TOYOTA MOTOR NORTH AMERICA

IT Strategy to deliver World Class Manufacturing using IoT

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Division Information Officer
Manufacturing & Engineering Business Systems
Toyota Motor North America - IS
TOYOTA IN NORTH AMERICA

- Corporate HQ, Plano, TX
  Transitioning from Torrance, CA; Erlanger, KY; and New York, NY
- More than 20 Sales Offices
- Nearly 1,500 Toyota and Lexus Dealers
- More than 30 Financial Offices
- Suppliers in more than 45 States & Provinces
- 11 R&D Facilities
- 14 Manufacturing Facilities
MANUFACTURING IN NORTH AMERICA

**Vehicles Produced**

**Kentucky**
- Camry
- Avalon
- Venza
- Camry Hybrid
- Avalon Hybrid

**Indiana**
- Sequoia
- Sienna
- Highlander
- Camry

**Texas**
- Tacoma
- Tundra

**Mississippi**
- Corolla

**Canada**
- Corolla
- Matrix
- RAV4
- RX

**Mexico**
- Tacoma

**Unit Plants**

**West Virginia**
- Four-cylinder and V6 engines & automatic transmissions

**Alabama**
- Engines & transmissions

**Kentucky**
- Four-cylinder (gas and hybrid) and V6 engines

**Parts Plants**

**Bodine**
- Cylinder heads, engine blocks, transaxle housings, and differential covers

**CAPTIN**
- Wheels

**TABC**
- Stamping, body weld, ED Paint (RR Axle), TMS service parts, catalytic converters, part model service parts
Background

- Very traditional separation of duties on the manufacturing floor between Production Engineering and IT
- An Explosion of Digital Opportunities on the manufacturing floor, but no concerted effort to pursue
- IT strategy to build capability and establish strong relationships with manufacturing members
- Early successes demonstrated to gathering of Plant Presidents & CEO resulted in establishment of a formal program led by IT

Program Strategies:

- Team Member Education
- Qualified Partners
- Proper Technologies
- New Methodologies
- Strong Manufacturing Relationships
- Execution Of Low-Risk Trials
What is the Internet of Things?

Connected machines
The Internet of Things (IoT) refers to Physical devices & objects (including Machines) connected to the Internet & each other for intelligent decision making.

People
Connecting people in more relevant valuable ways

Process
Delivering the right information to the right person (or machine) at the right time

Data
Leveraging data into more useful information for decision making

Smart Manufacturing - The intelligent real-time orchestration and optimization of business, physical and digital processes within factories and across the value chain.
25 billion
Connected “things” by 2020
—Gartner

$1.7 trillion
Market for IoT by 2020
—IDC

Source: McKinsey
PROGRAM OVERVIEW

Goal: Visualization to improve Plant Management

Immediate action, prevent issue | Standardize & Prioritize the task | Reduce Gemba burden

INDUSTRIAL BIG DATA ANALYTICS PLATFORM

I. TM DEVELOPMENT
   - Automated Call-in System
   - Team Member Rotation
   - Group Leader Portal
   - TM Time Entry
   - Quality Circle
   - Environmental & Chemical Mgmt
   - Health & Safety
   - Regional EIS
   - Best Practices & Kaizen
   - Regional Online KPI
   - Smarthand

II. OPERATIONS
   - Digital Andon System
   - Line Data Collection & Digital Reporting Sys
   - Production Control Monitoring System
   - Electronic Productivity Analysis Board – Moment by Moment
   - Environmental Production / Energy Management

III. MAINTENANCE
   - Computerized Maintenance Mgmt Sys
   - Line Data Collection System
   - CMMS Mobile Analytics

IV. QUALITY
   - Inspection Control Sys
   - Change Point Mgmt
   - Toyota Measurement / Collection Sys
   - Quality Data Mgmt. Sys
   - Stamping Scrap Data Collection
   - Parts Traceability & Containment
   - Vehicle Sampling System
   - eContainment
   - Part Quality Info Mgmt
   - Traceability, Supplier Audit & Compliance

V. LOGISTICS
   - Control Tower / Dashboard
   - Advanced Shipping Notice
   - Supply Chain Vis / Survey
   - Yard Management System
   - Delayed Dispatch / Abnormal Event Tracker
   - Real Time Internal eKanban
   - Parts Call Management System
   - Internal Logistics Mgmt. System (ILMS)

STANDARD & SECURE IT INFRASTRUCTURE

Reduce daily burden of Production Admin - Voice of GL
Real time & historical visualization of plant status for Problem solving
Proactive, Preventative, Predictive Maintenance to improve OA/OR
Accurate inspection process. Quick & preventive fix of defect
Real time visualization of the supply chain AFS parts status
Objective: Improve Manufacturing Quality and Productivity by embracing and enabling the Toyota Production System through the delivery of significant IT contribution incorporating the principals & strategies of IOT.

