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Meeting

March 19, 2019

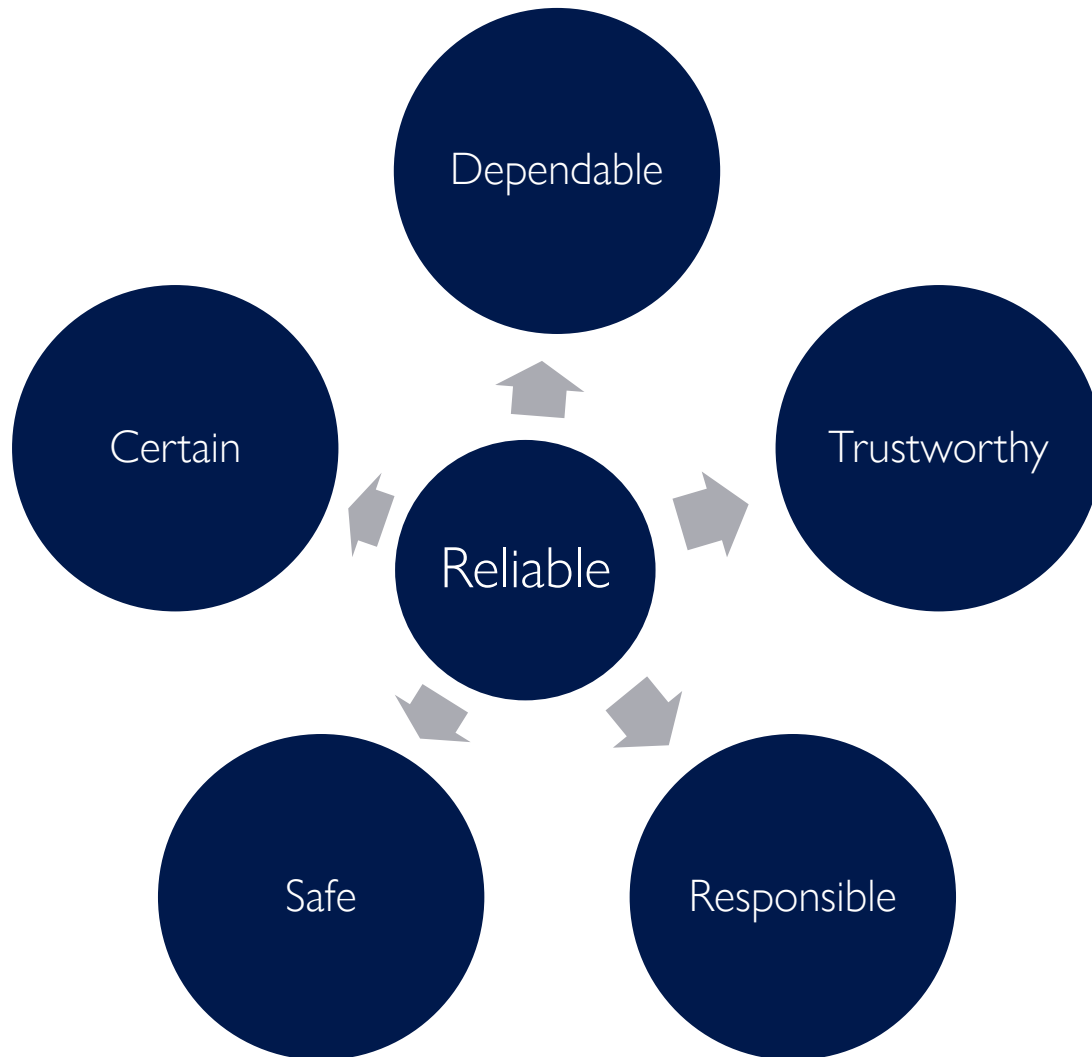
Running Reliably: The World Through the Lens of a Globetrotting Reliability Engineer



Abstract

- Traveling and working outside the US provides incredible opportunities to observe how other countries and cultures achieve reliability. Because reliability requires both people and objects to function well for a certain time under specific conditions, it means quite different things in different places! Politics, geography, culture, climate, and society norms all influence how reliability is defined, perceived and achieved.
- In a presentation that is equal parts travelogue and technology review, learn more about the fascinating ways reliability is achieved around the world and how you can apply some of these lessons in your own organization. Case studies include examples of reliability management in the US, Ethiopia, South Africa and New Zealand with technologies ranging from automobiles to tracking devices. See clever, cost-effective solutions and cross-cultural approaches that you might not have considered because of where you work and live.

