iNEMI

International Electronics Manufacturing Initiative

2007 Roadmap Overview

Jim McElroy

APEX 2007

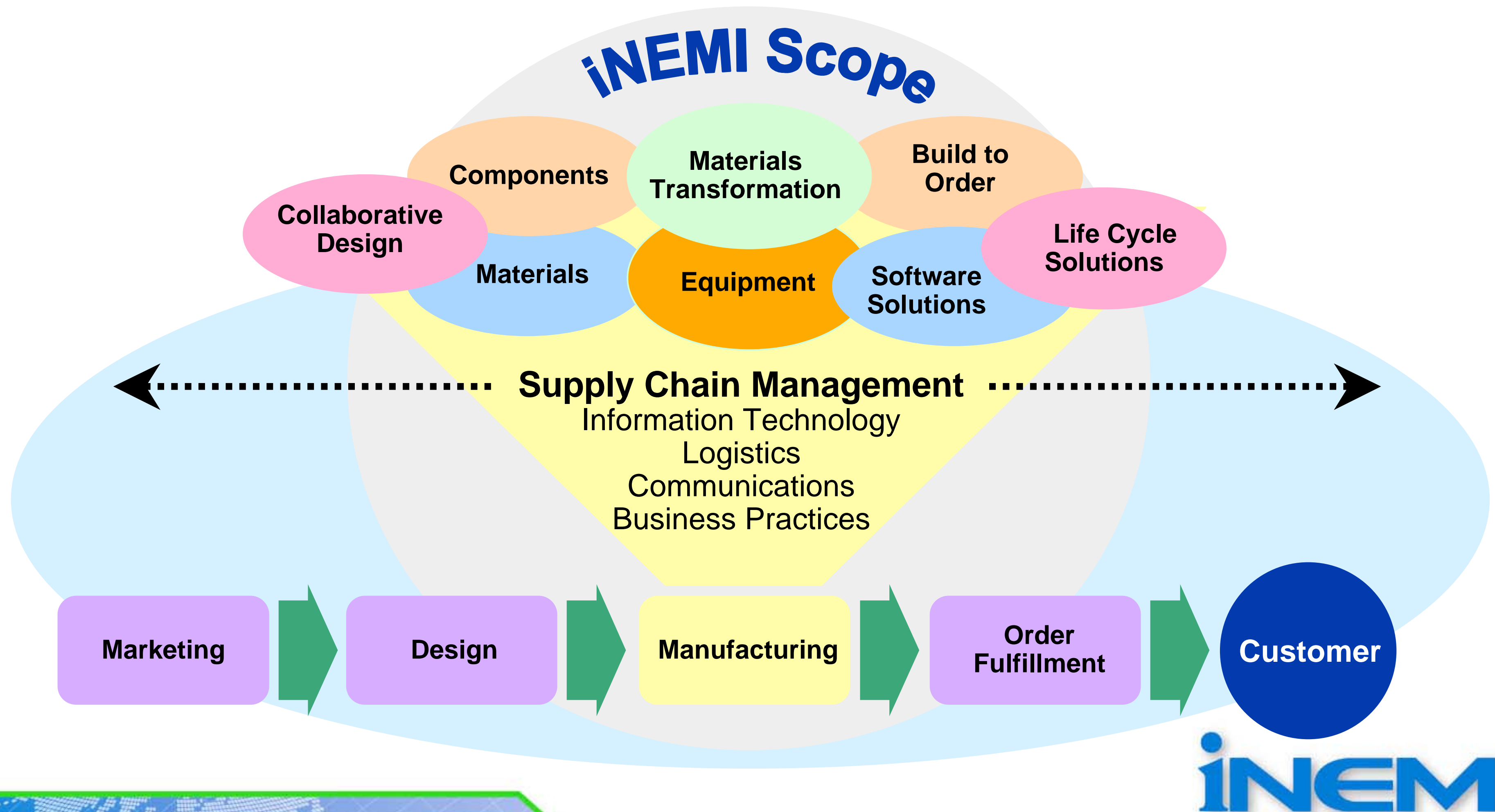
Advancing manufacturing technology

Topics

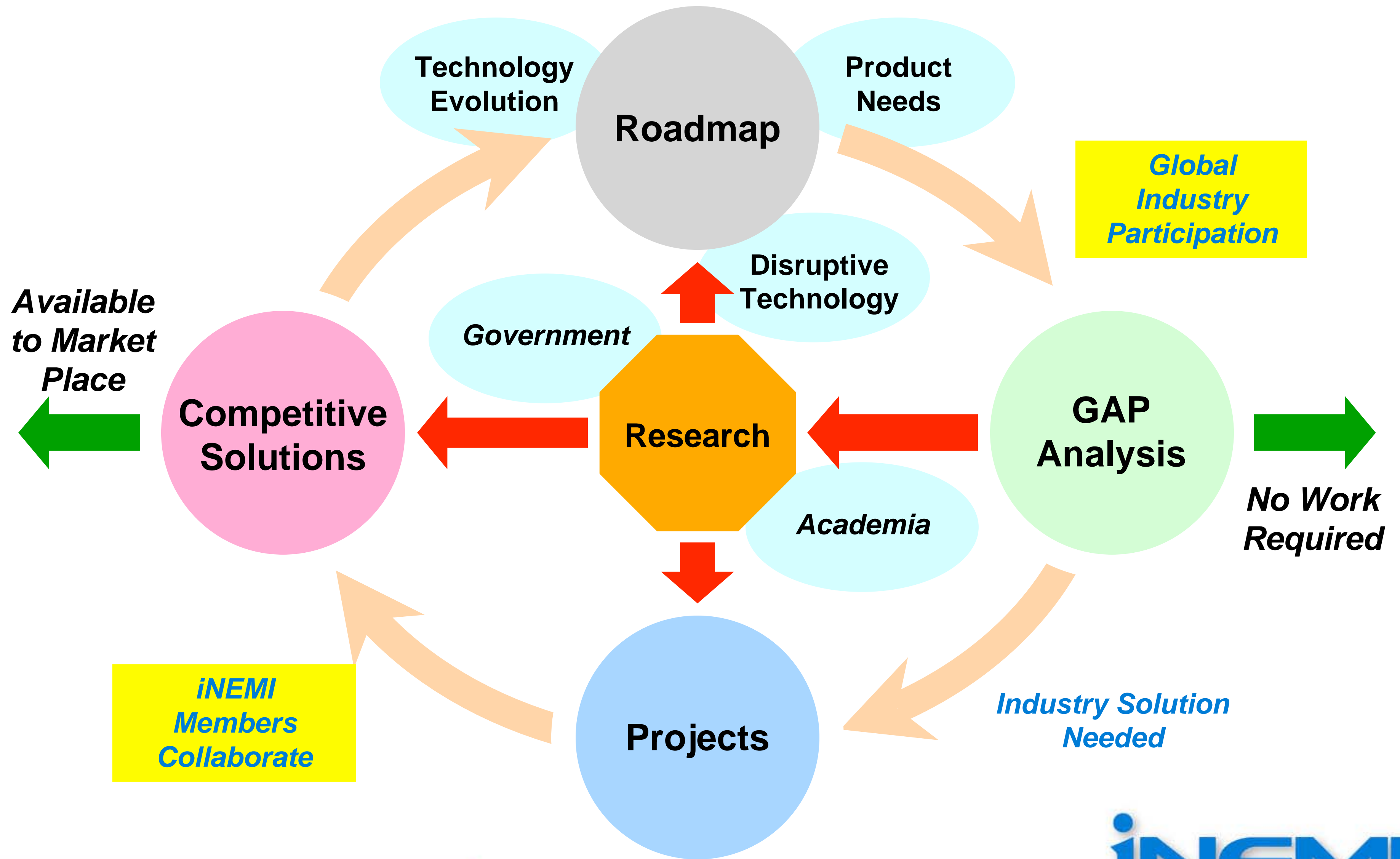
- **iNEMI Overview**
- **iNEMI Roadmap**
  - **Definitions**
  - **Structure**
  - **Linkages**
  - **International participation**
  - **Leadership**
  - **Conclusions**
  - **Next steps**

iNEMI Mission

***Identify* and *Close* TECHNOLOGY GAPS which includes the development and integration of the electronics industry supply infrastructure.**



Methodology



iNEMI

OEM/EMS Members

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Medtronic
Alleviating Pain · Restoring Health · Extending Life

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Cookson Electronics
A Division of Cookson Group plc

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Instruments

INDIUM CORPORATION
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ITW Kester

Vitronics Soltec

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ENOVIA

MatrixOne

NanoDynamics™

NIHON SUPERIOR CO., LTD.

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technologies

UGS
Transforming the process of innovation

tyco
Electronics

TERADYNE

TEXAS INSTRUMENTS

iNEMI

Association/Consortium, Government, Consultant & University Members

Développement
économique
