From Greenfield to Fab – Infrastructure & Facility Requirements for Semiconductor Manufacturing

SEMI Vietnam Semiconductor Strategy Summit
Ho Chi Minh City, 10th September, 2013

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M+W Group at a Glance

The leading global engineering and project company with…

- more than 7,700 employees worldwide
- world class EHS records and awards
- technical expertise in process and automation
- sales exceeding 3 bn USD in 2012

…. for high-tech production facilities, mission critical infrastructure and energy & environmental solutions …. 

- more than 200 Semiconductor Fabs realized
- more than 10 GWp Photovoltaic Fab capacity realized
- largest Nanotechnology Research Center built
- over 300 successfully completed turnkey projects

…. committed to deliver customer value
Recognitions and Strategic Initiatives

- Gold Recipient of “Safety and Health National Award” in Malaysia
- “Solar Industry Award” 2010 and 2011 in the Turnkey Category
- “Safety and Health Award 2011” for M+W Singapore
- “TOP 100” of Germany’s World Market Leaders
- “Facility of the Year 2011” Award for our Customer Novartis Vaccines
- “Global Growth Company” World Economic Forum, Dalian, China, 2011
- “Excellent Contractor Award” for M+W Group by Beijing Orient Electronics
- “Construct Secure” Platinum Award for M+W US
- “Supplier of the Year Award 2008” for M+W Group by Carl Zeiss
- Founding Donor of Trust “2 Degrees for Climate Protection”
Our Industries

Advanced Technology Facilities
- Semiconductor
- Flat Panel Display
- Photovoltaics
- Battery Cells

Life Science & Chemicals
- Pharma & Biotech
- Food & Nutrition
- Consumer Care
- Chemicals

Energy & Environment Technologies
- Renewable Energy
- Waste to Energy
- Power Plants
- Oil & Gas

High Tech Infrastructure
- Science & Research
- IT & Telecom
- Space & Security
- General Industries

Process Automation
- Chemicals
- Pharma & Biotech
- Food & Nutrition
- Automotive
- Semiconductor
- Oil & Gas, Paper

Products & Services
- Cleanroom Products
- Air Handling Units
- Contracting
- Controlled Environments
- Technology Center
- Operation & Maintenance
M+W Group as an Enabler in Emerging Markets

- Bosch, Australia, 1999
- TSMC Fab II, Taiwan, 1999
- SMT, Thailand, 1999
- Chartered Fab II, Singapore, 1992
- Masdar Institute, UAE, 2010
- CDTA, Algeria, 2001
- ST Microelectronics, Morocco, 1999
- SIX Semiconductors, Brazil, 2013
- Angstrom-T, Russia, 1988

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Key Factors for Success Semiconductor Fab Development

- Identify Target Markets & Products
- Process Technology Licensing
- Process Equipment & Automation
- Personnel Recruitment & Training
- Available Services, Materials & Consumables
- Financing Options
- Site Selection
- Building Facilities Engineering & Construction
- Process Equipment Installation & Qualification
- Process Technology Implement. & Qualification
- Operations Concept & Ramp-up

VIABLE COST MODEL AND BUSINESS PLAN
New Wafer Fab Project in Vietnam Baseline Data

- Location
  - Saigon High Tech Park (SHTP), Vietnam

- Product
  - Integrated Circuits, tbd.

- Key manufacturing data
  - Process technology: CMOS
  - Target technology node: 180 / 100 nm
  - Wafer size: 200 mm
  - Target manufacturing capacity: 5,000 -10,000 WSPM*

- Additional functions under discussion:
  - R&D, Assembly & Test, Training, Parts Clean, etc.

