Counterfeit Components – Assessment Methodology and Metric Development

iNEMI Project Team

Project Chair: Colm Nolan (IBM)

Project Manager: Mark Schaffer (iNEMI)

Assessment Methodology and Metric Development of Counterfeit Components

Scope	• Identify and develop methodologies with associated metrics to assess the overall extent of the counterfeit problem in the electronics industry.
Purpose	• Enable organizations to assess the risk of counterfeit use in their respective industries, the risk of untrusted sources of supply in that industry and generate the total cost of ownership associated with those risks.
Applicability	• Any organizations that procure EEE parts and devices, whether such parts and devices are procured directly or integrated into electronic assemblies or equipment.
Supply Chain Sector	• Any part of the supply chain utilizing electronic products though development focus was from an Information Technology perspective
Commodity(s) Covered	• EEE parts
Overview	• This project was completed in October 2013 after 1.5 years of work by a collaborative industry group. • 3 calculators we developed for use by industry: assessing risk of untrusted sources of supply, assessing risk of counterfeit use and a total cost of ownership • Goal is to provide more visibility to the problems of counterfeit components and where to focus resources on minimizing risk

Counterfeit Components – Assessment Methodology and Metric Development

Background

What Counterfeit Components Are

A counterfeit component is a fraudulent part that has been confirmed to be a copy, imitation, or substitute that has been represented, identified, or marked as genuine, and/or altered by a source without legal right with intent to mislead, deceive, or defraud.

Different Date Code

Courtesy of CCAW

Black-Topping & Refurbish

Definition is from SAE 5553 and 6081

Why CC Is an Issue/Why Do You Care

- 2 problems
  - Top line problem from biz perspective – how brand is respected
  - Bottom line concern – warranty costs, RMA - impact on profit
- Liability issues
  - Expenditure of resources (man-hours) to support field accidents/failures for products that significantly impact human safety
  - Public Safety
- Numbers!
  - Field service cost in US is over $1100/incident[1]
- Limited Supply of high demand market products and end-of-life products
  - Enhance likelihood of CC

1. TSIA (Technology Services Industry Association), December 15, 2011

Supply Chain Security

- iNEMI member products live in the middle of supply chains
  - Member products rarely begin or end a chain
  - We live in the middle of supply chains
- Therefore, iNEMI members must play both roles:
  - As the consumer / customer
  - As the supplier / vendor
- iNEMI is an ideal organization to pilot concepts or to test proposals
- What iNEMI member companies demand from suppliers must also be delivered to their customers
  - More specifically, all customers will need improved visibility into manufacturing data

Assessing the Risk of Counterfeit Components

Introduction

Counterfeit Components – Assessment Methodology and Metric Development Project began in March 2012

Its purpose and scope...

Identify and develop methodologies with associated metrics to assess the overall extent of the counterfeit problem in the electronics industry. The outputs will enable iNEMI members to assess the risk of counterfeit use in their respective industries, the risk of untrusted sources of supply in that industry and generate the total cost of ownership associated with those risks.

Scope of Work – Phase 1

- Focused on those attributes which are of most value to supply chain and the participating project members.
- Applicable to multiple spaces across the supply chain.
- Identify and develop methodologies with associated metrics to assess the overall extent of the counterfeit problem in the electronics industry. The output will enable iNEMI members to:
  - Assess the risk of counterfeit use in their respective industries
  - Assess the risk of untrusted sources of supply in that industry
  - Provide methodology to generate the total cost of ownership associated with those risks.
- The methodologies and strategies apply to all phases of the manufacturing cycle and supply chain. Not only do counterfeit components have a serious impact on the OCM, but impact all downstream users from the legitimate component brokers; to the OEMs that integrate these components; and to the end-user.
- Metrics to assess the overall extent of the problem and anti-counterfeiting will be identified for all phases.

This Project IS:	This Project IS NOT:
Project 1: Counterfeit Components - Assessment Methodology and Metric Development	
Identify any related research or development within the industry and academic communities	Development of a specific standard(s)
Review and tabulate successes that have worked in the past (BKM/BKP)	Biased towards specific brokers, suppliers, geographies, or market segments
Develop a methodology to evaluate or assess the risk of counterfeit use	
Assess the aggregated risk of untrusted sources of supply	Repeat of prior or existing work
Develop an assessment / mitigation strategy Long term cost of ownership	Not focused on quality issues or standards
Define / develop a metric that can identify the scope of the problem	Missing piece is the history (e.g., storage conditions, …)
Assess the effectiveness of the methodologies developed	
Review and finalize methodology	How to capture quality information / data
Focused on those attributes which are of most value to supply chain and the participating project members	
Applicable to multiple spaces across the supply chain	

Counterfeit Components – Assessment Methodology and Metric Development

Results

Introduction

The team began by sharing experiences and expectations.

