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Track 2, Session 5

A Reliability Engineer's Use of Warranty Cost Information

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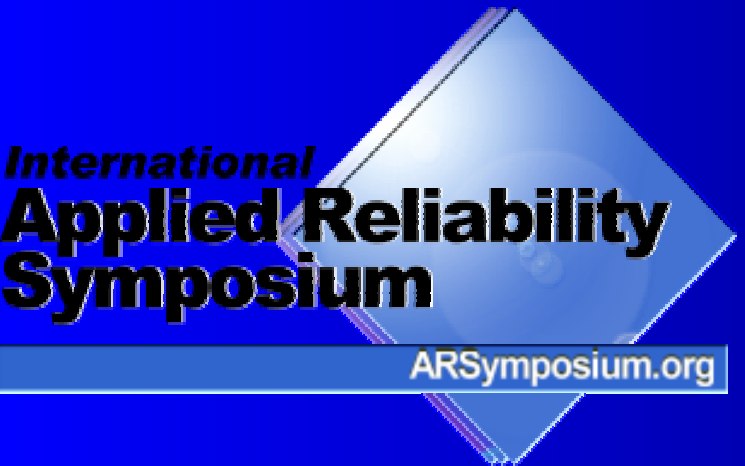

Introduction

- Many (most, all?) product have a warranty
- Examples of how to use this information in your reliability engineering work
- Discuss with the audience any relevant background and interests that they bring to the presentation.

Electric Light

"Good enough for our transatlantic friends, but unworthy of the attention of practical or scientific men."

British Parliament report on Edison's work
1878

Agenda

- Introduction
- Warranty Management
- Warranty and Total Product Cost
- Components
- Pockets of Competences

Overview

- Warranty as a percent of revenue
- Warranty as a cost per unit

- Who own's warranty?

- How much warranty expense is right?

- What is the right investment to reduce warranty?

Warranty Week

www.warrantyweek.com

Computers

"There is no reason for any individual to have a computer in their home."

Ken Olson
Digital Equipment Corp. 1977

Warranty Management Issues

- What could go wrong?
- Point-of-Sale story
- R&D to Finance story
- Call Center feedback story
- Cost Reduction story

Warranty Management Solutions

- Warranty Councils
- Senior Management Pay-for-Performance
- Consistent metrics - recorded and tracked
- Root cause investigations of cost sources
- Tools and methods, plus awareness

Warranty Management Connections

- Reliability Goals
- Reliability Predictions
  - Design for Reliability
  - Accuracy and business risks
  - Cost Analysis
- Verification & Reaction
- Cost Reduction efforts include Warranty

The Telephone

"That's an amazing invention, but who would ever want to use one of them?"

Rutherford Hayes
US President, 1876

Total Product Warranty Cost

- How do you set a warranty goal?
- Given a warranty goal
  - Set reliability targets
  - Set reliability apportionment
- Or, given a failure rate, determine warranty
- Warranty = Failure Rate * Cost/unit * #units

When?

- Warranty period
  - Focus on period of financial risk to company
  - Actual Warranty as scorecard
- Design life of product
  - Focus on period of satisfaction risk to consumer
  - Customer Satisfaction surveys as scorecard

Reliability Specifications Example

- Given two fan datasheets
- Fan A has a mean time to fail of 4645 hours
- Fan B has a mean time to fail of 300 hours
- Both same price, etc.
- Choose one to maximize reliability at 100 hours

Reliability Specifications Example

- Consulting an internal fan expert, you are advised to get more information

- Fan A has a Weibull time to fail shape parameter of 0.8
- Fan B has a Weibull time to fail shape parameter of 3.0

$$\mu = \theta\Gamma\left(1+\frac{1}{\beta}\right)$$

Reliability Specifications Example

- Fan A has a scale parameter of 4100 hours
- Fan B has a scale parameter of 336 hours

- Use the Weibull Reliability function

$$R(t) = e^{-(t/\theta)^{\beta}}$$

- Fan A reliability at 100 hours is 0.95
- Fan B reliability at 100 hours is 0.974

Reliability Specifications Example

- Given two fan datasheets

- Fan A has a mean time to fail of 4645 hours
- Fan B has a mean time to fail of 300 hours

- What about later, say 1000 hours

- Fan A reliability at 1000 hours is 0.723
- Fan B reliability at 1000 hours is 3.5E-12

Television

"People will soon get tired of staring at a plywood box every night."

