Mask Automation: A Wafer Fab Perspective

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Topics

Supply Chain Collaboration

Mask Shop to Fab Communication

Requirements

Enterprise Level Reticle Management

Electronic Communication Protocols
Supply-Chain Collaboration Requirements

Reticle Suppliers

Staged
In Process
Shipped

Fab A
Fab B

SEMI P-10 Compliant
Device Design data & specs

Ability to define & communicate key states & events on a per supplier, customer, & reticle basis

Finanical systems e-commerce

IC Design & Mask Prep

Design Win
Tape Out
In Work

Lot Schedules Priorities

Lot Schedules Priorities

Build Status CofC

Scheduling, Prioritization
Factory Required Dates

Scheduling, Prioritization
Factory Planning

Mobile User

Shipping Status

Receive

Ship

Build Status

Financial systems e-commerce
Mask Shop to Fab Communication Requirements

Fab Needs (From Mask Shop):
1. Order confirmation
2. Manufacturing status & delivery prediction (ETA)
3. Manufacturing data (metrology & inspection data)
4. Quality audit information

Mask Shop Needs (From Fab):
1. Forecast
2. Prioritization of orders & WIP (Centralized)
3. Special requests or measurement requirements
4. Actual fab reticle required date (lot arrival, any early requirements)
5. Delivery confirmation
Order Confirmation

Order acknowledgement

Commercial terms

• Price
• Order specification
• Committed delivery date

Data preparation results

• % Clear
• Data error notification (gap/sliver, missing data, unresolved data)
Manufacturing Status & Delivery Prediction (ETA)

Mask shop process step
- Litho, Write, Etch, etc. + Chrome or psm process loop
- Metrology & inspection
  - CD
  - Registration
  - Pre-pell inspection, post-pell inspection

Delivery Prediction (ETA)
- Current: Subjective estimate
  - Order entry (based on history)
    - 50% confidence (~ best case, very early)
    - 90% confidence (~ slightly early)
    - 99% confidence (~ due date)
  - ETA estimate / delivery window estimate (in-line feedback + history)
    - Best case (no issues)
    - Typical (typical repair, cycle time)
    - Worst case (reject, major repair, tool issues, production backlogs)

- How to make more objective?
  - Simulation
  - Yield model
  - Statistic model

- Factor in feedback from wafer fab on lot arrival or factory required date
Manufacturing Data (Metrology & Inspection Data)

**Metrology**
- Example: CD, Registration, Phase angle, Transmission,
- Possibly: key process data
- Multi-site measurement results
  - Engineering requested data: Typically needed early
  - Normal production data: Archival purposes
  - Is data specification based or information only?

**Inspection**
- Inspection results
- Inspection tool settings
- Classification results
- AIMS results
- Marginal or questionable defects (customer notification)
- Opportunities?
Quality Audit Information

Certificate of Conformance (CofC)

Waiver request

• Data package supporting waiver
• Waiver approval audit trail
Enterprise Reticle Management Requirements

Reticle Asset Sharing, Location, Usage, and Availability Status

Inter-company, Inter-fab Reticle Lifecycle Tracking

Store Fab Technology and Product Capabilities

Store Supplier Performance Data

Waiver Repository

Visibility of Design Win Pipeline

Reticle Order Forecasting

Enterprise-wide Reticle Analysis & Reporting
Supply-Chain Collaboration Requirements

Ability to define & communicate key states & events on a per supplier, customer, & reticle basis

SEMIP-10 Compliant

Device Design data & specs

- Scheduling, Prioritization
- Factory Required Dates
- Metrology and litho tool coordinate data

Financial systems e-commerce

- Lot Schedules
- Priorities
- CofC Build Status

Fab A to Fab B transfer

IC Design & Mask Prep

- Design Win
- tape out
- In Work

Mobile User

- Build Status
- Lot Schedules
- Priorities

Reticle Suppliers

- Staged
- In Process
- Shipped

Reticle Shipping Status

- Ship
- Receive

Lot Schedules Priorities

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Reticle Shipping Status

- Ship
- Receive

Lot Schedules Priorities

Build Status CofC
## Information Transfer Alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Email Parsing</td>
<td>• Universally supported &amp; understood</td>
<td>• Delivery not guaranteed</td>
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<td></td>
<td>• Firewall independent</td>
<td>• Subject to content corruption</td>
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<tr>
<td></td>
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<td>• Parsers required at each end to automate</td>
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<td>Web Connect (Eg, Web Server)</td>
<td>• Browser-based client UI</td>
<td>• Some firewall challenges</td>
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<td>• Higher reliability than email</td>
<td>• More complex implementation</td>
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<td>• Can leverage advances in web technologies</td>
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<td>Third Party Application Service Provider</td>
<td>• Enables pooling of subscriber inputs for analysis</td>
<td>• Complex to manage X different customers with X different state</td>
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<tr>
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<td>• High reliability</td>
<td>models, X different measurement and custom field configurations and,</td>
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<td>• Outsourced support &amp; maintenance</td>
<td>possibly, X different language needs.</td>
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<td>• Steep development curve due to need for completely different</td>
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<td>database, GUI, and database.</td>
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<tr>
<td>Ftp Transfer Site</td>
<td>• Ease of use. Familiar technology.</td>
<td>• Does not guarantee adherence to SEMI P-10 or other specified data</td>
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<td>• Great for the sender as they don't have to reshape their data into</td>
<td>structure.</td>
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<td>XML.</td>
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