Reliability WHATs & WHYs



Factors

Geography

Experience

Industry

Culture

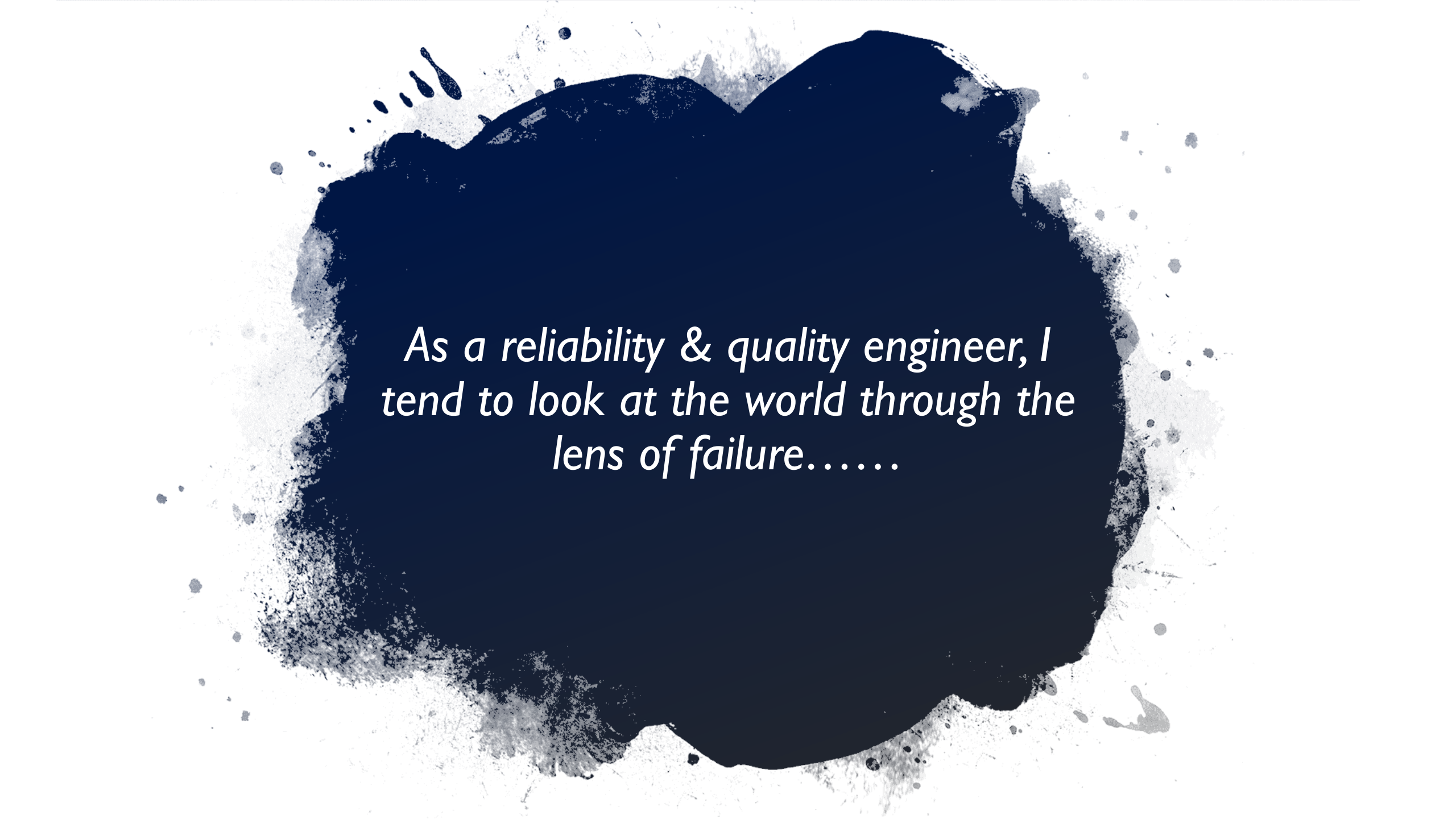
Politics

Background

History

Worldview

Cost



*As a reliability & quality engineer, I
tend to look at the world through the
lens of failure.....*

“Science is an ongoing race between our inventing ways to fool ourselves, and our inventing ways to avoid fooling ourselves.”



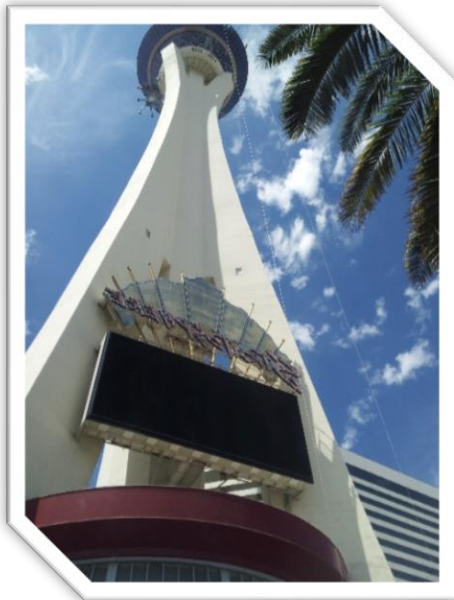
Biases we have.....

And how we overcome them!

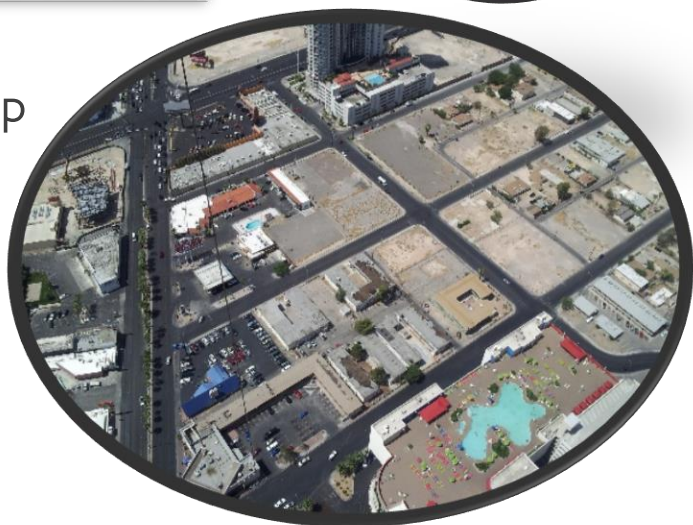


https://globalsmt.net/articles_&_papers/reliable-reliability-data/#

Reliability is very personal....