et régional

Some Definitions…

- **PEGs – Product Emulator Groups**
  - “Virtual Product” defining future product technology attributes
  - Key cost and density drivers
- **TWGs - Technology Working Groups**
  - Develops roadmaps
  - Presently 19 TWGs of “content experts”
- **TIGs - Technology Integration Groups**
  - Develops technical Plan based on:
    - Roadmap findings
    - Gap analyses
  - iNEMI Projects are formed under TIGs

2007 Roadmap Priorities

- Maintain strong linkages with other roadmaps.
- Strengthen and realign Product Emulators.
- Expand regional, global roadmap meetings.
- Expand emphasis on disruptive events (business & technical).
- Expand emphasis on identifying market needs and business situations.
- Increase quantification of needs.
- Prioritize Research and Deployment needs.
- Increase strategic vision of the roadmap: 2013-2017
- Release at APEX 2007

International Roadmap Workshops

- **Gained Additional Participation by holding regional workshops in Asia, Europe, and North America.**
  - **Asian Workshop held in conjunction with HDP '06 Conference at Shanghai University.**
  - **European Workshop held in conjunction with Semicon Europa at Messe Munchen.**
  - **North American Workshop held at iNEMI Headquarters in Virginia.**
- **Goal of increased participation achieved!**
- **Laying foundation for further participation on future cycles.**

