Preventing Supplier Quality Problems

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A Practical Approach to Defect Prevention Planning

Dennis R. Owens
Sandia National Laboratories

SAND No. xxxxxxxxx

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Objectives

At the end of this presentation, you should be able to:

- **Understand how to rethink your approach to supplier quality (critical thinking beyond procedures and policy)**
- **Identify critical factors and attributes of a well defined team of professionals (the minimum set)**
- **Understand how to calculate the budget proposal to influence your managements decision making and answer trade-off questions on risk mitigation**
- **Review a tool to help stimulate thinking on data collection**

Note: the focus of this approach is for product /service considered critical to quality (CTQ) objectives or long lead time items.

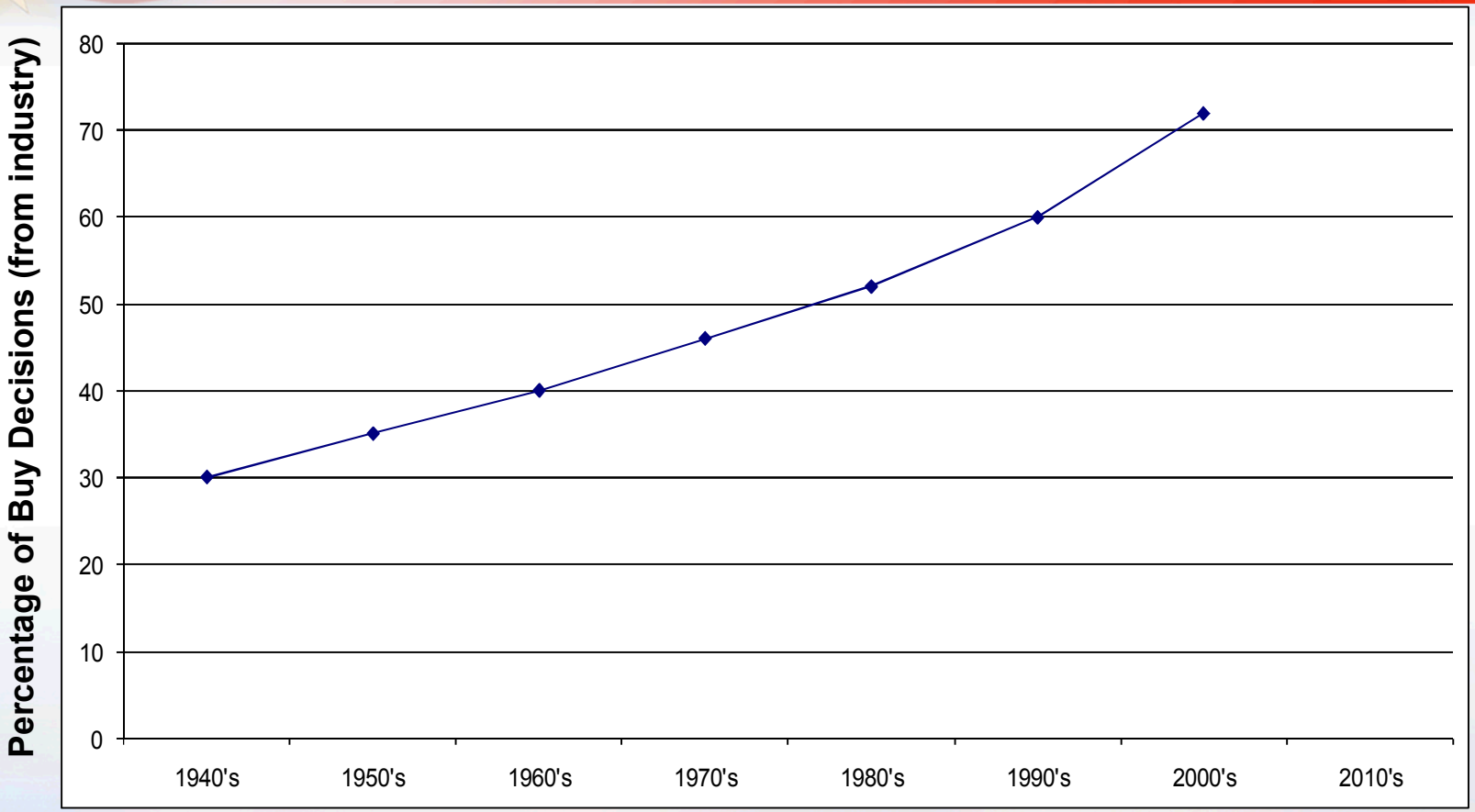
A bit of Wisdom

- ***Relationships with suppliers can be like a marriage and breaking up something like divorce. How well the marriage or well the breakup goes depends on how conflict is managed and how well the rules of engagement were in the first place(i.e. the contract)***

Sherry R. Gordon

Author of Supplier Evaluation and Performance Excellence (A guide to meaningful metrics and successful results)

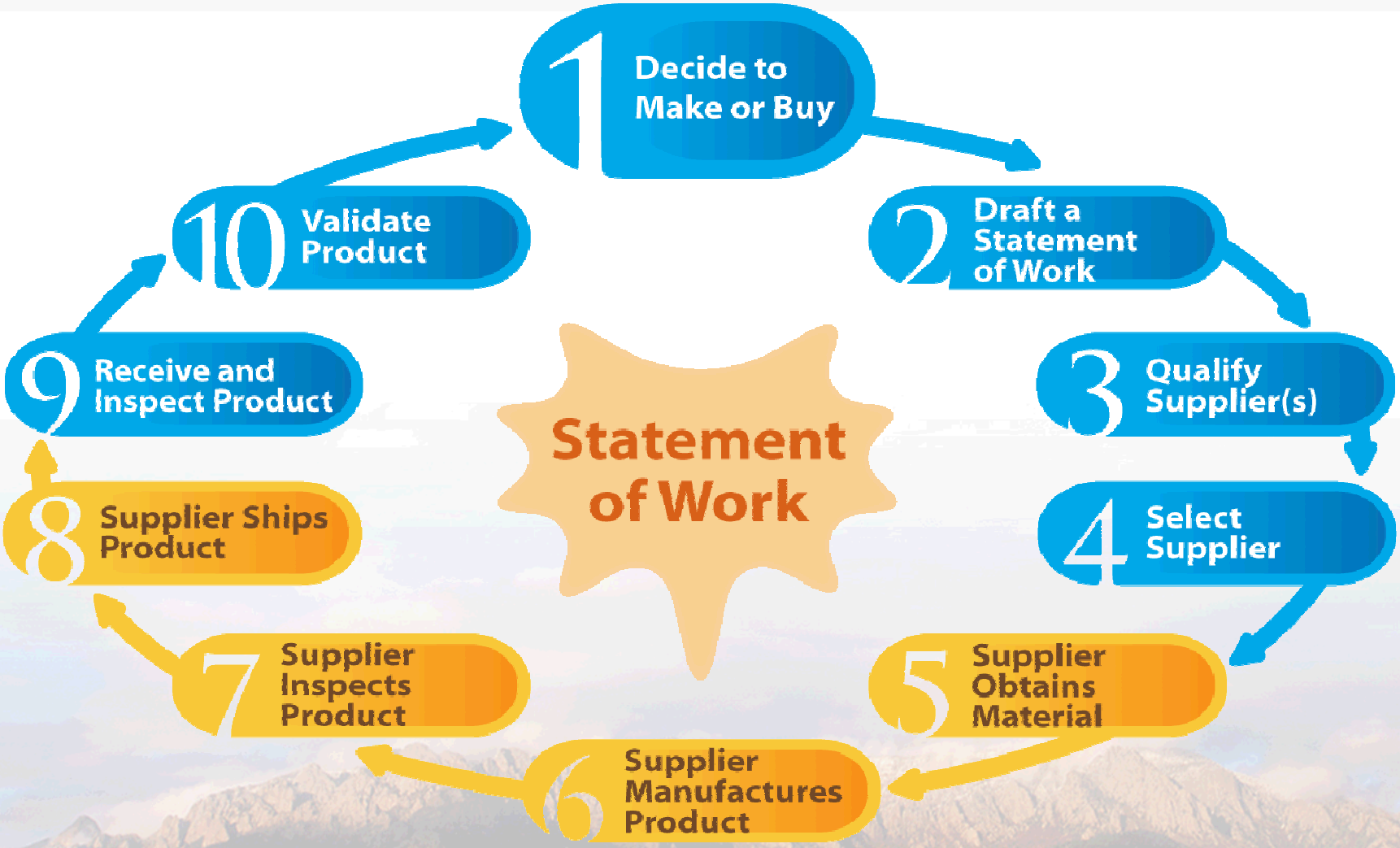
Why should you Care about Supplier Quality Supplier Quality?



The need to manage supplier quality is becoming increasingly important as in-house manufacturing shrinks and the use of external suppliers grows.

