iNEMI

International Electronics Manufacturing Initiative

Implementing the System-in-Package Technical Plan

Productronica

17 November, 2005

Agenda

• 09:00	Welcome and Introduction	Jim McElroy
• 09:10	iNEMI Technical Planning Process	Jim McElroy
• 09:20	iNEMI SIP Roadmap	Juergen Wolf
• 09:40	iNEMI SIP Technical Plan	Bob Pfahl
10:00	Break	
• 10:10	SiP Reliability Project Proposals	Bob Pfahl
10:30	Discuss and prioritize projects	
• 11:00	Determine interest for consortial implementation	
• 11:30	Next Steps	
• 12:00	Adjourn	

iNEMI

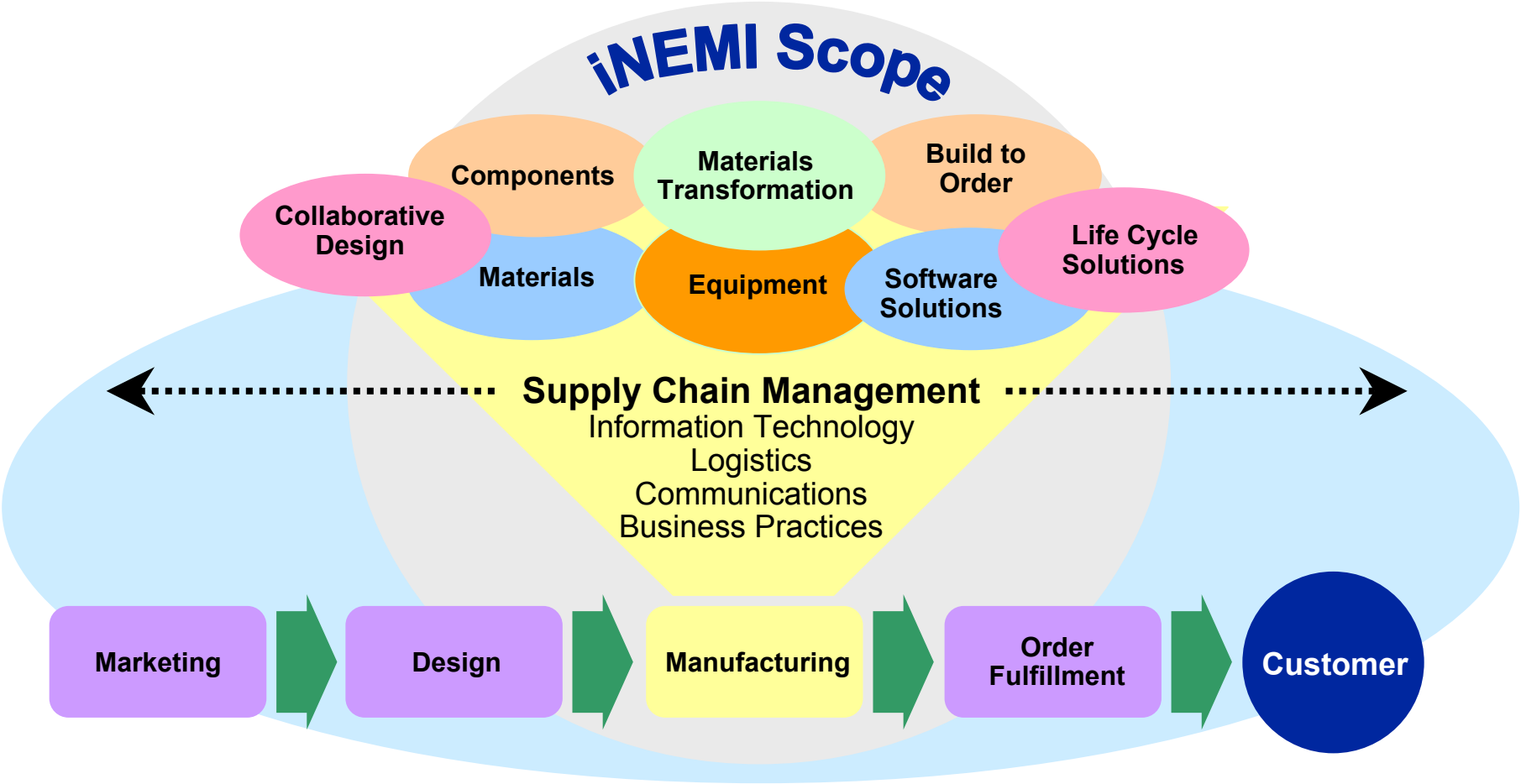
International Electronics Manufacturing Initiative