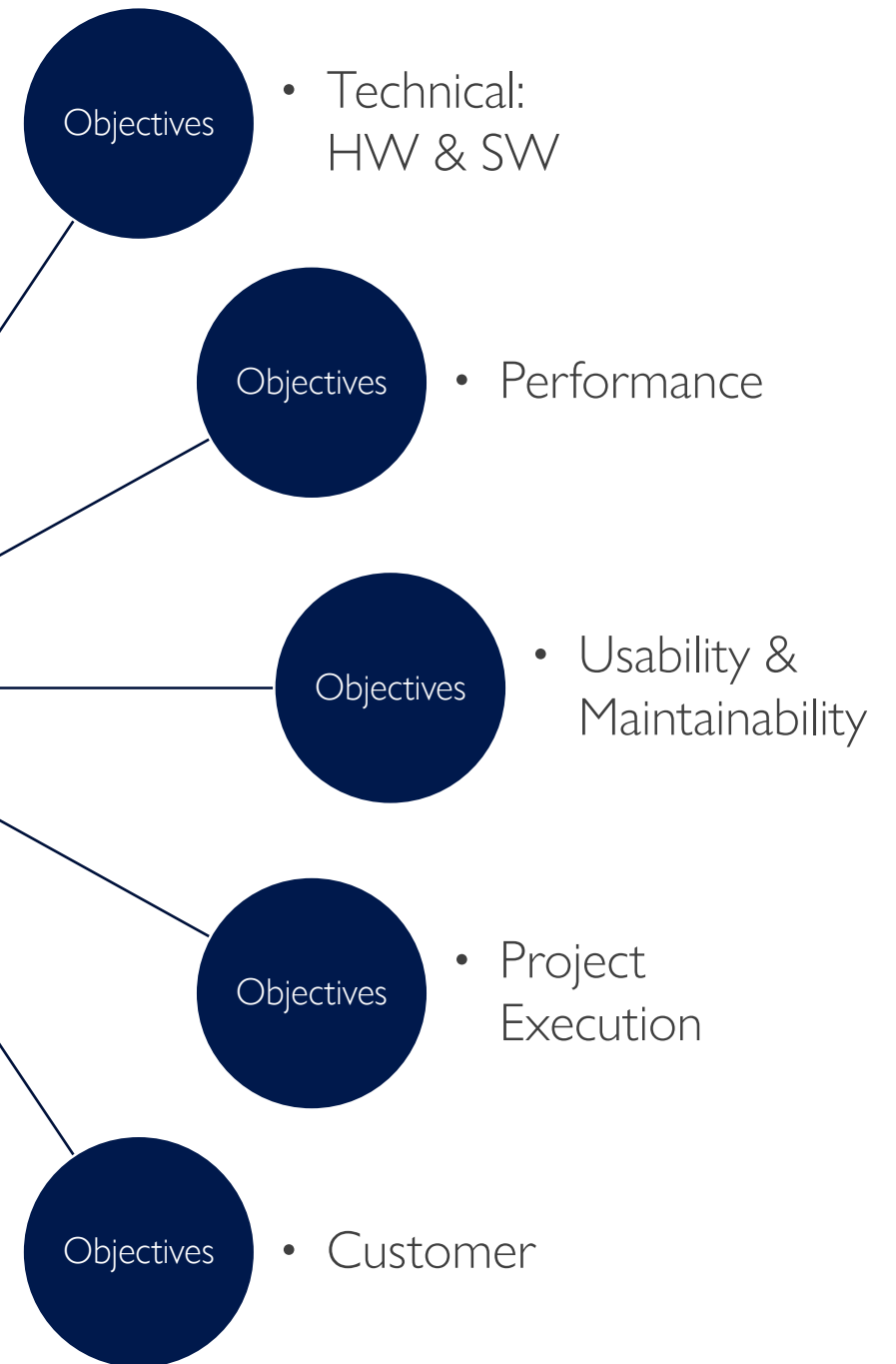
~855 ft drop



*For me, reliability =
reducing RISKS of
failure, disappointment,
pain, expense*

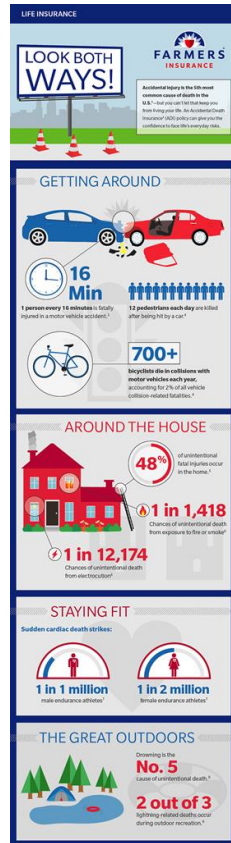
In reliability, risks are the uncertainties that matter*

- Threaten 1 or more objectives
- Some uncertainties don't matter



*Approach by Dr. David Hillson, <http://www.risk-doctor.com/>

What risks are you worried about?