Reference: Ragatz & Sandor(Michigan State University)

The Process: Preventing Supplier Quality Problems



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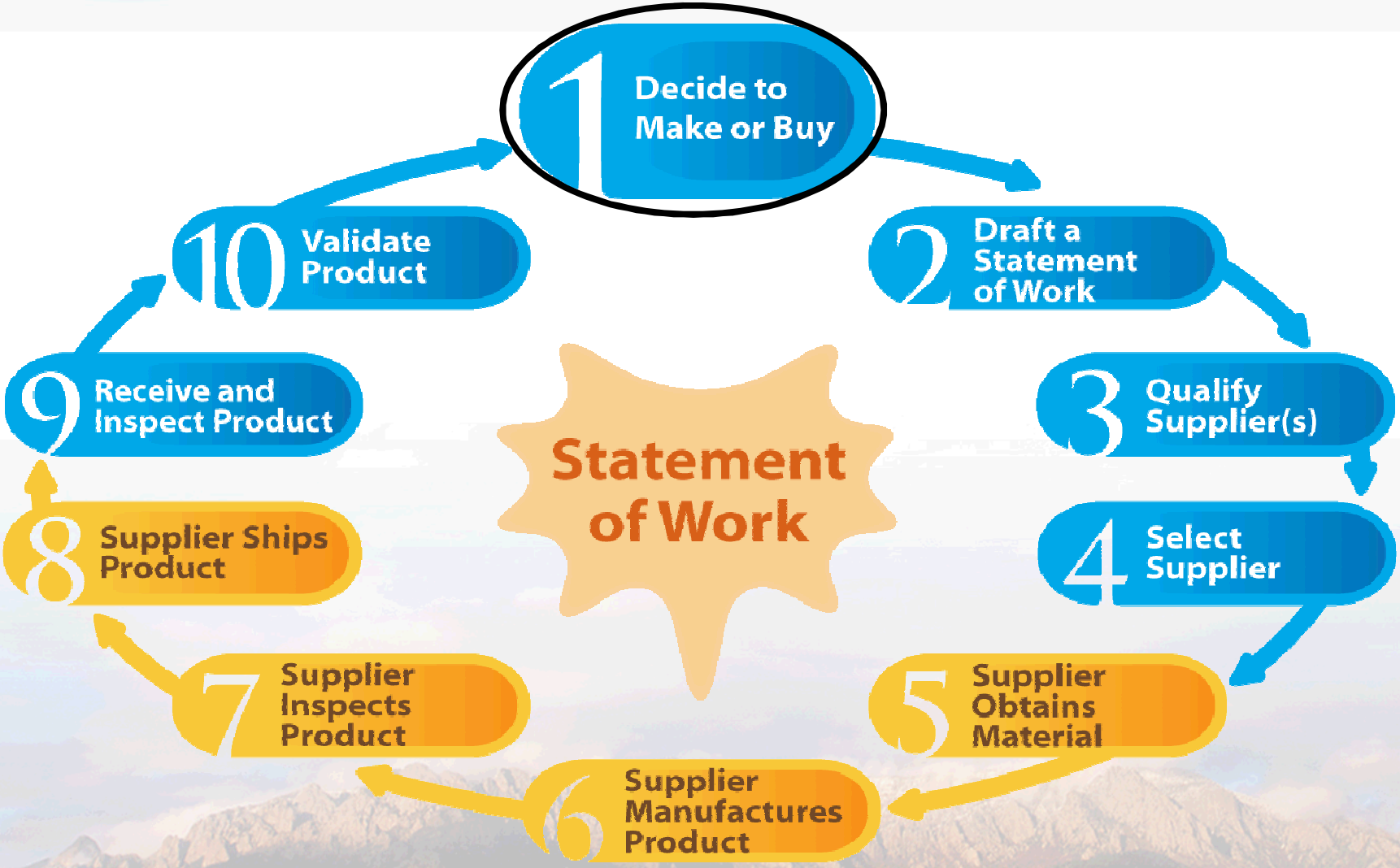
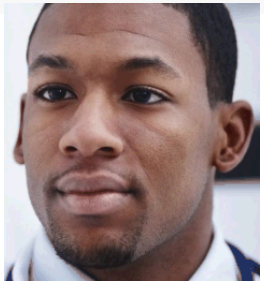


Form the Team



Technical Lead

- Specify requirements
- Define budget and schedule
- Set a decision date
- Clarify roles on team and Make/Buy responsibilities

Quality Engineer

- Verify that existing requirements are current, complete, consistent and sustainable
- Identify risks in Make/Buy options

Buyer

- Provide procurement guidance on Make/Buy decision
- Explain financial, contractual considerations dealing with suppliers

Who Else Might You Consider?

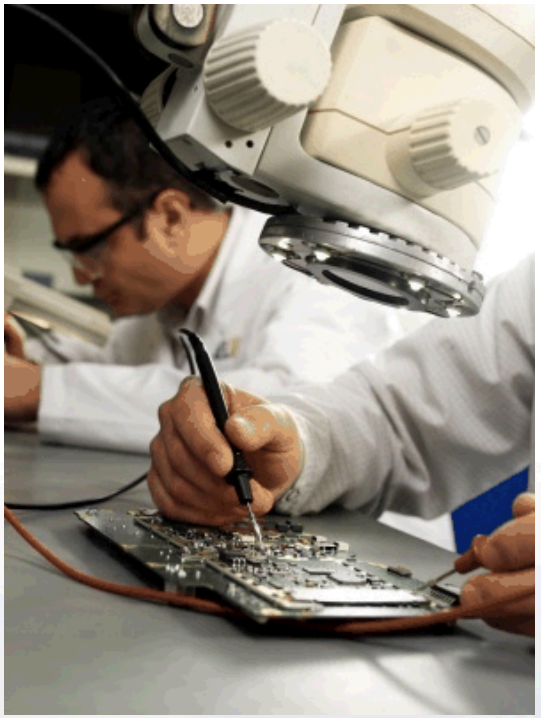
Gather Information to Prepare for Make/Buy Analysis

- **Requirements and Goals**
  - **Product specifications,**
  - **Quantities,**
  - **Process requirements,**
  - **Business requirements**
- **Project schedule, budget, other constraints**
- **Risk assessment for project**

Make/Buy decisions are typically made early in the project

Identify Critical Factors That Impact Make/Buy Decision

- Product maturity
- Funding availability and timing
- Schedule constraints
- Resources (time, money, personnel, equipment)
- Technical competence and readiness
- Level of oversight needed
- Reliability and availability
- Past experience and results
- Risk management opportunities
- Quantity required (capacity and “interest”)
- Price/cost
- Financial health & stability
- Costs, risks of qualification



The Make/Buy analysis involves prioritizing critical factors

Weigh the Risks

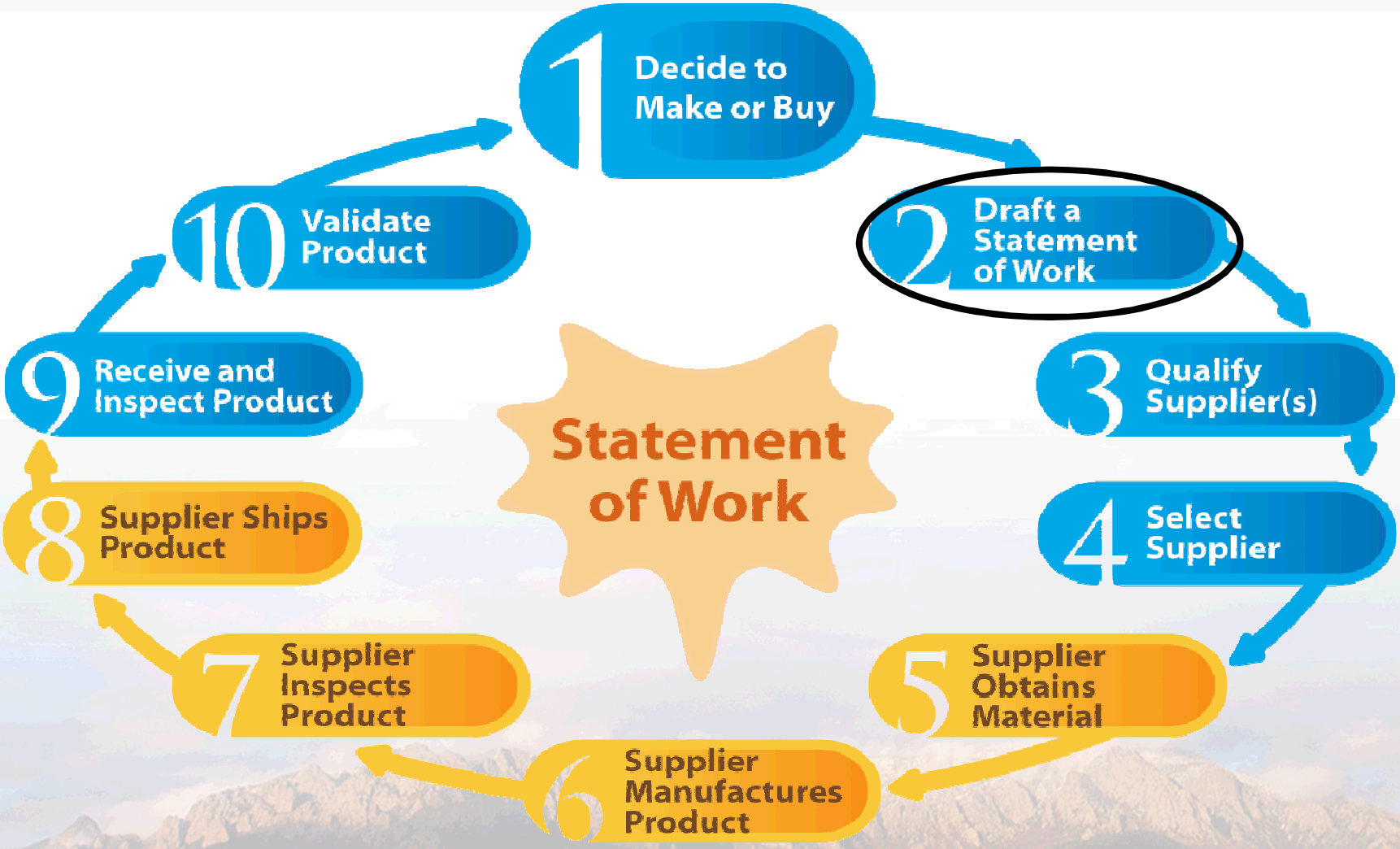
- **Identify and assess the risks of Make and Buy – be honest!**
- **Risk management planning**
  - **How would you mitigate these risks if you Make?**
  - **How would you mitigate these risks if you Buy?**

Decide to Make or Buy

- Which choice, Make or Buy, provides the best value to SNL and our customers?
- Which choice, Make or Buy, mitigates more risk?
- Decide
- Record analysis, decision and rationale

What decision provides the best VALUE and the least risk for you and our customers?