Industry Collaboration

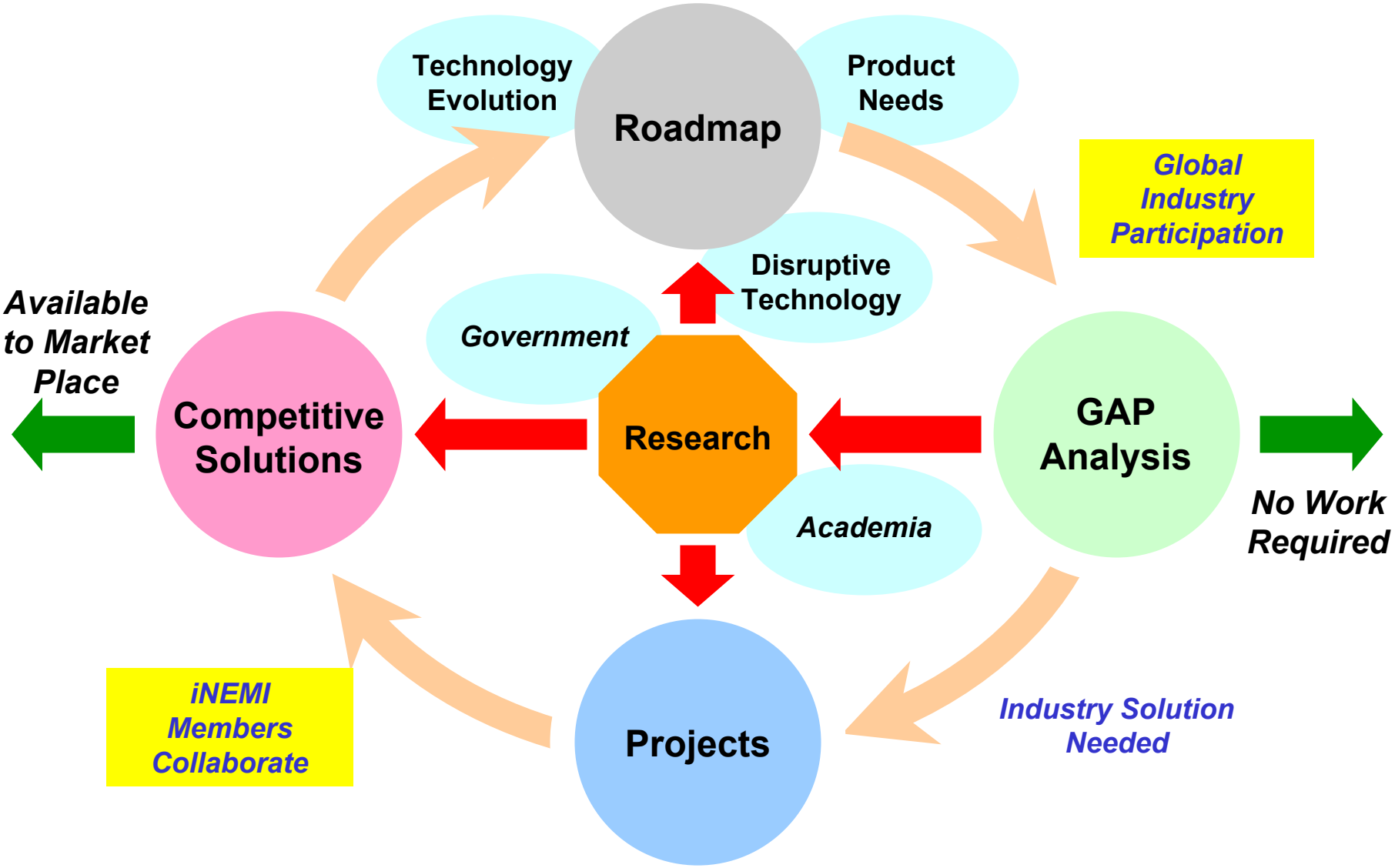
Productronica 2005

Mission

Assure Leadership of the Global Electronics Manufacturing Supply Chain for the benefit of members and the industry



Methodology



Value Proposition

"Connect with and Strengthen Your Supply Chain"

- iNEMI offers the opportunity to collaborate with the entire supply chain in an efficient manner
  - To understand and accelerate strategic directions
  - To define future needs and opportunities
  - To jointly create industry standard solutions.
- Today's increasingly distributed supply chain makes this more important than ever.
- iNEMI is a member driven organization that adapts to industry changes quickly and provides timely leadership.
- iNEMI provides important deliverables:
  - Technology roadmaps
  - Research priorities
  - Forums on key industry issues
  - Deployment projects.

What Does iNEMI Do For the Industry?

Leverage the combined power of companies to provide industry leadership

- **iNEMI roadmaps the global needs of the electronics industry**
  - **Evolution of existing technologies**
  - **Predictions on emerging/innovative technologies**
- **iNEMI identifies gaps (both business & technical) in the electronics infrastructure**
- **iNEMI identifies and prioritizes research needs.**
- **iNEMI stimulates worldwide standards to speed the introduction of new technology & business practices.**

What Does iNEMI Do For its Members?