Number of Americans killed annually by:	
Islamic jihadist immigrants ¹ :	2
Far right-wing terrorists ¹ :	5
All Islamic jihadist terrorists (including US citizens) ¹ :	9
Armed toddlers ² :	21
Lightning ³ :	31
Lawnmowers ⁴ :	69
Being hit by a bus ⁴ :	264
Falling out of bed ⁴ :	737
Being shot by another American ⁵ :	11,737

¹10-year average of terrorist attacks - "Deadly Attacks Since 9/11," New America, <http://securitydata.newamerica.net/extremists/deadly-attacks.html>

²www.snopes.com/toddlers-killed-americans-terrorists/

³10-year average of deaths by lightning, NOAA, www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

⁴10-year average, Underlying Cause of Death 2014, CDC, <http://wonder.cdc.gov/>

⁵10-year average 2005-2014, CDC, Injury Prevention & Control: Data & Statistics (WISQARS™) www.cdc.gov/injury/wisqars/fatal_injury_reports.html



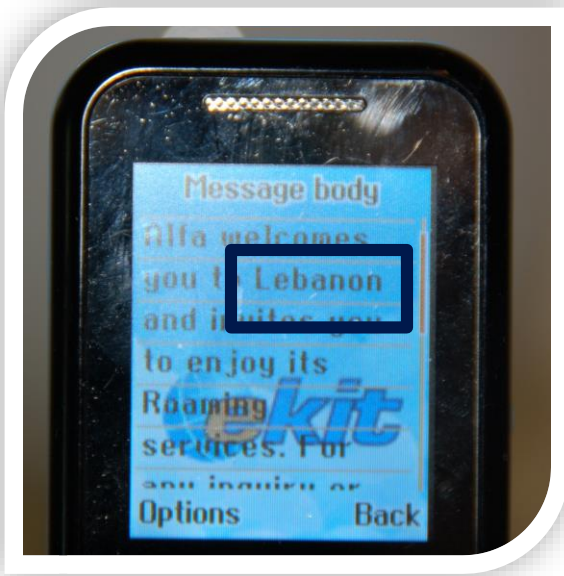
How can we find risks & improve
reliability in our projects?

Sometimes It's Simple

- Types of Technical Risks
 - *New parts*
 - *New processes*
 - *New suppliers*
 - *Changing requirements*
 - *Unknown use environments*
 - *Changing business environment*
 - *New technologies*



But sometimes we need to explore....

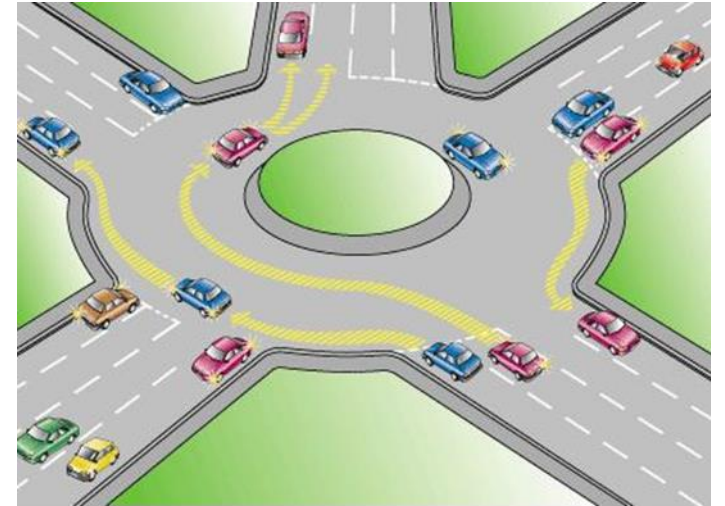


*Traveling has
given me some
great insights
along with a
few scares....*



New Zealand: A Roundabout Approach to Reliability (Geography)

- Extremely common in country
- Safer for drivers & pedestrians than traffic circles & signal intersections
 - **Reduce injury crashes by 75 %**
 - **Reduce traffic fatalities by 90 %**
- More reliable & cheaper
 - Traffic signals cost money to install, maintain & operate
 - Vulnerable to weather-related disruptions including wind, trees, power outages, even bright sunlight



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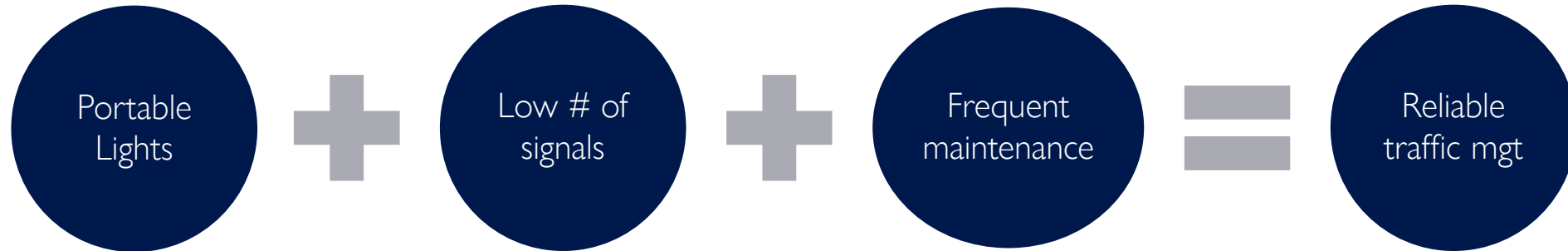
New Zealand: I became an unreliable driver! (Experience)



- Transposed location of levers for turn signals & wipers
 - Location of turn varied by whether manufacturer is Asian or European
- Why shouldn't location of critical controls be standard in vehicles or at least standard within a given country?
 - *Resulted in me turning on the wipers rather than signaling a turn!*

New Zealand: A Roundabout Approach to Reliability (Environment, Culture)

Portable Traffic Lights



Eliminate need for people to manage traffic

Used in areas where 1 lane is temporary



One Way Bridge Warning

- Permanent 1 lane marked by “give way” sign indicating who has right of way
- Red arrow indicates the direction which yields

New Zealand: Seismic Shifts in Reliability (Geography)

- How is reliability managed when the ground is unstable?
- In Wellington, buildings marked with “Earthquake Prone Building” notices
 - Provided a 10-year deadline for fixes!

