Predicting the Customer Experience
Using Monte Carlo Analysis to Model and Manage Warranty Returns

Ronald Lim, ASQ CMQ/OE
Cheryl Tulkoff, ASQ CMQ/OE, CRE
National Instruments
Ronald.Lim@ni.com
Cheryl.Tulkoff@ni.com
Outline of Abstract (Page Example)

• Introduction to National Instruments (NI) – Culture and Process
• Risk Defined
• Warranty Analysis Today
• Warranty Analysis of the Future
• Questions & Feedback
MISSION STATEMENT

NI equips engineers and scientists with systems that accelerate productivity, innovation, and discovery.
**NI’s Optimistic Culture**

- We hire people with a can-do attitude!
- We’ll just try really hard and everything will turn out right!
- When does our culture create a problem?

**If Things Go Exactly as Planned, We’ve Got it Made!**

- Overly optimistic plans rarely work
  - Too many variables, no capacity for unknowns
  - Can result in a risky / unknown situation
What is Risk?

- DANGER
- OPPORTUNITY
- UNCERTAINTY

VARIANCE FROM GOALS

RISK
Measuring Risk Using Analytics

KPI
(Key Performance Indicator)

PAST

STRATEGY

KRI
(Key Risk Indicator)

RISK

FUTURE
## Examples of Risk Indicators

<table>
<thead>
<tr>
<th>If ...</th>
<th>then there is a chance that ...</th>
<th>even if right now...</th>
</tr>
</thead>
<tbody>
<tr>
<td>the fuel level is low</td>
<td>the car will stop soon</td>
<td>it is faster than ever</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>If ...</th>
<th>then there is a chance that ...</th>
<th>even if right now...</th>
</tr>
</thead>
<tbody>
<tr>
<td>production test finds no problems</td>
<td>products will fail in the field</td>
<td>the test yield is high</td>
</tr>
</tbody>
</table>
Managing Risk

Risks can be

**Avoided**
(If, improved design, increased testing)

**Accepted**
(If, within the customers’ and company’s risk tolerance)

**Reduced**
(If, controls, continuous improvement, redundancy, sparing)

**Shared**
(If, paid extended warranty)

Inherent risk – impact of controls = Residual Risk
NI historical process has been:

- Set target improvement rates
- Monitor warranty return rates
- Support engineer review all hierarchy of product level
- Drive action through continuous improvement (CI) teams
- Effective but now diminishing returns for effort
- Reactive
### Old Method to Manage Warranty

<table>
<thead>
<tr>
<th>Metric</th>
<th>Method</th>
</tr>
</thead>
</table>
| Warranty - Lagging | Set global reduction goals on 12-month product returns  
|                | Analyze and report data with regular cadence                           |

**Systems**

Monitor Virtual Systems Failure Rate (VSFR)
Why Change?

**Driving Forces**
- Difficult to distinguish improvement from normal variation
- Goals set arbitrarily
- High effort, limited impact
- Need Leading & Balanced Indicators
- Need shorter feedback loop to improve
- Proxy of products in the field that does not represent actual system

**Restraining Forces**
- Established, comfortable
- Well Understood
- Tradition / habit
- Long term trends would be lost
- Have data system structure in place
- Job responsibilities would need to change
- New data & new reports required

**Force Field**
## Warranty Analysis Changes: Using Risk Tool

<table>
<thead>
<tr>
<th>Metric</th>
<th>2018 forward</th>
</tr>
</thead>
</table>
| Warranty - Lagging | No global reduction goals  
• Set warranty goals for special projects/products  
• Monitor 12-month warranty returns with stripe control limits  
• Manage exceptions, recalls & notifications per Quality Escalation process |
| Warranty - Leading | Use Monte Carlo Analysis to make warranty return predictions using historical data                                                             |
| Systems            | Develop new Systems metrics with Systems Evolution Team. Pilot new system analysis using @Risk calculator                                       |
Product Families Guard Bands

- Calculate Warranty Control limits for product families
  - Use warranty data & SPC limits
  - Send email alerts when limits exceeded
  - Continuous Improvement Teams review exceptions
  - Issues handled through Quality Escalation processes

Calculated RMA Control Limits
Warranty Guard Band

- Statistical rigor
- Considers history plus normal variation
- Can predict forward
- Mean +/- 3 sigma

<table>
<thead>
<tr>
<th>Product</th>
<th>Calculated Limits</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>-3 Sigma</td>
<td>-2 Sigma</td>
<td>- Sigma</td>
<td>Mean</td>
<td>Sigma</td>
<td>2 Sigma</td>
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<tr>
<td>A</td>
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<td>-0.11%</td>
<td>0.22%</td>
<td>0.54%</td>
<td>0.87%</td>
<td>1.20%</td>
</tr>
<tr>
<td>B</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>C</td>
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<td>-0.03%</td>
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<td>0.94%</td>
<td>1.43%</td>
</tr>
<tr>
<td>D</td>
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<td>-0.05%</td>
<td>0.51%</td>
<td>1.07%</td>
<td>1.17%</td>
<td>1.43%</td>
</tr>
<tr>
<td>E</td>
<td>-0.71%</td>
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<td>-0.09%</td>
<td>0.22%</td>
<td>0.53%</td>
<td>0.84%</td>
</tr>
<tr>
<td>F</td>
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</table>
Establish Rates based upon P20%, P50%, P80%
Metrics Proposal: Systems Failure Rate

- Pilot system Warranty Returns of actual systems Calculator tool with @Risk model
- Allocate resources to drive improvement in key area versus globally
Impact and Results

- Reducing Support Engineers time spent on analysis by 80%
- Since Q1 2018, targeted product improvement helped drive warranty return rate down by ~20%
- Better system integration planning and maintenance strategy
Drive focused use of resources of warranty returns with greatest impact to customers & the business

Make warranty return predictions using historical data
- Based on similar products
- Based on previous revisions of products

Use prediction to assist with sparing strategies for production users

Use modeling and prediction to perform analysis over different warranty periods
- Standard
- Extended
- Custom
Ronald is a dynamic leader with over 20 years of Quality and Engineering leadership experience in R&D and Manufacturing in top Fortune 500 companies. He is passionate and intensely focused on driving for Quality and inculcating a Customer Focus culture.

Throughout his career, Ronald has had extensive experience in helping multinationals pioneer factory startup, expanded R&D design centers in Malaysia and worked internationally. His true passion lies in helping set strategic vision and leading the team to realize the vision.

Ronald earned his Masters of Engineering in Design and Manufacturing from University of Hull, UK and is working on his Master of Science in Technology Commercialization (MSTC) program at the University of Texas at Austin. He is an ASQ Certified Manager of Quality and Organizational Excellence and obtained his Six Sigma Green Belt from Motorola.
Cheryl has over 20 years of experience in electronics manufacturing focusing on reliability and failure analysis. She is passionate about applying her unique background to accelerate product design and development while saving time, optimizing resources, and improving customer satisfaction.

Throughout her career, Cheryl has had extensive experience training others. She is a published author and a senior member of both ASQ and IEEE. She is an ASQ Certified Reliability Engineer and Certified Manager of Quality and Organizational Excellence.

Cheryl 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 her free time, Cheryl loves to run! She’s 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. She also enjoys travel and has visited 46 US states and over 20 countries around the world. Cheryl combines these two passions in what she calls “running tourism” which lets her quickly get her bearings and see the sights in new places.