.conf2015

Using Splunk to Harness Zebra's Manufacturing and Device Data to Gain Visibility and Provide Operational Intelligence

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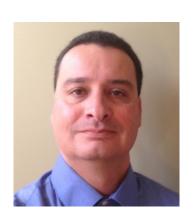
Zebra Technologies

splunk>

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Speaker Bio

- Manufacturing Test Engineering Manager
- Develop manufacturing test solutions for board and product level
- Hardware and software utilized
- C#, .NET, LabVIEW
- BS EET DeVry – Chicago
- Project Lead for deploying Splunk into Zebra

ZEBRA

1969: Founded as Data Specialties

1980: First barcode printer developed, primary focus

1998: Merged Eltron, Desktop, Card printers

2000: Acquired Comtec, Mobile printers

2013: IoT Zatar platform, MotionWorks sports solutions, Hart Systems

2014: Acquired Motorola's Enterprise business, Scanners, Mobile PC, WLAN

Enterprise Asset Intelligence

CORE INDUSTRIES

RETAIL | T & L | MANUFACTURING | HEALTHCARE

Zebra makes businesses as smart and connected as the world we live in

Zebra builds tracking technology and solutions that generate an enormous amount of actionable information and insight, giving companies unprecedented visibility into their businesses by giving physical things a digital voice

Follow the Zebra.

Solutions provided to **95%** of <u>Fortune 500</u> companies

FedEx · CAMPBELL HAUSFELD · Tropicana · VAIL RESORTS · Johnson Controls · NHS nhs.uk
Cadbury Schweppes · BOSCH · caprabo · Aventis · CATERPILLAR
SONY · Coca-Cola
MAERSK · PHILIPS · Kimberly-Clark · Ford · Carlsberg
FM LOGISTIC · Dean FOODS · CIT CORREOS · BYGGmax
Duke UNIVERSITY · GE · Manpower · BOEING · UPS · DHL · ARSOE
AWOSON TOOL · amazon.com · TC · Walmart Save money. Live better.
Jumbo · Welch's · Driscoll's

ZEBRA

Printers & Services

Industrial	High Performance & Midrange	Card	Mobile
Desktop	Kiosk	Print Engines	ZebraCare

Supplies

Specialty	Card Printer

RFID

RFID	RFID Encoders

Software

CardStudio	Link-OS

WLAN

MPact	WiNG
Security & Location Platform	Software

Intelligent Infrastructure: Platforms, Controllers, AP

Mobile Computing

Industrial Mobility	Customer Facing	RhoMobile Suite / Workforce Connect Software	Field Mobility

Data Capture

RFID	Handheld	Engines	Hands Free

Internet of Things

ZATAR. **Application Enablement Platform**

Services

Network Implementation

Application Implementation

Network Optimization

Technical Support

Device and Asset Management

Network Infrastructure Management

Device Repair

Agenda

ZEBRA

- Challenge / Problem statement
- Journey
- Deployment
- Reports / Dashboard
- Company Adoption
- Internal Use Cases
- Cool Items and Wishlist
- Summary
- Next Steps

Challenge / Problem Statement

ZEBRA

CURRENT STATE	EXPECTED FUTURE STATE
Limited data collected	**Extensive data** collections (Test History, Test Data, Device Data)
Data not shareable across departments	Departmental / **user access to data**
No reporting capability	**Searchable, reports, dashboards**
IT change control to release new data elements take long to implement in a typical database	**Extensible**
Increased volume generates more data	**Scalable**
Extract limited data and Excel as analytics engine, time consuming	**Analytics**
Customer issues cannot be resolved due to limited data	**Time series based events** of device history (Production, Reconfig, Repair)
Physical printed record keeping at CM	**e-record**
React to issues and anomalies in data	**Alerting**

Project

- **Capture complete** device **data** and test **history** when devices are produced, reconfigured and repaired

- Replace the current architecture with a more **robust and flexible solution** that allows better storage along with adding **analytical and trending capabilities**

- Data will be **easily shared** to enable better business decisions across Quality, NPD, Tech Support and Service/Repair

- Project Goals
  - **Lower time to resolution** of quality and customer issues
  - **Proactive monitoring** for anomalies
  - **Faster feedback** to New Product Development to drive better designs
  - Hard **cost savings** target of $90,000/yr through test consumable reduction

DATA DATA DATA

ZEBRA

Zebra uses Test Utilities to execute tests on a device.