Darryl F. Zanuck
Twentieth Century-Fox, 1946

The Cost Reduction Example

- Given a FET that costs 10 cents, a new procurement engineer finds a new FET vendor that only charges 5 cents.
- Switch?
- What else to consider?

The Cost Reduction Example

- Given a FET that costs 10 cents, a new procurement engineer finds a new FET vendor that only charges 5 cents.

- $0.05 FET has MTBF of 50,000 hours
- $0.10 FET has MTBF of 75,000 hours

- 1000 hours of operation
- shipping 1000 units
- Cost to repair unit $250

The Cost Reduction Example

- Total Cost of $0.10 FET

$$R_{0.10}(1000) = e^{-\left(\frac{1000}{75{,}000}\right)} = 0.987$$

- #Failed = (1-0.987) 1000units = 13.25
- Cost of Repairs = 250*13 = $3250
- Total Cost = $3250+0.10*1000 = $3350

The Cost Reduction Example

- Total Cost of $0.05 FET

$$R_{0.05}(1000) = e^{-\left(\frac{1000}{50,000}\right)} = 0.98$$

- #Failed = (1-0.98) 1000units = 20
- Cost of Repairs = 250*20 = $5000
- Total Cost = $5000+0.05*1000 = $5050

The Cost Reduction Example

- Total Cost of $0.50 FET

$$R_{0.50}(1000) = e^{-\left(\frac{1000}{100,000}\right)} = 0.99$$

- #Failed = (1-0.99) 1000units = 10
- Cost of Repairs = 250*10 = $2500
- Total Cost = $2500+0.50*1000 = $3000

The Cost Reduction Example

- Result?

FET Cost	Repair Cost	Total Cost
$0.10	$3250 75,000 hrs	$3350
$0.05	$5000 50,000 hrs	$5050
$0.50	$2500 100,000hrs	$3000

Aviation

"The popular mind often pictures gigantic flying machines speeding across the Atlantic and carrying innumerable passengers...it seems safe to say that such ideas are wholly visionary."

Wm. Henry Pickering
Harvard astronomer, 1908

Component Challenges

- Cost driving manufacturing to lost labor cost areas of the world
- Pb-free causing redesign/reformulation
- Outsourced design & manufacturing facilities gaining “commodity’ component selection

- Other than yield - who’s watching Quality, Reliability and Warranty?

Component Challenges

- P50 formula error example
- Cracked ceramic capacitors

Component Challenges

- Trust and verify solution
- Build strong, technically verifiable, language into purchase contracts
- Check construction and formulation on periodic basis

Nuclear Energy

"Nuclear powered vacuum cleaners will probably be a reality within 10 years."

Alex Lewyt
vacuum cleaner manufacturer,1955

Pockets of Competences

- Lesson learned from outsourcing of PCA manufacturing (Singapore story)
- Lessons learned from various capacitor issues
- Lessons learned from HP-Cannon Laser Printer partnership

Pockets of Competences

- Add (or keep) technical depth in areas of risk
- Create business processes that keep this expertise effective in preventing field issues
- Provide deep technical knowledge behind traditional procurement activities

Medicine

"The abdomen, the chest, and the brain will be forever shut from the intrusion of the wise and humane surgeon"

Sir John Erichsen
leading British surgeon, 1837

Summary

- Measure and track warranty
- Do the math
- Keep deep technical capabilities to supplement and reinforce partnerships
- Request feedback from the audience

Where to Get More Information

- Newsletter and seminars
  http://Warrantyweek.com
- Warranty Cost: An Introduction article
  http://quanterion.com/ReliabilityQues/V3N3.html
- Economics of Reliability, Chapter 4 of Handbook of Reliability Engineering and Management, 2nd Ed. Ireson, Coombs & Moss

Presenter's Biographical Sketch

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