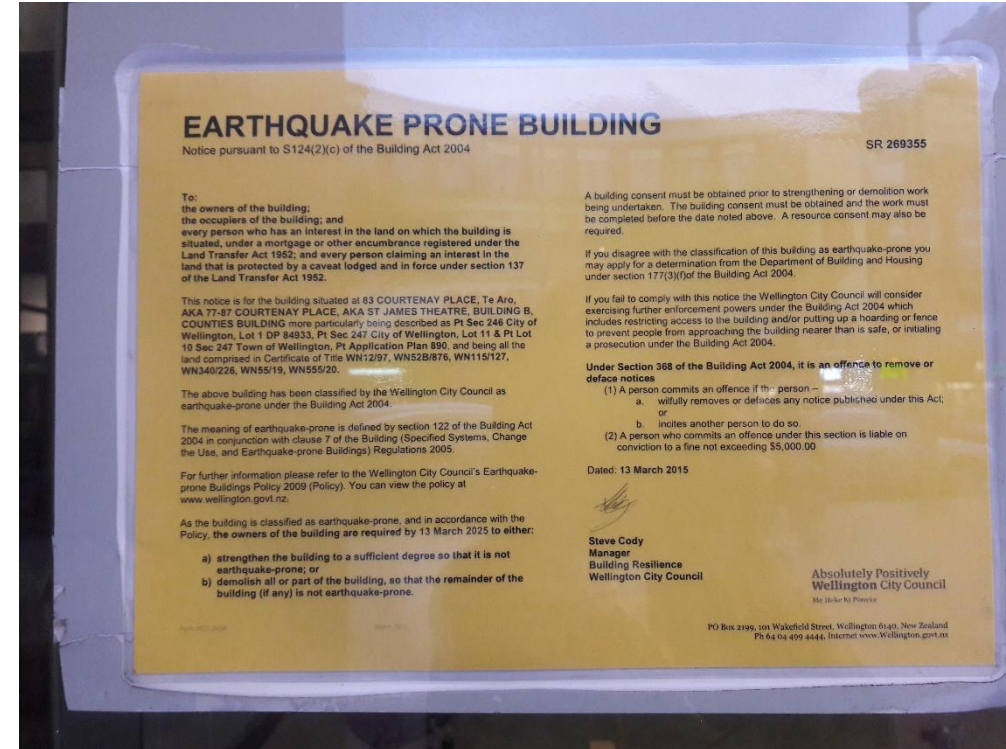


Figure 1 Earthquake Prone Building Notice
Image courtesy Cheryl Tulkoff

Table 1: Frequency of New Zealand Earthquakes (1960 to 2015)

Magnitude	Annual Average	Minimum	Maximum	"Rule of Thumb"
4.0 - 4.9	451	184	1,343	1 per day
5.0 - 5.9	51	19	127	4 per month
6.0 - 6.9	2.7	0	9	5 per 2 years
7.0 - 7.9	0.4	0	2	1 per 2.5 years
8.0 or over	0	0	0	1 per century*

Table: Earthquakes & landslides are a fact of life

New Zealand: Seismic Shifts in Reliability

Important buildings vulnerable

Undertook a massive retrofit to Parliament to install earthquake mitigations: base isolators

While focus here is on building stability & safety, earthquakes also pose serious hazards to all types of infrastructure – power, water.....



Figure: Parliament & the Parliamentary Library, images courtesy of Cheryl Tulkoff

- <https://www.parliament.nz/en/visit-and-learn/how-parliament-works/fact-sheets/earth-move>
- 417 base isolator bearings were installed in the existing foundations under Parliament House and the Parliamentary Library
- Buildings were separated from their original foundations by a 20mm seismic gap

New Zealand: Seismic Shifts in Reliability



Cutting into the original foundation

Installing base isolators required:

1. Propping up the whole building section by section
2. Cutting out large 7-ton blocks of the existing foundations
3. Building new concrete foundations to hold the isolators

Quite impressive to see the scale of this retrofit!



Old foundation with base isolator

*Base isolation reduces the transfer of earthquake forces from the foundations to the building above and reduces the need for extensive and intrusive strengthening concrete shear walls throughout the building.

How Great Is Your Risk of Earthquake Damage?

About 5,000 earthquakes can be felt each year in the United States. Earthquakes occur most frequently west of the Rocky Mountains. Historically, however, the most violent earthquakes struck the central United States. All 50 States and all U.S. territories are vulnerable to earthquakes. Forty-one States or territories are at moderate to high risk. Since 1900, earthquakes have hit 39 States.

