YOUR LEADER
IN RELIABILITY SOLUTIONS

provides tailored reliability solutions that advance our customer’s products in the market.

Adam Bahret - Extensive experience in program strategy, reliability analysis, accelerated testing and HALT in the fields of robotics, medical devices, consumer electronics, and heavy equipment.
What is Reliability?

• Formal Definition
  – “The probability that an item will perform its intended function under stated conditions, for either a specified interval or over its useful life.”
Are they edge cases or real cases?

• Customer use our products in many imaginative ways.

• We make fun of the guy who uses the lawnmower to trim the hedges

• We pay out the warranty claim

* “Even though there is clearly internal corrosion from submersion of the camera”
When do we get to make our case?

- *But there is no court trial where we get to make our case.*

- *We do get sued even though it was a “weird” way to use the product*

- *We do pay millions in warranty expense even though the product was used outside our intended specifications*
What “Brand” do we want?

- **We want that bullet proof label.**
  - *That is the holly grail for reliability*
  - *This proverbial award is given to products that perform as intended in situations that customers know they shouldn’t be using the product in.*

“For me it’s a power drill left in plaster dust.”
#36 Photive Hydra Waterproof Wireless Bluetooth Speaker

⭐⭐⭐⭐⭐ It LITERALLY survived a tornado!,
December 29, 2015

By Jason Shaw

Verified Purchase (What’s this?)

This review is from: Photive HYDRA Waterproof Wireless Bluetooth Speaker. Rugged Shockproof and Waterproof Portable Wireless Speaker. (Wireless Phone Accessory)

I bought this for my father-in-law for Christmas. His home was completely demolished by an EF4 tornado the next day. The following day entailed torrential rain. Today, we found the speaker amongst the soaking wet rubble of his home. Amazingly, it powered right up and is in perfect working order.
Can we create a better product?

- We should incorporate methods in our product development programs that look to assess these conditions highly varying conditions.

- In many cases the improvements to get us to “bullet Proof” may be free
Warranty

Law suits

Customer satisfaction

Brand value

Improved design functionality

New products
• The gap Use Case 7 fills is finding response to stresses that, although unlikely, *may occur* and could be addressed with design improvement.

• We are able to add robustness through faster testing and *correlate* it to extreme field stresses.

• We may mitigate that failure mode that started to show up a year after *release* because the product is used in a manner we didn't expect.

• We may *improve* the definitions of the *base use cases* as we explore the unusual.
  “Because sometimes the unusual is more common than we think. “
Use Case 7 is the way a customer may use your product in a manner that is way beyond what we design for.

My Dad when he used to load 300lbs of firewood into the back of his Nissan Sentra.

Having your parents car in a full drift in the mall parking lot (I’ve heard of this happening).

When you don’t change the oil.
(We called it automatic oil changes. The ratio of leaking to filling matched the consumption of normal oil changes.)
A portable radio is one you could carry and plug in somewhere else.

But then something big happened. The Transistor was invented in 1947. By 1954, portable radios became much smaller and more portable.
Formal Definition

“The probability that an item will perform its intended function under stated conditions, for either a specified interval or over its useful life.”

- Play music for people in a room
- Sits on a table, desk, or floor
- Play music for people walking
- In the rain
- In the dirt
- On a bicycle
- Mowing the lawn
- Dropped on concrete
- Indoors at temperature people like to be in (i.e. cozy)
- Below freezing
- In the sun at 110F
- Salt
- Water
- Dirt
- Dust
1. Dropped
2. Wet

- Driven around in van with no packaging Not tied down
- Next to a wood saw (saw dust intake)
1960’s
- Driven around in van with no packaging
- Not tied down

1970’s
- Next to a wood saw (saw dust intake)

1980’s
- Loaded in truck
- Next to wood saw

1990’s
- Loaded in truck
- Next to wood saw

- Temperature cycles
- Salt tests
- Start/Stop tests
Where does USE CASE 7 fit into programs?
Reliability Testing Measures and Improves Product Reliability