Getting started required:

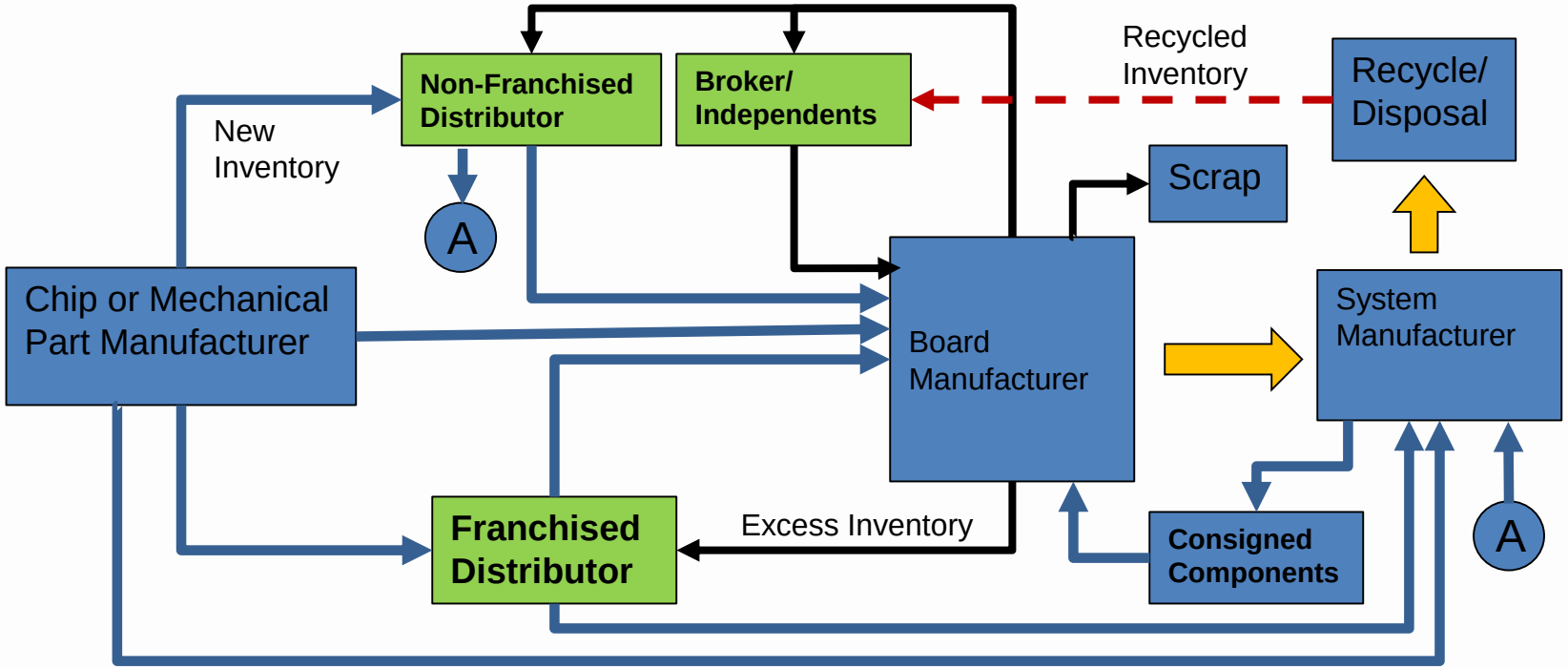
- Agreement on definition of Terms & Vocabulary
- Listing reference documents or standards known to anyone on the team
- Describing to each other Practices that seemed to work and Practices that clearly did not work
- While discussing Practices, we discovered how cluster maps helped us tie a longer & more complete supply chain together

- This preparation was necessary before work on the actual Calculators could begin

NOTE: The Cluster Maps are electronics industry centric, which results in an electronics industry centric value chain

Board Manufacturer Cluster

Wafer Manufacturer	Chip Manufacturer	Board Manufacturer	System Manufacturer	After Market Sales and Refurb Support	Recycle/ Disposal
Raw Material Manufacturer	Mechanical Part Manufacturer				



A chip mfg relative to board mfg is an open market entry strategy. Multiple channel Marketing of their product. Driven by economy of scale of the factory/fab.

Project Output

- Three unique risk assessment calculators have been developed
  - Risk of counterfeit use
  - Evaluation of untrusted sources of supply
  - Long-term cost of ownership.
- A white paper of the tasks undertaken by the team and the tools developed has been written, published and presented in multiple venues

Risk of Counterfeit Use – Calculator #1

- This calculator quantitatively asses the relative risk of a product being counterfeit
- Can be used by
  - Component Manufacturers – identify risk for their product
  - Product Designers – identify risk of products to be used or of end product
  - Distributors – identify products at risk and those requiring extra controls
  - End Users – identify risks of selected products and provide product ranking
- It is based on 4 key attributes – product profile, supplier and supply line characteristics, counterfeit deterrents used on the product and channel characteristics
- The user selects the appropriate rating for each of the elements from the rating table and the calculator provides an overall risk assessment for that product.
- The higher the rating, the higher the risk of counterfeit for that product
- The relative ratings for a product portfolio enables the company to focus their efforts on the high risk products.