The Process: Preventing Supplier Quality Problems



What's a Statement of Work?

A package of drawings and documents

- All your requirements
- Additional detail so your supplier can understand what you really want

A basis for mutual understanding

- Improving collaboration with your supplier
- Answering the supplier's questions
- Ensuring you get the product you want on time and within budget— no mistakes

The heart of the contract

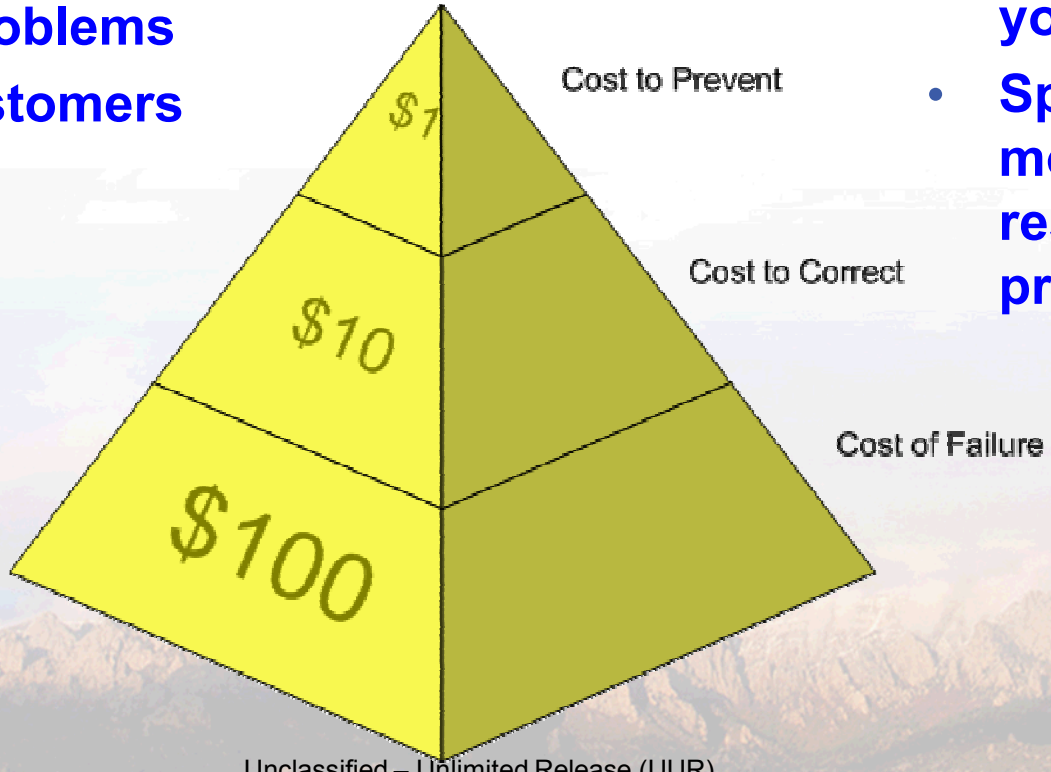
- The basis for product acceptance and payment
- The foundation for any legal argument over defects or failures

Plan ahead because everything comes back to the Statement of Work

Why Draft a Statement of Work?

- **With a Statement of Work**
  - **Stay within budget**
  - **Minimize rework**
  - **Deliver on time**
  - **Prevent problems**
  - **Satisfy customers**

Vs



Without SOW

- **Exceed budget**
- **Increase rework**
- **Deliver late to your customer**
- **Spend time and money resolving problems**

Who Does What?

Technical Lead

- Assembles team
- Sets schedule
- Analyzes technical capabilities

- **Quality Engineer**
- Identifies potential vulnerabilities
- Recommends requirements or evidence for SOW to prevent problems

Buyer

- Sole authority who can commit on Sandia's behalf
- Raises relevant questions
- Polishes the SOW

How is the Statement of Work Used?

- Spells out what we need to learn from prospective suppliers, via the Request for Quote, before selecting a supplier
- Forms the core of the Contract
- Defines acceptance criteria spelling out what we will need to see before we accept the product, and pay.
- Lays the legal basis for refusing to pay, or negotiating for rework, repair, scrap in case of defects.

The Process: Preventing Supplier Quality Problems

Supplier Rating. What does it really mean?

A Certified Supplier: is one that after an extensive investigation, is found to provide quality products or service of such a level that routine inspections are no longer needed. James L. Bossert, Editor, The Supplier Management Handbook, sixth edition

A Preferred Supplier: is one that exceeds the minimum qualifications, requires less quality review or oversight and attains a level of performance that makes you want to more business with them rather than Approved Suppliers. Sherry R. Gordon, Supplier Evaluation and Performance Excellence

An Approved Supplier: is one that meets the minimum qualifications as a source and can do business with them. (in other words, they have a "fair" chance of doing it right) Sherry R. Gordon, Supplier Evaluation and Performance Excellence

Lets look at this a different way

The supplier we want: is one that has shown a complete and thorough understanding of our needs. In doing so, the supplier has set in place a process that has been investigated and has been found to yield products or services that meet or exceed our requirements. James L. Bossert, Editor, The Supplier Management Handbook, sixth edition

Regardless of the definition used it needs to cover the predictive nature of how to ensure tomorrows production is going to be better or at least equal to yesterday (if yesterday was a good day) James L. Bossert, Editor, The Supplier Management Handbook, sixth edition

Make Sure You Have the Inputs You Need

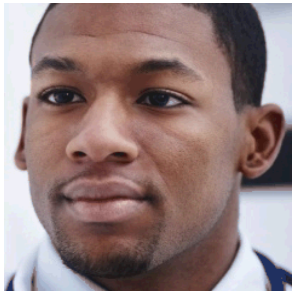
Confirm

- **You have reviewed any existing information about the supplier**
- **You have reviewed the Statement of Work**
  - All product requirements and specifications
  - Process requirements
- **You have reviewed proposals**
  - Supplier responses to Sandia's Request for Quote (RFQ)

Evaluate Candidates

Compare proposals against the evaluation criteria

Technical Evaluation Team looks at responses on technical issues



- **Are the projects referenced by the candidate similar in scope, size and complexity to the proposed project?**
- **Does the candidate have a record of conforming to specifications and to accepted workmanship standards?**
- **Does the candidate have a good record of containing and forecasting costs on previously performed cost-reimbursement contracts?**
- **Have they adhered to contract schedules?**
- **Have they demonstrated cooperative behavior?**
- **Are they committed to customer satisfaction?**
- **Do they have a business-like concern for the interest of the customer?**

Buyer does separate analysis of pricing

Identify a small group of supplier candidates

Decide Which Suppliers are Qualified

Record your decision, and the evidence behind it

- Write up the strengths and weaknesses of each supplier, so you can defend your decision
- Include RFQ, proposal, and supplier assessment info
- If appropriate, input your evaluation results in your tracking system

You are now ready to select one of these suppliers, and award a contract

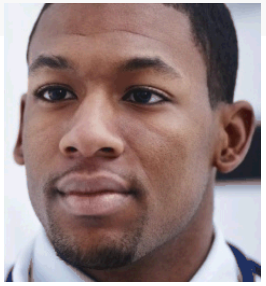
The Process: Preventing Supplier Quality Problems

Evaluate Competitors

Technical team reviews:

Proposals from finalists

- Team's initial evaluation of each proposal (Module 3)
- Reports on site visits



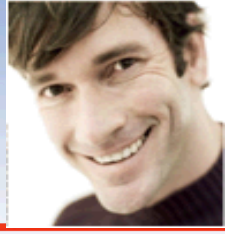
Buyer reviews:

- Total life-cycle costs
- Financial capability of each finalist
- Reasonableness of price

Decide "Best Value" and Trade Offs

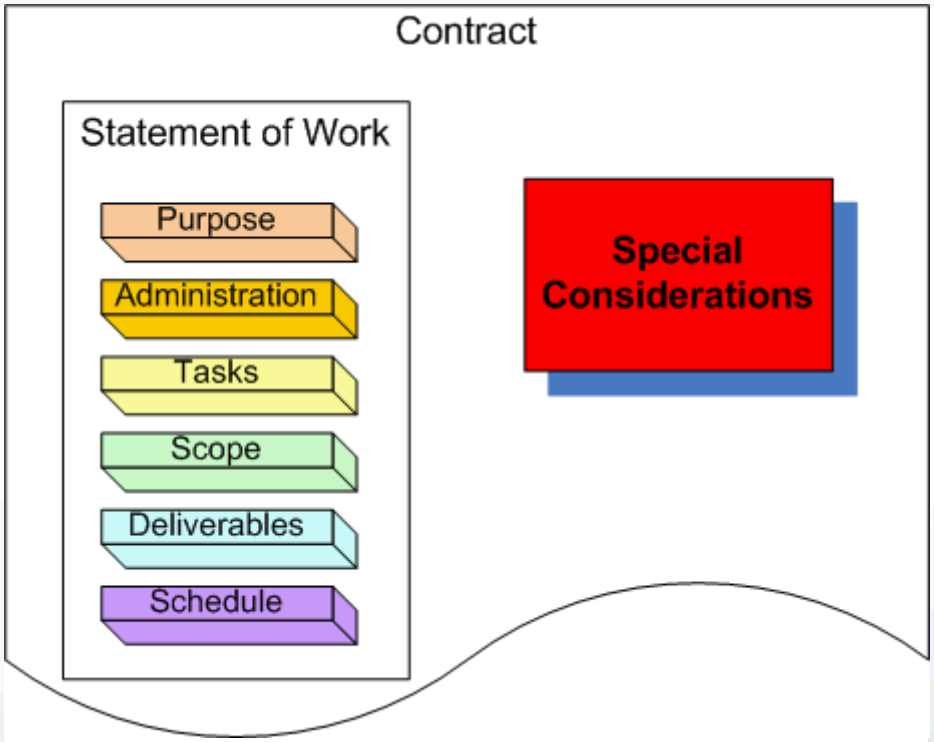
- **Technical team reaches agreement on technical winner, then meets with Buyer to decide which supplier offers the Best Value (trade off)**
- **To decide Best Value, consider more than price:**
  - Technical capabilities and resources
  - Past performance
  - Related Experience
  - Safety
  - Schedule
  - Total life-cycle costs
  - Financial capability
  - Reasonableness of price