Leverage the combined power of member companies to provide industry leadership

- **iNEMI stimulates research/innovation to fill gaps**
- **iNEMI sponsors workshops and forums on emerging technology and issues**
- **iNEMI works with other organizations to ensure that government policy recommendations are aligned with our mission.**
- **iNEMI establishes implementation projects to eliminate gaps**
  - **Develop processes**
  - **Evaluate alternative technologies**
  - **Identify equipment needs**
  - **Determine component requirements**
  - **Develop standards proposals**
  - **Communicate results to members**

iNEMI

Industry Leaders belong – OEM/EMS

iNEMI

Industry Leaders belong – Suppliers

3M
Agilent Technologies
agile
AMD
Asymtek A NORDSON COMPANY
COHERENT superior reliability & performance
Cookson Electronics A Division of Cookson Group plc
DOVER
ECT
E2OPEN
Endicott Interconnect Technologies, Inc.
Henkel A Brand like a Friend
INDIUM CORPORATION OF AMERICA
KESTER
ERSA GLOBAL CONNECTIONS
Heraeus
FCI
MatrixOne
NIHON SUPERIOR CO., LTD.
KLA Tencor
NanoDynamics Inc
PCN ALERT
ROHM HAAS ELECTRONIC MATERIALS
Senju Comtek
Speedline technologies
TERADYNE
Texas Instruments
TOTAL Parts Plus
tyco Electronics
Universal
VECTRON INTERNATIONAL A DOVER COMPANY
Vitronics Soltec A DOVER COMPANY

