




# Fundamentals of HALT

Fred Schenkelberg

2nd Worst  
4 letter  
acronym







If we know  
about a failure,  
we can fix it



It's a  
discovery  
process





Do you know how  
your product will

fail?



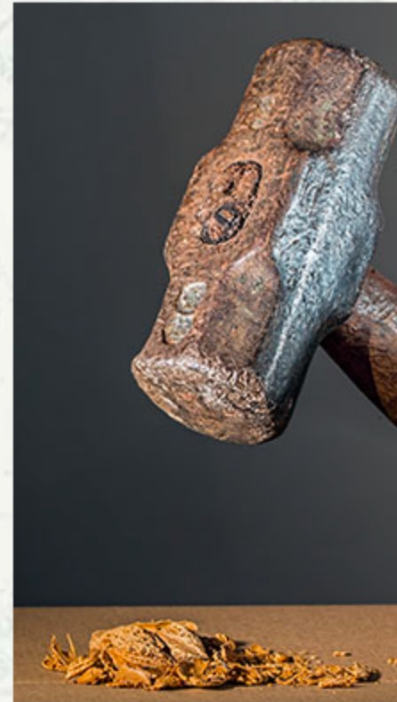
# 4 Steps to Accomplish HALT



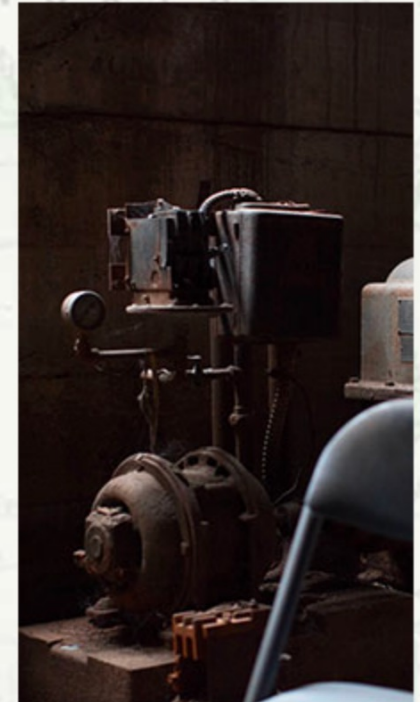
Brainstorm Stresses



Select Stresses



Apply Stresses



Do the  
Failure Analysis



# Brainstorm Stresses



As many as possible

Build on risk analysis and FMEA work