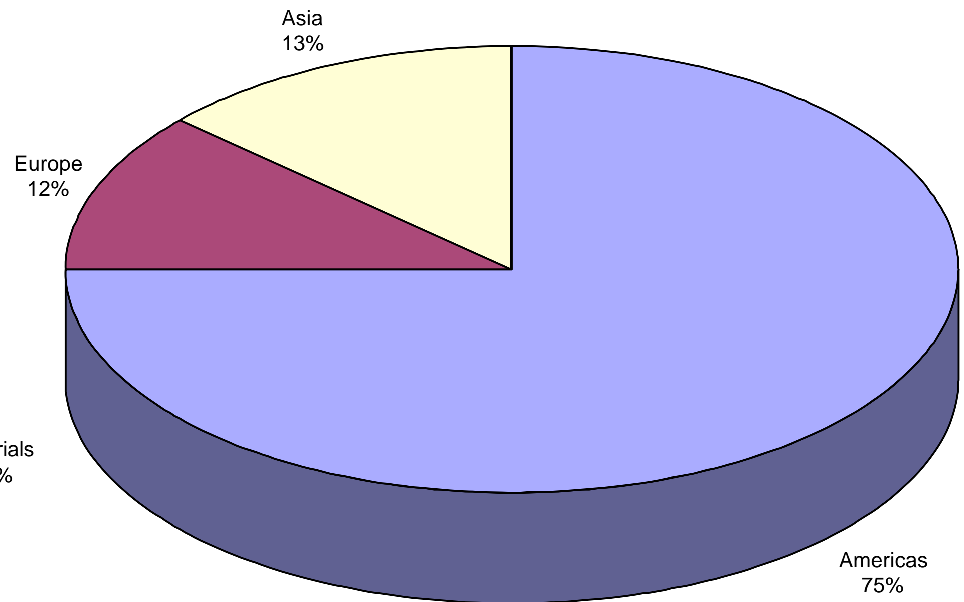
Statistics for the 2007 Roadmap

- > 500 Participants
- > 265 Companies/organizations
- 17 Countries from 4 Continents
- 19 Technology Working Groups (TWGs) (added Organic & Printed Electronics)
- 5 Product Emulator Groups (PEGs)
- Over 1300 Pages of Information
- Roadmaps the needs for 2007-2017

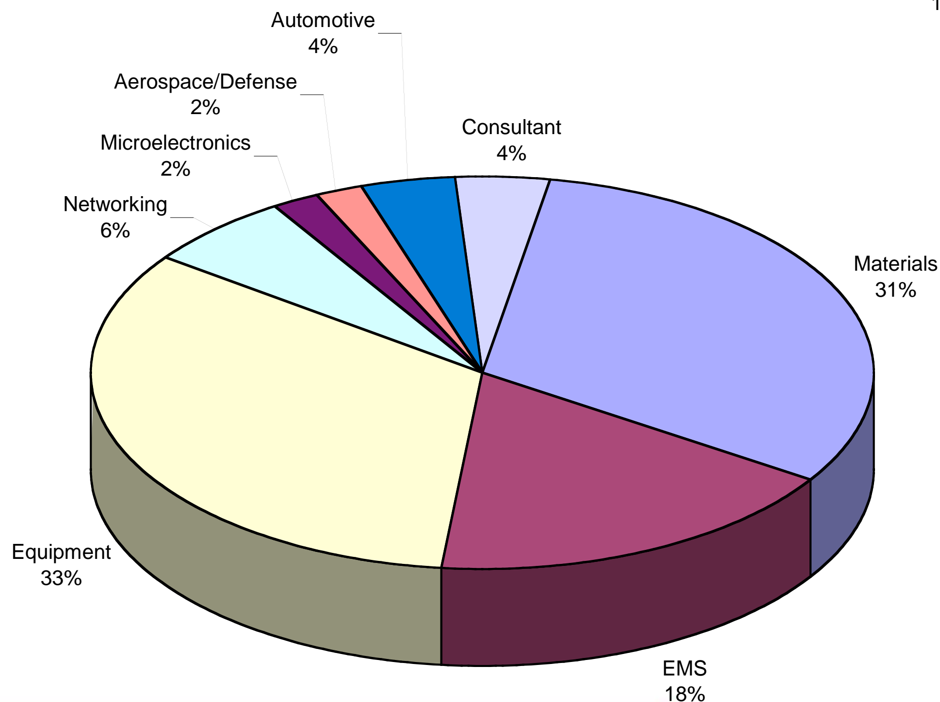
Board Assembly TWG Members

Active Participants: 85

Participation by Region



Participation by Industry (45 firms)



iNEMI

Why do Companies Participate in iNEMI Roadmap?

- leads to a better understanding of the "state of the art" in those areas of participation.
- Early access to the roadmap chapter's information.
- Opportunity to shape the industry's future priorities concerning R&D.
- Opportunity to impact iNEMI's future direction through "technology gap" identification and solutions most important to your company.
- Those who participate in the Roadmap creation get a broad view of the supply chain landscape from customers, competitors, and suppliers.
- Roadmaps can become "self fulfilling prophecies" as many within Industry focus on the identified challenges.
- As General Dwight D. Eisenhower was fond of saying, "It's not the Plan (that is created) but the Planning (process) that provides maximum insight".