Industry Leaders belong

Consultants, Government, Organizations & Universities

AeA

AMR Research

EIA Electronic Industries Alliance

IPC ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

CMAP CENTRE FOR MICROELECTRONICS ASSEMBLY AND PACKAGING

IEEC

PURDUE

Georgia Institute of Technology

MIT

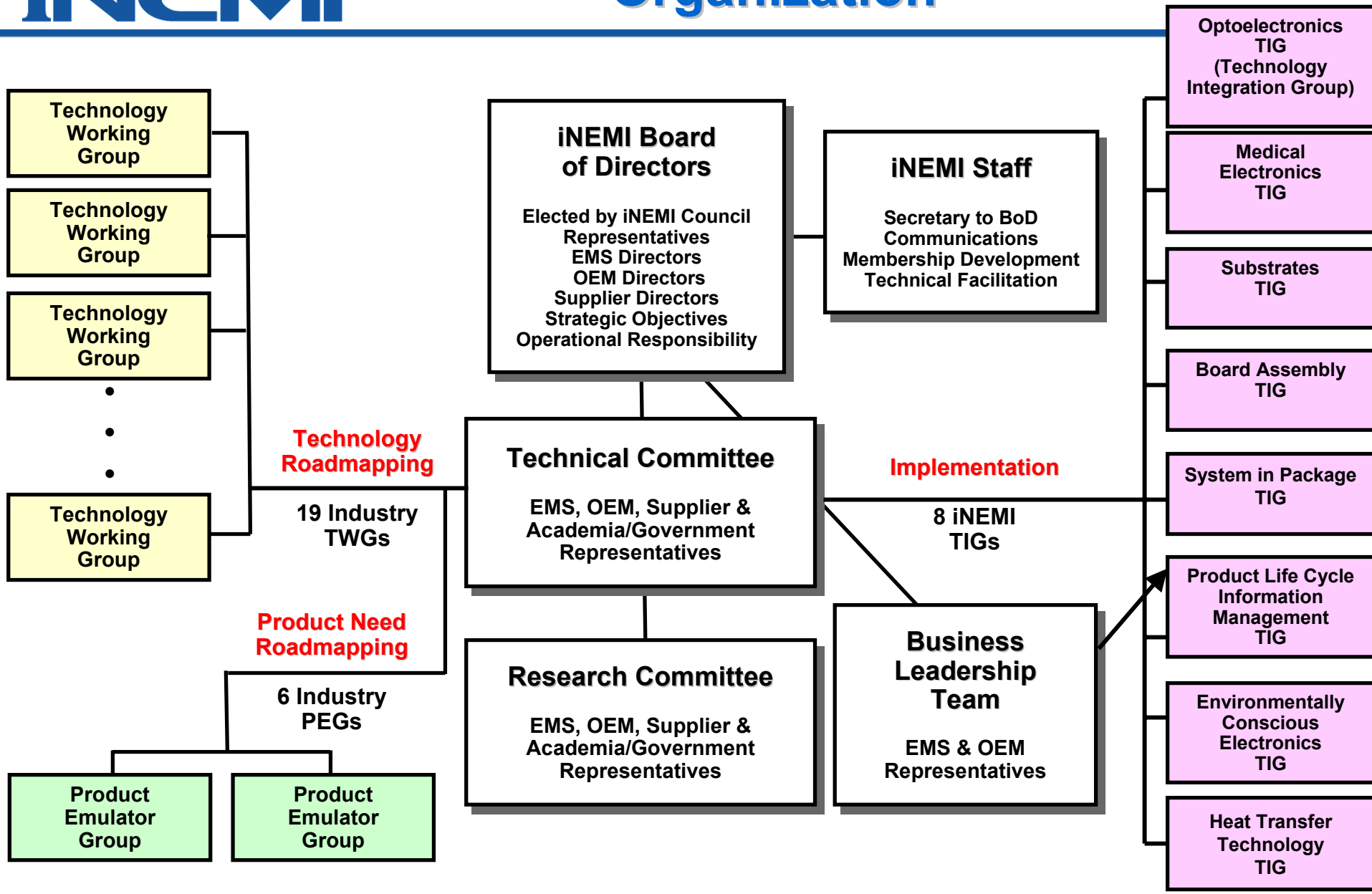
NCMS

Virginia's Center for Innovative Technology

Développement économique et régional Québec

NIST

Organization



Key Elements in Value

- The companies represented
  - OEMs who are market leaders in innovative products
  - EMS providers who are global leaders in manufacturing
  - Leading suppliers for manufacturing equipment, materials, components, and software.
- The specific participants within those companies
  - Board of Directors
  - Technical Committee
  - Council Members
- Reputation of iNEMI as an industry leader
  - Roadmapping
  - Industry forums
  - Collaborative projects to close identified gaps:
    - Lead-free interconnect
    - Distributed manufacturing software standards

iNEMI

International Electronics Manufacturing Initiative

Productronica Events

Increase Participation of European Firms

Innovation Priorities for 2015 Vision

Productronica Forum, Hall A6, 13:00-13:30

Bob Pfahl, iNEMI will present highlights from the September 2005 iNEMI Innovation Leadership Forum and the iNEMI Roadmap.

iNEMI/IPC Standard for Exchanging RoHS Composition Data

Productronica Forum with ZVEI-Podium, Hall B3, 14:20-14:50

Richard Kubin, E2open, will provide the status of materials data composition exchange standards and urge global standardization.

Wednesday, 16 November

Implementing the iNEMI/IPC Composition Data Exchange Standards

iNEMI Conference Room A 61, 9:00 - 12:00

(Co-sponsored by IPC)

This meeting will encourage industry to adopt the IPC-1752 standard

2007 iNEMI Roadmap/European Kick-Off Meeting

iNEMI Conference Room A 61, 13:00 - 17:00

(Co-sponsored by IEEE's CPMT Society, Fraunhofer IZM, IMAPS Europe)

Implementing the iNEMI System-in-Package Technical Plan

iNEMI Conference Room A 61, 9:00 - 12:00

This meeting will review and prioritize gaps identified in the iNEMI Technical Plan and develop projects to close the gaps.

Update on Pb-Free Soldering Optimization

Productronica Forum, Hall A6, 13:00-13:30

Denis Barbini, Vitronics Soltec will provide the latest update on three ongoing iNEMI projects to optimize Pb-free soldering:

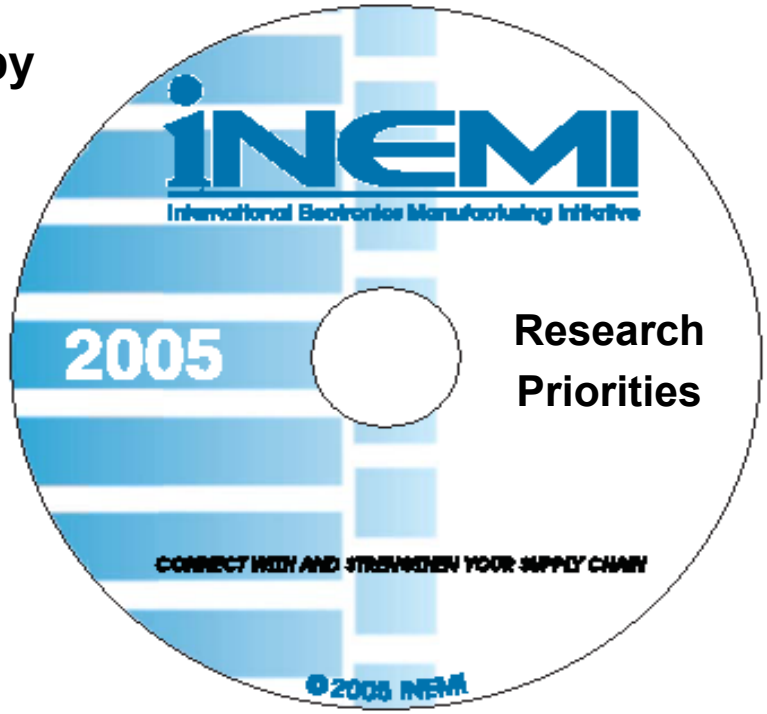
System in Package Technology

Productronica Forum with ZVEI-Podium, Hall B3, 13:30-14:00

Bob Pfahl, iNEMI will discuss identified SiP technology needs and the iNEMI action plan

2005 Research Priorities

- Gap analysis completed
- 10 year priorities created
- Ready for distribution
- Contents:
  - Technology Research Needs by Product Sector
  - Priorities Summarized by Research Area
    - *Manufacturing Processes*
    - *System Integration*
    - *Materials & Reliability*
    - *Energy and the Environment*
    - *Design*
  - Significant Gaps and Issues from Roadmap
  - Options for Innovation



www.inemi.org

Email contacts:

Jim McElroy

jmcelroy@inemi.org

Bob Pfahl

bob.pfahl@inemi.org

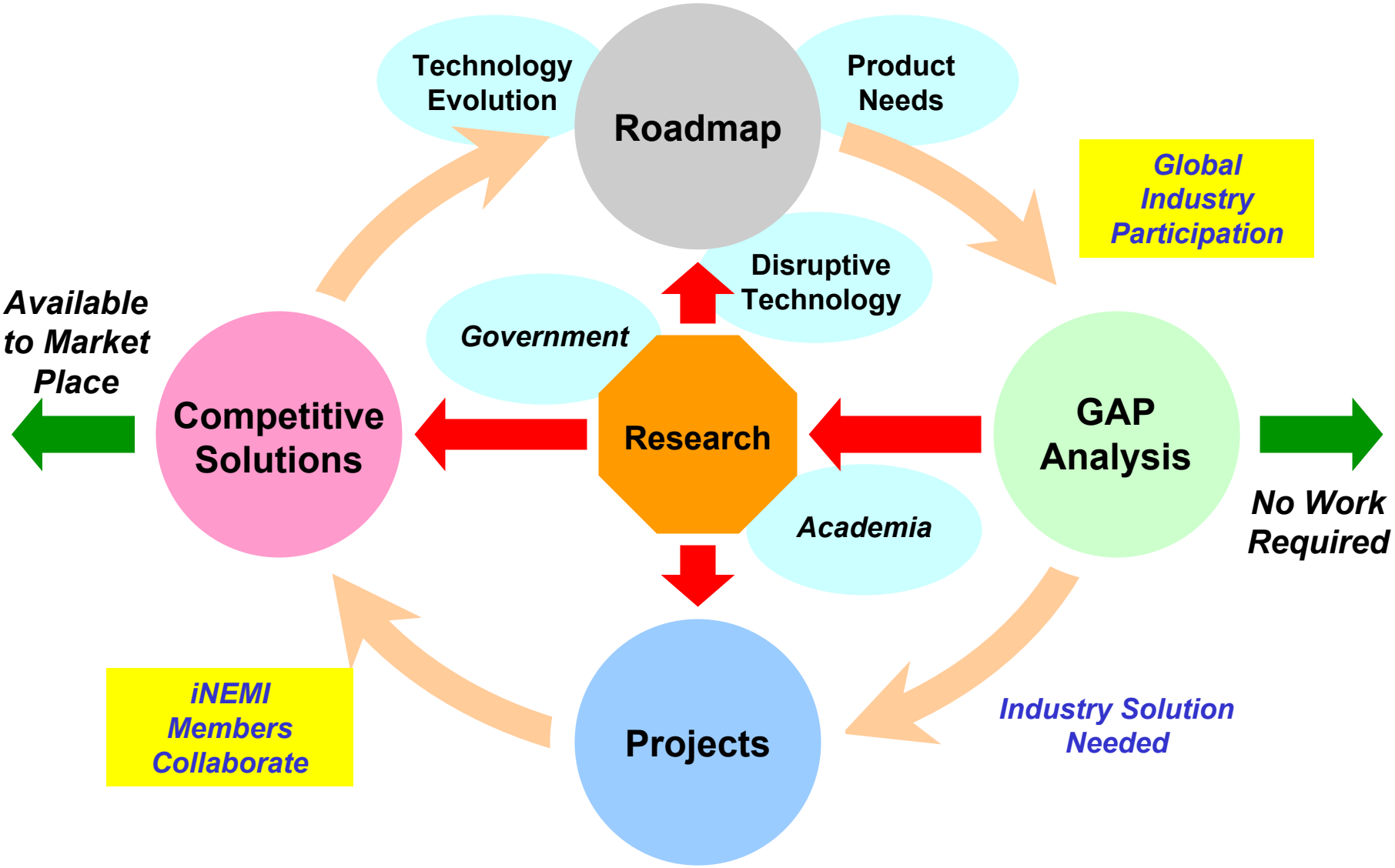
iNEMI

International Electronics Manufacturing Initiative

Technical Planning Process

Identifying and Closing Gaps

Methodology



Roadmapping vs. Deployment

- iNEMI roadmaps technology in 19 different areas.
- Each roadmap chapter is created by a Technology Working Group (TWG).
- From the Roadmap, iNEMI identifies the need for deployment activities and forms Technology Integration Groups (TIG).
- iNEMI currently has TIGs in 8 different areas.
- Each project is organized within a TIG.
- Roadmap and project groups are made up of industry people (including leadership):
  - TWG's are open to industry participation
  - Projects are made up of iNEMI members

Projects Close Gaps

- A gap is defined as a technology need that will not be satisfied without additional action by industry.
- Projects typically:
  - Develop/evaluate processes and/or protocols
  - Evaluate alternative technologies
  - Identify equipment needs
  - Identify/evaluate communication schemes
  - Determine component requirements
  - Develop standards proposals

