An Integrated Approach for Semiconductor Wafer Fab Implementation

SEMI Vietnam Semiconductor Strategy Summit

Ho Chi Minh City, September 2014
Contents

- M+W Group & Asia Company Profile
- Sustainable and Cost Efficient Fab Design
- Integrated Project Approach
M+W Group in the Semiconductor Industry
Overview

Leading global engineering and construction company...
- More than 8,500 employees worldwide
- World-class Environmental Health & Safety standards
- Technical expertise in process and automation

... for semiconductor production facilities
- 70% of the world’s 300mm Fabs were designed by M+W Group
  - More than 200 semiconductor Fabs designed and built
  - Over 4 million m² of manufacturing area designed and built
- Installed over 11,000 tools since 2003

450 mm Wafer  CNSE NanoFab Xtension  IMEC 450 mm
M+W Asia Overview

- Actively executing projects in Asia for over 20 years
- Singapore is Asian Headquarters
- Successfully completed over 700 projects in Asia
- 2012 sales of over US$ 1 billion (31.5% of M+W Group’s global sales)
- Performed over 100 million construction man-hours in Asia over the last 5 years

M+W Vietnam

- Head Office: Ho Chi Minh City
  12nd Floor, Petroland Tower
  12 Tan Trao, Tan Phu Ward, District 7
  Ho Chi Minh City
  Tel.: +84 8 5410 9229
  Fax: +84 8 5410 9228

- Branch Office: Hanoi
- Established in 2007
- General Director: Robin Tan
M+W Asia Expertise in Wafer Fab Design and Construction

**Infineon**
Kulim
Malaysia
2011 - 2013

- **Power Fab 2**
- **Design + Build**
  - 200mm and 300mm Wafer
  - Total Building Area: 100 000 m²
  - Second fab at Kulim site, designed with 200 and 300mm capabilities
  - Stand alone facility complete with new CUB and gas farm

**STATS ChipPAC**
Singapore
2012 - 2012

- **Test & Assembly Facility Expansion**
- **General Contractor**
  - Total Building Area: 18 000 m²
  - New 4-storey expansion building for logistics and cleanroom production

**Texas Instruments**
Angeles
Philippines
2007 - 2010

- **Phase 1 + Extension – Bump & Test Facility**
- **Design + Build**
  - Cleanroom Area: 40 000 m²
  - Design and build contractor for complete cleanroom for Bump, Probe, Test and Assembly Facility
  - Cleanroom Class 100 and 1000
  - LEED Gold certification
M+W Asia Expertise in Wafer Fab Design and Construction

**Siltronic Samsung JV**
- **SSW JV Fab 300-3**
- Design, Build + Hook-Up
- Singapore
- 2006 - 2008
- 350 000 WOPM 300mm Wafer
- Production Area: 18 170 m²
  - Integrated manufacturing line ingot to wafer
  - Additional on-site Crystal Pulling
  - Cleanroom Class 10 and 100 (13 810 m² Fab, 4 360 m² Crystal Pulling)

**Confidential Client**
- **Semiconductor Project**
- Design, Build + Hook-Up
- Singapore
- 2007 - 2008
- Production Area: 22 000 m²
  - Cleanroom Class 100 ballroom and bay/chase
  - Site master planning for 60ha site – 4 Fab complex
  - Advanced FFU concept

**1st Silicon**
- **Fab 1**
- Design + Build
- Kuching, Malaysia
- 1999 - 2000
- 20 000 WOPM 180nm on 200mm Wafer
- Production Area: 8 500 m²
  - Cleanroom Class 100 turbulent
  - SMIF / Minienvironment Concept
EHS Recognitions from our Clients in Asia

Singapore
Winner of 3 WSH Performance Awards & 6 SHARP Awards

Philippines
Safety Recognition Award by Department of Labor and Employment

Malaysia
Winner of 2 National Safety & Health Excellence Awards & 3 MOSHPA Gold Awards

India
Winner of 1 Two Star & 1 Three Star Award from Confederation of Indian Industry Client Recognition of Safety Excellence

…and many more recognitions for EHS Excellence from our clients
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Sustainable and Cost Efficient Fab Design

Pre-Requisites

- Thorough investigation and understanding of client’s needs (inside-out approach)
- Process technology selection based on the anticipated product portfolio
- Process equipment and automation level as per the selected technology (mix)
- Appropriate fab concept
  - Building & facilities specifications adjusted to the real needs
  - Appropriate sizing of utilities
  - High area utilization
  - No “nice to have” features
  - Energy efficient
  - As green as affordable

The function, operation and shape of any facility are primarily driven by process & manufacturing requirements.
Sustainable and Cost Efficient Fab Design
Energy and Environmental Technologies

**Energy Efficiency**

**Energy Efficient Products & Components:**
- Cleanroom Products
- Controlled Environments

**Energy Efficient Systems & Concepts:**
- Energy Recovery

**Decentralized Power Generation:**
- Co-/Trigeneration Plants

**Environmental Technology**

**Environmental Technologies:**
- Water & Waste Water Treatment & Recycling Systems
- Contamination Control

**Green Building Technologies:**
- Site Selection, Material, Building Design & Operation, Energy & Water Efficiency, Indoor Environment Quality

**Energy Storage**
- Thermal and Electrical

**Renewable Energy**

**Renewable Energy Technologies:**
- Free Cooling
- Geothermal & Air Heat Utilization by Heat Pumps
- Photovoltaic Power Plants
- Solar Thermal Systems
Energy Conservation and Energy Efficiency Optimization through FAB Energy Modelling

Finite natural resources can be saved through decreased energy consumption, increased efficient energy use and/or renewable energy supply sources.