Organization

<Global Exec Steering Committee>
MFG EVP, SVPs, IT GVP, Toyota Way SVP

<North America Exec Steering Committee>
1 BUSINESS & 1 IT EXEC LEAD

<AIT4Mfg Program Leads>

<IT PMO>

<Business PMO>

<Working Team>
I. PEOPLE DEVELOPMENT – VOICE OF GROUP LEADER

Integrated & automated tools to reduce Plant Floor administrative burden allowing more time on Quality, Productivity, Safety, & Team Member Development.

Key Activities:

1. Group Leader Portal (Mobile)
2. Automated Time Entry (Mobile app with location services)
3. Automated Call-In System & TM Rotational Assignment
Example: Automated Call In & Team Member Rotational Assignment System

I. PEOPLE DEVELOPMENT – VOICE OF GROUP LEADER

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| Reduce burden during morning startup:  
✓ Quickly visualize available workforce for the shift  
✓ Create Manpower Schedule based on versatility (Qualification, Ergonomic constraints, history). | 25 mins savings per Group Leader per shift = $5.5M per year in time savings |
II. OPERATIONS – PLANT VISUALIZATION

Network connected plant equipment enabling visualization of process operating conditions stored in Industrial Big Data share (IIOT) for Analytics.

**Key Activities** | **Purpose - Benefit**
--- | ---
Real Time Andon | Visualized process level status for immediate action.
Production Control Monitoring System | Shop level vehicle progress visibility (ex. Buffer, OA, OR, DT).
Electronic Performance Analysis | Moment by Moment visualization (ex. line call, downtime).
II. OPERATIONS – PLANT VISUALIZATION

**Real-time production information for shop leaders to visualize and respond immediately to downtime, Andon pulls, and stop by pitch.**

**Reading PLC sensor data for near real-time visibility & decision making**

**Estimated $3M per shift in elimination of downtime** across North America when fully deployed based on initial deployment results.
III. MAINTENANCE

Computerized Maintenance Management System (CMMS) - Real time & historical data collection from Plant equipment, meters, gauges into CMMS with Mobile enabling proactive, preventative, & predictive maintenance.

Increased Operational Availability

- Inventory reduction & increased repair speed.
- Cycle / Event based maintenance.

Downtime

Predictive Maintenance

Sending maintenance request for Monday. I'm predicting I'll need my oil changed.

Got it. Thanks, BOT10!

Reactive
Fix AFTER it breaks

Planned
Fix BEFORE it breaks

Predictive
MAINTAIN not break it

Predictive
REFINE & avoid breaks

Predictive
Enhance & Sustain
III. MAINTENANCE

Example: CMMS Mobile (TOAD - Toyota Operation Availability Device)

<table>
<thead>
<tr>
<th>Description - Purpose</th>
<th>IoT Component</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve Plant OA through an integrated real-time mobile notification and dispatch system (TOAD). 1. Simple 3 Signal Trigger per Machine (Fault/Call/Continuous) 2. Detail Fault Request</td>
<td>Real time PLC / Machine integration &amp; notification</td>
<td>Reduction of 40k mins per month (MTTR) = $6M per year in labor savings.</td>
</tr>
</tbody>
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## IV. QUALITY

Electronically record & visualize vehicle quality inspection results. Provide real-time condition feedback to inspection TM using mobile and PC (IoT) solutions.

<table>
<thead>
<tr>
<th>Key Activities</th>
<th>Purpose - Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection Control System</td>
<td>Common inspection platform providing integrated part &amp; process traceability.</td>
</tr>
<tr>
<td>eContainment</td>
<td>Capture vehicle containment &amp; inspection results real time in plant, yard, and at ports preventing flow out of defects to customer.</td>
</tr>
<tr>
<td>Smart Hand Sander IOT Sensor</td>
<td>Utilize motion sensor in Paint Sander to capture movement providing feedback on good or no good movement. Expanding to many other areas.</td>
</tr>
</tbody>
</table>
IV. QUALITY

Description - Purpose

Capture measurement data for Critical Fitting Points enabling:
1) Visibility to OK vs No Good condition
2) Real time data analysis and reporting
3) Shift workload from data handling to problem solving

IoT Component

Machine integration providing immediate measurement feedback. Use of Mobile to audit.