2007 Product Emulator Groups (PEGs)

Emulators	Characteristics
Portable / Consumer	High volume Consumer Products for which cost is the primary driver including Hand held, battery -powered products driven by size and weight reduction
Office Systems / Large Business / Communication Systems	Products which seek maximum performance from a few thousand dollar cost limit to literally no cost limit
Medical Products	Products which must operate within a highly reliable environment
Automotive	Products which must operate in an automotive environment
Defense and Aerospace	Products which must operate in extreme environments

2007 Technology Working Groups (TWGs)

Modeling, Simulation, and Design

Connectors

RF Components & Subsystems

Test, Inspection & Measurement

Sensors

Passive Components

Thermal Management

Organic & Printed Electronics

Packaging

Optoelectronics

Semiconductor Technology

Ceramic Substrates

Mass Storage (Magnetic & Optical)

Energy Storage Systems

Organic Substrates

Board Assembly

Final Assembly

Customer

Product Lifecycle Information Management (PLIM)

Environmentally Conscious Electronics

Red=Business Green=Engineering Blue=Manufacturing Blue=Component & Subsystem

2007 Technology Working Group (TWGs)

Business Processes / Technologies	Chair(s)	Co-Chair(s)
Product Lifecycle Information Mgmt.	Eric Simmon, NIST	Joanne Friedman, Connekted
Design Technologies		
Modeling, Simulation & Design Tools	Sanjeev Sathe, ASE	S.B. Park, Binghamton U. Yi-Shao Lai, ASE
Environmentally Conscious Electronics	Mark Newton, Dell	Joe Johnson, Cisco
Thermal Management	Cam Murray, Carl Fisher 3M	
Manufacturing Technologies		
Board Assembly	Dongkai Shangguan, Flextronics	David Geiger, Flextronics Ravi Bhatkal, Cookson
Final Assembly	Steven Davidson, Delphi	Reijo Tuokko, Tampere U.
Test, Inspection & Measurement	Michael Reagin, Delphi	Michael J. Smith, Teradyne

2007 TWG Leadership (cont.)

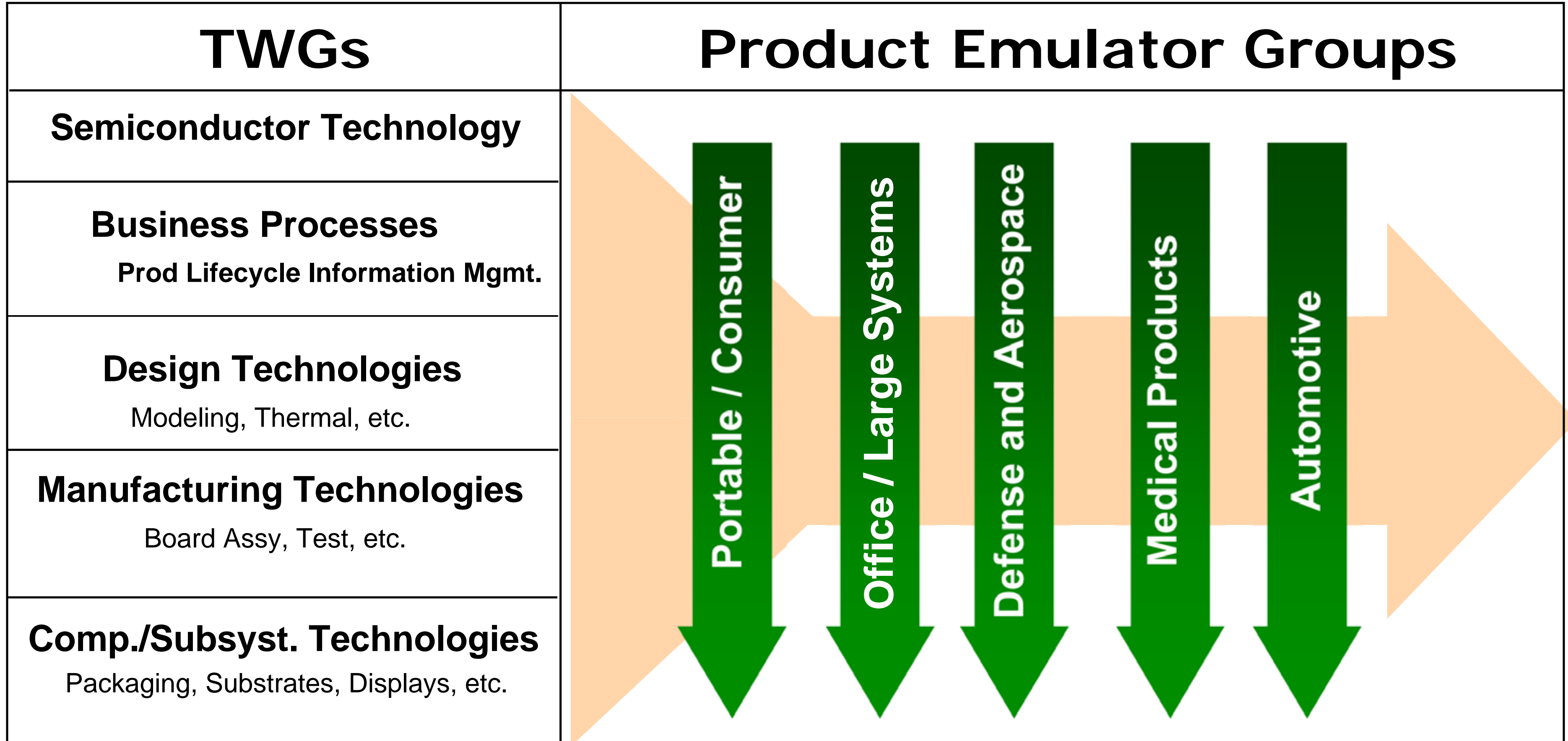
Component Subsystem Technologies	Chair(s)	Co-Chair(s)
Semiconductor Technology	Paolo Gargini, Intel	Alan K. Allan, Intel
Optoelectronics	Rick Clayton, Consultant	
Passive Components	Philip Lessner, Kemet	Joseph Dougherty, PSU
Packaging	Joseph Adam , Skyworks Solutions	Bill Bottoms, NanoNexus
Connectors	John MacWilliams, Consultant	
RF Components & Subsystems	Eric Strid, Cascade Microtech	J. Stevenson Kenney, GIT John Barr, Agilent , V.J. Nair, Intel
Sensors	Tim McBride, Sensata Technologies	Mike Azarian, U. Maryland
Interconnect Substrates (Ceramic)	Howard Imhof, Metalor	Ton Schless, Midas Vision
Energy Storage & Conversion Systems	Dan Doughty, Sandia Labs	Ralph Brodd, Broddarp Randhir Malik, IBM
Interconnect Substrates (Organic)	John T. Fi sher, Consultant	Henry Utsunomiya, Consultant
Mass Data Storage	Tom Coughlin, Coughlin Associates	Roger F. Hoyt, Retired
Organic & Printed Electronics	Dan Gamota, Motorola	Jan Obrzut, NIST Jie Zhang, Motorola