Standards Alliances

Currently we have standards alliances with the following organizations:

iNEMI

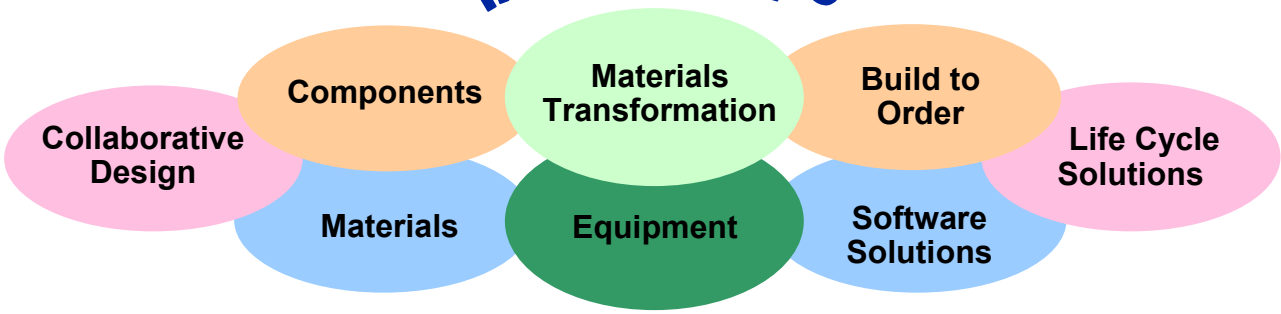
- IPC
- IEEE
- EIA/JEDEC
- RosettaNet

Scope of Actual Projects

- Most iNEMI Collaborative projects have dealt with gaps in the following areas:
- Materials
  - Packaging & Assembly
  - Reliability
  - Manufacturing processes
  - Properties
- Environment
  - Pb-Free
  - Manufacturing processes
  - Standards
- Information Management
  - Distributed design/mfg. environment
  - Data Exchange
  - Interoperability
  - Standards

iNEMI

iNEMI Scope



Substrates TIG Projects:

- High Frequency Materials Effects on HDI
- Optoelectronics for Substrates

Board Assembly TIG Projects:

- Pb Free BGA's in SnPb Assemblies
- Substrate Surface Finishes for lead free
- SMT Reel Labeling
- Pb-free BGAs in SnPb Assemblies
- Lead-Free Nano-Solder

Product Life Cycle Information Management TIG Projects:

- PDX Extensions & Updates
- Materials Composition Data Exchange
- Offspring Industry Adoption (IPC 2581)

Optoelectronics TIG Projects:

- Fiber Optic Splice Loss Measurement
- Fiber Connector End-Face Inspection

Heat Transfer TIG:

- Just being defined
- Address process & standards

Environmentally Conscious Electronics TIG Projects:

- Lead-Free Assembly & Rework
- Tin Whisker Accelerated Test
- Tin Whisker Modeling
- Tin Whisker User Group
- Lead-Free Wave Soldering Assembly
- RoHS Transition Group
- Lead-Free Rework Optimization
- High Rel RoHS Compliance

System in Package TIG:

- Just being defined
- Address equipment, process, & standards

Medical Electronics TIG:

- Just being defined
- Address standards

How TIGs are Defined

- TWG chairs identify potential gaps during roadmap development process, recommend follow-up activities.
- iNEMI Technical Committee (TC) reviews TWG recommendations.
- TC decides on formation of Technical Integration Groups (TIGs) to address gaps.
- TIGs review identified gaps and develop Technical Plan; TC approves.
- TIGs, with TC approval, undertake projects to close gaps.

How Projects are Defined

- Hold project formation meeting
- Members develop Statement of Requirements
  - User/business case driven
  - What is needed
  - Desired outcome of project
- Identify leaders
- Members develop Statement of Work
  - Project plan with identified tasks, check points and end dates
  - Companies expected to participate
  - Results expected and how documented
- Members sign Project Statement
  - Formally commit resources as agreed
  - Specify information sharing process
- Carry out project, report quarterly