Place the Contract



Buyer negotiates final contract, and commits Sandia to the terms

- The contract is a final legal document
- Any later changes to the contract must be negotiated between the Supplier and your organizations Buyer



The final Statement of Work package is incorporated into the contract.

Don't Forget. The contract vehicle you use has impact on the final results

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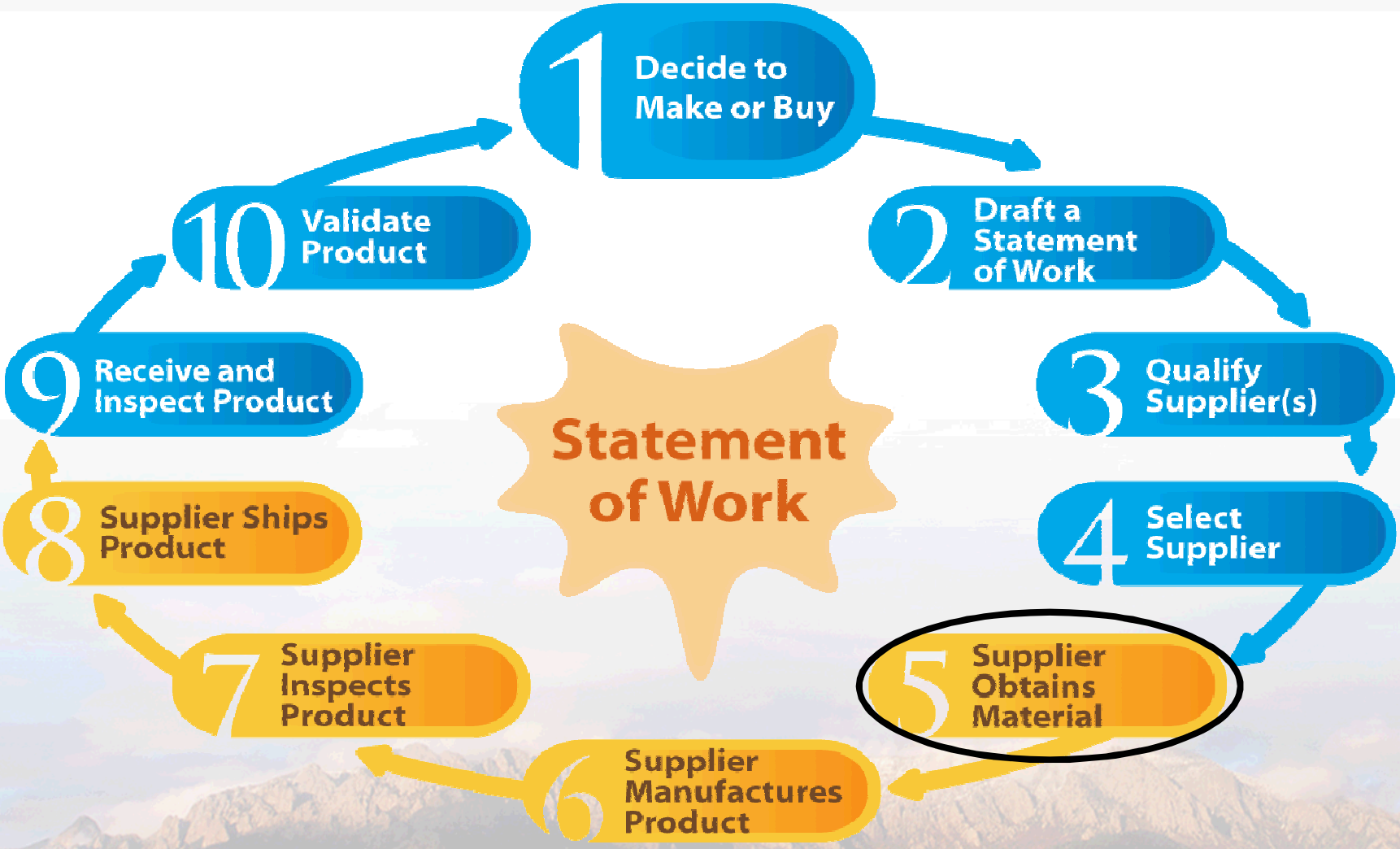


Supplier Receives and Inspects Material

Include requirements in SOW:

- How supplier "**receives**" material
- How supplier **verifies** compliance with your requirements
- How supplier **manages** and **communicates nonconformances**

Involve Subject Matter Experts (SME) during planning and SOW development

Suspect/Counterfeit Items

The threat IS real

Suspect Item:

Inspection indicates that the product may not conform to established Government or industry accepted **specifications** or national consensus **standards**

Counterfeit Item:

A suspect item that is:

- A **copy** or **substitute** without legal right or authority to do so
- A product whose material, performance, or characteristics are **knowingly misrepresented** by the supplier.
- A product that has been **mislabeled** or shipped with **fraudulent documentation/certification**

How far down does your supply chain verification go?

Counterfeit AMP02

- **None of the samples had the correct die for this Analog Devices Part**
  - Some had Maxim Die
  - Others had wrong PMI Die

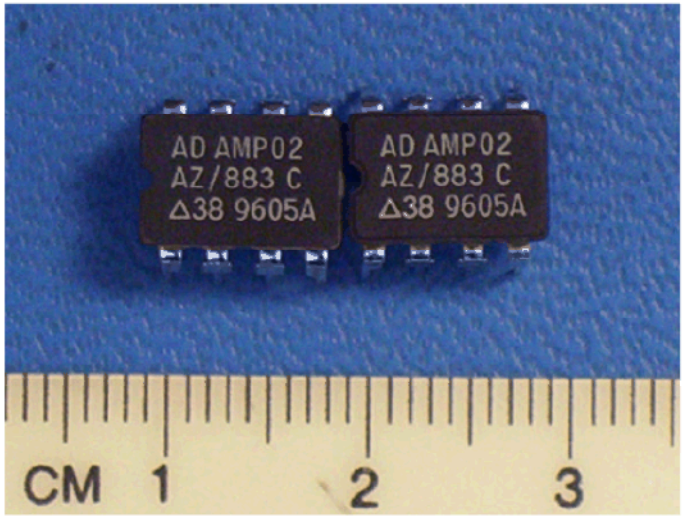


Figure 1 Optical photo of the parts as they were received for analysis. Note all markings are identical.

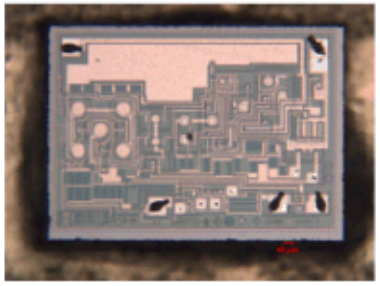


Figure 8 Optical photo of the die found in S/N 1. Note the die is noticeably different than S/N 2.

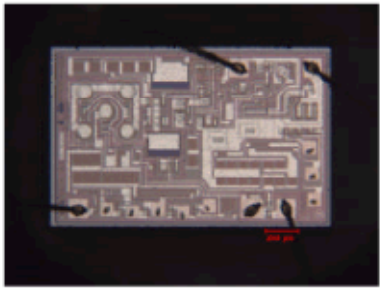


Figure 9 Optical photo of the die found in S/N 2. Note the die is noticeably different than S/N 1.

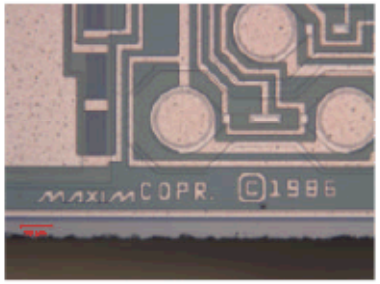


Figure 10 Optical photo of die markings found in S/N 1. Note the manufacture of the die is Maxim.