Risk of Counterfeit Use - Calculator #1

1. Select the Product Type & Profile

2. Select the supply Line profile

3. Select the counterfeit Process controls

4. Select the output & channel characteristics

Risk of Counterfeit Use v3.1

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Methodology to Evaluate or Assess the Risk of Counterfeit Use

CF = Counterfeit

Profile		Input					Process				Output							
Select or Enter Product Type	Demand / EOL	Supplier	Supply Line	Mitigation & Controls	Supplier History	Input Score	Ease of Counterfeit	Ease of Detection	Counterfeit Controls	Process Score	Sales Channel	Excess Inventory & Prototype	Customer	Rework	Ease of Fraudulent Reuse	Disposal	Output Score	Total Rating
Hard Drive	3	1	1	1	1	1	5	3	2	30	4	4	5	3	1	1	240	524
	0	0	0	0	0		0	0	0		0	0	0	0	1	0		

Please select the rating from the table below that best corresponds to the description for that rating.

Rating = 1	Product has Low demand and is not EOL	OCM	Direct from OCM	Supplier has Strong Mitigation & Controls	No known Counterfeit Incidents	Very difficult to counterfeit; requires factory access or capital investment >$1M	Easy to detect, e.g. by check of packaging, documents, labels, history	Uses Unique Overt and Covert Controls & identifiers that are easy to validate	Direct- OCMs/ Manufacturers /Suppliers	Minimal Excess Inventory. Very limited prototyping/tight OCM security and traceable records that are digitally signed/encrypted and/or independently audited.	Direct to OEM	In-house only under tight controls in certain designated areas, tight security and traceable records (signed / encrypted and/or independently audited)	Exponential factor from 0 to 2; 0 being impossible to reuse to 2 being very easy or trivial to reuse.	In house only, on site physical destruction, traceable records (signed / encrypted and/or independently audited)	1
Rating = 2	No 2 rating	No 2 rating	No 2 rating	No 2 rating	No 2 rating	Requires major equipment / facilities such as wire bonders and laser markers, >$100k capital	Possible by optical inspection	Unique Overt or Covert Controls / identifiers that are easy to validate	Known channel: Franchised/ Authorized Distributors	Excess and prototype inventory under tight controls and security	Trusted Sales Rep and Franchised Distributor to OEMs	In-house + vendor, under tight controls and security	This exponent modifies the Disposal rating chosen.	In house + vendor physical destruction, traceable records, third party certification*	2
Rating = 3	Product has Low demand and is EOL or high demand and not EOL	Authorized Distributor	Multiple known suppliers	Some evidence of mitigation / controls	Counterfeit supply suspected	Requires moderate equipment and capital ($10k-100k)	Possible by routinely applied 2D X-ray inspection, decapsulation	Overt and Covert Controls / identifiers but validation not easy	Limited - OEMs/ CMs and some use of Brokers	Significant inventory but under tight controls and security	Trusted Sales Rep and Unfranchised distributor to CMs	Primarily offsite vendor based, with controls and security.		Offsite vendor, with controls and records for physical destruction	3
Rating = 4	No 4 rating	No 4 rating	No 4 rating	No 4 rating	No 4 rating	Needs simple equipment such as sand blasters and ink printers (<$10k capital)	Requires advanced analytical tactics, i.e. XRD, CSAM, 3D X-ray	Some overt controls / identifiers but validation not easy	Very Limited - Primarily Reputable Independent Distributors /Brokers	Some controls in place. No traceable records. No security	Independent Distributors, dependent on end user oversight.	Offsite some controls in place. No traceable records. No security		Offsite vendor, some controls and records. No proof of physical destruction	4
Rating = 5	Product has High demand & is EOL	Broker or Ind. Distributor	Supply line not defined / clear	No evidence of mitigation / controls	Counterfeit supply confirmed	Easy - little / no investment required (<$1000)	Difficult to detect; nearly indistinguishable from authentic	No special controls in place	No control / Unknown- Unknown Independent Distributors/Brokers /Unknown Sources	Excess and prototype inventory not controlled	Customer not defined, open market.	Offsite Vendor, no controls and no traceability		Vendor or no vendor. No controls, no records	5

Counterfeit Risk of Use - Examples

Range of products to be assessed

FLASH product is the highest risk

Risk of Counterfe

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Methodology to Evaluate or Assess the Risk of Counterfeit Use