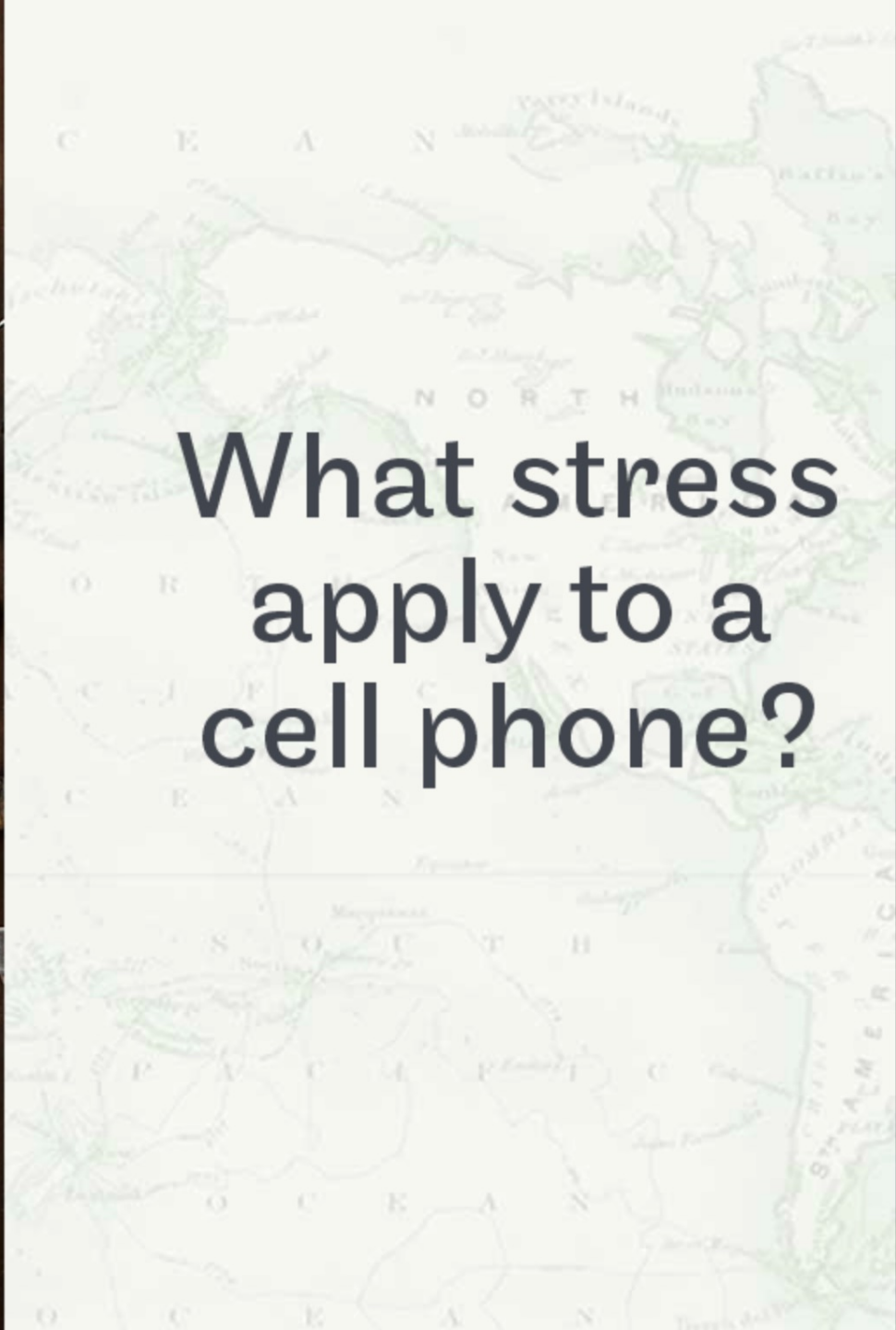
Use a range of anchors  
weather  
use  
installation  
etc.

What factors cause failure mechanisms to engage?





What stress  
apply to a  
cell phone?



# Select Stresses



What factors have highest risk?

Narrow down to short list

Pareto Principle

Least design margin

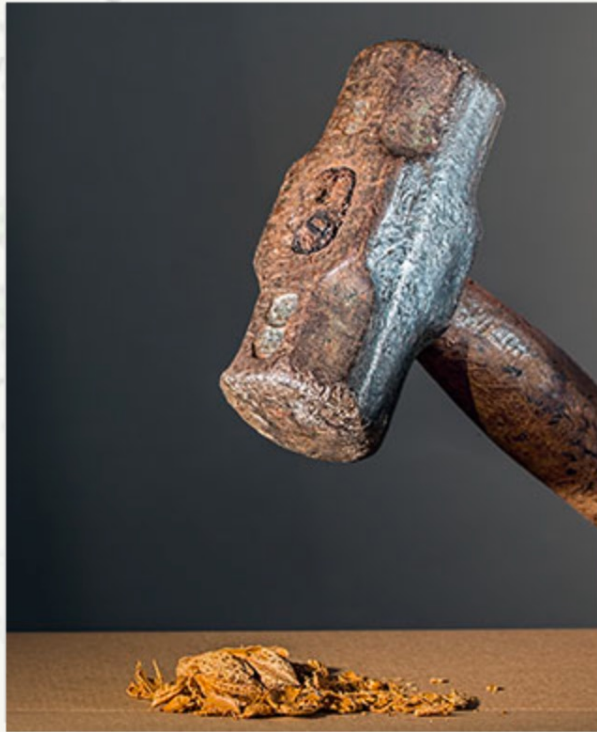
Most unknowns



**What  
stresses to  
apply to a  
cell phone?**



# Apply Stresses



This is the fun part.