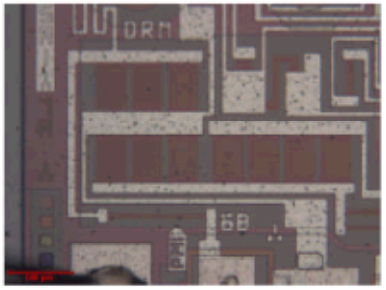


Figure 11 Optical photo of the die markings found in S/N 2. Note the manufacturer of the die is PMI

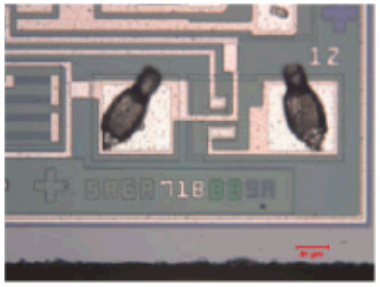


Figure 12 Additional die marking photos of S/N 1

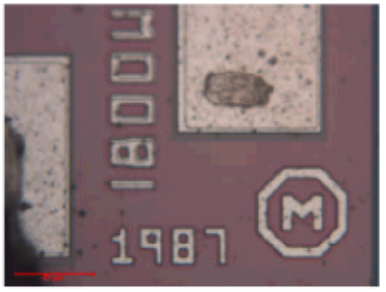


Figure 13 Additional die marking photos of S/N 2

Suspect/Counterfeit Items

Where do we find suspect/counterfeit items?

- Newly supplied or purchased items
- Equipment already installed

Government-Industry Data Exchange Program(GIDEP) sends alerts

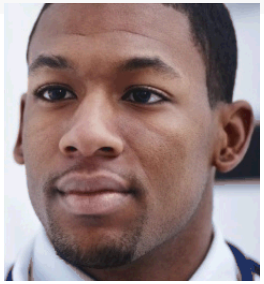
- http://www.gidep.org/

Supplier Stores Conforming Material

Why should we care?

- **Potential for major problems if material stored improperly**
- **If your product's material needs special storage, preservation, protection, handling**
  - Include requirements in SOW
  - Verify compliance
    - Obtain evidence!

Roles of the Team Members



Technical Lead

- Verify supplier QMS during technical evaluation
- Specify requirements for incoming material
- If NC – determine impact on product performance
- ID requirements for special handling

Quality Engineer

- Verify implementation of supplier QMS
- Map material requirements and specifications to supplier processes
- Determine additional evidence required to disposition NC
- Help develop special handling requirements
- Follow up on corrective actions at supplier after NC

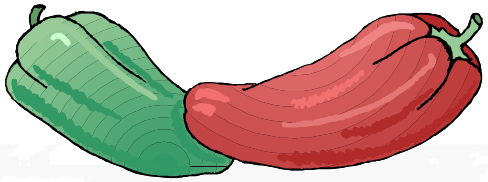
Buyer

- If GFM/P include in contract
- Assure special handling requirements in contract
- Assist with resolution of NC via contract

The Process: Preventing Supplier Quality Problems

What are the Supplier Manufacturing Lessons?

- **Suppliers may change materials or processes during manufacturing – Be sure you're notified about changes that impact your product.**

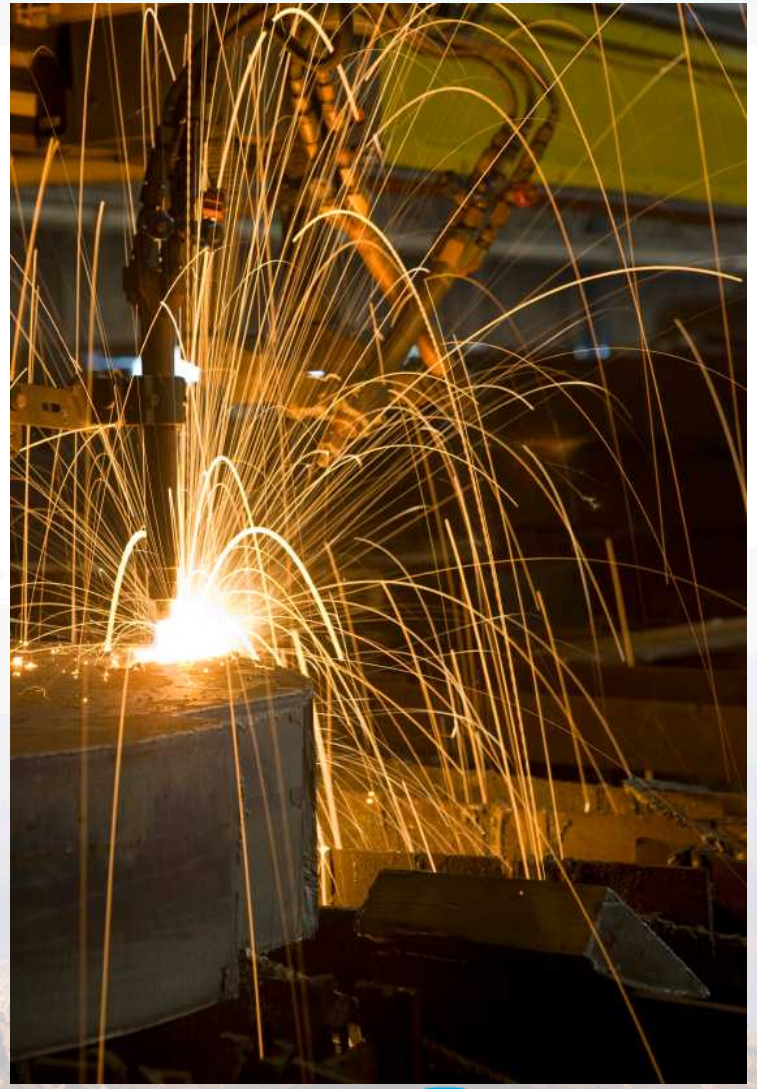


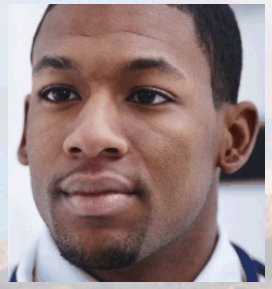
If you don't specify it, the supplier may not make it!

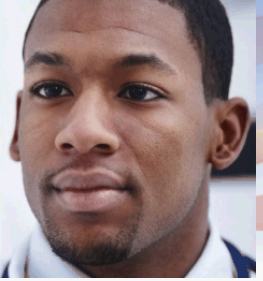
Keep Your Team Involved

"Good things only happen when planned; bad things happen on their own." **– Philip Crosby**

- **Plan for team involvement during manufacturing**
  - Reviews
  - Assessments

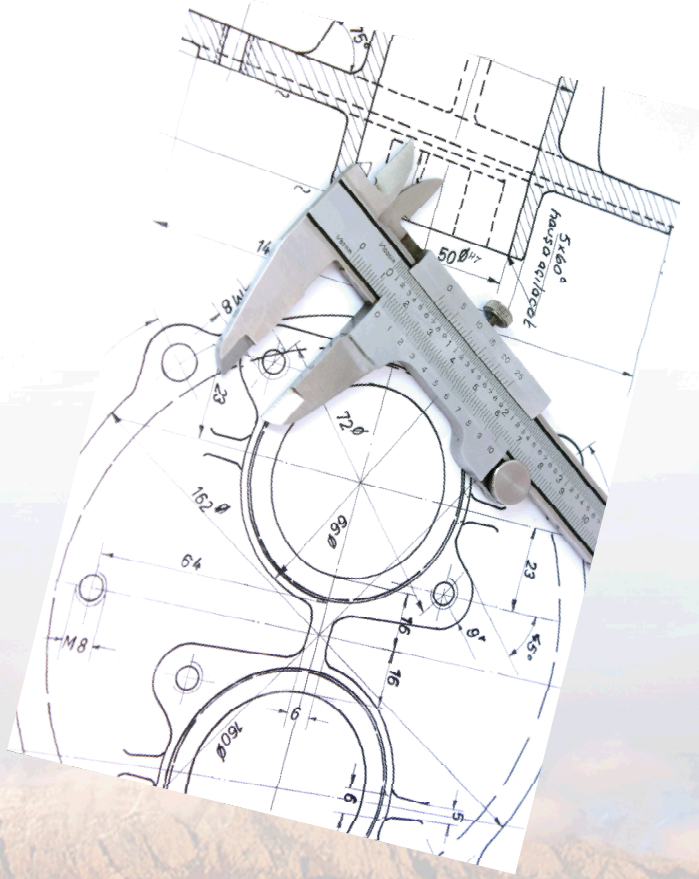






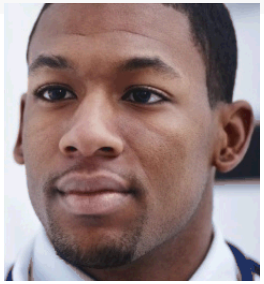
Review Manufacturing Plan

- **Technical Lead & QE verify, with supplier, elements such as:**
  - **What is the production schedule?**
  - **What is the process flow?**
  - **When are the production reviews?**
  - **Are there in-process inspections?**
  - **Is there special tooling / gauging?**
  - **Are there environmental concerns?**
  - **How are you controlling key characteristics of the product?**



Is the supplier ready to turn the key?

