NEMI National Electronics Manufacturing Initiative, Inc.

Electronics Manufacturing Migration

SAC Meeting

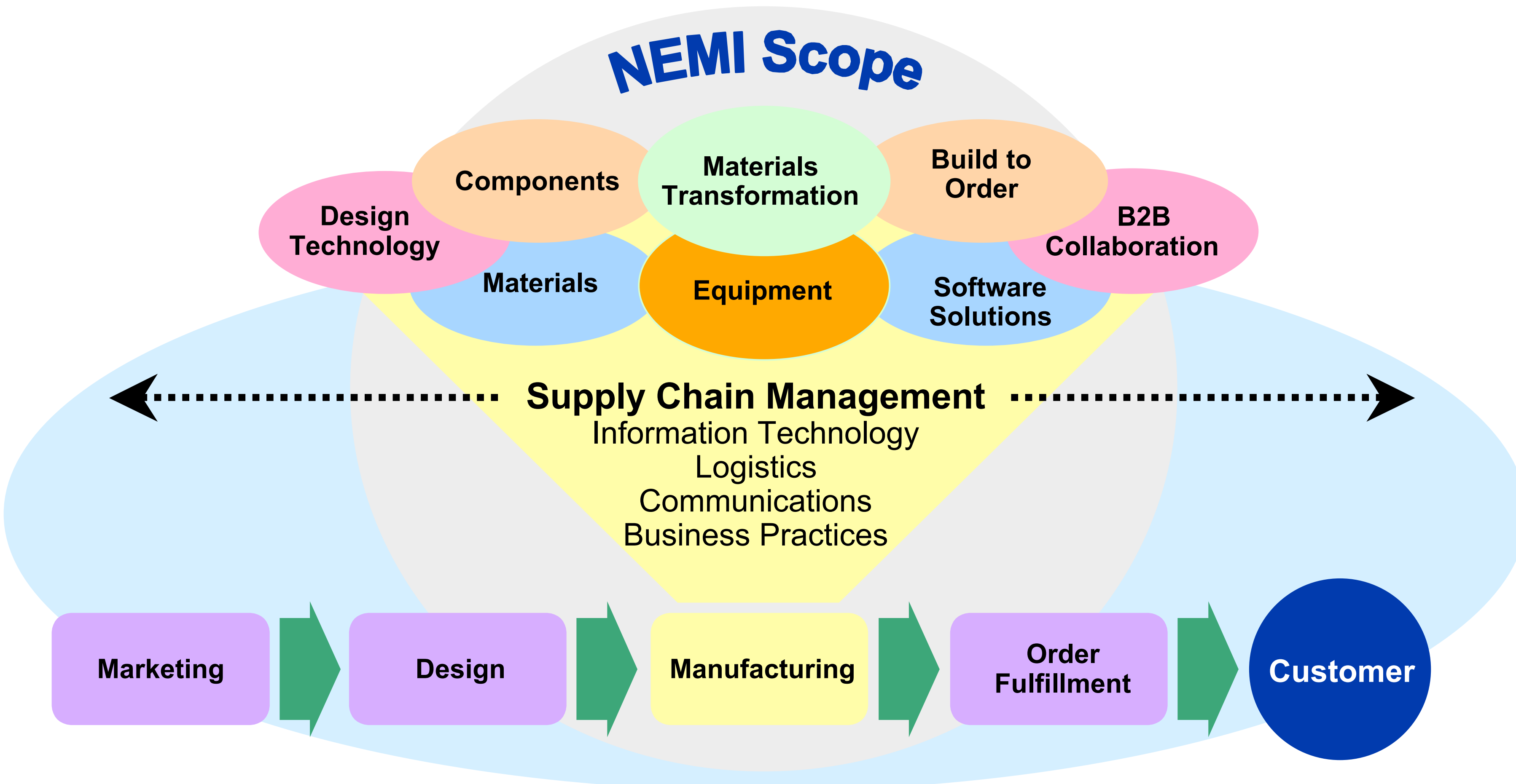
November 13, 2002

Topics to be discussed

- Background
- Selected Roadmap conclusions
- Why China?
- NEMI forum on Mfg. in China

NEMI Mission

Assure the Global Leadership of the North American Electronics Manufacturing Supply Chain



Connect with and Strengthen Your Supply Chain

What Does NEMI Do?