-**Test History**
History of test performed by the test utility on the device.
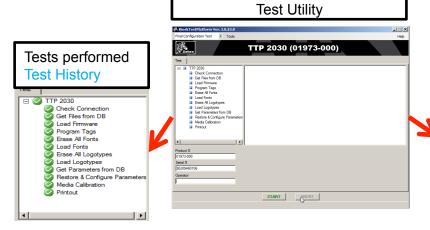
- **Test Data**
Any data deemed necessary to log and store that is not provided by Device (Printer) Data.

- **Device (Printer) Data**
Raw data output of a device (printer).

Test Utility

Tests performed
Test History

Test log creates Test Data

Running: Check Connection...
Controller Board Rev: L
Found printer's device ID: TTP 2030
Reset the parameters of the printer to default values...
Initial Firmware Version = 3.99
Check Connection...PASSED
Elapsed Time: 00:00:08.3800000

Running: Get Files from DB...
Get Files from DB...PASSED
Elapsed Time: 00:00:00.5530000

Running: Load Firmware...
Initial firmware = 3.99
Evaluating tag ...
Current Tag : "HWT:103716D;PCA:103716-L;MFT:J;PRD:2010060
Programming tag prior to firmware load ...
Deleting Tag...CUS:
Deleting Tag...tagMODEL
Deleting Tag... MOD
Writing Tag...tagMODEL:TTP 2030
"HWT:103716D;PCA:103716-L;MFT:J;PRD:201006060906;SN:90J
Uploading shipping stone firmware before uploading final firmware.
Uploading firmware version: 1814-399.bin
Number of bytes written: 129899
Firmware Version = 3.99 Verified

TESTS PASS - SN: 90J09460106

Total Elapsed Time: 00:04:22.6440000

Device (Printer)
Data formats

Journey

ZEBRA

- Explored
  - Data Historians
  - Manufacturing Operations Management (MOM)
  - Manufacturing Operations Center (MOC)
  - Oracle tables / Business Intelligence (BI) reports
  - SQL tables
  - Quality Management Systems (QMS)

- Cost and lead times to implement yielded poor ROI

Journey

- Zebra IS – CIO recommendation to Director to Test Engineer's

- Splunk? What's that?

- Sales Pitch – "It can read that. And that. And that."

- Inspirational story on Splunk web

- Proof of Concept comparing Excel to Splunk yielded….
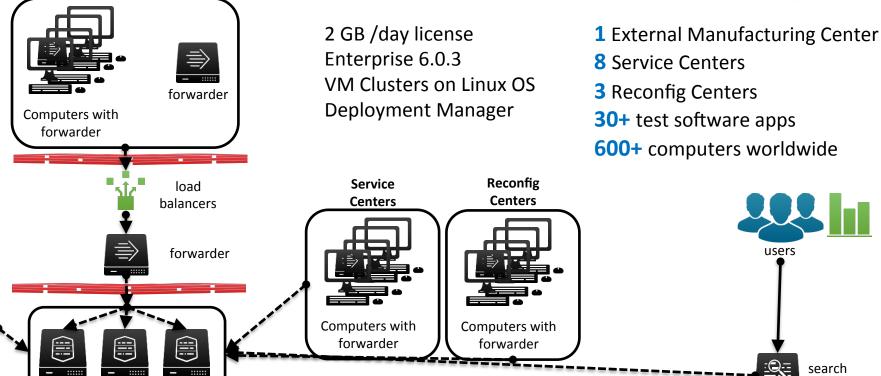
- … Profession Services Engagement over 5 weeks to architect, configure, deploy, modify internal software, build reports and dashboards.

