Common Development Topics for Semiconductor Manufacturers and their Suppliers in Germany

SEMICON Europa 2013 – TechARENA 1: Secondary Equipment Session

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Agenda

- Motivation, Chosen Approach and Work Performed
- Results: Main Topics and Agreed Activities
- Starting Points towards “Industry 4.0”
- Complementary Aspect for Equipment Makers: “450 mm“
- Summary and Outlook
Motivation

- European semiconductor industry is quite heterogeneous:
  - Products: MM, MtM, automotive, power, sensors, …
  - Production environment: 300 mm fabs, grown 150/200 mm fabs

- Challenge for all: **How to increase productivity to keep manufacturing in Europe?**

- But given the different states, backgrounds and strategies: what are shared aims and common needs, what are potential paths that can be taken together?

- Step taken here:
  - Clarify needs and cross-cut activities at national level (Germany) by a study, carried out by Fraunhofer IISB
  - Focus on 200 mm MtM fabs
Chosen Approach

Objective:
Actively support networking between business and science on 3 levels

- **IC makers and their suppliers**: Foster discussion and collaboration by identified cross-cut topics and concrete, agreed activities.
- **Fraunhofer IISB**: Update with regard to latest needs of IC-makers, equipment suppliers and software suppliers to align own R&D activities accordingly. Dissemination of results.
- **German BMBF** (funder of the study): Consolidated status of the German IC makers and their suppliers with focus on “More-than-Moore”.
Chosen Approach

- Start with topics and participants from a dedicated interest group
  - Semiconductor equipment and materials, production
  - Automation
  - Yield enhancement
  - Test equipment and methods
- 1st: Needs of the IC manufacturers
  - Workshops with experts at the manufacturers’ sites
  - Collect interests and status
- 2nd: Discussion with suppliers
  - Joint workshops on selected main themes
  - Matching needs and competencies
- Screen outcome for commonalities and **concrete joint actions**
## Work Performed

<table>
<thead>
<tr>
<th>IC-Makers</th>
<th>Bosch</th>
<th>ELMOS</th>
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<tbody>
<tr>
<td></td>
<td>GlobalFoundries</td>
<td>Infineon</td>
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<td>Siltronic</td>
<td>Texas Instruments</td>
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<td>X-FAB</td>
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<table>
<thead>
<tr>
<th>Topic</th>
<th>Participating Users &amp; Suppliers</th>
</tr>
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<tbody>
<tr>
<td>Equipment Forum</td>
<td>Applied Materials, CEA-Leti, FRT, HQD, IMEC, Jenoptik, Metryx, PVA TePla, ST Microelectronics, Süss Microtec, University at Albany</td>
</tr>
<tr>
<td>Automation (first meeting)</td>
<td>ACI ecoTec, AIS Automation, ASM, Bosch, ELMOS, HAP, Infineon, Peter Wolters, Roth &amp; Rau, Siltronic, SÜSS MicroTec, VDI/VDE-IT, X-FAB</td>
</tr>
<tr>
<td>Automation (second meeting)</td>
<td>ASM, Bosch, ELMOS, HAP, Infineon, Roth &amp; Rau, Schiller Automatisierungstechnik, Siltronic, X-FAB</td>
</tr>
<tr>
<td>Equipment</td>
<td>AIS Automation, ASM, Centrotherm, ELMOS, HAP, Infineon, Bosch, Roth &amp; Rau, Siltronic, Solutions on Silicon, Texas Instruments, Vistec, X-FAB</td>
</tr>
<tr>
<td>Test</td>
<td>austriamicrosystems, Bosch, Elmos, Freescale, GlobalFoundries, Infineon, Micronas, NXP, Rood MicroTec, Texas Instruments</td>
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Overview about the workshops carried out during the study
Results: Main Topics

Main Challenge
- How to enhance productivity in a MtM production environment!

Results
- 3 main topics
- Collected themes summarized in 6 categories
- Important aspect: Especially in the MtM area, “classical” front-end and backend processes merge increasingly
Results: Main Topics and Agreed Activities

Distribution of the three main topics across the entire production process

- **Data-driven Productivity Enhancement**
  - APC Methods and Predictive Techniques
  - Data Infrastructure

- **Automation**
  - Simulation
  - RFID-Tags
  - Best-Practices-Database

- **Equipment**
  - Equipment Refurbishment
  - Equipment Assessment
  - Equipment Database