Leverage the combined Power of Member Companies to Provide Industry Leadership

- **NEMI Conducts Industry Forums on Emerging Topics**
- **NEMI Roadmaps the Needs of the North American Electronics Industry**
- **NEMI Identifies Gaps (both business & technical) in the North American Infrastructure**
- **NEMI Stimulates R&D Projects to fill these Gaps**
- **NEMI Establishes Implementation Projects to Eliminate these Gaps**
- **NEMI Stimulates Standards to speed the Introduction of New Technology & Business Practices**

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Roadmap Structure - 18 Groups/Chapters

Digital Silicon Technology

Business Processes/Technologies
- Product Life Cycle Information Management

Design Technologies
- Modeling, Simulation, and Design Tools
- Thermal Management
- Environmentally Conscious Management

Manufacturing Technologies
- Board Assembly
- Test, Inspection, and Measurement
- Final Assembly

Component/Subsystem Technologies
- Packaging
- Connectors
- Interconnection Substrates - Organic
- Interconnection Substrates - Ceramic
- Passive Components
- RF Components
- Optoelectronics
- Displays
- Mass Data Storage
- Energy Storage Systems

Connect with and Strengthen Your Supply Chain

The Changing Landscape

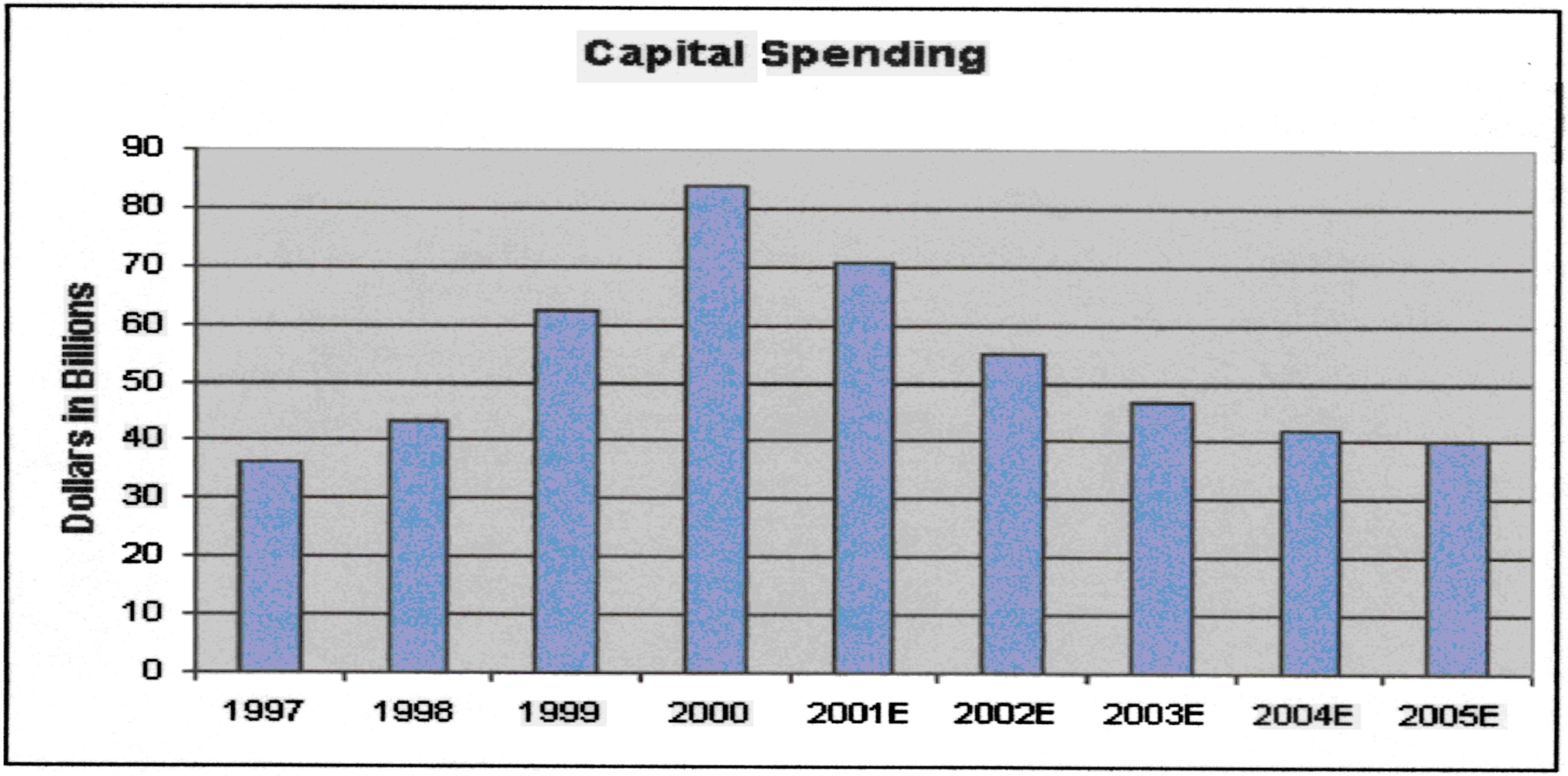
- New Volume Drivers
  - 1 billion cell phones by 2005/6
    - Cell phone innovation slowdown has led to standard I/C's and commoditization of the technology
    - Overtake PC for web access by 2004/5
  - 2 billion Bluetooth by 2006/7
  - Optoelectronics growth stopped through 2003
    - Isolated areas of strong growth
  - PC growth stalled, market share shifting
  - Auto electronics growth remains strong (spurred by new functionality in the car)

