Challenges and Opportunities of Automation in Electronics Manufacturing

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Overview

Bringing automation into Semiconductor Assembly requires an automation roadmap. As the automation in the factory ranges from toolsets, material handling to communication with suppliers and customers, a well planned sequence of implementation is needed that is aligned with key goals of the factory such as cost, quality, scale and cycle time. A maturity model approach is explored.
This presentation contains forward-looking statements that involve risks and uncertainties, including, but not limited to, statements regarding our manufacturing strategies, our product and technology positioning and compute platforms, the anticipated benefits of our automation processes, executing on our integrated strategic plans, realizing our strategic imperatives, including our embedded flash devices and storage technologies. Forward-looking statements should not be read as a guarantee of future performance or results, and will not necessarily be accurate indications of the times at, or by, which such performance or results will be achieved, if at all. Forward-looking statements are subject to risks and uncertainties that could cause actual performance or results to differ materially from those expressed in or suggested by the forward-looking statements.

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Factory Automation Challenges

• **Semiconductor Manufacturing is Inherently Complex**
  – Human Resource Complexity
  – Process Complexity
  – Equipment Complexity
  – Materials Complexity
  – Supply Chain Complexity

• **Inadequate Management of Complexity Drives Waste**

• **Objectives of Factory Automation**
  – Optimal planning and utilization of resources
  – Waste minimization
  – Reduced capital and operating costs

• **A Structured Approach Based on Maturity Model is Adopted**
## Automation Maturity Levels

<table>
<thead>
<tr>
<th>Function</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERP</td>
<td>Company Wide</td>
<td>Customer &amp; Supplier Collaboration (Transactional)</td>
<td>Collaboration (Real-Time)</td>
</tr>
<tr>
<td>Shop Floor Execution</td>
<td>MES Process Execution</td>
<td>Automated Transactions</td>
<td>MES linked to critical events</td>
</tr>
<tr>
<td>Recipe Management</td>
<td>Auto Recipe Download</td>
<td>Auto Recipe Updates</td>
<td></td>
</tr>
<tr>
<td>Traceability</td>
<td>Date Code/Batch</td>
<td>Single Unit</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Schedule</td>
<td>Machine Status/Auto alarm</td>
<td>Predictive using sensor data</td>
</tr>
<tr>
<td>Material Handling</td>
<td>Manual</td>
<td>Robotic</td>
<td>Real-Time Dispatch</td>
</tr>
<tr>
<td>Quality</td>
<td>SPC/Error Proof</td>
<td>Integrated with MES</td>
<td>Predictive</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>Yield/Event Based</td>
<td>Toolsets/Materials</td>
<td>Predictive Analytics</td>
</tr>
</tbody>
</table>
Manufacturing: Integrated & Connected
Western Digital Lights OFF iFACTORY
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Efficiency Productivity

- OTD
- MMR
- Yield
- Error Proof
- OEE
- Mean-Time Between Assistance
- MTBF

Dispatch

Storage

Competency

Process

Control/

Learning Curve

Cycle-Time

6 Losses

DPPM

LRR

OFE

Support Function Attribution

Manpower Cost

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Next Steps & Challenges: Machine Learning, Big Data and Maturity Model

*Interactions between Materials, Equipment and Processes*

- **Toolsets:** Sensors to allow Machine Learning based Predictive Maintenance.
  - Machine Learning: Toolset interaction with process and materials.

- **Toolsets:** Software upgradeable Toolsets to support a feature roadmap i.e. Autonomous cars.

- **Process Controls:** Communication between Process Steps for automatic corrections and adjustments. (Real-Time feedback between AOI Systems and the Toolset creating process drifts)

- **Big Data:** Prioritization of analytics to improve yields and reduce downtime. (Product, Process, Toolsets)

- **Maturity Model:** SEMI task force
Thank You
About the Presenter

Hem Takiar
Vice President of Packaging and Assembly Engineering at Western Digital where he manages development teams worldwide spanning over six countries, covering semiconductor and electronics products for Retail, OEM and Enterprise world. With more than 35 years of experience in semiconductor assembly and device packaging, Hem has been instrumental in setting up greenfield assembly/test operations in Shanghai including extensive assessments of such factory options in other parts of the world including India. In his one of the prior roles at Western Digital, Hem was responsible for setting up a corporate Quality and Reliability function spanning over six countries. He holds a M.S. degree in Materials Science from University of Illinois, Urbana Champaign.