Using the PI System to manage energy for a more sustainable future

Kevin ROSATI
Presentation agenda

1. About Toyota
2. European energy monitoring strategy
3. Implementing PI System at TME
4. Developing plant’s Energy Monitoring Systems
5. Learning points & Next steps
6. Conclusion
1. About TOYOTA
Toyota – in the World

- Established in 1937
- 53 manufacturing companies in 28 countries and regions, outside of Japan
- Vehicles sold in more than 170 countries and regions worldwide
- 10.594 million vehicles sold worldwide in CY 2018
- Market share: 45.6% in Japan, 14.0% in US in CY 2018
- More than 13 million cumulative hybrid sales
- Operating income totalled €19.3 billion in FY18-19
- Around 370,000 employees worldwide
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*Includes wholly owned companies as well as joint ventures, RDs, and contractual manufacturing.

5 regional headquarters
15 design and R&D centers
69 manufacturing companies worldwide

Toyota – in the World
Toyota – in Europe

• Began selling cars in 1963
• 9 manufacturing plants in 7 countries
• Over €9 billion invested since 1990
• More than €6 billion spent with European-based suppliers per year
• 1,035,430 vehicles sold in CY2018
• More than 2,000,000 hybrid vehicles sold in Europe
• 5.0% market share in CY 2018
• Employees (approx.): 20,000 (direct / including TPCA, 50/50 joint venture Toyota/PSA Peugeot Citroën)
Manufacturing facilities

- **TMUK – Engine Plant (incl. hybrid)**
- **TMUK – Corolla (Hybrid & Touring Sports)**
- **TMMP-J - Engine Plant**
- **TMMF – Yaris & Yaris Hybrid**
- **TPCA - AYGO**
- **TMMP-W - Engine & Transmission Plant**
- **TMMT – Corolla, Toyota C-HR (Hybrid)**
- **TMR – Camry & RAV4**
- **Toyota Caetano Portugal - Land Cruiser**
Driving sustainability

First hybrid vehicle in 1997

Worldwide hybrid cars development

First mass produced H₂ car

Toyota Prius (1997)

Toyota Mirai (2014)
Data: a key element of energy reduction

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2. European energy monitoring strategy
From a time consuming process…

**Plant by plant:**
- 8 different plants using 8 different EnMS
- No monitoring standard, difference in capabilities
- Benchmark is very difficult and time consuming

**From headquarter point of view:**
- When doing analysis, long time to gather data (upon demand)
- Need to combine all data, match formats (timestamps / units)
- Probability of man error is important
… to an ideal quick access to data

- 1 system to communicate with all plants devices
  Centralized infrastructure in headquarter

- Easy observation / comparison
  Curve superposition, intuitive trend analysis

- Smart reporting
  Automated detailed reports, easy to update

How to implement:

Step 1
Central Energy Monitoring

Step 2
Plant’s energy monitoring improvement

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3. Implementing the PI System

Target:

- Implement a central EnMS
- Keep plant’s local system operational
- Keep possibility for plant to use
- Optimize resources investment
Why OSIsoft PI System?

1. Pi System offers a good flexibility
   Possibility to build framework as we want, and adapt on European level / Plant level

2. It was a proven solution
   Several implementation cases available, good references

3. It can work with any protocol
   Plenty of interfaces, possible to connect the different systems that we have
Implementing the PI System

Asset framework architecture:

1. Collect
   - Energy meter template (per energy type)
   - Measurement and calculation (physics, average, maximum)

2. Manage
   - PI UFL interface
   - Plant
   - Manufacturing shop
   - PI Server

3. Deliver
   - Automated report
   - Trend analysis
   - Real-time analysis

About Toyota

European energy monitoring strategy

Implementing the PI System at TME

Developing plant EnMS

Learning points

Conclusion & Next steps

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Equipment performance report

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Moving one step further

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EU-Monitoring improvement

- Central EnMS
- Plant’s local system operational
- Possibility for plant to use
- Minimize resources investment

Plant’s energy management improvement

How to proceed?
Developing plant EnMS

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Who want to see data?

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<table>
<thead>
<tr>
<th>Facility engineer</th>
<th>Shop engineer</th>
<th>Plant management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy reporting, energy supply optimization, equipment management</td>
<td>Project follow-up, troubleshooting, abnormality management, start/stop management</td>
<td>Strategic planning, business impact</td>
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Facility engineer: Energy reporting, energy supply optimization, equipment management

Shop engineer: Project follow-up, troubleshooting, abnormality management, start/stop management

Plant management: Strategic planning, business impact
Developing plant EnMS

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- Collect
  - Energy DB
- Manage
  - Trend analysis
  - Automated report
  - Dashboard monitoring
- Deliver
  - BI
  - Predictive analytics
- Already implemented
  - Power BI
- Starting development
  - Event Frames
  - Smart monitoring
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Plant's result

<table>
<thead>
<tr>
<th>Energy Performance Indicator (kWh/day⁻¹)</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption 236130 kWh</td>
<td>Cost 15,897.30 €</td>
</tr>
</tbody>
</table>

Remarks:

Comments / explanations:

<table>
<thead>
<tr>
<th>Energy Performance Indicator (kWh/day⁻¹)</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption 152042 kWh</td>
<td>Cost 4,586.15 €</td>
</tr>
</tbody>
</table>

Remarks:

Comments / explanations:

<table>
<thead>
<tr>
<th>Energy Performance Indicator (m³/day⁻¹)</th>
<th>Compressed air (5 + 7b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption 155,000 m³</td>
<td>Cost 1,215,654 m³</td>
</tr>
</tbody>
</table>

Remarks:

Comments / explanations:
## 5. Learning points

<table>
<thead>
<tr>
<th>#</th>
<th>Step</th>
<th>Learning point</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All</td>
<td>It is easy to connect a lot of data points, but we must be sure about the accuracy and the reliability of the data</td>
</tr>
<tr>
<td>2</td>
<td>Implementation</td>
<td>It is better to spend more time to build an efficient Asset Framework to simplify delivery tools development</td>
</tr>
<tr>
<td>3</td>
<td>Implementation</td>
<td>Plant’s members involvement is a difficult but mandatory step</td>
</tr>
<tr>
<td>4</td>
<td>Monitoring</td>
<td>It is important to keep enough people trained to maintain the system</td>
</tr>
<tr>
<td>5</td>
<td>Delivering</td>
<td>Discussion with « end-customer » is important to build an efficient delivery tool (dashboard / report)</td>
</tr>
</tbody>
</table>

Next steps: Finish pilot trial and roll out to other plants
6. Conclusion
### CHALLENGES

- No sufficient energy data flow from manufacturing plants
- No standard for energy monitoring in manufacturing plants

### SOLUTION

- Implementing a centralized European framework
- Develop a plant size monitoring structure and roll-out in every plant

### BENEFITS

- Hard benefits: Tangible energy reduction in pilot plant
- Soft benefits: Empowering our engineers to take more efficient actions

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We managed to combine business application with significant step toward our corporate vision. Let’s continue to improve and transform our industry.

Chris TORFS, Senior Mngr, Plant & Environment div.

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"Nice picture"
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  Energy monitoring, Energy Reduction, Facility management improvement
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