Benefit

Reduction of 20 mins per vehicle audit & quality flowout avoidance= $1.8M per year savings & avoidance

Example: TMCS - Toyota Measurement Collection & Vision System
V. LOGISTICS
Deploy electronic systems utilizing Internet enabled logistics tracking sensors & tools to provide real time part visualization preventing parts shortage and supporting JIT delivery (ex. RFID, GPS, Scanning).
V. LOGISTICS

**Description - Purpose**
Provide 100% visibility of all parts orders tied to trailers in the yard. Provide timely and accurate communication of trailer moves between dock workers and shunt drivers.

**IoT Component**
RFID, GPS tracking, GeoCoding Yard with integrated mobile calls

**Benefit**
Estimated **$3M savings per year** in reduction of Part Expedites

**Example: Yard Management System**

<table>
<thead>
<tr>
<th>Current</th>
<th>Arrivals (Call Dispatch)</th>
<th>No Tracking</th>
<th>Dock Delivery (Radio)</th>
<th>Dock Pickup (Radio)</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arrive at Plant</td>
<td>Enter Gate</td>
<td>Park Trailer</td>
<td>Movement Request</td>
<td>Receive Request</td>
</tr>
<tr>
<td></td>
<td>RFID Tag</td>
<td>RFID Reader</td>
<td>RFID Tracked</td>
<td>Touchscreen</td>
<td>Rugged Tablet</td>
</tr>
</tbody>
</table>

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Information Systems
INDUSTRIAL BIG DATA ANALYTICS

Use Case 1: **Paint Defect Analysis**
- Reasons for Paint defects in TMMK Lexus ES impacting Vehicle Quality

Use Case 2/3: **Warranty vs Alignment**
- Warranty claims compared to Mfg Quality Defects including Alignment data and Dealer Claim Investigation

Use Case 4: **Change Point Mgmt**
- Correlation between Mfg change points and Quality Defects

Use Case 5: **TM Skill Gap**
- Correlation between Mfg Defects & Team Member capability

1 = Vehicle WILL have defect
0 = Vehicle will NOT have defect

Rules auto-generated

60 Million Data Records
Goal:
Visualization to improve Plant Management

Immediate action, prevent issue | Standardize & Prioritize the task | Reduce Gemba burden

INDUSTRIAL BIG DATA ANALYTICS PLATFORM

35 Active Projects
$23M Investment
$600M Benefit
OUR APPROACH…
RECOMMENDATIONS FOR CREATING A SUCCESSFUL IOT PROGRAM
Focus on Core Principles… Embracing and Enabling “Lean”
SEQUENCE OF STEPS:

- Pick opportunities carefully, start small
- Understand current business process & capabilities
- Define the ideal business process
- Identify the necessary conditions and integrations
- THEN....Identify the technology
- Identify innovation opportunities
- Build vendor partnerships and internal relationships
- Build pieces and integrate incrementally
- Deliver successfully, reapply and celebrate
- Reflect and identify next opportunities
INFORMATION SYSTEMS ROLE ON THE PLANT FLOOR

- Provide proactive **business leadership and cross-functional architecture**.

- **Engage** plant executives on business opportunities and local priorities.

- Direct on-floor observation with Engineers (**genchi-genbutsu**) 

- Demonstrate capabilities **1 by 1 to gain trust** from skeptical business counterparts.

- Deliver actual value with a few motivated bus units. Add functionality and plants over the time, improving **iteratively**.

- **Break down silos** and bring stakeholders together.
TECHNOLOGICAL FRAMEWORK FOR SUCCESS

- Wired and Wireless Capabilities as Standard for all areas of facilities
- Digital Plant communication Connecting equipment to the network
- Focus on small application development methodology and teams based on iterative delivery
- Organization wide use of mobile devices and a Mobile agnostic development approach
- Business Intelligence and Analytics Framework
- Pre-installed server infrastructure
TECHNOLOGICAL FRAMEWORK FOR SUCCESS

- Internet of Things
  - Wired and Wireless Capabilities as Standard for all areas of facilities
  - Digital Plant communication
  - Connecting equipment to the network

- Agile Development
  - Focus on small application development methodology and teams based on iterative delivery

- Mobile / Social
  - Organization wide use of mobile devices and a Mobile agnostic development approach

- Analytics
  - Business Intelligence and Analytics Framework

- Build Farm, Converged Infrastructure
  - Pre-installed server infrastructure
CONTACT INFORMATION

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THANK YOU!