2007 Product Emulator Groups (PEGs)

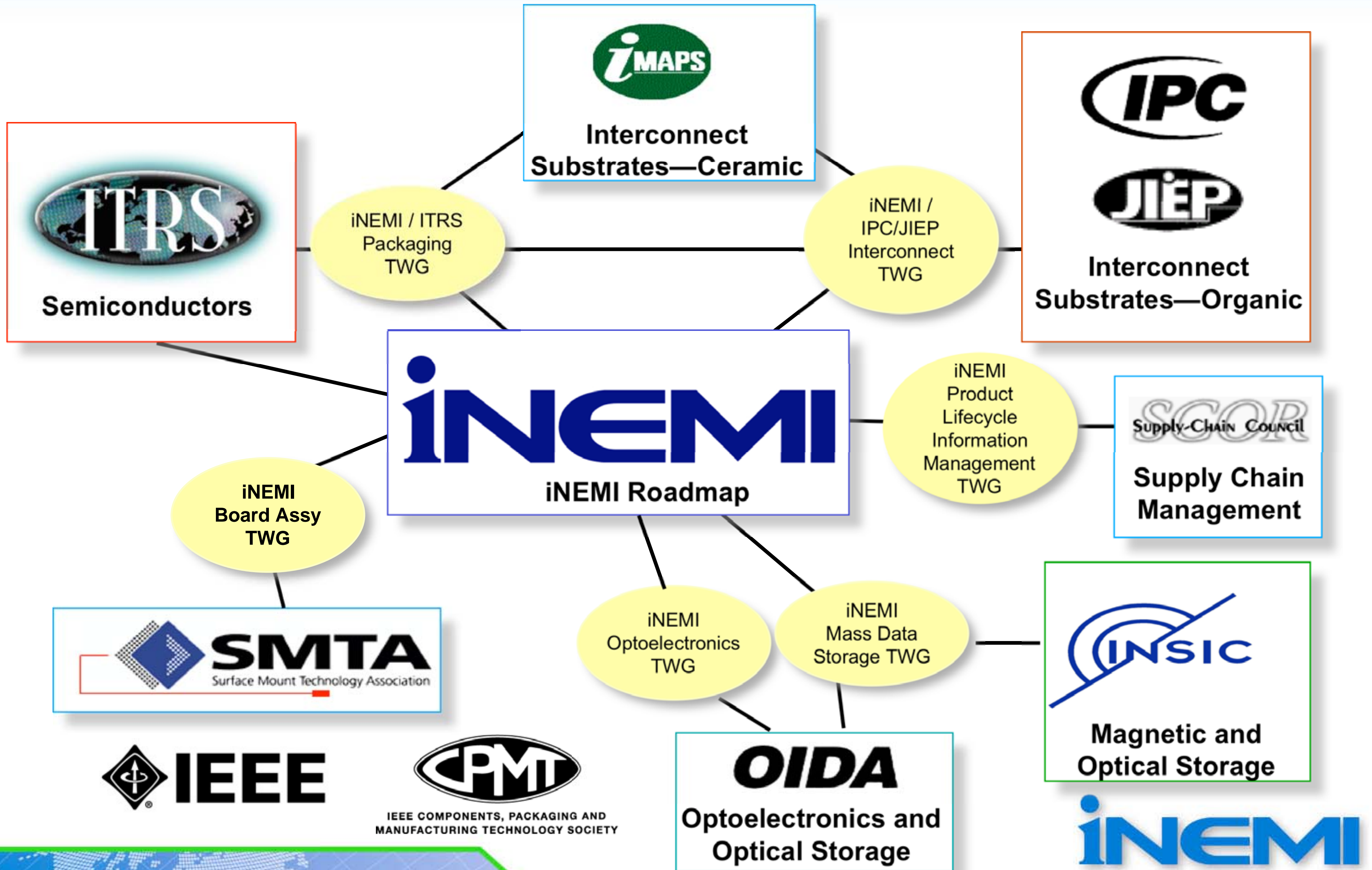
Product Emulator	Chair(s) 2006
Automotive Products	Jim Spall, Delphi
Aerospace/Defense Products	William E. Murphy, Lockheed Martin
Medical Products	Anthony Primavera, Guidant Terry Dishongh, Intel
Consumer / Portable Products	Susan Noe, 3M
Office/Lar ge Business System Products /Telecom	Erich Klink, IBM Europe Tom Pearson, Intel