*Why don't we hear more about earthquake testing & protection more in the US?
(Culture?)*

<https://training.fema.gov/emiweb/is/is394a/05earthquake-0306.pdf>

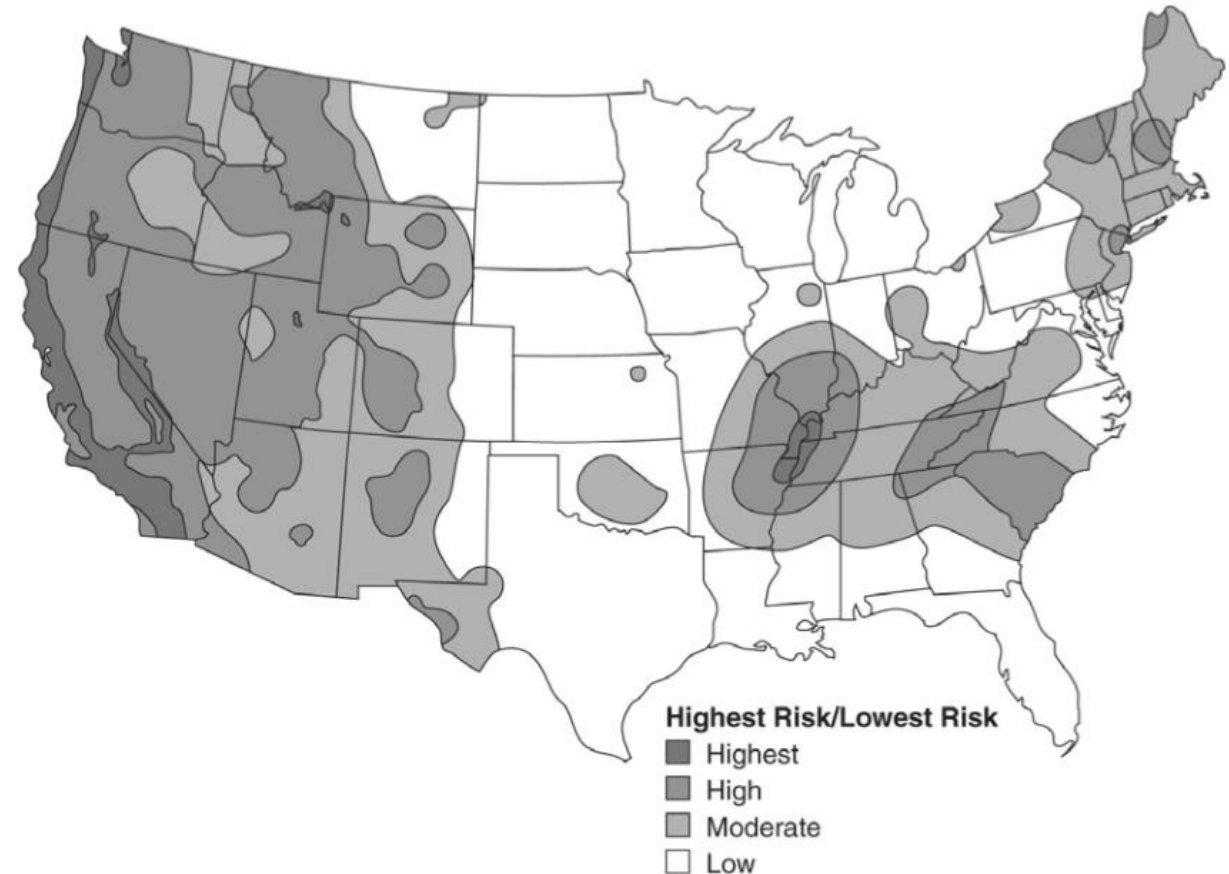


Figure 1. Seismic Hazard Map

Ethiopian Electronics Manufacturing Powers Up



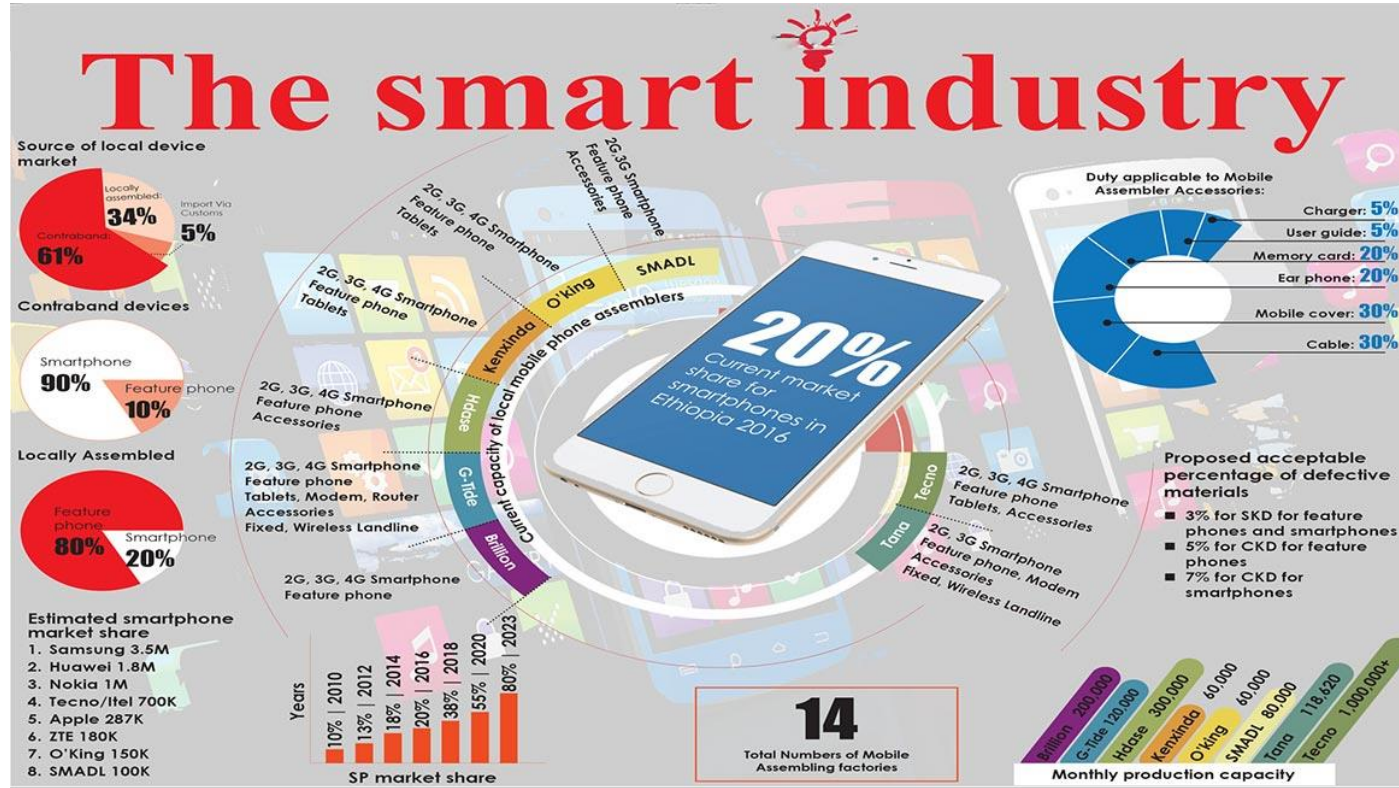
- Asfaw lives in a single room with his Aunt
- Lacks running water & plumbing but does have electricity
- Owns a mobile phone (not a smartphone) & has access to computer & internet at school
- Power goes out ~ 8 times / month