Deployment Architecture

External Manufacturing Center

forwarder

Computers with forwarder

load balancers

forwarder

master node

splunk>

indexer   indexer   indexer

2 GB /day license
Enterprise 6.0.3
VM Clusters on Linux OS
Deployment Manager

1 External Manufacturing Center
8 Service Centers
3 Reconfig Centers
30+ test software apps
600+ computers worldwide

Service Centers

Computers with forwarder

Reconfig Centers

Computers with forwarder

users

search head

ZEBRA

Dashboard
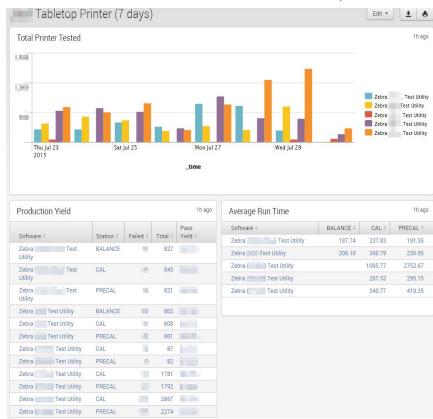
- Quick view of production data

- Report yields
  - Address low yields
  - Drive quality improvements
  - Focus on most common failure events

- Report testing run times
  - Monitor for high run times
  - Optimize and gain efficiency

Reports
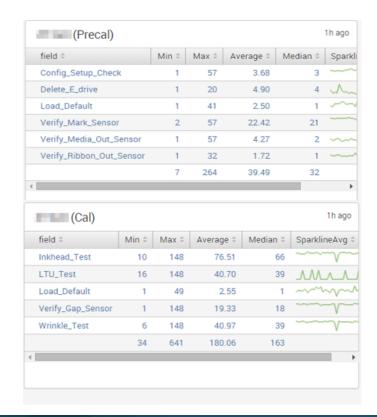
- Quick view of sensor calibration data at production

- Report min, max, avg, media
  - Allows baselining existing product for new product development efforts
  - Monitor for anomalies in sensor performance

field ⇕	Min ⇕	Max ⇕	Average ⇕	Median ⇕
Align_w/LED_OFF	0.235	0.275	0.264	0.255
Align_w/LED__ON	3.882	4.314	4.219	4.216
DC_Offset___0	0.000	0.020	0.000	0.000
LED_/_Gain_MAX	4.588	5.000	4.913	4.922
Media_Gain_MAX	4.608	5.000	4.932	4.941
Media_Gain__x10	2.392	2.941	2.762	2.765
Media_Gain__x2	0.412	0.510	0.480	0.490
Media_Gain__x5	1.000	1.255	1.148	1.157
Media_Sensor	83	90	84.989	84
Refl_w/LED_OFF	0.020	0.039	0.020	0.020
Refl_w/LED__ON	0.922	2.902	2.176	2.176
Take_Label	28	73	38.287	37
Trans_Base	34	36	34.991	35
Trans_Bright	96	143	113.065	112
Trans_Gain	2	2	2.000	2
Web_Sensor	45	57	50.267	51

CAL Data

Reports
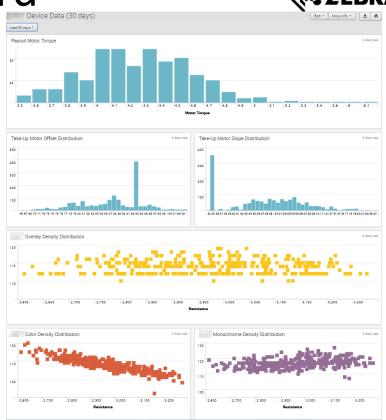
- Quick view of test consumable usage rates at production

- Report min, max, avg, median
  - Allows baselining existing product for new product development efforts
  - Optimize tests that report high media usage
  - Viewable by test process

field ⬦ (Precal)	Min ⬦	Max ⬦	Average ⬦	Median ⬦	Sparkli
Config_Setup_Check	1	57	3.68	3	
Delete_E_drive	1	20	4.90	4	
Load_Default	1	41	2.50	1	
Verify_Mark_Sensor	2	57	22.42	21	
Verify_Media_Out_Sensor	1	57	4.27	2	
Verify_Ribbon_Out_Sensor	1	32	1.72	1	
	7	264	39.49	32	