CF = Counterfeit

Profile		Input					Process				Output							
Select or Enter Product Type	Demand / EOL	Supplier	Supply Line	Mitigation & Controls	Supplier History	Input Score	Ease of Counterfeit	Ease of Detection	Counterfeit Controls	Process Score	Sales Channel	Excess Inventory & Prototype	Customer	Rework	Ease of Fraudulent Reuse	Disposal	Output Score	Total Rating
ASIC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
FPGA	3	3	3	3	1	27	3	3	3	27	3	3	3	3	1	3	243	579
CPU	5	5	5	5	3	375	3	3	5	45	3	1	3	3	1	3	81	1,874
Thermal System	1	5	3	1	1	15	3	3	3	27	5	5	5	5	1	5	3,125	1,913
Tantalum Capacitor	3	5	3	3	5	225	3	5	5	75	5	5	5	5	1	5	3,125	6,356
DRAM	3	1	5	3	3	45	3	3	3	27	3	3	3	3	1	3	243	620
FLASH	5	5	5	5	5	625	5	3	5	75	5	5	5	5	2	5	15,625	49,594
Hard Drive	3	1	1	1	1	1	5	3	2	30	4	4	5	3	1	1	240	524
	0	0	0	0	0		0	0	0		0	0	0	0	1	0		

Area of greatest concern / focus on FLASH

The risk calculator for untrusted sources (#2)

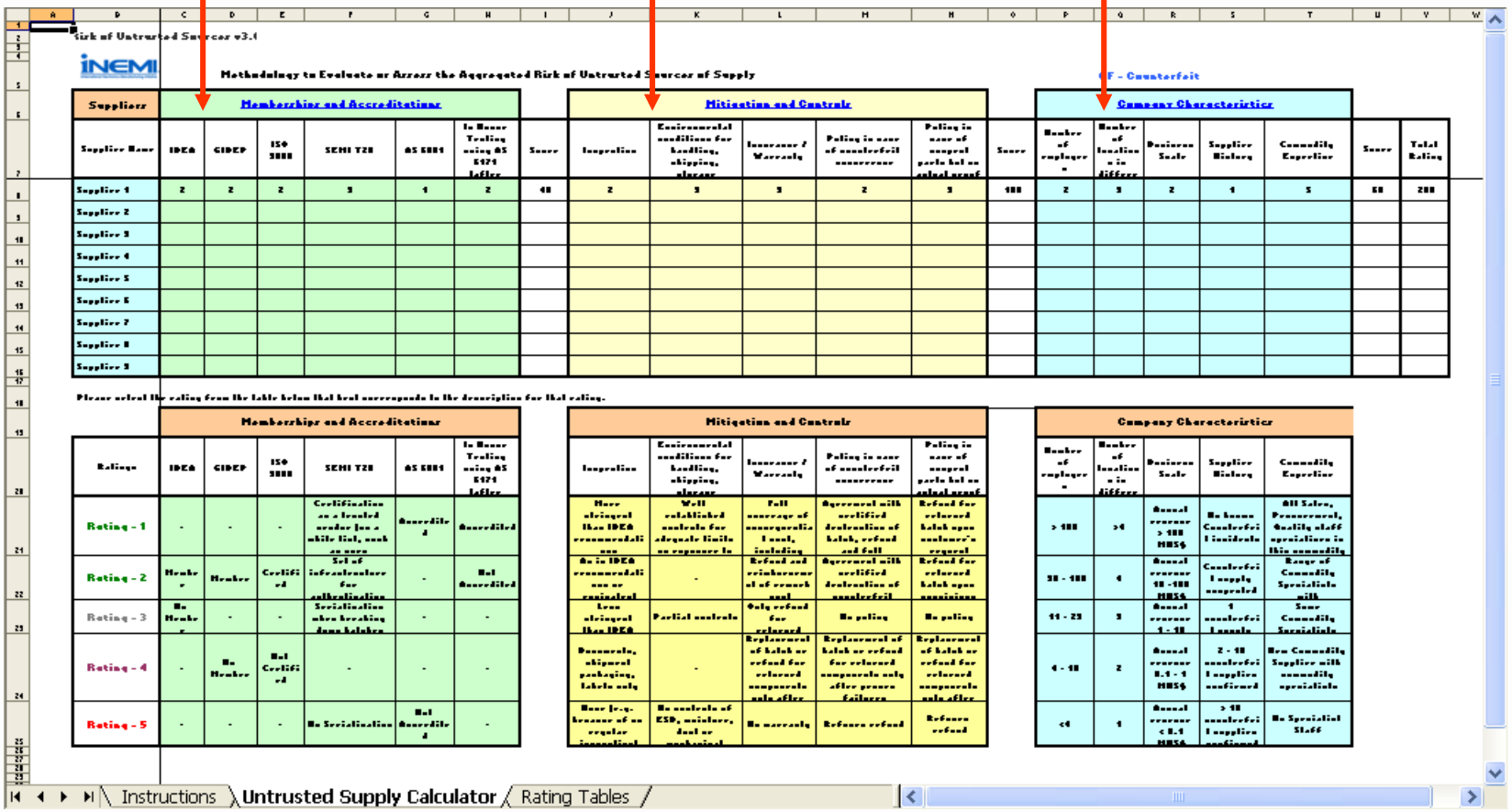
- Based on objective information, the calculator produces relative ratings which are expected to be correlated to the risk of receiving counterfeits from untrusted sources.
- The ratings can support a decision whether to purchase from a particular source or which of several suppliers to choose.