Lowest risk single stress at first

Individual stresses

Combined stresses

Increase till failure

Capture details about each anomaly

Patch/repair/isolate and continue



What  
should we  
do if the  
screen goes  
dark at  
 $-30^{\circ}\text{C}$ ?



# Do the Failure Analysis



This is the important step

Gather data immediately

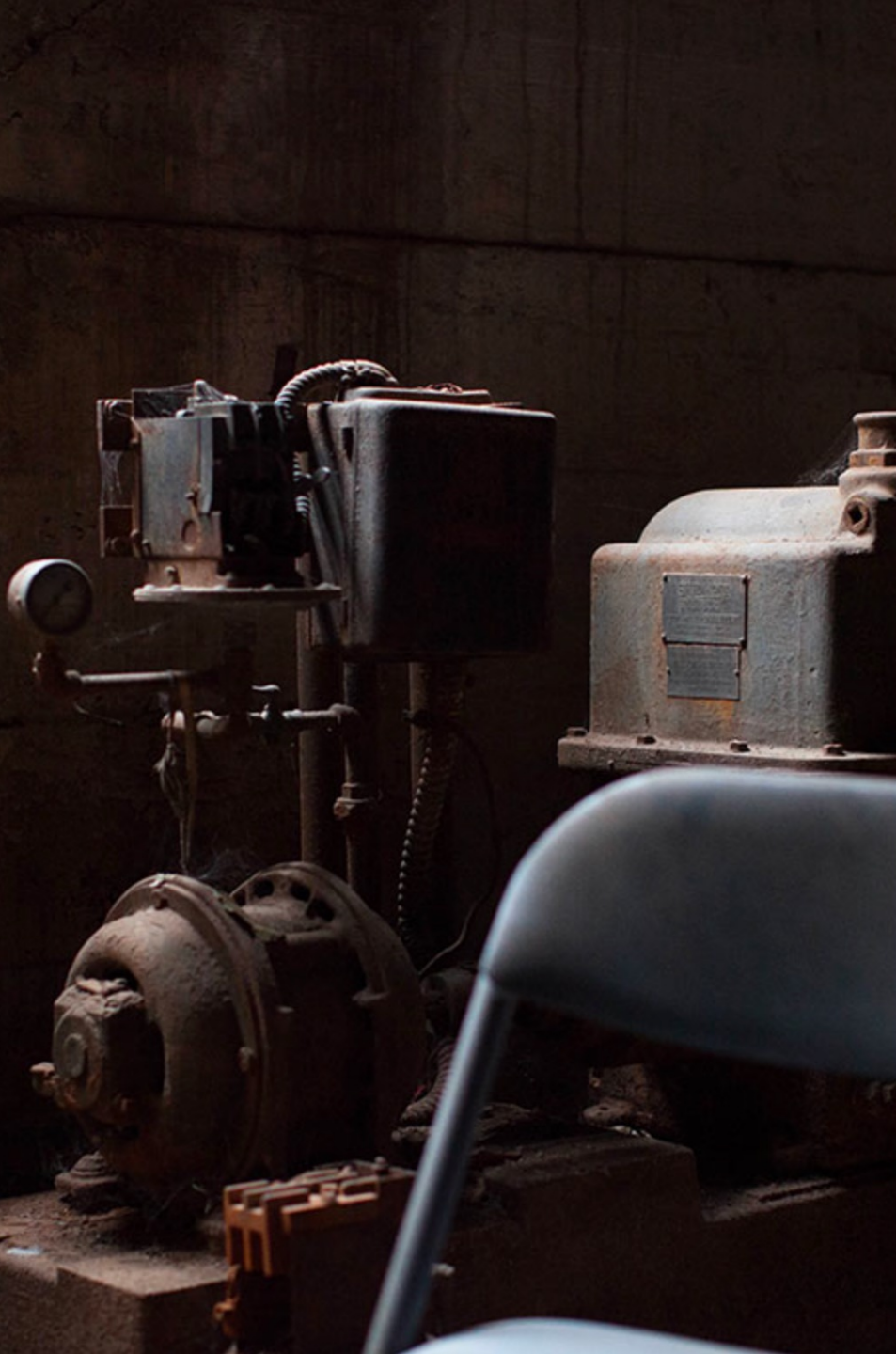
Document symptoms and observations

Get to the root cause

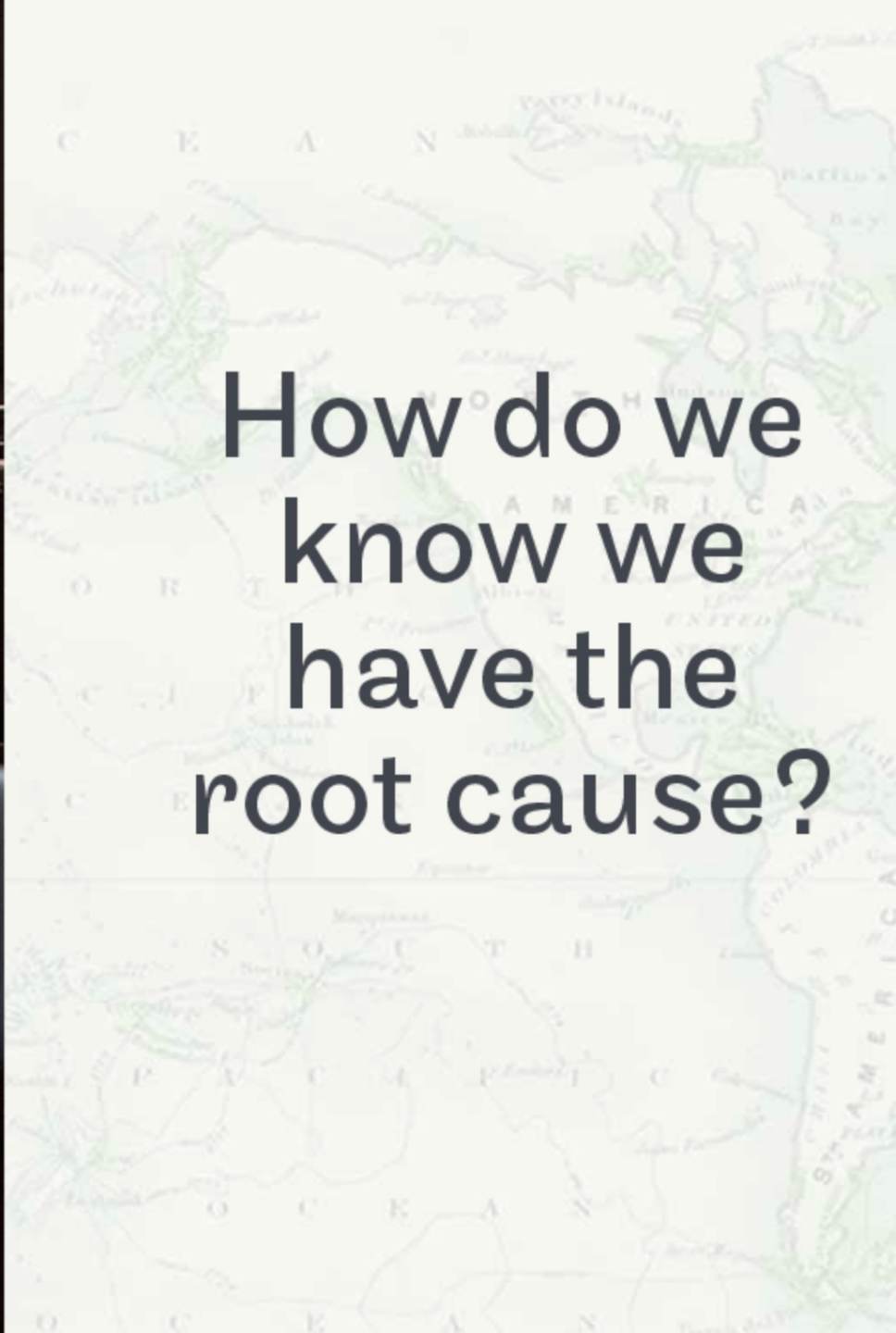
- 5 whys

- 8D failure analysis process





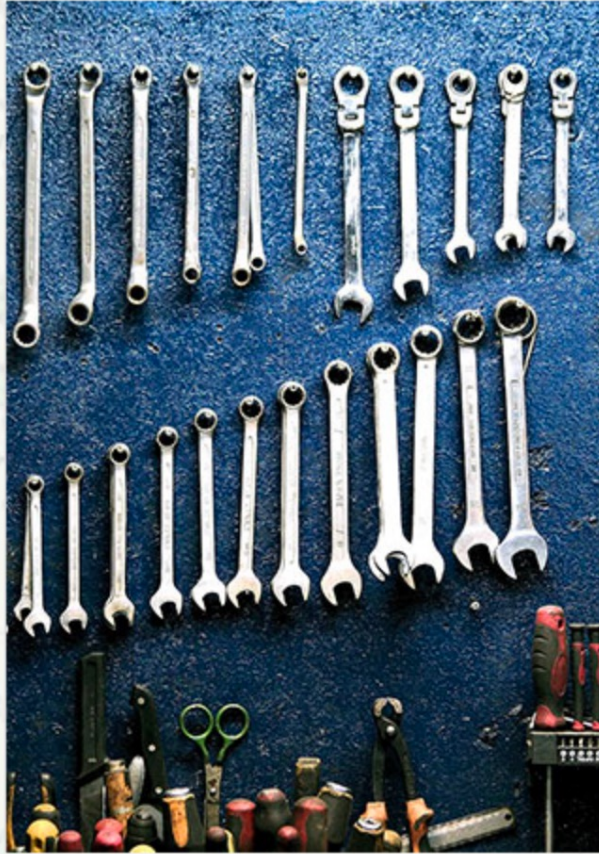
How do we  
know we  
have the  
root cause?



Do We Address All  
Failure Mechanisms?



# The HALT Concept



Preparation



Finding Limits



Technological Limits

# HALT Preparation



Before, prior, plan,  
prepare, anticipate

Define scope and purpose of study  
system, product, process,...