Summary of Key Responsibilities During Manufacturing



Technical Lead

- Identifies cost, performance, schedule issues – calls buyer
- Assures delivery on time, budget & quality
- Updates drawings as needed – calls buyer for contract changes
- Leads manufacturing reviews & oversees activities

Quality Engineer

- Supports manufacturing plan review
- Validates corrective actions
- Ensures requirements complete & met
- Identifies gaps & risks
- Supports reviews & assessments during manufacturing

Buyer

- Formal notification to supplier of significant issues
- Makes needed changes to contract
- Enforcer of the contract if problems arise

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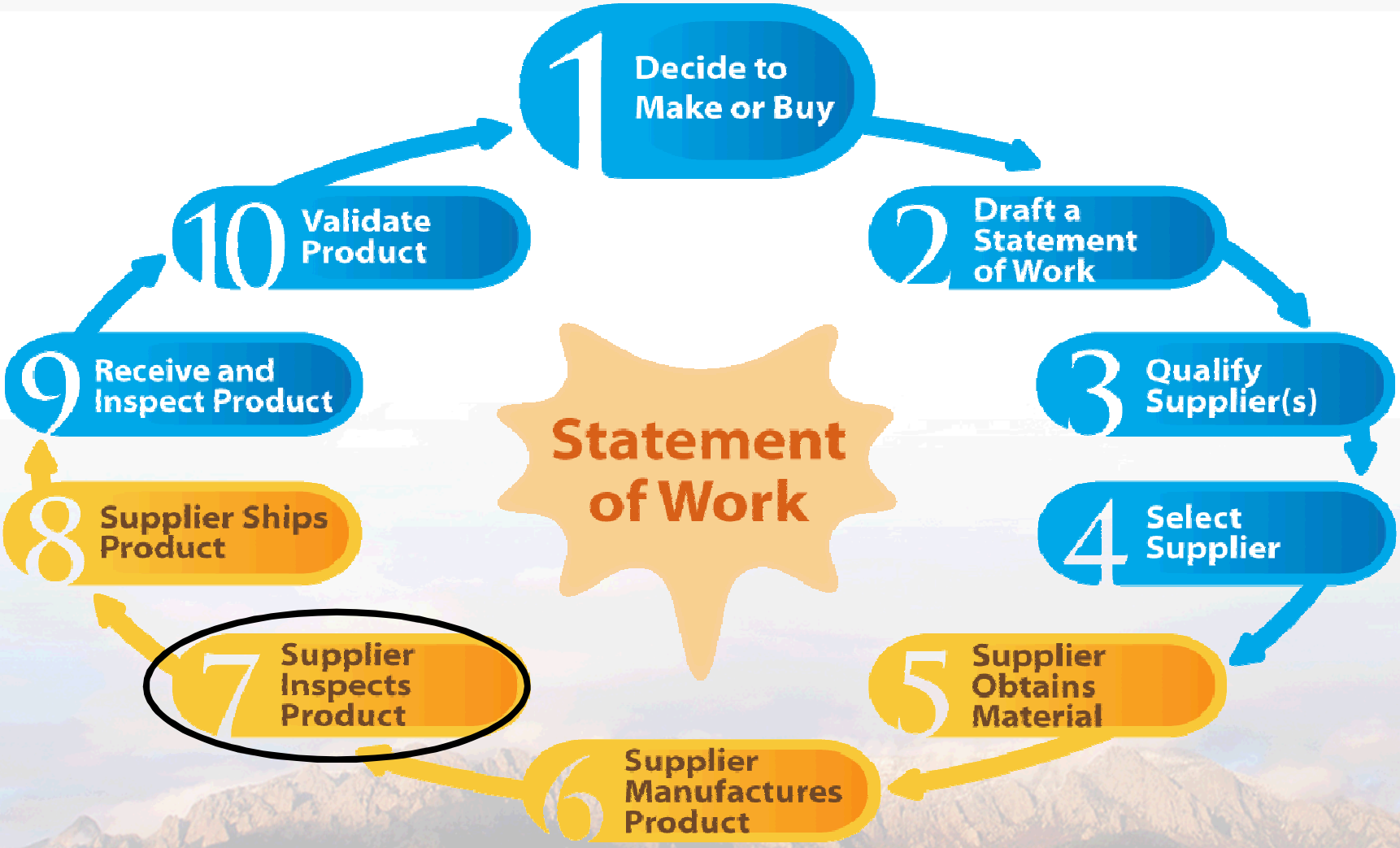
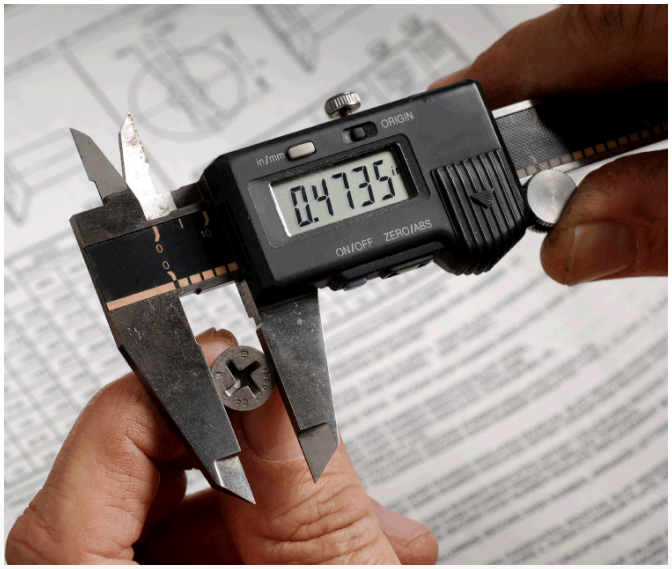


Supplier Inspects / Tests final Product

- **Based on SOW, Supplier's inspection processes include:**
  - Adequate testing and inspection processes
  - Documentation to certify final product
  - Required calibration of measurement and test equipment
  - Trained inspection and testing personnel



Clear requirements for inspection minimize failures and the need to invoke the NC process to rework, repair, or scrap.

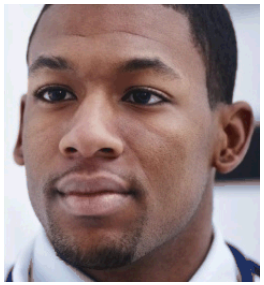
Supplier Prepares Data Package

- **Product = hardware/software + evidence that requirements were met**
- **Evidence = Lot Record Book (LRB) or a Data Package**

"……just remember that the writing is the evidence of the thinking. **The thinking is where the value is."**

However, there will be times you will need the evidence!

Roles During Product Inspection



Technical Lead

- Re-verifies supplier is clear on all requirements and meets them as in SOW.
- Informs larger team of status and Reports NCs to buyer.
- If NC then determines if work needs to stop

Quality Engineer

- Supports Tech lead in verifying Supplier met requirements in SOW.
- Reviews supplier data package with Tech lead.
- Makes sure any process change agreed upon was documented.
- Follows up on improvements, corrective / preventive actions at supplier
- If product is NC, then supports analysis and procedures established in NC process.

Buyer

- Coordinates with Tech lead and QE to make sure contract is being followed by Supplier.
- If NC, then assesses impact on contract
- Develops recourse options
- Enforces contract if necessary

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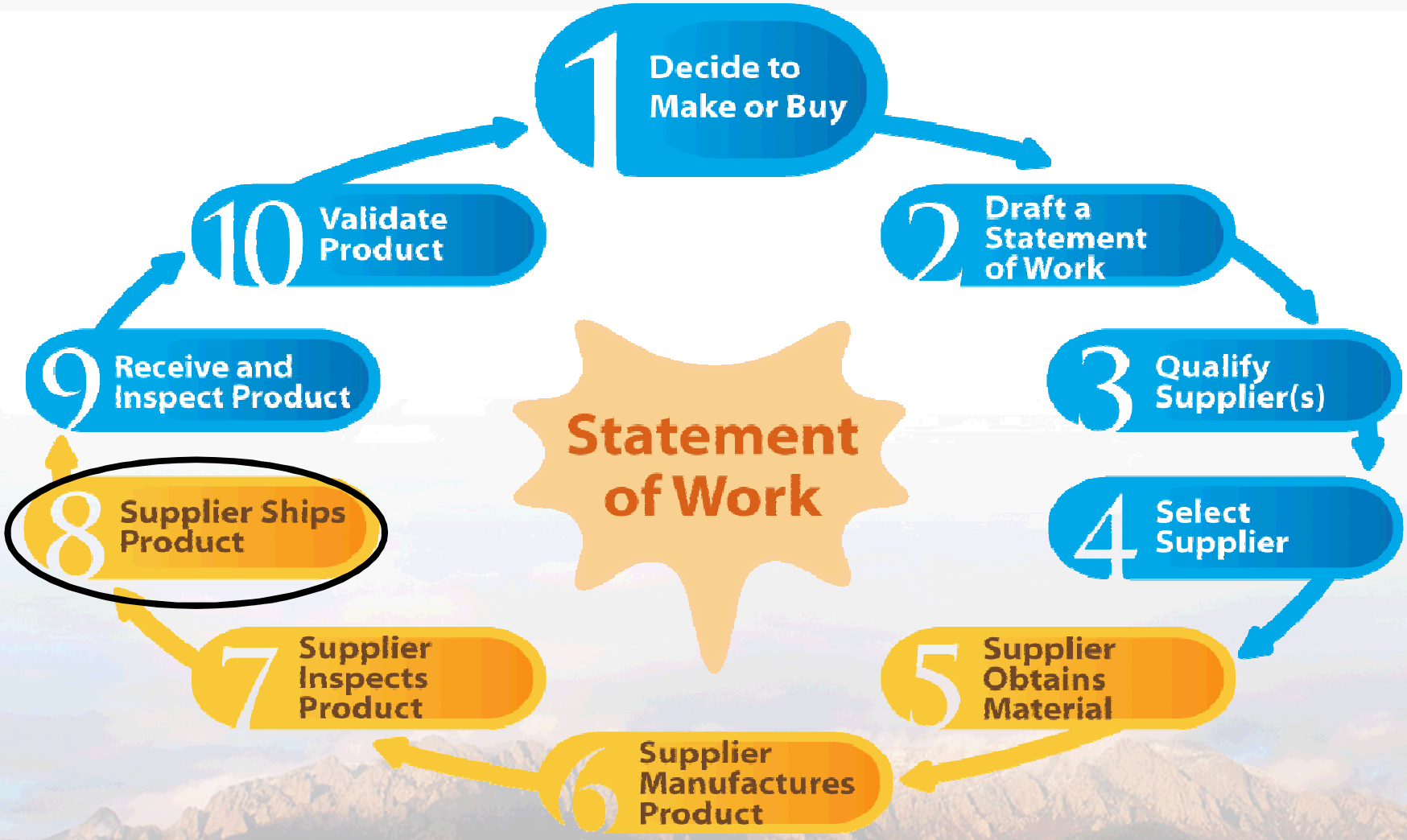
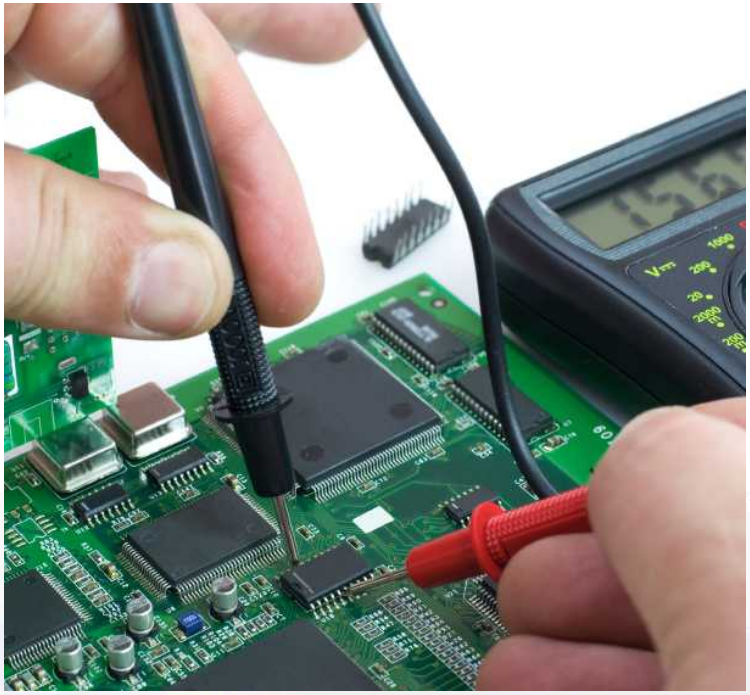