Board Assembly Chapter Highlights

- Board assembly handles most of the direct-material costs for electronics products and is critical to electronics supply chain
- Board assembly is being impacted by MEMS, optoelectronics and wireless communications packaging technology development
- Movement of volume board assembly to low cost areas of the world – primarily China – continues
- The majority of the remaining N.A. assembly will be related to NPI and service – areas needing improvement
  - Efficiency and utilization of high mix/low volume lines
  - Set up times and the adoption of factory information integration with real time optimization
  - Ramps to volume and line flexibility
  - Qualification processes for materials, process development
  - DPMO leverage to understand package performance
  - DFx tools level of integration with factory data systems

Optoelectronics Capital Expenditure Forecast

Capital Spending Totals



Source: Optical Oracle

2002 Roadmap Portable Product's Highlights

- **Standard RF I/Cs have rendered new cell phone products commodities favoring I/C manufacturing**
- **Same result for portable SMT board assemblies in general**
- **Main driver for portable devices continues to be unit shipping volume**

  - 400 M cell phones in 2002 still drive packaging and assembly trends for this cycle

  - Game boxes at 40M in 2002 and other future products with volumes > 10M/year may drive I/C design/packaging
- **N.A. manufacturing at same crossroads that precipitated the formation of NEMI in early 1990's**

  - EMS outsourcing trend leading the transition to offshore labor

  - For many products, virtually complete

Portable Product Emulator is Packaging Driver

Key Parameters for Portable Product Sector

First Year of Significant Production	Metric	2003	2005	2007	2013
Cost					
Board Assembly (Conversion) Cost	¢ per I/O	0.5	0.45	0.4	0.3
Substrate Cost (6-layer, blind/buried)	$\$/cm^2$	0.055	0.04	0.03	0.03
Microvia Board Cost (4-layer)	$\$/cm^2$	0.04	0.03	0.025	0.015
IC Package Cost	¢ per I/O	0.7	0.65	0.5	0.4
Design-Packaging Density					
Average Component I/O Density	I/O per cm^2	70	80	100	140
Max Component I/O Density**	I/O per cm^2	280	320	350	450
I/O per Component, avg.	#	6	7	7.5	9
Package I/O Pitch (Perimeter)	mm	0.5	0.5	0.5	0.5
Max I/O per package	I/O/pkg	324	400	424	480
Package I/O Pitch (Area Array)	mm	0.5	0.5	0.5	0.5
Substrate Lines and Spaces	microns	75	65	65	35
Substrate Pad Diameter*	microns	225	200	175	125
Max # of I/Os per Product	solder joints	5500	5500	5000	4000
Components per cm^2	$\#/cm^2$	15	15	17	25
Max Components per cm^2	$\#/cm^2$	50	55	60	25

Situation Analysis

- **Most segments of market are either flat or still in decline**
  - Companies struggling to get back to profitability
  - New technology investments impacted
  - In spite of this scenario, some are growing market share
- **Relentless restructuring of industry**
  - Driven by competitive forces
  - Focus on Core Competency; Outsource the rest
  - Expanding focus of EMS Providers (full service)
- **Rapid and intense movement to China/Far East**
  - Huge market potential (long term)
  - Low cost structure (short term)

Future of Electronics Industry

- Like other industries before us, electronics is maturing to become more of a commodity
  - May no longer be fueled by technology as dominant driver
  - Winners will excel at meeting customer's needs
  - Low costs/low margins will be the norm
  - A few large players may dominate.
- Looking for next "killer Applications" to spurn future growth of industry (technology driven)
  - Wireless
  - Homeland Security
  - Medical
  - Small entrepreneurs may still flourish.
- Once electronics becomes true commodity, technology as a product differentiator could become both more important (for higher margins) and more elusive.

