IOT & RELIABILITY

PRACTICAL EXAMPLES AND GOOD PRACTICES

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Reliability Needs in Industry

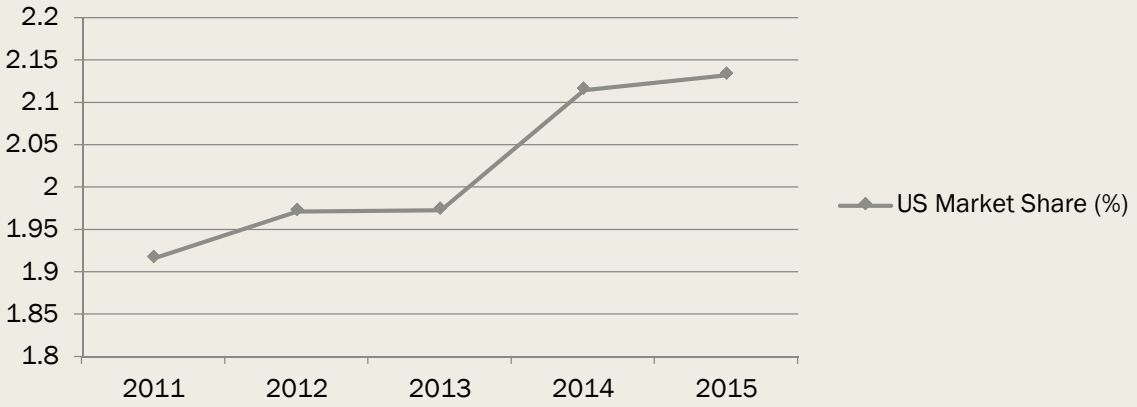
- How important is quality/reliability?
  - *Every Boards and CEO will say it is paramount*
  - *Their actions may tell you a different story!*
- Motivation?
  - *It is all about business!*

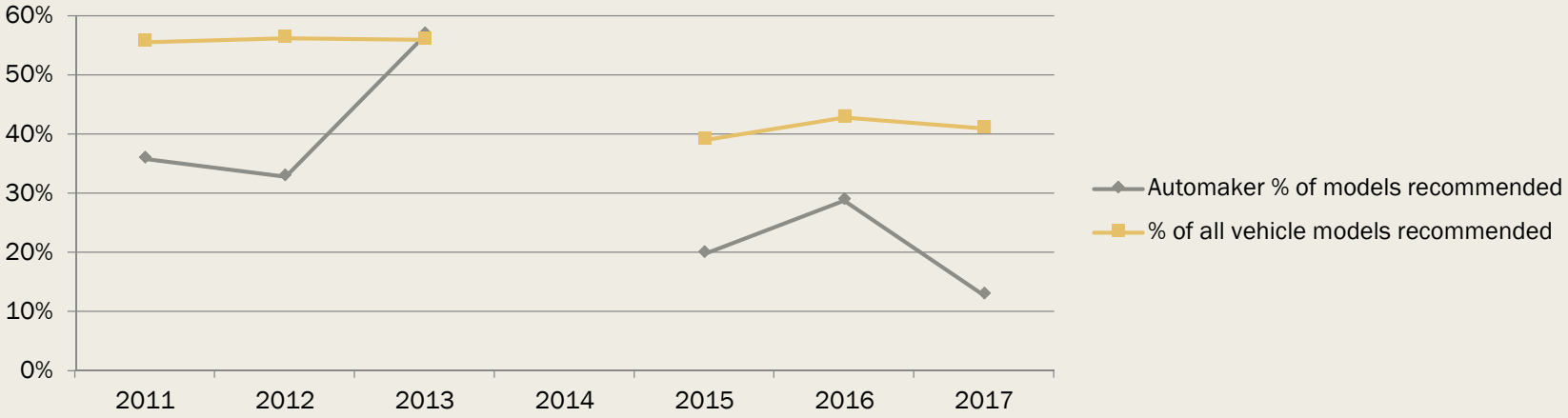
Reliability Comparison

- Who has better reliability/quality?
  - *Automaker that has ranked in bottom 1/3 in terms of quality for the past 6+ years*, with less than 1/3 of their vehicles recommended by CR*
  - *Large domestic HVAC manufacturer with less than 1% warranty return rate in 2 years*
  - *Medium size domestic IoT service company with 60% annual product refurbish rate*