Screenshot of Untrusted Source Risk Calculator

1. Select memberships & accreditations

2. Rate mitigation & controls

3. Fill in information on company characteristics



Examples

- Supplier A is ISO 9000 certified. Therefore, enter the rating 2 into column E in the row of supplier A.
- Supplier B is not ISO 9000 certified. Therefore, enter the rating 4 into column E in the row of supplier B.

Screenshot from sheet Rating Tables

Rating	IDEA	GIDEP	ISO 9000
Rating = 1	-	-	-
Rating = 2	Member	Member	Certified
Rating = 3	No Member	-	-
Rating = 4	-	No Member	Not Certified
Rating = 5	-	-	-

Supplier Name	ISO 9000
Supplier A	2
Supplier B	4

Cells from sheet Untrusted Supply Calculator

Conclusion on examples

- After entering the complete input information, the total rating result in column V is 103 for supplier A and 8249 for supplier B. Choose supplier A, not B.
- Due to the extremely high rating for supplier B, consider to disqualify supplier B from any purchases until he improves.

Supplier Name	Total Rating
Supplier A	103
Supplier B	8249

Counterfeit Losses & Costs – Calculator #3

- This calculator provides an estimate of the costs and losses associated with counterfeit product
- There are 3 assessments provided
  - A) Total loss estimate by product
  - B) Loss estimate by GEO or market
  - C) Total Counterfeit Cost & Losses estimate.
- The total loss estimate is based on the output from calculator #1 … where the counterfeit risk result is classified as low, medium or high
- The loss by GEO or market is generated using the World Bank Corruption Control index
- The Total Counterfeit Cost is an estimate of all aggregated costs & losses incurred by a company where counterfeit product has entered that company's supply chain.

Total Counterfeit Loss – Calculator #3 (A)

1. Input the products to be assessed

2. Input risk of counterfeit use from calculator #1

3. Input industry estimate of counterfeit use

4. Input the estimated w/w Revenue for the product

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Total Counterfeit Loss Estimation

Products	Risk of Counterfeit	Industry Counterfeit Estimate	W/W Product Revenue US$ (K)	Estimted Losses US$ (K)
Product 1	Medium	5%	200	6.67
Product 2	High	3%	50	1.50
Product 3	Low	3%	100	1.00
Product 4	Medium	3%	250	5.00
Product 5	Medium	3%	100	2.00
Product 6	High	3%	150	4.50
Total			**850.00**	**20.67**

Estimated Counterfeit Revenue Losses

Counterfeit Loss by GEO – Calculator #3 (B)

1. Input all countries / markets the product is sold

2. Input estimated or target Revenue for that market

3. Input the Corruption Control Index for that market (World Bank)

iNEMI International Electronics Manufacturing Initiative

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Counterfeit Loss Estimation by Geography or Market

Products	Losses Estimated US$ (K)	Country or Region	Revenue US$ (K)	Corruption Control Index	Losses by Country US$ (K)
Product 1	$6.67	China	60	30.3	3.63
		India	30	35.1	1.69
		US	100	85.3	1.28
		Germany	10	92.9	0.06
	Total		200		
Product 2	$1.50	China	20	30.3	1.14
		US	30	85.3	0.36
	Total		50		

Estimated Counterfeit Revenue Loss by Country / Market

Total Counterfeit Cost – Calculator #3 (C)

1. Input estimated counterfeit Rate (internal or external data)

2. Input all costs – actual or estimated

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iNEMI International Electronics Manufacturing Initiative

Company Confidential

Total Counterfeit Cost & Losses Estimate

					€ (K)	
Estimated Counterfeit Rate	1.00%					
Revenue Impacted (1)	1,500	€ (K)				
- Revenue Loss			x CF Rate	$15.00	€ (K)	
Warranty Costs (2)	20.00	€ (K)	x CF Rate	$0.20	€ (K)	
Service / Repair Costs (3)	15.00	€ (K)	x CF Rate	$0.15	€ (K)	
Monitoring Costs (4)	0.050	€ (K)				
Prevention Costs (5)	0.010	€ (K)				
Product Protection Costs (6)	0.100	€ (K)				
Litigation / Enforcement Costs (7)	0.050	€ (K)				
Liability Costs / Consequential Damages (8)	0.010	€ (K)				
Brand Damage				$20.00	€ (K)	
- Brand Value	20,000	€ (K)				
- Brand Damage Estimate % (9)	0.10%					
Total Cost / Losses				$35.57	€ (K)	