iNEMI

International Electronics Manufacturing Initiative

2005
Technical Plan

Mining the 2004 Roadmap

iNEMI

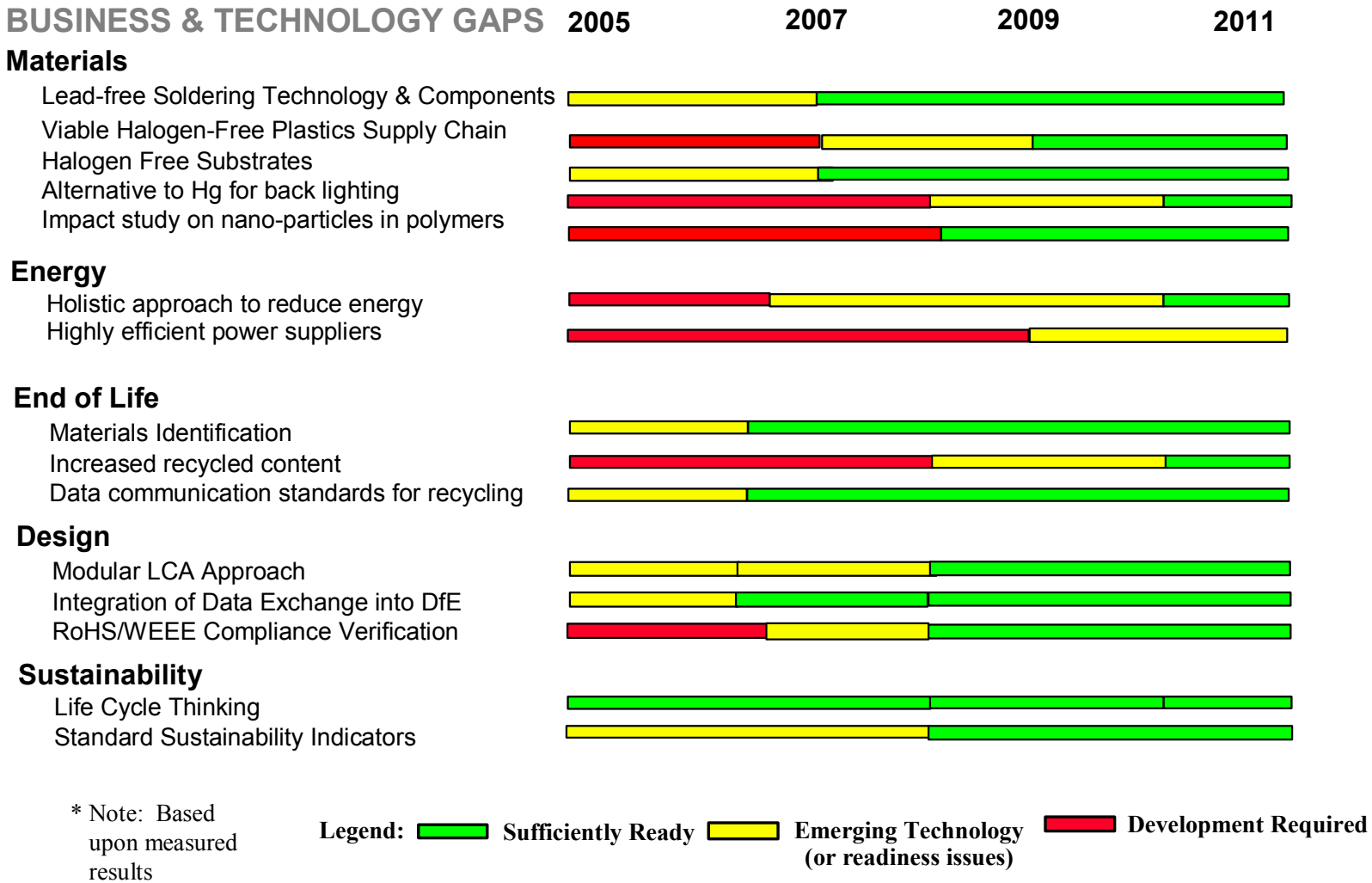
International Electronics Manufacturing Initiative

ECE
Technical Plan

Shift from Defensive Position on Environmental Topics

Example Gap Analysis: ECE

2005 ECE Technology Gap Analysis



Technical Plan
Example: ECE Five-year Plan

2005 ECE Integration Plan

DRIVERS
- Legislative/regulatory
- Market Competitiveness
- Sustainable Development
- Customer Requirements

ATTRIBUTES
Elimination of Materials of Concern
Energy Efficiency
End-of-Life Recycling
Design for Environment
Increased Sustainability

DEPLOYED TECHNOLOGY
Design for Environment Approach (DfE)
Lead-free soldering
Alternative Finishes
Non-halogenated flame retardants (early adopters)
Management System (EMS)
Data communication standards

RESEARCH & DEVELOPMENT
Non-halogenated flame retardants
RoHS/WEEE Compliance Tools
Increased recycled content
Modular LCA
Standard Sustainability Indicators

ELV **2005**

ATTRIBUTES
Elimination of Materials of Concern
Energy Efficiency
End-of-Life Recycling
Design for Environment
Increased Sustainability
Product Marking
Substance Bans

DEPLOYED TECHNOLOGY
DfE
Lead-free
Non-halogenated flame retardants
RoHS/WEEE Compliance Tools

RESEARCH & DEVELOPMENT
Modular LCA
Highly efficient power supplies
Hg-free backlighting
Impact of nano-particles in polymers
Standard Sustainability Indicators
Increased recyclability

WEEE/RoHS **2007**

ATTRIBUTES
Elimination of Materials of Concern
Energy Efficiency
End-of-Life Recycling
Design for Environment
Increased Sustainability
Product Marking
Substance Bans
Recycling Targets
Waste Minimization
Recycled Content

DEPLOYED TECHNOLOGY
Modular LCA
Nano-particles in Polymers
Recycled polymers

RESEARCH & DEVELOPMENT
Highly efficient power supplies
Hg-free backlighting
Standard Sustainability Indicators

2009

ATTRIBUTES
Elimination of Materials of Concern
Energy Efficiency
End-of-Life Recycling
Design for Environment
Increased Sustainability
Product Marking
Substance Bans
Recycling Targets
Waste Minimization
Recycled Content
Life Cycle Analysis