What is the objective of packaging and shipping?



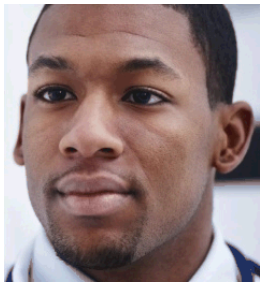
Protect and preserve the integrity of the part

Product Ready to Ship

- Product successfully completes supplier final inspection

Time to execute the plan!

Key Responsibilities



Technical Lead

- Analyzes design, vulnerabilities, risks and determines product packaging and shipping requirements
- Ensures requirements are documented in the SOW
- Informs buyer of changes needed to SOW

Quality Engineer

- Assesses supplier packaging, shipping, handling and inventory management capabilities
- Provides input to technical lead regarding packing and shipping requirements
- Supports analyses in the event of questions or issues

Buyer

- Supports SOW development
- Makes needed changes to contract/SOW
- Communicates requirements and changes to the Supplier

Confirm Requirements

- **Ensure that supplier knows <u>current</u> packaging & shipping requirements**
- **Risk mitigation considerations**
  - Was product ordered long ago due to lead time?
    - Ensure that packaging and shipping requirements are thoroughly addressed
  - Accomplish requirements review with Supplier
  - Provide Supplier custom Sandia designed and built container for shipping product
  - QE, Tech lead witness and inspect packaging at Supplier's location before shipment

The Supplier

Supplier Packages Product

Supplier complies with packaging requirements

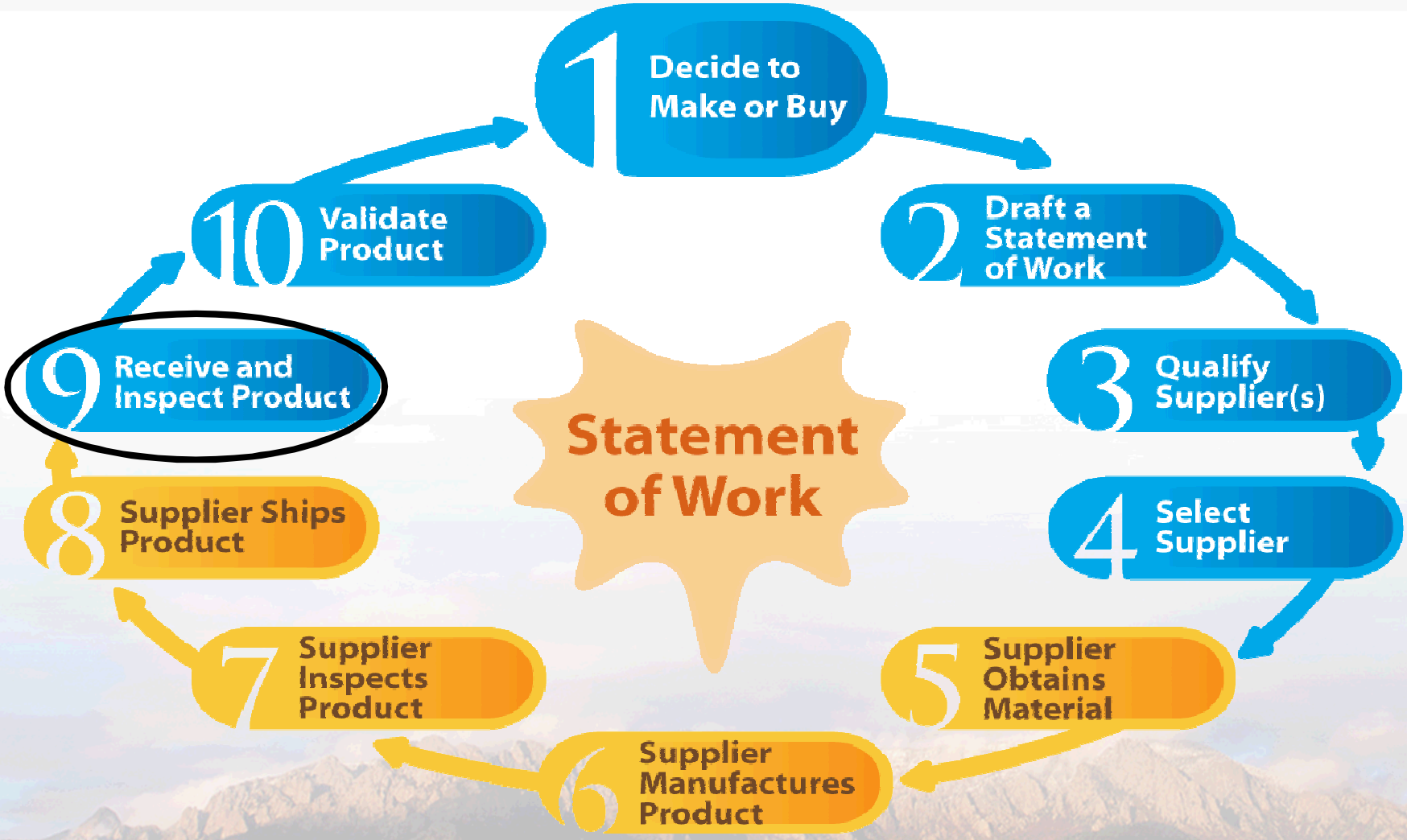
- Documentation/ approvals such as DOT / NNSA completed for shipping
- Packaging materials and methods comply with regulations, specifications, security and SOW requirements
- Supplier must contact Buyer if there are compliance questions

Supplier Ships Product

- Shipping documentation finalized
- Shipment scheduled and product picked up
- Product in transit and tracked (shipper or waybill number)

Keep your "eyes on the ball!"

The Process: Preventing Supplier Quality Problems



Purpose of Incoming Inspection

To verify that the product meets all requirements: safe, reliable, conforming to specifications

- **For Completed product – becomes final inspection**
- **For Product going to next assembly – Incoming Inspection is not the last inspection activity**

Verify — "You built the product right."

- **We verify that correct specifications exist, and that the product has been made to those specifications**

The main purpose is to catch defective product before it is used

Inspect the Data Package

Inspect Supplier Data package - verify conformance to documentation required by SOW

- **Raw materials certifications**
- **Work Travelers**
- **Details of products processed by outside suppliers**

Inspect the Product

Verify conformance to hardware ordered in SOW

- Follow documented procedures.
- Check that all required previous tests have been performed and passed.
- Prepare inspection report of product

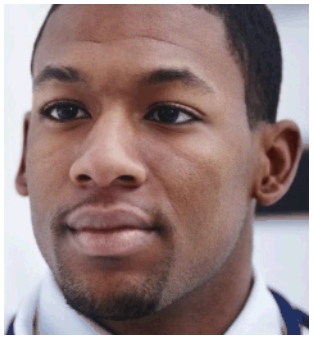
Types of inspection, testing

- Visual- check product identification, damage
- Destructive/Non Destructive ultrasonic, magnetic, x-ray, mechanical, electrical, functional

Incoming inspection and testing can protect you against using a defective product.

What if the Product Fails Incoming Inspection?

Segregate items that are not accepted, for material review.



Support the team

- Invoke Non-Conformance Process
  - Do failure analysis, determine root cause
  - Assess risk, impact on cost and schedule

Ask: Did my supplier cause the problem?