- Process equipment will be refurbished

*WSPM: Wafer Starts per Month
New Wafer Fab Project in Vietnam
Manufacturing Environment - Requirements

- Manufacturing environment
  - SMIF / Mini-environment (ME)

- Cleanroom specification
  - Class 1,000 / Class 1 (in ME)

- Material transportation and storage
  - Trolleys and WIP shelves

- Vibration criteria
  - VC-D in critical areas

- Floor load of main production area
  - 20 to 25 kN/m²

- Mode of operation
  - 24/7, 365 days per year
New Wafer Fab Project in Vietnam
Key Facility Design Considerations

Environmental Requirements

Facilities Specifications

Equipment Setup

Material Handling

Concept

Logistics

Requirements
Cross-Section through a Typical Wafer Fab
2-Level Fab Concept

- Cleanroom with FFU recirculation air concept
- Open room (Ballroom), no cleanroom walls required (except for segregation)
Typical Wafer Fab Complex
Fab Building Impressions

Plenum
Cleanroom
Raised Floor
Sub-Fab
Typical Wafer Fab Complex Site Master Plan (2 Fab Modules)

- Key considerations for the site requirements include:
  - Geotechnical compliance
  - Traffic flow
  - Connectivity to public infrastructure
  - Utility supply
  - Future expandability
  - Code compliance
Pre-Requisites for the Establishment of a Semiconductor Fab Complex

Market
- Clients
- End users
- Suppliers
- Business partners
- Competitors
- Universities
- R&D centers

Financial Aspects
- Development funds & government incentives
- Tax & regulatory policies
- Market introduction programs
- Cost of labor
- Cost of land
- Cost of - electricity - water - waste water - natural gas

Workforce
- Availability of qualified workforce
- Education system
- Union’s influence
- Labor productivity
- Attractiveness for expatriates

Others
- Political climate
  - Investment situation
  - Financial governance
  - Legislation adherence
  - Property rights
  - Competition and regulation
- Environmental regulations
  - Exhaust air
  - Waste water
  - Noise
- Codes and permitting process

Overall Infrastructure
- Road infrastructure
- Airports
- Seaports
- Railway infrastructure
- Hospitals

Technical Infrastructure
- Availability and quality of
  - Electrical supply
  - Water supply
  - Waste water disposal
  - Natural gas supply

FACILITY
Semiconductor Front End Manufacturing Multiplier for Infrastructure & Employment

Wafer Fab
- Managers
- Engineers
- Technicians
- Operators
- Administration

Supply Chain and Finishing Industry
- Back end
- OEM’s / service providers
- Photomask suppliers
- Materials suppliers
- Electronics industry

Typical Leverage 1:4 to 1:6
Source: M+W Group data

+ 1,500 employees

Social Infrastructure
- Domestic construction
- Retail
- Health care
- Research and education
- Local suppliers

+ 1,500 employees

800 employees
The Supply Chain and it’s Participants

Research & Development

- Design Services
- Design Tool Vendors
- IP Vendors
- Materials Vendors (Si, Consumables)
- Equipment Vendors
- Semiconductor Vendors (IDMs)
- Foundries
- Fabless Semiconductor Vendors
- Distributors
- Manufacturing and Design Services (EMS, ODM)
- Test and Packaging Services
- Subcomponent OEMs
- Equipment Distribution Channel
- Service Providers
- Software and Content Providers
- Subcomponent OEMs
- Automotive
- Entertainment
- Electronics Industry
- Computers & Software
- Medical Applications

Source: Based on Gartner, 2005
Semiconductors Enable Diversification into New but Related Technologies

Semiconductor
1. System design
2. Manufacturing
3. Research Competence

Nano

MEMS

Crystalline Silicon / Thin Film Photovoltaic

Opto

Displays
Summary
Challenges and Opportunities for Vietnam

- The major challenge is to evaluate and consider all key success factors by:
  - Developing a feasible business plan
  - Selecting a compatible manufacturing and process technology provider
  - Assembling global best-in-class players for project planning and execution
  - Continuing co-operation with the region and existing infrastructure
  - Recruiting industry professionals and local talents for first wafer fab start-up

- Key opportunities for Vietnam:
  - Front end wafer fab as the key enabler to accelerate development of its high-tech industry
  - The growth of domestic infrastructure and supply chain
  - Upstream and downstream development of the supply chain
  - Diversification of the product portfolio through new companies & spin-offs
  - Creation of new highly qualified job opportunities with a high multiplier
  - International recognition of Vietnam as a new player in the high-tech sector
THANK YOU!

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