DEPLOYED TECHNOLOGY
Highly efficient power supplies
Hg-free backlighting
Standard Sustainability Indicators

RESEARCH & DEVELOPMENT
Dematerialization
Energy Reduction

2011

www.inemi.org

Email contacts:

Jim McElroy

jmcelroy@inemi.org

Bob Pfahl

bob.pfahl@inemi.org

iNEMI

International Electronics Manufacturing Initiative

System in Package 2005 Technical Plan

Bob Pfahl

SiP Technology Integration Group

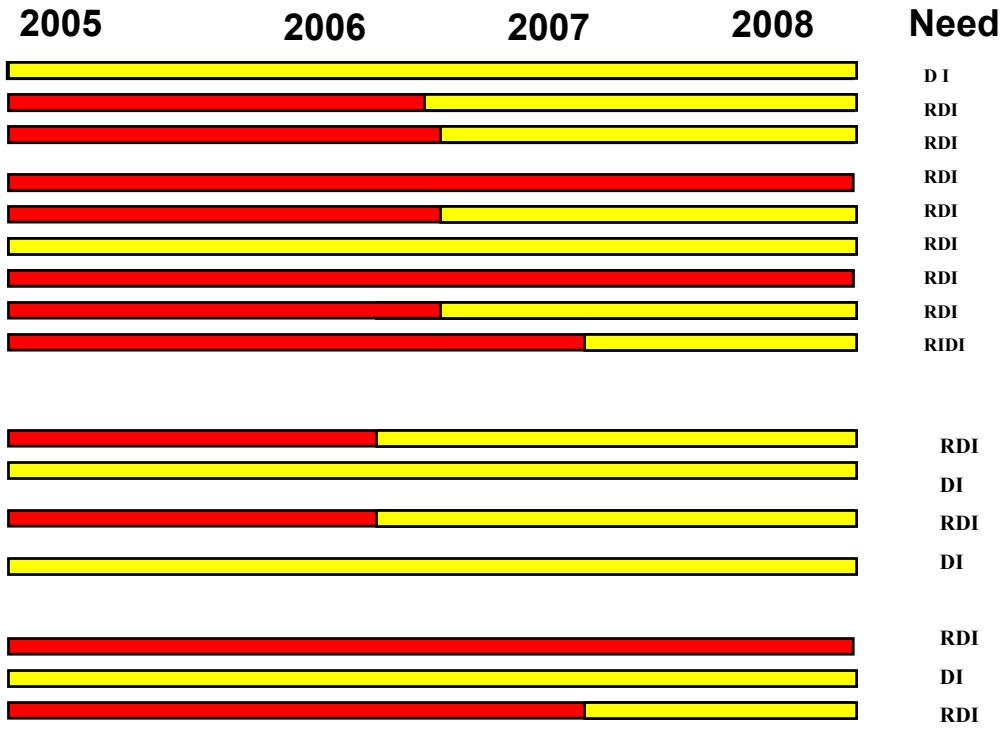
Chair: Joe Adam, Skyworks

- **Developed focus areas for Gap Analysis:**
  - **Reliability**
  - **Substrates**
  - **Materials**
  - **Equipment**
  - **Design Tools**
  - **Standards**
- **Completed a Technical Plan with Prioritized Gaps**
- **Next Step:**
  - **Organize Projects to Close the Gaps**

SIP TIG Objectives

- To identify research projects which have the highest impact on SIP development, are executable, and will get broad support
  - There are many gaps which may not be addressable through the iNEMI project structure
  - The list of possible projects is very long with lots of competing approaches so finding common project interest is a critical objective
- Identify sponsor companies within iNEMI and target companies for recruitment into iNEMI research projects
  - Most of the leading SIP companies are not iNEMI members

System In Package Gap Analysis



X = Not Req'd
R = Research
D = Development
I = Implementation

Technology Sufficient

Technology—More Dev. needed

Critical Need for R&D

iNEMI SIP TIG Gaps

- **SIP Manufacturing Productivity Improvement Projects**
  - Alternative singulation techniques
  - Mechanical sawing process development
  - Alternative die attach techniques – electrically & thermally conductive films
  - Factory Standards
  - PCB solder mask to mold compound adhesion measurement methods, correlation to CSAM
- **SIP Substrate and Interconnect Technology Projects**
  - Low cost patterning techniques for interconnect
  - Drilling processes
  - High frequency design and simulation tools for RF and mix signal design
  - Low cost mixing of high frequency with high power dissipation

SIP Technology Gaps

- System In Package Reliability Projects
  - Thermal mechanical modeling of complex SIP structures and materials combinations
  - Development of passive component test methods for embedded components in mold compounds
  - Analysis of materials properties under reflow conditions
  - Lead free solder joint integrity in embedded SIP applications
  - Solder joint reliability for low stand-off solder joints in
  - Very thin organic film materials properties and adhesion mechanisms in this epoxy bonds
  - Thin die mechanical properties under varying surface conditions
  - Analysis of electroless finish plating solder joints
  - Interfacial resistance of conductive epoxy pastes