North American Role

- Supply chains are increasingly Global
  - Not bound by geographic or political boundaries
  - Easily reconfigured to compete
    - Local market access
    - Competitive costs
- North America continues to excel in innovation
  - Web based services/infrastructure
  - Product Design (in some segments)
  - New Product Introduction
- Volume Mfg. continues its off-shore migration
  - China today
  - India tomorrow?
- Global Enterprises have decreasing loyalty to any particular region.

Topics to be discussed

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- **Selected Roadmap conclusions**
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Competitive Factors for Manufacturing

Where does a mature electronics industry go for manufacturing?*

- Good supply of low cost motivated labor.
- Right skills mix to form critical mass.
- Large/growing market with distribution access.
- Trade and financial centers that provide fertile ground for entrepreneurs.
- Political climate that favors industry growth with minimal barriers.

* Prismark Partners

What’s the answer?

- If low cost labor were the only criteria, many countries would be attractive:
  - Brazil
  - China
  - India
  - Philippines
  - Russia
  - Thailand
  - Turkey
  - Vietnam

- China is unique in strongly meeting all five criteria.

How is this different?

Migration of manufacturing is not a new phenomenon. Movement to China is unique:

- Speed of transition
- Breadth of transition
- Many players
  - North American
  - European
  - Taiwanese
  - Chinese
- Across supply chain
  - OEM/ODM
  - EMS
  - Components
  - Equipment

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Background for NEMI China Forum

- Growth of Electronics Mfg. in China is explosive
  - Today 7.5% of Electronics assembly in PRC
  - Projected to be 35% by 2020 (Prismark Partners)
  - Americas expected to shrink from 39.7% to 28%
- Most NEMI member companies are engaged
  - Some have been in China for a number of years
  - Others are much earlier in the cycle
- NEMI is a viable venue for working supply chain relationships and challenges
- NEMI will continue to add value to members
  - We believe we can add value to growth of Mfg. in China
  - We need to determine what we will do
  - We need to determine how we will do it

NEMI Scenario on China

- **Plan requires strong member support at all critical milestones**

- **Current approach based on following steps:**
  - **Forum in North America on mfg. in China**
  - **Forum in China to further develop value proposition/ objectives of NEMI initiative within China.**

N.A. China Forum

Goals of Forum:

- Share experiences between members
  - Doing business in China
  - Alternative strategies for China presence
- Discuss needs of NEMI member companies
  - Develop list of “broad interest” topics
  - Value/interest of forming NEMI China Council
  - Other opportunities for collaboration
- Lay ground work for first session in China
  - Assuming support from NEMI members
  - Assuming support of member China operations

NEMI China Forum Agenda

Opening talks – Business Landscape

- Mr. Stoyan Tenev, Lead Economist, International Finance Corporation (IFC), World Bank
- Dr. Shiuh-Kao Chiang, Prismark Partners

Government Representative:

- Mr. Ni Xiang Yu, Vice Chairman, Tianjin Economic Technological Dev. Area

NEMI Company talks (share experiences):

- Dr. Robert C. Pfahl, Director International & Environmental Tech. R&D, Motorola, Inc.
- Mr. Jim Lee, General Manager of Intel Shanghai Mfg. Plant, Intel Corp.
- Mr. Sean Tzou, Solectron Corporate Vice President, Managing Director Shinei, Ltd.
- Mr. Ian P. McEvoy, President, Universal Instruments Corp.
- Dr. Hua Du, General Manager, Shipley (Dongguan) Chemicals Ltd.

Break out topics for afternoon (e.g.):

- NEMI Member needs
- Barriers/Challenges for doing business
- The IP risks – how to mitigate

Results of China Forum

- **Great exchange of ideas between companies**
  - **Many common challenges**
  - **A number of differences**
- **Good “shopping list” of ideas for collaboration**
- **Support from membership to take next step.**

Summary

- The Electronics Industry continues to mature
  - High volume/low cost/low margins
  - Driven by fulfilling customer needs
- Functions (e.g. product design, mfg.) will be allocated to regions based on
  - Capability
  - Proximity to markets
  - Margin optimization
- Managing life cycle in this distributed environment is complex – collaboration across supply chain more critical than ever.