Reliable power & electronics needed!



Ethiopian Electronics Manufacturing Powers Up (Politics)

- 14 factories for mobile phones
- Produce 34% of the mobile phones in the country
 - 20% smartphones
 - 90% of smartphones smuggled in
- Why?
 - Electronic components have to be imported
 - Up to a 7% failure rate!



Prepaid Energy Meter



Tracking South African Electronics (Cost, Culture)

- Prepaid energy meter made in South Africa
 - Airbnb owner “topped” meter when we arrived
- Users pre-pay for electricity before using it
 - Pay via a smartcard, token or key
 - Can be loaded at stores or via a smartphone app
- NOT cheaper than standard service
 - Benefits landlords more than users – reliability of bill payment!

Tracking South African Electronics



- Trackers monitor & prevent poaching of wildlife
 - Easy to use, reliable & affordable for a wide variety of animals
 - Battery can last up to 3 years
- Home to Cybertracker software
 - Enables everyone from scientists to non-literate indigenous trackers to keep tabs on tagged animals

Figure 2 VHF Tracking Collar on a rhino, image courtesy of Michael Tulkoff

Death Valley: A Hot Topic (Environment)



Most people who read the weather forecast don't plan a summer visit to Death Valley National Park!

FIGURE: FURNACE CREEK VISITOR CENTER AT DEATH VALLEY NATIONAL PARK



Temperature



iPhone needs to cool down
before you can use it.



slide for emergency

A Hot Topic

- Cell phones didn't fare well in high temps
- Screen quickly went black or displayed errors indicating they were too hot
 - Few minutes exposure to AC resulted in rapid recovery

A Hot Topic



IMAGE: AC “BR” ERROR CODE
INDICATING LOW VOLTAGE

- Resort transformer failure resulted in no power for 1 hour & no AC for 2 days
 - Telltale “boom” & all the lights went out
 - Backup generator restored power but insufficient to supply AC units
 - No contingency plans... except to leave!



A Hot Topic

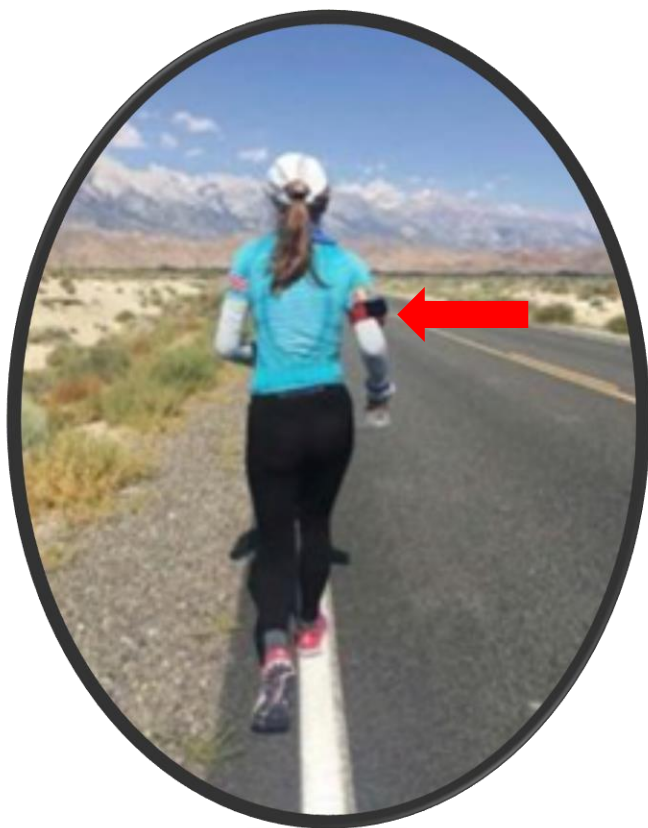


Image: GPS Tracking Device on right arm

- Satellite-based GPS tracker with live tracking
 - Device & web service performed reliably throughout the 48 hours of the race
- Satellite phones, fitness bands & GPS watches also held up well in the extreme conditions
- Cars.. Not so well if you tried to use the AC



What have I learned & borrowed?



