Bite of Science - Manufacturing

Srini Matam
General Manager, Drivetrain, TMMWV

Safety Commitment: I will use my critical eye to improve safety
Srini Matam - Background

- Originally from India, living in US for 29 years. Has a wife and two daughters.

- **Education**: Bachelor of Technology in Mechanical Engineering and Masters in Production Engineering. Special projects: Electron Beam Welding, Laser cutting of materials

- **Career History**:
  - 1989 - 1990: Mechanical Engineer, Mazagon Dock, Submarine Manufacturing
  - 1990 - 1998: Software Engineer, Information Systems (various companies)
  - 1998 - 2012: Software Engineer -> General Manager, Toyota, Information Systems
  - 2012 - 2014: General Manager, Toyota, Production Control (Supply Chain Management)
  - 2015 - 2018: Asst. General Manager of Toyota Georgetown, KY, Powertrain Manufacturing
  - 2018 - 2019: General Manager of Toyota West Virginia, Drivetrain Manufacturing

- **Hobbies**: Cricket, Football, Books and Travel
Toyota Motor Manufacturing West Virginia
Buffalo, WV
TMMWV Background

- $1.6 B Investment
- 1,700 Team Members
- 1.9M Sq. Ft.
- Export to Canada
- 90% WV Natives
- $8M Donations
Engines and Transmissions
# 4-Cylinder Engine (2ZR)

## Our Products and Customers

<table>
<thead>
<tr>
<th>Number of Unit Models</th>
<th>7 Models</th>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Volume</td>
<td>310,000 / Year</td>
<td>449,000</td>
<td>TMMMS TMMC</td>
<td>Corolla</td>
</tr>
<tr>
<td>Assembly C/T</td>
<td>44&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staffing #</td>
<td>183</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shift Structure</td>
<td>Assy. = 2</td>
<td>Mach. = 2</td>
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</tbody>
</table>
# V6 Engine (2GR)

## Our Products and Customers

<table>
<thead>
<tr>
<th>Number of Unit Models</th>
<th>5 Models</th>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Volume</td>
<td>249,000 / Year</td>
<td>249,000</td>
<td>TMMI</td>
<td>Highlander Sienna</td>
</tr>
<tr>
<td>Assembly C/T</td>
<td>54”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staffing #</td>
<td>260</td>
<td></td>
<td>TMMC</td>
<td>RX350</td>
</tr>
<tr>
<td>Shift Structure</td>
<td>Assy. = 2, Mach. = 2</td>
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</table>
### Our Products and Customers

<table>
<thead>
<tr>
<th>Number of Unit Models</th>
<th>4 Models</th>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Volume</td>
<td>216,000 / Year</td>
<td>216,000</td>
<td>TMMCC</td>
<td>Rav4</td>
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<tr>
<td>Assembly C/T</td>
<td>58”</td>
<td>SOP 10/2018 - Machining</td>
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<tr>
<td>Staffing #</td>
<td>195</td>
<td>SOP 2/2019 - Assembly</td>
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<tr>
<td>Shift Structure</td>
<td>Assy. = 2</td>
<td>Mach. = 2</td>
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<td></td>
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</tbody>
</table>
### DAT 1 (Mid)

#### Our Products and Customers

<table>
<thead>
<tr>
<th>Number of Unit Models</th>
<th>1 Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Volume</td>
<td>242,000 / Year</td>
</tr>
<tr>
<td>Assembly C/T</td>
<td>54.5”</td>
</tr>
<tr>
<td>Staffing #</td>
<td>193</td>
</tr>
<tr>
<td>Shift Structure</td>
<td>Assy. = 2, Mach. = 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>242,000</td>
<td>TMMK</td>
<td>Camry</td>
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</table>
# Our Products and Customers

<table>
<thead>
<tr>
<th>Number of Unit Models</th>
<th>5 Models</th>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prod. Volume</td>
<td>242,000 / Year</td>
<td>242,000</td>
<td>TMMK</td>
<td>Avalon Lexus ES</td>
</tr>
<tr>
<td>Assembly C/T</td>
<td>56&quot;</td>
<td></td>
<td>TMMI</td>
<td>Highlander</td>
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<tr>
<td>Staffing #</td>
<td>181</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Shift Structure</td>
<td>Assy. = 2</td>
<td>Mach. = 3</td>
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### Our Products and Customers

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<thead>
<tr>
<th>Number of Unit Models</th>
<th>Yearly Capacity</th>
<th>Customers</th>
<th>Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Model</td>
<td>120,000</td>
<td>TMMI</td>
<td>Sienna Highlander</td>
</tr>
<tr>
<td>Prod. Volume</td>
<td>120,000 / Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly C/T</td>
<td>100”</td>
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<tr>
<td>Staffing #</td>
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</tr>
<tr>
<td>Shift Structure</td>
<td>Assy. =2, Mach. = 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SOP 4/2020
Skills in manufacturing

- Engineering
- Maintenance
- Information Technology
- Business process Management
- Problem solving
Technologies
Robots at work

Collaborative Robot
Tic Tac Toe Robot
Automated Guided Vehicles (AGV)
Comparison of Human hair to Machining Tolerances

1 Micron = 1/1000 of millimeter
CNC Programming

Beginning XYZ position
- Add temperature compensation

Spindle speed (RPM)
A54(A270.0)
#501=54
G56G43G0Z594.5H09
G56G00X[-131.9+#666+#546]Y[-46.6+#686+#566]S10000M50M08
G00Z430.6
N901I2Q5000M50M08
G01Z417.5F2000.
G09G01Z399.9F12000.
G00Z430.6
I3Q0

Rapid move to position #2
Move position #3 at feed of 2000mm/sec
A54(A270.0)
#501=54
G56G43G00Z594.5H09
G56G00X[-131.9+666+#546]Y[-46.6+686+#566]S10000M50M08
G00Z430.6
N901I2Q5000M50M08
G01Z417.5F2000.
G09G01Z399.9F12000.
G00Z430.6
I3Q0

Move position #4 at feed of 12000mm/sec
A54(A270.0)  
#501=54  
G56G43G00Z5.4H09  
G56G00[X[-13.9+#666+#546]Y[-46.6+#686+#566]Z510000M50M08  
G00Z430.6  
N901I2Q5000M50M08  
G01Z417.5F2000.  
G09G01Z39.9F12000.  
G00Z430.2  
I3Q0  

Rapid return to position #5
Transmission CAD simulation
CAD - Gear Meshing developed by co-op
3D printed Cooling fans
Torque Gun Holder
Jig Holder
Predictive Technologies
Sensor Type #1 Accelerometer (Vibration)

Fan Motor Vibration

Measures Vibration X and Y Axis Directions
Sensor Type #2 Pressure

Furnace **MUST** maintain positive pressure

If positive pressure is not maintained:
- Oxidization of parts
- May cause an explosion
- Must utilize recovery methods
Sensor #3 Example Temperature

Pressure Transducer Sensor Measures Temp of Furnace Shell

Accelerometer Sensors Measure Temperature of Motor and Pump
Augmented Reality
Microsoft HoloLens

AUGMENTED REALITY

Virtual Layout for machine installs
How can we support?

• Plant Tours to Teachers and Students
• STEM day for students. Shadow with engineers, maintenance, Quality Engineering
• Share Job Responsibilities of Engineers, Maintenance
• Show Automation (Robots, Automated Guided Vehicles)
• Show Training area (Engine Fundamentals, Transmission fundamentals, Problem solving etc.)
• Share CAD development and 3D printing
Q & A