Total Counterfeit Cost

Risk Calculator Domains

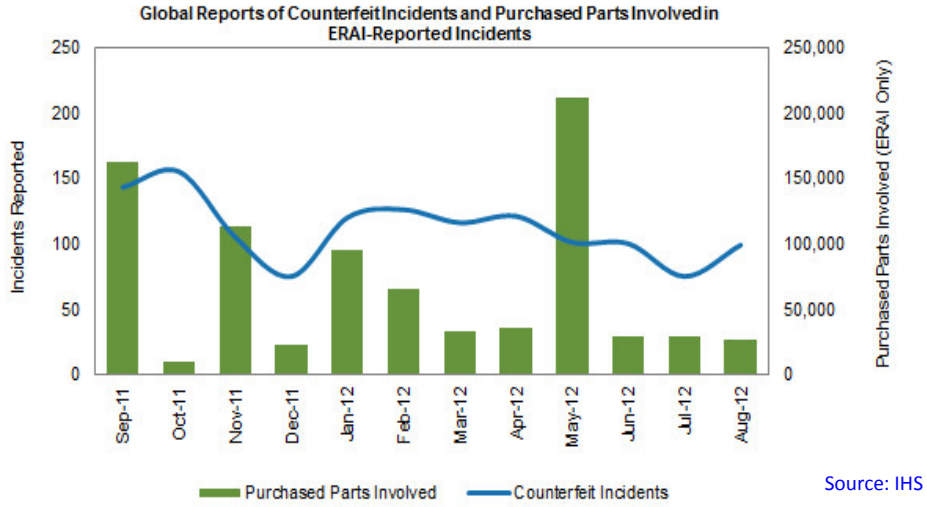
	Production	Legacy	Design
Aerospace & Defense	G19 Calculator	G19 Calculator	Silicon Expert Calculator
Automotive	iNEMI Calculator	G19 Calculator	Silicon Expert Calculator
Medical	iNEMI Calculator	G19 Calculator	Silicon Expert Calculator
High-End Systems	iNEMI Calculator	G19 Calculator	Silicon Expert Calculator
Office Systems	iNEMI Calculator	iNEMI Calculator	Silicon Expert Calculator
Consumer & Portable	iNEMI Calculator	iNEMI / G19†	Silicon Expert Calculator

†Appliances in *Consumer & Portable* sector has field service time of 7 to 15 years.

How Big is the Problem?

2012 Situation

- Actual number of counterfeit electronic parts globally is unverifiable.
  - Reason, purchased parts only reflect subset of all reported incidents.

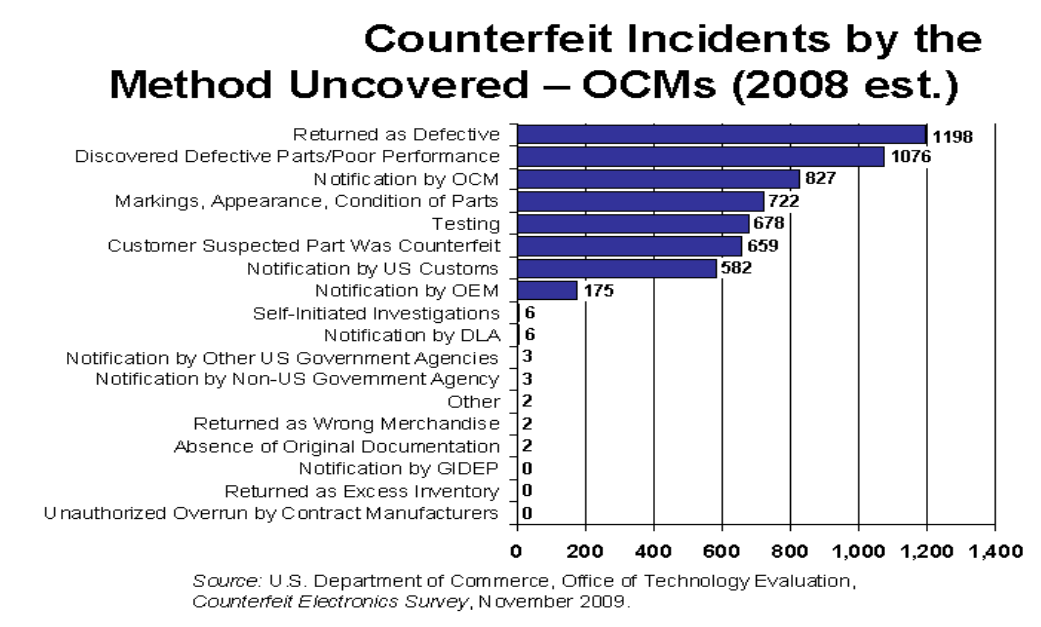


Source: IHS Parts Management, October 2012

- Total of separate verified incidents of counterfeit-parts was 1,336 for transactions over 834,079 parts actually purchased, in 2012
- A single incidents could be from 1 to N devices.
- Six year confirmed incidents of counterfeit parts, is 12 million.