* - Excludes 2014 data

Automaker





Sources: Bureau of Economic Analysis (BEA), official sales data, CR

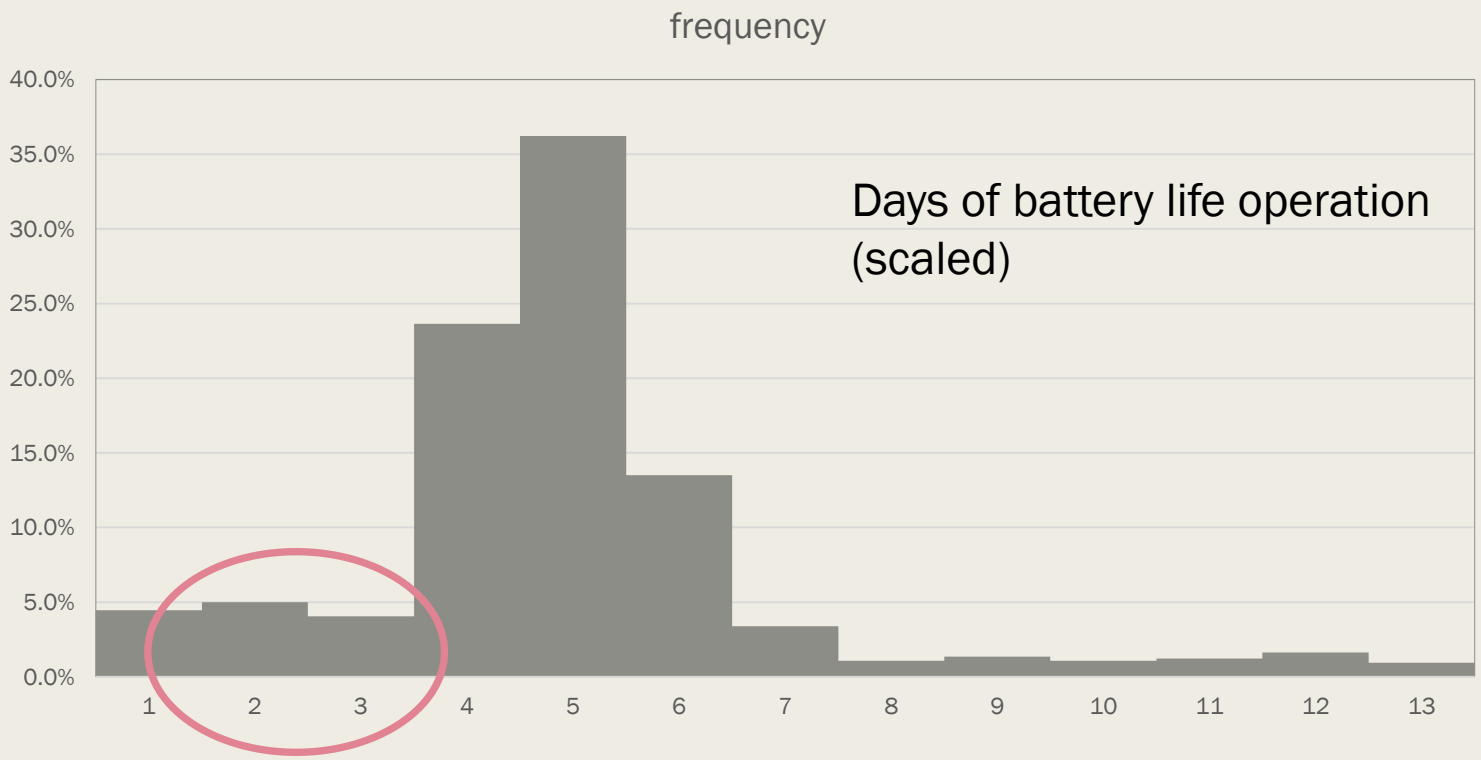
What's The Point?

- There is no engineering discipline closer tied to business than reliability!
- You have to know the business well to be successful!

Predicting Battery Life Example

- Goal: Predict the battery life of a product in the field
- Battery life is measured in days of operation
- Presented data has been normalized (target = 5)
- 10+ years of development of the battery model
- Years of testing and development, $$$ spent
- Design and manufacturing test verification
- Close quality monitoring and reliable partners

Predicting Battery Life Example



Predicting Battery Life Example – Device Analysis

- Bring sample devices that failed in the field
- Put them through rigorous testing and verification to find the failure cause
- … except they do not fail – their battery life is 10% higher than model predicts
- Why?

IoT Promise

- IoT tools will not:
  - *Magically solve your product issues by themselves*
- IoT tools will:
  - *Help you find your product issues so you can remedy them*
  - *Help you learn about your customer*
  - *Help you learn the market product operates in*
- IoT is a platform for quality improvement

Best Companies

Companies with highest product quality and reliability:

- Know their markets extremely well and they design, test and verify in their markets well
- Have made a strategic decision to invest in quality
- Design for quality from ground up