Roadmap Development

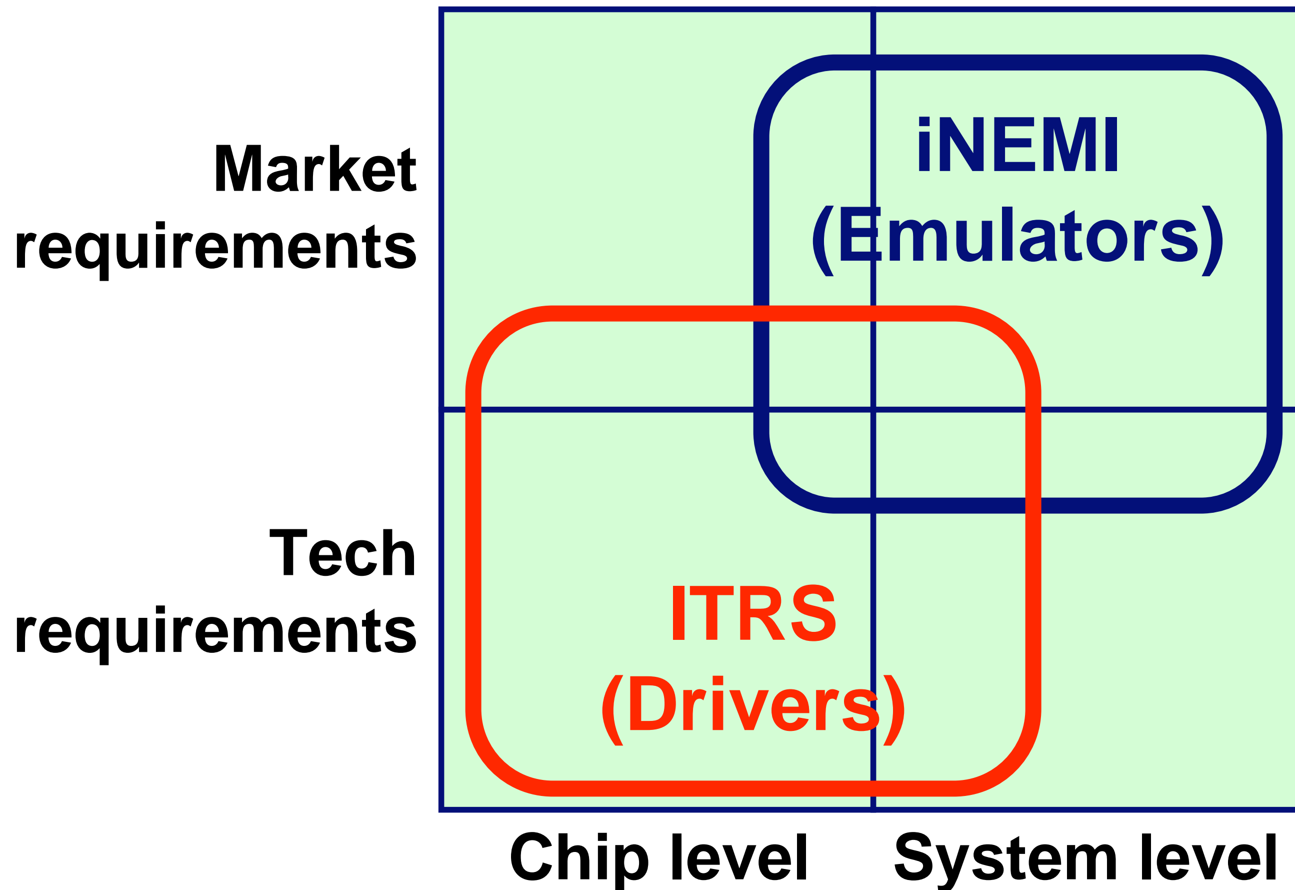
Product Sector Needs Vs. Technology Evolution