Method of Discovery Most of the Time

- Majority of counterfeit components discovered by OCM(s) during the process of EMS/ODM/CM vendor return material authorizations (RMA).
  - Typically vendors return components as defective, exhibiting poor performance or having incorrect marking or physical appearance.



Reporting Mechanism Situation

- Most OCM(s) have no formal mechanism for vendors to report and confirm counterfeit parts.
  - For those that collect information they track mostly: type of part counterfeited; source countries; companies and individuals involved.

Variables Tracked By Internal Counterfeit Database*		
Variable	Discrete Manufacturers	Microcircuit Manufacturers
Suspected/Confirmed Counterfeit Products	100%	100%
Countries of Origin	89%	95%
Known/Suspected Companies and Individuals	89%	85%
Source of Reporting	78%	95%
Other	11%	25%
*Taken as a percent of those companies encountering counterfeits who maintain an internal database.		
Source: U.S. Department of Commerce, Office of Technology Evaluation, *Counterfeit Electronics Survey*, November 2009.		

- Very few OCM(s) database track *"hard data"* variables: affected customer; dollar value parts; part numbers; type of counterfeits and CBP activities.

Barriers and Recommendations

- Current data is too sparse to draw meaningful conclusions.
- No culture to track hard data now.
- Inspectors and/or vendors do not know subtleties of an authentic part.
- There is no one central clearinghouse to collect information when counterfeit parts are detected.
- Need to find a way for industry to aggregate more hard data over time.
- Currently no concept of an umbrella “trusted” third-party entity through which information shared.

Validation of the Project

Present work of the team to experts in the field of counterfeit components ... are we on the right path?

YES!

- **simplicity and flexibility of the calculators was key**
- **motivated conversations to help lift the veil**
- **look beyond assessment and into fraud**

The calculators help you decide where to begin

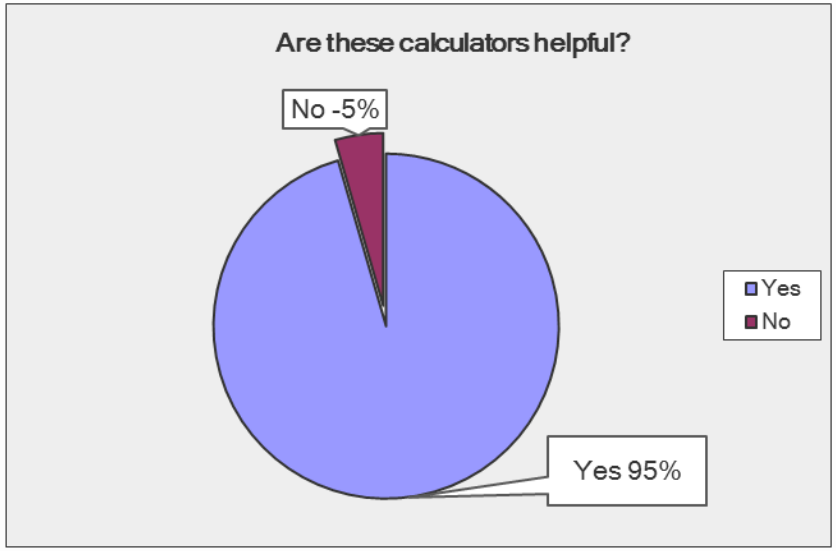
Socialization of Project

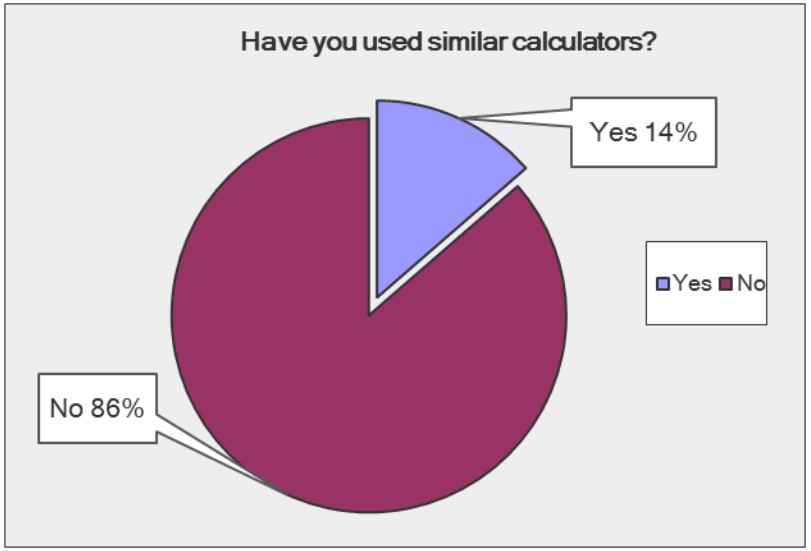
Presented at multiple conferences, conducted well attended webinars and published white papers in multiple areas.