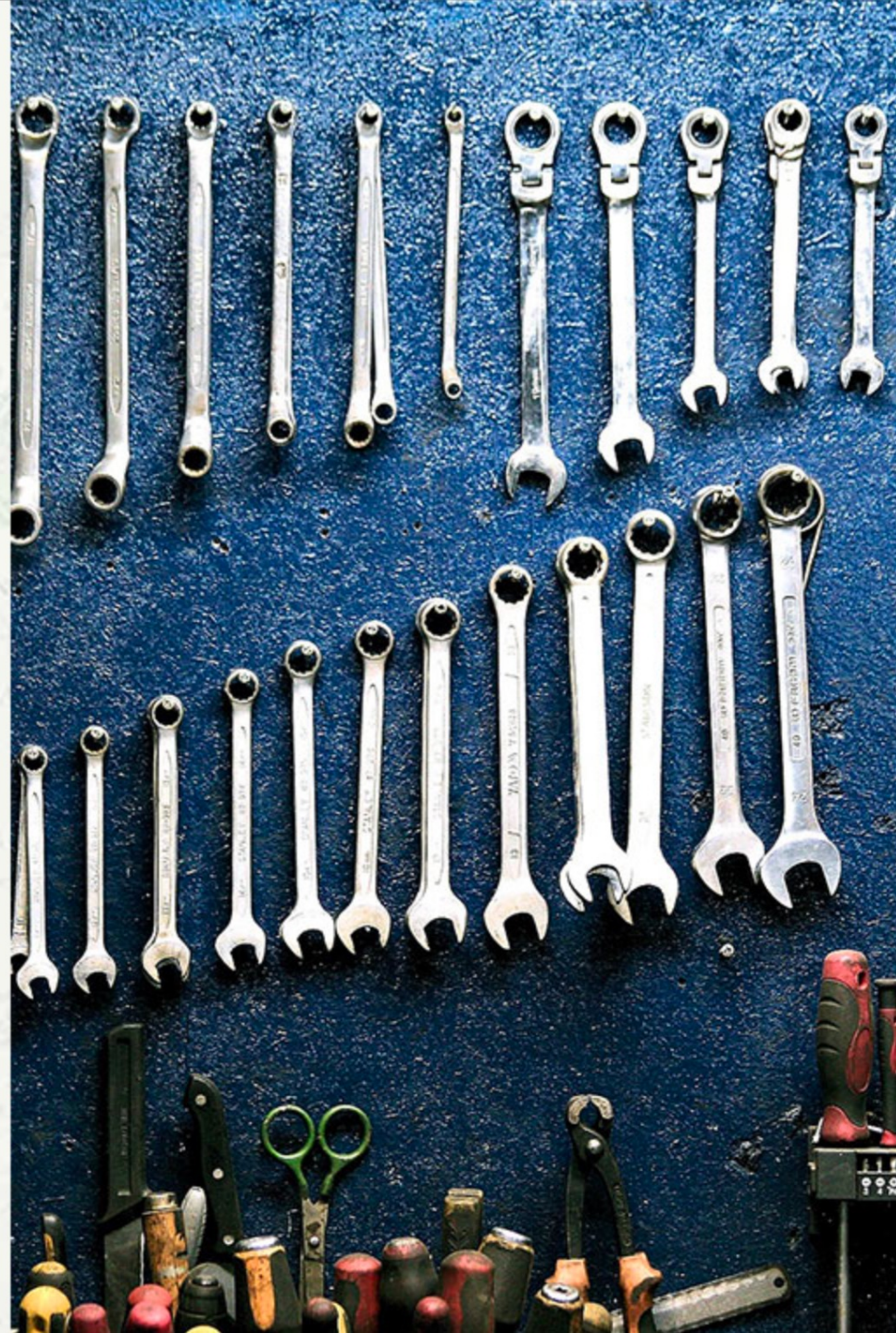
How will you measure or detect  
problems?

How will you apply the stresses?

What are known failure mechanisms?



For Drop  
stress,  
how high  
should  
go?



# Finding Limits



Find the amount of applied stress, for each stress under consideration to cause failure

Incremental increase in stress and check performance

Back off stress to determine if hard failure or not

What is the stress envelope of operation?



If the  
housing  
melts, is  
that going  
to far?



# Technological Limits



Fundamental properties at play

Phase transitions

Characteristic of the design

This is good, right?



How  
would you  
prioritize  
the  
identified  
failures to  
address?