1h ago

field ⬦ (Cal)	Min ⬦	Max ⬦	Average ⬦	Median ⬦	SparklineAvg ⬦
Inkhead_Test	10	148	76.51	66	
LTU_Test	16	148	40.70	39	
Load_Default	1	49	2.55	1	
Verify_Gap_Sensor	1	148	19.33	18	
Wrinkle_Test	6	148	40.97	39	
	34	641	180.06	163	

1h ago

Dashboard

- Quick view of product performance over time

- Report distribution of data
  - Characterizes product performance over time
  - Detect anomalies
  - Support baseline efforts

Other Uses Case at Zebra
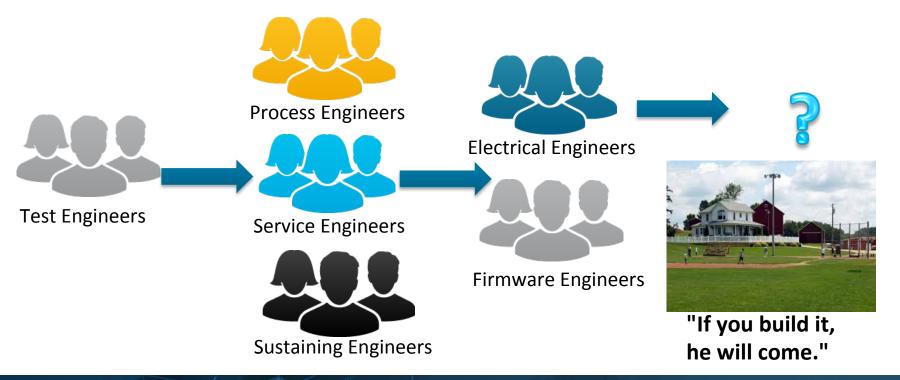
- Faster time to customer resolution
  - Quick access to test history and device data answers the state of the printer when shipped

- New product development
  - Baseline current product
  - Capture data early in development phases to drive improvements in design prior to mass production
  - Focus on most common failure events

- Anomaly detection
  - Set alerts to capture known defect patterns that prevent shipment of product

- Data retention
  - Eliminate paper record keeping by logging electronic data
  - Reduce test consumables, optimizing test time and reducing costs

- Process improvements
  - Leverage existing reports to optimize printer calibration process of existing products

Company Adoption

- Goal is shareable data. Build your own reports / dashboards

Process Engineers

Test Engineers

Service Engineers

Sustaining Engineers

Electrical Engineers

Firmware Engineers

"If you build it, he will come."

Cool Items and Wish list

ZEBRA

COOL ITEMS IMPLEMENTED

- Timestamp extracted from filename with epoch time format
  - Records local time event occurred, used transform to extract timestamp, better geo location tracking

- Device serial number extracted from filename

- New JSON data file format implemented for test history data set

- Splunk sub-searches
  - Cool search method allows doing a search within a search

WISHLIST

- Prevent reordering JSON raw text event data when syntax highlighting is on

- Integration examples with statistical packages with limits monitoring (i.e. SPC)

- Monitor process controls
  - Cp, Cpk

- Overall Equipment effectiveness
  - OEE

Summary

ZEBRA

NEW CURRENT STATE
✓ **Extensive data** collections (Test History, Test Data, Device Data)
✓ Departmental / **user access to data**
✓ **Searchable, reports, dashboards**
✓ **Extensible**
✓ **Scalable**
✓ **Analytics**
✓ **Time series based events** of device history
✓ **e-record**
✓ **Alerting**

Next Steps

- Continue to leverage data to drive efficiencies

- Lean Six Sigma initiatives data driven

- Record board level test data

- Expand into unique data generating devices that improve manufacturing processes

- Continue training others in the company to use Splunk

- Champion Splunk for other internal use cases

Supporting Cast

- Test Engineers

- Zebra IT

- Zebra Sponsors
  - CFO, CIO, VP, Directors

- Splunk

- Many others along the journey