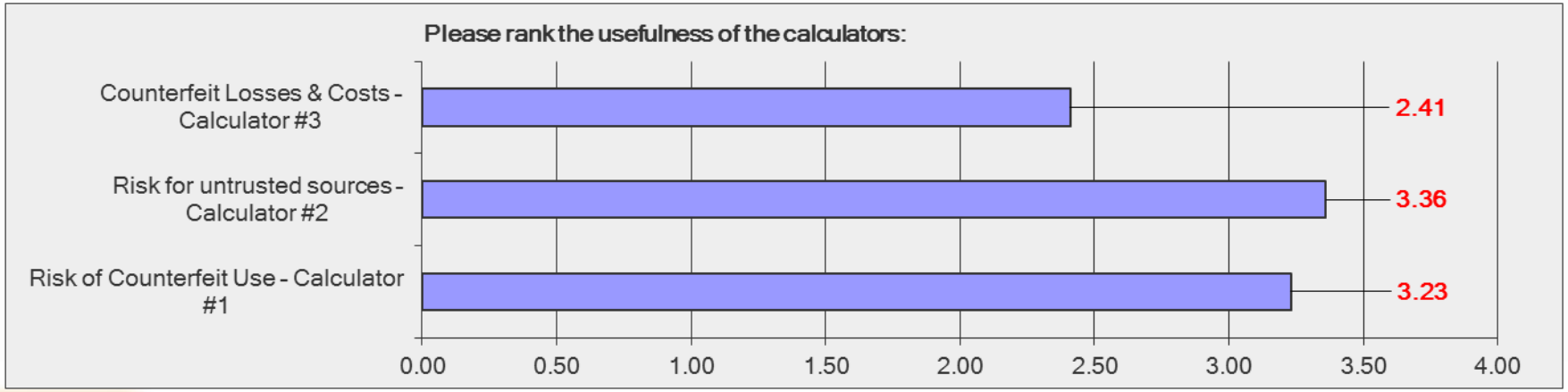
- SMTA East 2012
  - Project Introduction
- Public iNEMI Webinars (2) – June 2013
  - All three Calculators
- INEMI Website – June 2013
  - Mid-Project White Paper
- SMTA East 2013 – June 26
  - Risk of Counterfeit Use Calculators
- ICEPT China– August 11-14, 2013
  - Mid-Project White Paper, focusing on Detection Methodologies
- Calculator Downloads – August, 2013
- SMT Magazine – September 2013
  - 2 articles based on Mid-Project White Paper
- Slideshare – September 2013
  - Abbreviated Calculator Overview posted
- INEMI Website – November 2013
  - End-of Project White Paper
- IPC-APEX 2014 – end of March 2014 in Las Vegas
  - End-of Project White Paper

Calculator Webinars and Survey Results

100+registered; actual attendance = 60; 22 survey responses







Highlights from Socialisation Activities

- Calculator Webinars + Survey
- Conferences
  - Different members of the team presented at 4 different conferences
- Publications
  - Online publication via iNEMI website
  - SMT Magazine, Sept 2013
- Calculator Downloads
  - Over 100 since October 30th

Doing the project allowed industry to speak with a single voice and reach a large audience

Next Step ... Phase 2

Calculator Life Cycle Project – Rotating Ownership

- Objective:
  - move calculators around industry segments to update and add in what is relevant to their industry.
  - Broader industry engagement in the calculators – Medical (Equipment), Automotive, Aerospace

- Plan:
  - Consecutive 1-year projects to develop a broader industry calculator set with a narrow focus on counterfeit components in the 3 areas identified with the existing calculators.
  - Does medical, automotive, aerospace have same problem as the rest of us?

- Proposal:
  - Request the TC to consider approving a project initiative that focuses on enhancing/broadening the counterfeit component calculators with iNEMI medical member input

Counterfeit Components Assessment Team

IBM

PLEXUS

CORELIS
An EWA Company

CISCO

IST INTEGRATED SERVICE TECHNOLOGY

calce

SANMINA

FLEXTRONICS

Celestica

Agilent Technologies

DELL

NIST
National Institute of Standards and Technology

Contact Information:

Mark Schaffer
marks@inemi.org
(512) 468 - 9596

Detailed Project Information:

http://www.inemi.org/project-page/counterfeit-components-assessment-methodology-and-metric-development

Acronym List

- CBP: Customs and Border Protection of USA
- CM: Contract Manufacturer
- EMS: Electronics Manufacturing Services
- OCM: Original Component Manufacturer
- ODM: Original Design Manufacturer
- RMA: Return Material Authorization