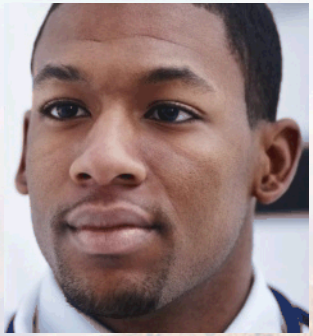
If **yes** – Go back to the supplier via Buyer

Work With the Supplier

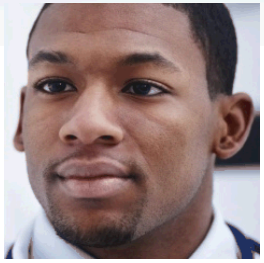
If the supplier contributed to the problem discovered in testing

The Technical Lead, Buyer and possibly QE, go back to the supplier to:

- Clarify, verify product requirements
- Check materials and processes used
- Collaborate for rework or repair
- Plan corrective actions and next steps with supplier
- Enforce or renegotiate the contract



Team Roles During Receiving and Inspection



Technical Lead

- Identifies specific inspection requirements
- Identifies storage requirements
- Identifies non-conformances
- Performs disposition activities

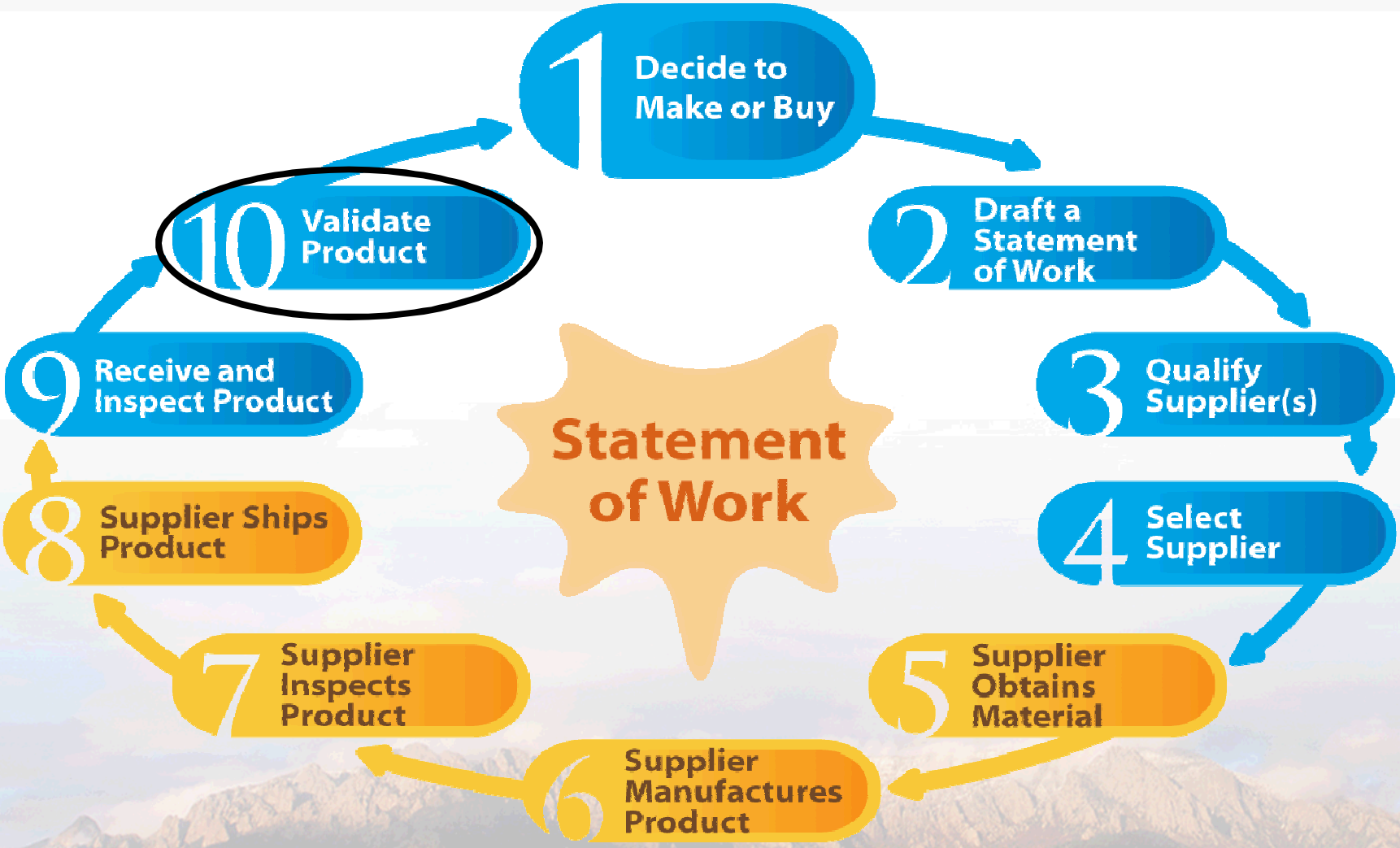
Quality Engineer

- Documents Non-Conformances
- Supports Tech Lead in the identification of non-conformances
- Provides input on storage requirements
- Assists/performs disposition activities
- Verifies corrective action effectiveness

Buyer

- Communicates non-conformances and issues to the supplier
- Negotiates any needed changes to contract

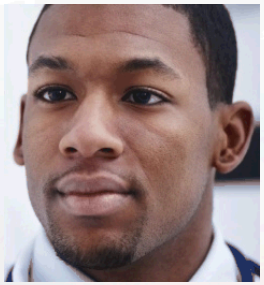
The Process: Preventing Supplier Quality Problems

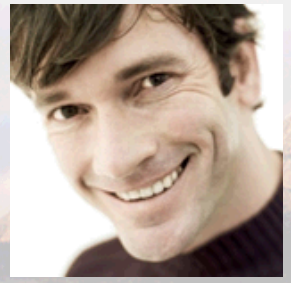


Get Records In Order

A good "customer" will want to review your records

- Statement of Work
- Records of site visits, audits, reviews, meetings
- Data package from supplier, test results, etc.
- Receiving Inspection results
- Other relevant information

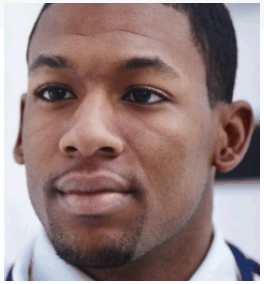




Your Team

The customer

Summary of Key Responsibilities for Product Validation



Technical Lead

- Assures records are in order
- If issues arise "did our part cause the nonconformance?"
- If supplier caused – work with the supplier
- Be available to next assembly customer

Quality Engineer

- Works with technical lead on supplier caused problems
- Supports technical lead
- Anticipates supplier's critical processes and effect on product validation – works with team to specify appropriate supplier requirements
- If problems – supports analyses
- May participate in validation activities

Buyer

- Works with technical lead on supplier caused problems
- Communicates with supplier and ensures all parties comply with Contract and SOW

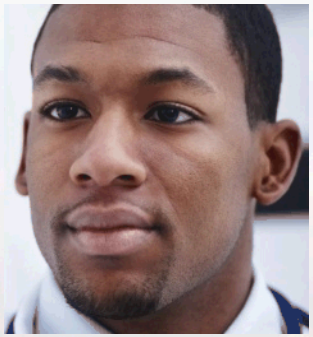
A nonconformance?

Work With the Supplier

If the supplier contributed to the problem discovered at your facility

The Technical Lead, Buyer and possibly QE, go back to the supplier to:

- Clarify, verify product requirements
- Check materials and processes used
- Collaborate for rework or repair
- Plan corrective actions and next steps with supplier
- Enforce or renegotiate the contract



Remember, disposition decisions can violate contract expectations.

What about Surveillance?

Definition: Ongoing monitoring and verification of the status of conditions, methods, procedures, and products, and analysis of associated records to ensure that the established requirements are being complied with.

Components of Supplier Surveillance:

- **QMS:**
- **Product Audit: An independent quantitative evaluation of conformance of product characteristics to defined requirements**
- **Process:**

Strategic Objective-forward based (or prevention): -a move away from QC inspections to system/process characterization and control.

Graded Approach

- **Certified Supplier or less important component- Low Surveillance**
- **Preferred Supplier or important component- Higher level Surveillance**
- **Approved Supplier or critical component- Resident Surveillance/deep involvement for improvement**

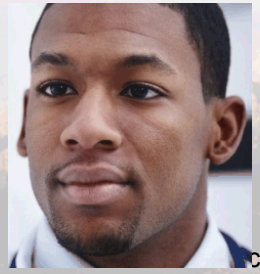
Rewards: less customer surveillance audits and elimination of incoming inspections, improved relationships

Ever consider the C=0 inspection philosophy applied to Surveillance?

Calculate the Budget

Using the process flow described you can create a budget estimate for your management team and provide the data necessary to make technical and economical tradeoffs based on risk. This approach can be applied to one or several procurements.

- Treat each module as a milestone of its own. Not all tasks listed will be appropriate for your procurement action so involve the team early.
- Expect each team participate to craft the best value position from their point of view. In some cases corporate policy may drive those decisions. Don't let compliance hamper your creativity and work within the boundaries.
- Document the accumulation of the activities in an overall plan. **Remember, the thinking is where the value is** (documentation is just capturing the rationale)
- If appropriate, use the plan to give your management (or funding source) the data they need to address risk.



Objectives

We are now finished but you have just begun. You now should be able to:

- **Understand how to rethink your approach to supplier quality (critical thinking beyond procedures and policy)**
- **Identify critical factors and attributes of a well defined team of professionals (the minimum set)**
- **Understand how to calculate the budget proposal to influence your managements decision making process and answer trade-off questions on supplier risk mitigation**
- **Use this information as a tool to help stimulate thinking on data collection**

Questions?