9 Contributing Organizations



Identified Needs
Increased Linkage Between ITRS and iNEMI Roadmap

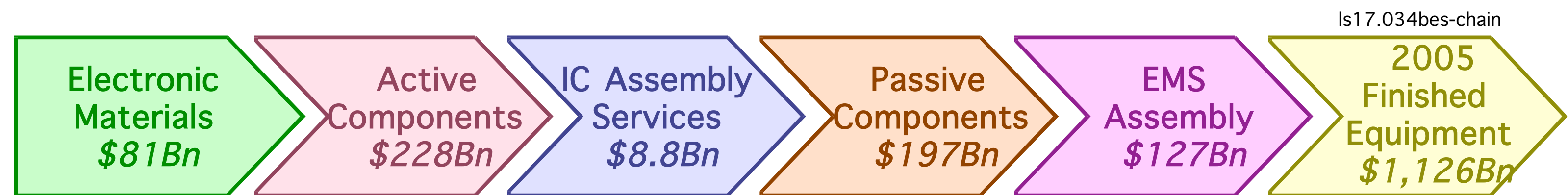


Top Down Input to Roadmap

- iNEMI Innovation Leadership Forum has been helpful in Establishing A Top Down Vision of the Industry as the foundation for the Roadmap:
  - Innovation driven by Consumer: killer experience.
  - Innovation links Invention to the Market, must have social value
  - Concept of "Open Innovation" thru collaboration, partnering
  - Collaboration takes various forms, new business models
  - Intellectual Property protection, management
  - Interoperability, Open source/standards
  - On-demand, flexible: what/when/where you need it
  - Consumer Electronics demands shorter cycle times

VALUE CREATION IN THE SUPPLY CHAIN

ls17.034bes-chain



Typical Companies	Sumitomo Bakelite, DuPont, Ablestik	Intel, STMicro, LSI Logic	Amkor, ASE, SPIL	Tyco, Molex, AVX, Sharp	Solectron, Sanmina-SCI, Flextronics	Dell, HP, Cisco, Nokia, Teradyne, Visteon, Siemens
Gross Margin	30%	45%	17%	25%	6%	30%
Operating Margin	10%	15%	8%	8%	2%	8%
R&D	7%	15%	2%	5%	<1%	8%
Margin Value	$8Bn	$34Bn	$0.7Bn	$16Bn	$3Bn	$90Bn
R&D Value	$6Bn	$34Bn	$0.2Bn	$10Bn	$1Bn	$90Bn
%Total R&D	4%	24%				64%

Source: Prismark Partners

iNEMI at 2007 Industry Venues

2007 iNEMI Roadmap -Highlights & Trends

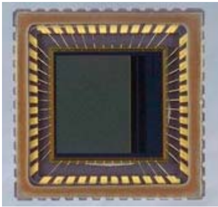
State of the Art

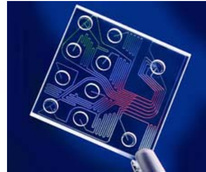
Situation	Examples	Implications
Market / product sector convergence:		
Medical-consumer	Home diagnostics	User-friendly interface, higher volume / lower cost
Automotive-entertainment	DVD in the car	Harsher environment for consumer products
Communication-entertainment	Transmission of music & pictures	Increased integration & greater miniaturization
Computing-entertainment	Integration of PC with media centers	Harmonization of interface standards
Miniaturization and thinner	Ultra-thin cell phones, low-profile packaging, stacked thin die	Ongoing technology and manufacturing investments in package and HDI.
NPI limited by environmental requirements	Growing list of requirements: China RoHS, EU REACH, etc.	Adds complexity and uncertainty to design and start-up. Global harmonization is needed.
Outsourcing of manufacturing continues to grow faster than overall industry	Migration to India and Vietnam	Integration of design & mfg. functions is more challenging than ever. More impetus for industry standard DFX methodology.
R&D moving to lower-cost regions / emerging markets	Technology centers in China & India	More responsive to local needs. Moving away from "one size fits all." Changing role for developed regions.

Anticipated Paradigm Shifts

Shift	Examples	Implications
Packaging materials will change over the next decade to meet reliability requirements	As density increases, today's material properties present barriers: TCE mismatch, dimensional stability, etc.	Investments in new materials systems. May require rethinking traditional reliability validation methodology.
Optical interconnect by 2017? No!	Work remains at exploratory level.	Competing technologies can meet needs at lower cost.
Low-frequency (printed) electronics for data input	Alternative technology for RFID item-level tags	Facilitates low cost point required by some applications.
New forms of data Input: displays, cameras, sensors, speech	Collision avoidance, smart RFID tags (e.g., sensors).	Drives new growth areas for electronics. Simplifies or enhances user experience.

Examples of Sensors


5MP CMOS Imager
(Kodak)


Bioanalyzer (Agilent Technologies)

Silicon Microphone
(Knowles Acoustics)

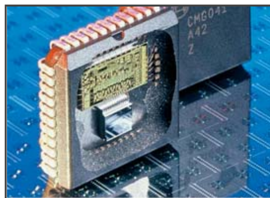
Angular Rate Gyroscope
(Silicon Sensing Systems)

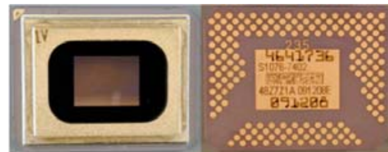
X-Wire Pedal Sensor
(Hella)

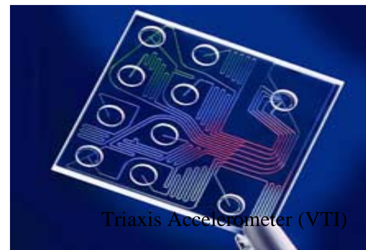
Oxygen Sensor (Delphi)

Adaptive Cruise Control Radar Module
(Continental Automotive Systems)

Methanol Concentration Sensor
(Sensata Technologies)


Rollover Angular Rate Sensor
(Robert Bosch)


Digital Light Processor DLP™
(Texas Instruments)


Triaxis Accelerometer (VTI)

Side Impact Sensor
(Robert Bosch)