Each test has a ratio of the measure and improve objective

**Improve Reliability**
- HALT
- HASS
- Stress Margin
- Reliability Growth
  - Full system cycle testing
- Accelerated Life Test
  - Measures end of useful life

**Measure Reliability**
- Life Cycle
- Stress Margin
  - Identifies ways to reduce failure rate during use life
- USE CASE 7
  - Margin
  - Exposes failures to aid robustness improvement
- Quality Failures
- Wear-out Failures

**Highly Accelerated Stress Screen**
- Keeps defects in house and provides input to improve manufacturing

**Product Life Curve**
- Failure Rate
- Time
- End of useful life
- Product Release
- Stress Related Failures
Mechanical & Electrical Reliability

Bathtub Curve

Overall Characteristic Life Curve

I
Infant Mortality

II
Useful Life

III
Wear-out

Failure Rate

Time

Product Release

End of useful life

Quality Failures

Stress Related Failures

Wear-out Failures
Mechanical & Electrical Reliability

Bathtub Curve

I
Infant Mortality

II
Useful Life

III
Wear-out

HALT
SMT
UC7

Failure Rate

Time

Product Release

End of useful life
Mechanical & Electrical Reliability

Bathtub Curve

I
Infant Mortality

II
Useful Life
HALT
SMT
UC7

III
Wear-out

Failure Rate

Time

Product Release
End of useful life
Definition of HALT

Highly Accelerated Life Test

HALT: Done to ruggedize the product and obtain large margins over the expected in-use conditions. Uses all stresses which can cause relevant failures. Stresses are not limited to field levels or stresses.

-”Accelerated Reliability Engineering: HALT and HASS”, Gregg Hobbs
Vibration

Electro Dynamic Vibration

One Frequency

Multiple Simultaneous Frequency

HALT Vibration

1 axis

6 axis
Temperature

Environmental Stress

HALT (Transition)

HALT (Limits)
Apollo F1 Motor Program
Stress Margins
Stress Exposure and Limits

- Lower Destruct Limit
- Lower Operational Limit
- Operating Specifications
- Upper Operational Limit
- Upper Destruct Limit

Margin

Stress Failures
Stress Exposure and Limits

After Margin Improvement

- Lower Destruct Limit
- Lower Operational Limit
- Upper Operational Limit
- Upper Destruct Limit

Operating Specifications

Margin

Stress

Failures
Emotional Acceptance of HALT

• First Stage -
  – “Don’t tell me my baby is ugly!”, “Of course it’s going to break”, “It doesn’t see that stress in the field.”

• Second Stage -
  – “Wow I didn’t expect that!”

• Third Stage -
  – “This gives me a great idea for improvement.”

• Fourth Stage -
  – “I have a new design. Can we do it again?”
Emotional Acceptance of UC7

• First Stage -
  – “It’s not our fault if they use it wrong. We are adding unnecessary product cost”

• Second Stage -
  – “Hmm. I have actually seen my wife do that with our product”
    *(That’s an actual quote from a sceptic in a UC7 session)*

• Third Stage -
  – “This gives me a great idea for improvement.”

• Fourth Stage -
  – “I have talked to other teams in the company about our success with UC7 and suggested they do it and we make it a standard practice.” *(Actual quote from the same person who was the skeptic at stage 2)*
The UC7 Process
Developing a Use-case and Environment Profiles

- **Create Levels/Profiles**
  - I typically start with three

- **Select key categories for use-case factors**

- **Summarize a typical customer for each profile**

- **From documented cases extract values for key categories**

- **What is your composite use case for limited test samples**
Why “7”?

One of the first things I do with customers that want to better understand their products reliability is ensure we have clearly defined use cases.

Use Cases are the typical cases

1. city driver
2. commuter
3. taxi driver

Use Cases

Do occur but are expected to be a very small percentage of users

High
Med
Low

or

1. city driver
2. commuter
3. taxi driver
Thank You for Attending

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