All Failures are NOT Created Equal

If the failure is not noticeable to the customer, it has small business impact

All failures matter to engineers, but not all failures matter to business

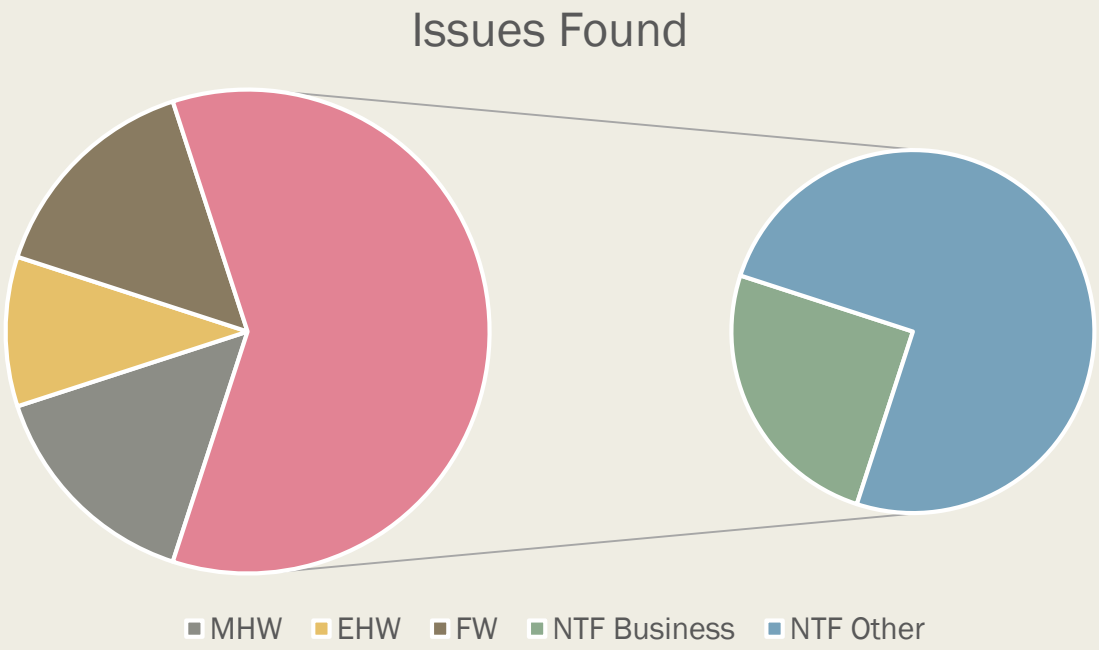
Product and Process Design

- Has to incorporate all key quality concepts:
  - *understand the customer and the market*
  - *design specifically for that market*
  - *know your reliability target (how many 9s?)*

Product and Process Design

- Development process to take advantage of modern design techniques:
  - *focus on correct design principles*
  - *hold correct design reviews*
  - *automatic regression testing*
  - *extended engineering diagnostics*
  - *correct field diagnostics*
  - *proper data reviews*
  - *proper return and warranty analysis*

Return Analysis
Significance of No Trouble Found

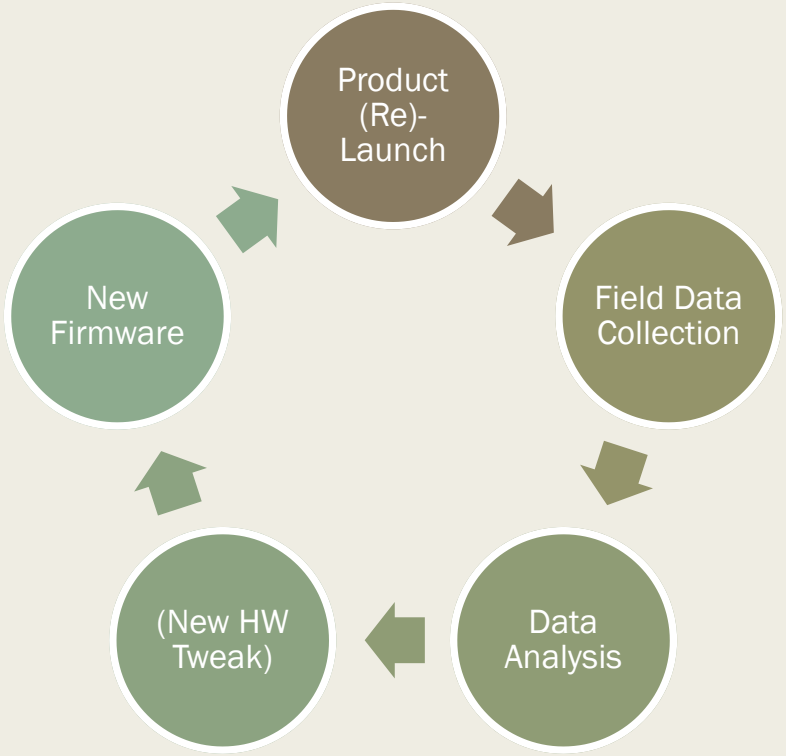


NTF Other – what are these?

Today’s Biggest IoT Mistakes

- Collect too much data
- Collect too little data
- Collect poor quality data
- Don't spend enough effort on analyzing data
- Insufficient understanding of customer market for reliability and prognostics

IoT Product Improvement Cycle



Current Trends

- Use IoT to learn about the market
- Use better market knowledge to improve product and quality of prognostics
- Improve quality of data (better components => better methodology)
- Automatic data analysis (AI)

Summary

Quality is a process that starts and ends with the customer and their market

IoT is a unique platform to help you learn about it in depth