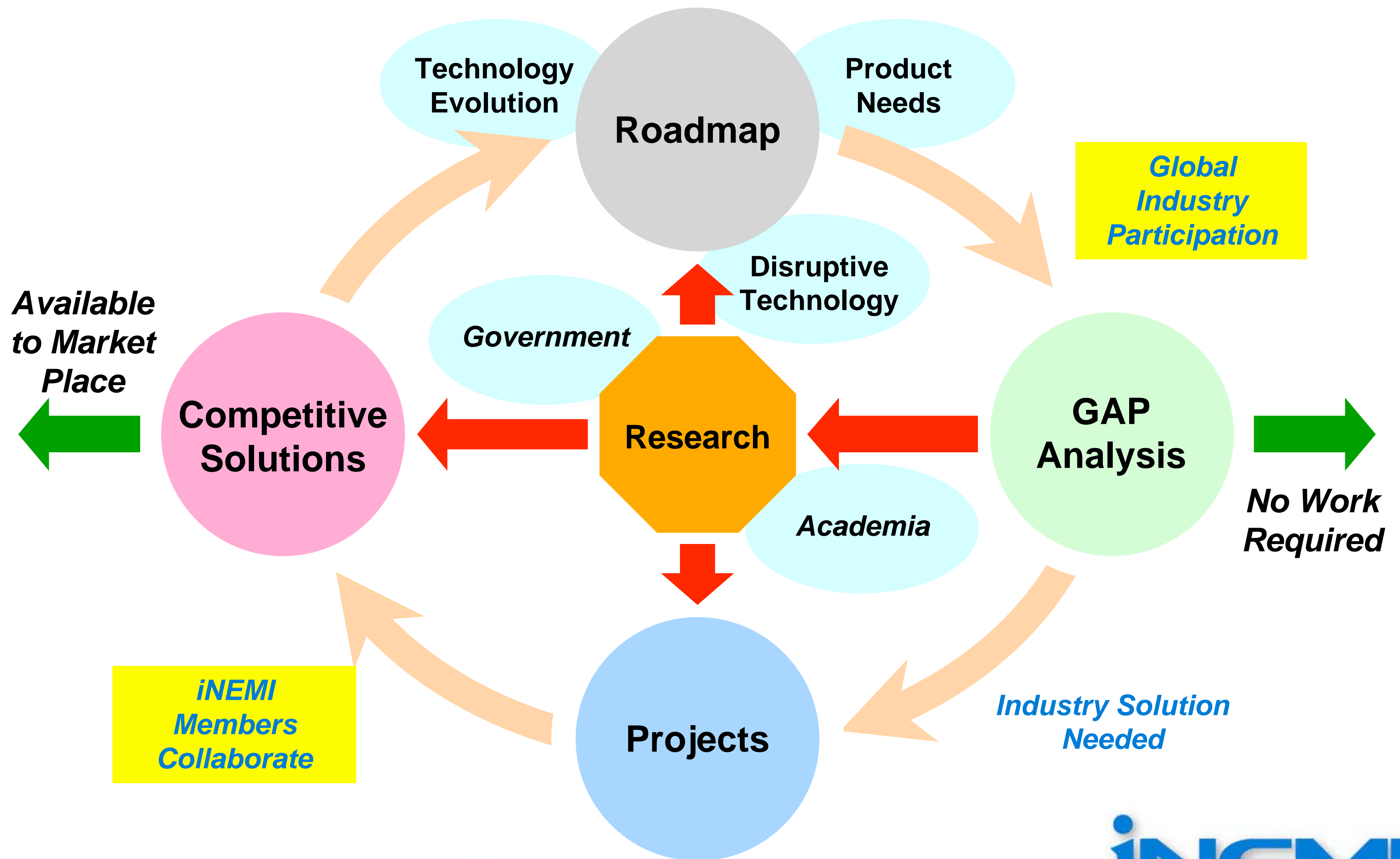
Diesel Common Rail Sensor
(Sensata Technologies)

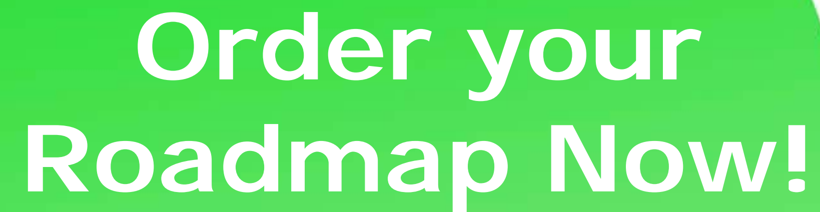
NOx Sensor
(Siemens VDO)

10-Year Challenges

Challenge	Description
Closing technology gaps:	
Active device technology	New CMOS structures; “beyond CMOS” topologies.
Thermal management	New materials and active cooling techniques.
Communications bandwidth	Growing requirements for moving data across the environment (from hand-held devices through the network).
Design and simulation tools	Ability to do concurrent design for circuit, thermal, mechanical, etc.
Science-based environmental improvements	Current regulations may not consider full “cradle to grave” impact.
Creating new product markets with social value:	
Energy	Higher efficiency power supplies, new energy sources for portable products.
Healthcare	Home diagnostics connected to healthcare professionals.
Security	Tamper-proof recognition / validation.

Next Step: Gap Analyses





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