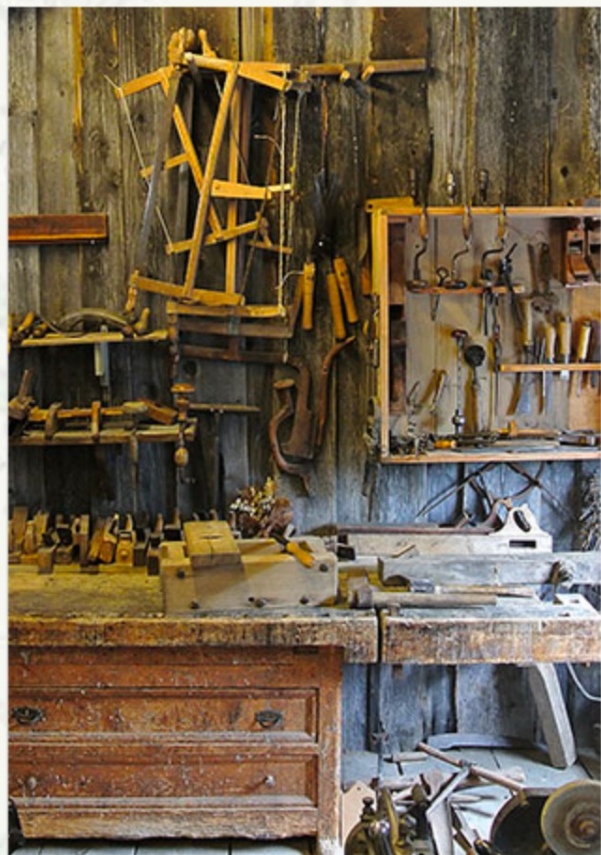
Rinse and  
repeat





How well are your  
HALTs working?

# What Could Go Wrong?



Only use HALT Chamber



Run standard profile



No Follow Up



# Only Use HALT Chamber

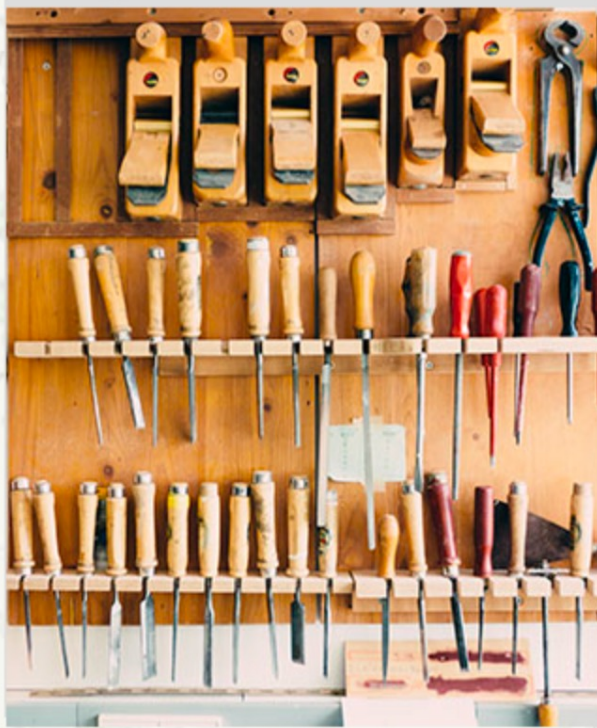


HALT Chambers include:  
thermal  
vibration  
power  
loading

They do not include:  
drop  
bend  
dust  
humidity  
...

While versatile they do not  
include all appropriate  
stresses

# Run a Standard Profile



Just because the last prototype or product survived a profile...

Running out of time or too many tests to run...

Take the time to find failures



# No Follow Up



Action, improvement,  
resolution, mitigation

No follow up or action on findings

Filling out the template or filing a report is  
not the goal here

How else have you  
seen a HALT go



# The finding and understanding failures creates HALTvalue

Plan the stresses to  
apply based on risk



Step stress to  
determine operating  
and destruct limits



Follow up on resolving  
finding

# More Information

Visit [AccendoReliability.com](https://AccendoReliability.com)

Let me know if you have any questions.

Check out the reliability engineering podcast network at [Reliability.FM](https://Reliability.FM)

Continue to explore your testing and make improvements.