those… I think.”

What do we mean by an “effective Quality Management System, or QMS? Let’s start by defining what QMS means. The QMS is the controls and standards by which the company conducts business. The QMS takes signals from all key corporate processes (e.g., order receipt, design, inventory, manufacturing, delivery) to monitor the health of these processes against these standards. It is impeditive that the QMS provides all levels of management, particularly executive management, with an accurate and timely “voice of the health of the processes.” Management then uses these signals (metrics) to take appropriate actions to ensure the continued health of the business and improve on a continual basis.

Your company has a core business area and from that produces a product. Maybe it's a cable harness or a circuit card or a rocket motor. Whatever that product may be, you have certain processes, procedures and policies that are followed for that product to be developed, produced and supported. That, then, is your QMS.

There are industry accepted standards that can be used to structure your QMS. ISO 9001:2008 or AS9100 are both industry recognized standards for effective QMS.

One of the main tenets of the ZERO initiative is having an effective QMS. The graphic below illustrates how a QMS is integrated into the life cycle of your product.