- The effect of savings and the complex primary, secondary and tertiary interactions between process equipment and facility systems can only be analyzed by modelling.

- A detailed FAB energy modelling tool:
  - Analyzes all energy fluxes of facility systems as well as process tools
  - Determines optimal saving potential scenarios within an acceptable ROI
  - Further cost saving potential through downsizing of facility systems

Effected Systems through Exhaust Reduction
### Energy Efficiency Consulting
### Sample Cost Savings of Recent Projects

<table>
<thead>
<tr>
<th></th>
<th>Project 1</th>
<th>Project 2</th>
<th>Project 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scope</strong></td>
<td>Total facility systems energy saving audit</td>
<td>Energy saving audit for air handling units only</td>
<td>Total facility systems energy saving audit</td>
</tr>
</tbody>
</table>
| **Scenario 1**       | Investment 1.1 m US$  
Savings 0.8 m US$/a  
→ Mean ROI: 1.4yrs | Investment 1.6 m US$  
Savings 1.2 m US$/a  
→ Mean ROI: 1.4yrs | Investment 50 k US$  
Savings 1.0 m US$/a  
→ Mean ROI: Months |
| **Scenario 2**       | Investment 5.0 m US$  
Savings 1.6 m US$/a  
→ Mean ROI: 3.5 yrs | Investment 1.8 m US$  
Savings 1.5 m US$/a  
→ Mean ROI: 1.7 yrs | Investment 1.9 m US$  
Savings 1.5 m US$/a  
→ Mean ROI: 1.3 yrs |

#### Diagrams
- **Water Balance**
- **Chiller & Cooling Tower**
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Integrated Project Approach
Challenges in Emerging Semiconductor Markets

- Interfacing to the existing infrastructure
- On-site material and parts sourcing potential
- Communication: language skills and cultural aspects
- Logistics & compliance with individual country-specific regulations
- Project set-up process can be time consuming
  - Project financing
  - “Back to back” agreements with suppliers
- Complexity requires….
  - Strong partnerships
  - Skilled project development & supervision of interdependent elements
Integrated Project Approach Setup Overview

The General Contractor closely coordinates project planning and execution with equipment supplier(s), thus providing a Single Point of Responsibility to the client.
Integrated Project Approach
Added Value for the Customer

- To serve emerging market requirements for coordinated services

- Added value for the customer:
  - Single point responsibility
  - Interfacing / integration optimized
  - Logistics synergies
  - Global supply chain network
  - Enabler for process technology transfer
  - Experienced resource pooling
  - Staff augmentation
  - Rapid knowledge transfer
  - Fast and reliable implementation
Integrated Project Approach

Important Scope Aspects for Used Equipment

- Correlation of equipment specs with technology requirements / approval by technology provider
- Adequate and skilled refurbishment
- SMIF upgrade capabilities
- Consumables / spares definition, sourcing and consignment/logistics
- Resources and schedule management
- Equipment acceptance testing
- Equipment documentation

Strong coordination and broad range of capabilities are necessary for successful and cost-efficient application of used equipment in wafer fab projects.

Source: AGSS
Integrated Project Approach
Case Study in an Emerging Market

Semiconductor Manufacturing Line in Belarus

Specifications
- Product: Integrated Circuits
- Technology: CMOS, 350nm on 200mm Wafer

Scope of Services
- Turnkey for Cleanroom and Facilities Upgrade, Process Equipment Delivery & Services, Process Technology Support

Key Features
- Modernization of existing facilities
- Technology based specification, procurement and refurbishment of pre-owned equipment (with partner)
- Equipment qualification, technology implementation support together (with partner)
Integrated Project Approach
Sample Project Schedule

Complementary scheduling and coordination of building & facilities design and construction with equipment and technology scope of work which provides improved matching of technical requirements and capabilities with a faster schedule.
Pre-Requisites for Semiconductor Projects in Emerging Semiconductor Markets

The realization of complex projects in emerging semiconductor markets requires strong partnerships with companies having a...

- Global footprint & fast resource deployment
- Strong network within the industry (partners and suppliers)
- Fast track Design/Build capabilities
- Specialized services down to process level
- Self-performance capabilities for selected subsystems and components
- General Contractor capabilities for an integrated project approach
THANK YOU!

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