Automation & high tech is not always the best approach



Adapt approach based on where it will be used



Consider adjacent industries & “severe” environment proving grounds

Earthquake = severe vibration & shock

Death Valley = stand-in for extreme temperatures (auto proving grounds)

Tropics = humidity, condensation, insects



Explore

- Consider reliability in the context of risks & objectives
- Challenge biases
- Looks for ideas in the world around you

You'll rarely see reliability data unless the results are overwhelmingly positive or negative - catastrophic event

Wrapping it Up.....

References

- A Roundabout Approach to Reliability
 - <https://www.theguardian.com/world/live/2016/nov/15/new-zealand-earthquake-floods-wellington-kaikoura>
 - <http://www.rtl.co.nz/c/Portable-Traffic-Lights/p/709/RTL-MPB-4000-Portable-Traffic-Lights.aspx>
 - Shashi S. Nambisan; Venu Parimi (March 2007). "A Comparative Evaluation of the Safety Performance of Roundabouts and Traditional Intersection Controls". Institute of Transportation Engineers.
 - <http://www.iihs.org/iihs/topics/t/roundabouts/qanda>
 - <http://www.heraldtribune.com/news/20090621/a-traffic-circle-and-a-roundabout-are-not-the-same>
 - <http://www.itscosts.its.dot.gov/its/benecost.nsf/0/215F723DB93D293C8525725F00786FD8>
 - <http://pugetsoundblogs.com/roadwarrior/2012/09/25/comparing-costs-of-roundabouts-and-traffic-signals/>
 - <https://www.nzta.govt.nz/resources/roadcode/about-driving/giving-way-on-one-lane-bridges/>

References

- Seismic Shifts In Reliability
 - <https://www.geonet.org.nz/quakes/statistics>
 - <http://info.geonet.org.nz/display/quake/Earthquake+Factors+and+Statistics>
 - <http://www.insurancejournal.com/news/international/2017/04/03/446608.htm?print>
 - Whitaker, Jerry C. The Electronics Handbook. Boca Raton, Fla: CRC Press, 1996. Print.
 - <https://www.fema.gov/national-earthquake-hazards-reduction-program>
 - <https://www.usnews.com/news/articles/2016-09-23/is-the-energy-grid-in-danger>
 - <http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=23171>
 - <http://www.earthquakecountry.org/step1/electronics.html>

References

- Tracking South African Electronics
 - <https://www.puc.texas.gov/consumer/facts/faq/Prepaid.aspx>
 - <https://www.elprocus.com/prepaid-energy-meter/>
 - http://www.itweb.co.za/index.php?option=com_content&view=article&id=46167
 - <http://wildlifeact.com/blog/gps-and-vhf-tracking-collars-used-for-wildlife-monitoring/>
 - <http://www.saeec.org.za/our-industry/electronic-manufacturing>
 - <http://www.ee.co.za/article/sa-based-prepaid-meter-manufacturer-sets-market-trends.html>
 - <http://www.ee.co.za/article/telkom-182-12-the-broadband-challenge-in-south-africa.html>
 - <http://www.ee.co.za/article/electronics-industry-great-future-sa.html>

References


- A Hot Topic
 - <http://www.badwater.com/event/badwater-135/>
 - <http://www.guinnessworldrecords.com/world-records/highest-recorded-temperature>
 - <https://www.weather.gov/lax/excessiveheat-automobiles>
 - <https://support.apple.com/en-us/>

References

- Ethiopian Electronics Manufacturing Powers Up
 - <https://www.export.gov/article?id=Ethiopia-Information-and-Communication-Technology>
 - <http://www.tradingeconomics.com/ethiopia/power-outages-in-firms-in-a-typical-month-number-wb-data.html>
 - <http://data.worldbank.org/country/ethiopia>
 - https://energypedia.info/wiki/Ethiopia_Energy_Situation
 - <http://www.thereporterethiopia.com/content/smart-industry>
 - <http://spectrum.ieee.org/biomedical/devices/ai-medicine-comes-to-africas-rural-clinics>



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THANK YOU

Speaker Biography

- I have over 20 years of experience in electronics manufacturing focusing on reliability and failure analysis. I'm passionate about applying my unique background to accelerate product design and development while saving time, optimizing resources, and improving customer satisfaction.
- Throughout my career, I've had extensive experience training others. I'm a published author and a senior member of both ASQ and IEEE. I'm also a ASQ Certified Reliability Engineer and Certified Manager of Quality and Organizational Excellence.
- I earned a Bachelor of Mechanical Engineering degree from Georgia Tech and a Master of Science in Technology Commercialization (MSTC) program at the University of Texas at Austin.
- In my free time, I love to run! I've had the good fortune to run everything from 5k's to 100 milers including the Boston Marathon, the Tahoe Triple (three marathons in 3 days) and the nonstop Rocky Raccoon 100 miler. I also enjoy travel and have visited 46 US states and over 20 countries around the world. I combine these two passions in what I call "running tourism" which lets me quickly get my bearings and see the sights in new places.



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