**Frontend**

**Backend**

**Test**
(Ass., Pack.)
## Results: Main Topics and Agreed Activities

<table>
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<tr>
<th>Main Topic</th>
<th>Agreed Activities</th>
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| **Equipment**                 | - Build a database for important equipment in terms of maintenance, spare parts and refurbishment.  
- Clarify requirements for a possible R & D project as cross-cut activity for equipment modernization (based on the above-mentioned database) with the involvement of resource and energy efficiency aspects.  
- Further networking of equipment users and suppliers, also at international levels, joint seminars and training, improve the support of "older" equipment by the manufacturer.  
- Establish a long-term funding framework for the ongoing evaluation of new equipment.                                                                                     |
| **Automation**                | - Conduct a workshop on "Simulation for automation."  
- Build a "best practices" database for equipment automation.  
- Implement automation solutions for thickness measurement and implantation.  
- Performance monitoring for automation systems, possibly as part of a joint research activity in the field of prediction and Equipment Health Factor (EHF).  
- Development of a "smart stocker".  
- Development of common approaches to RFID tags for 6"/ 8" cassettes.  
- Discussion on new solutions for transport systems for 150/200 mm cassettes.                                                                                           |
| **Data-driven Productivity**  | - Develop common data formats and appropriate data converters for frontend and backend.  
- Concept study for a comprehensive data infrastructure (network) as the basis for gradual, specific and prioritized improvements to existing infrastructures.  
- Pre-competitive development of APC methods and predictive techniques across the overall production chain (frontend, backend, test).                                                                                          |
Results

Two Trends

- **Catch-up**
  - Productivity by Automation

- **Today’s R&D Topics**
  - Productivity by data-driven manufacturing optimization

ITRS: „From reactive to predictive“

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Starting Points towards “Industry 4.0”

First Industrial Revolution
through the introduction of mechanical production facilities with the help of water and steam power
First mechanical loom, 1784

Second Industrial Revolution
through the introduction of a division of labor and mass production with the help of electrical energy
First assembly line Cincinnati slaughter houses, 1870

Third Industrial Revolution
through the use of electronic and IT systems that further automate production
First programmable logic controller (PLC), Modicon 084, 1969

Fourth Industrial Revolution
through the use of cyber-physical systems

Degree of complexity

Source: DFKI (2011), siemens.com

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Starting Points towards “Industry 4.0”

- Semiconductor Industry: APC, logistic simulation
- Semiconductor Industry: APC, manufacturing optimization
- Semiconductor Industry: Logistic optimization
- Semiconductor Industry: Know-how management
- Resilient Fab
- Self-organizing, adaptive Logistics
- Technology data Marketplace
- Sustainability by Up-Cycling
- Intelligent Maintenance
- Smart Factory Architecture
- Networked Production
- Customer Integrated Engineering
- Application Scenarios
- Integrated Engineering
- Resilient Fab
- Self-organizing, adaptive Logistics
- Technology data Marketplace
- Sustainability by Up-Cycling
- Intelligent Maintenance
- Smart Factory Architecture
- Networked Production
- Customer Integrated Engineering
- Application Scenarios

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Complementary Aspect for Equipment Makers: “450 mm“

- Feedback from 29 companies
  - 21 companies have solutions available for 450 mm, or in planning/development respectively
- Synergies with 200/300 mm-technology
  - Wafer handling
  - Interfaces for automation
  - Energy and media consumption
- Requests for funding support
  - Development, launch and marketing
  - On site at CNSE or imec
- Often, direct access to information and contacts in the area of 450 mm technology is missing (→ EEMI 450 initiative!)
Summary

- 12 Workshops with high level of openness, and willingness for cooperation among each other and with other industries.
- 3 main topics identified:
  - Equipment, Automation, Data-driven Manufacturing Optimization
  - with more than 40 potential cross-cut topics
  - At least 3 agreed activities per main topic
  - Backend/Test as a (new?) core area: unique feature of EU? KET?
- Backlog in automation, but chance in R&D for “data-driven productivity enhancement”
- Starting points towards “Industry 4.0” identified
- Discussed “450 mm” as complementary aspect for equipment makers
Outlook

- Collaboration in the „agreed activities“
- Strategic Networking (GMM, strategic working groups, study-group "Industry 4.0“, …)
- Clarify mid-term activities and R&D topics - and address them jointly:
  - Development of APC methods and predictive techniques across the overall production chain
  - Framework for equipment assessment at European level
  - Equipment refurbishment ("lift 200 mm equipment to the technical level of 300 mm tools")
- Networking at EU/international level: 450 mm, SEA, …
- How can the increasing importance of backend / test be met?
Acknowledgments

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Thanks for your attention!