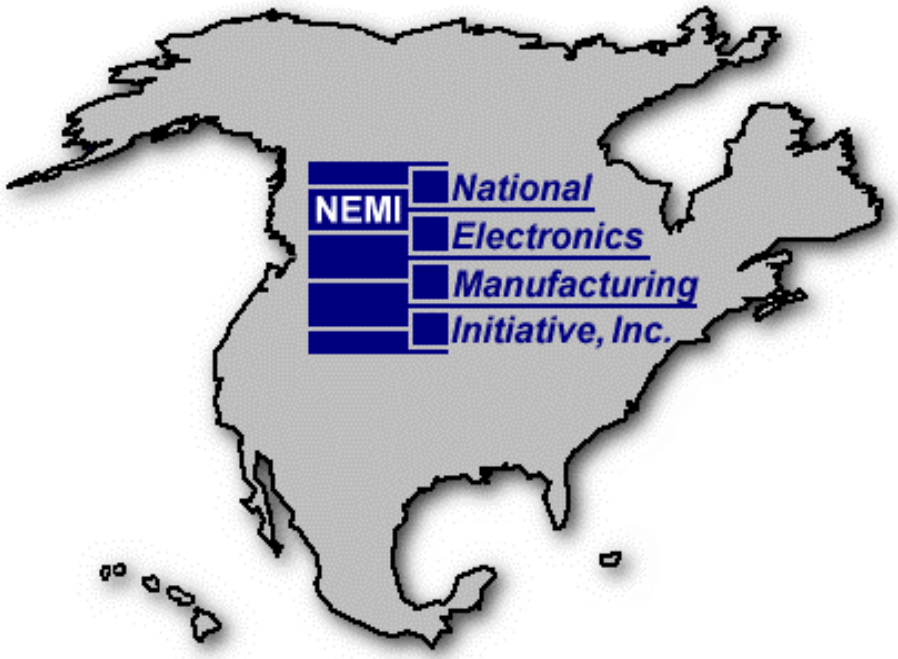
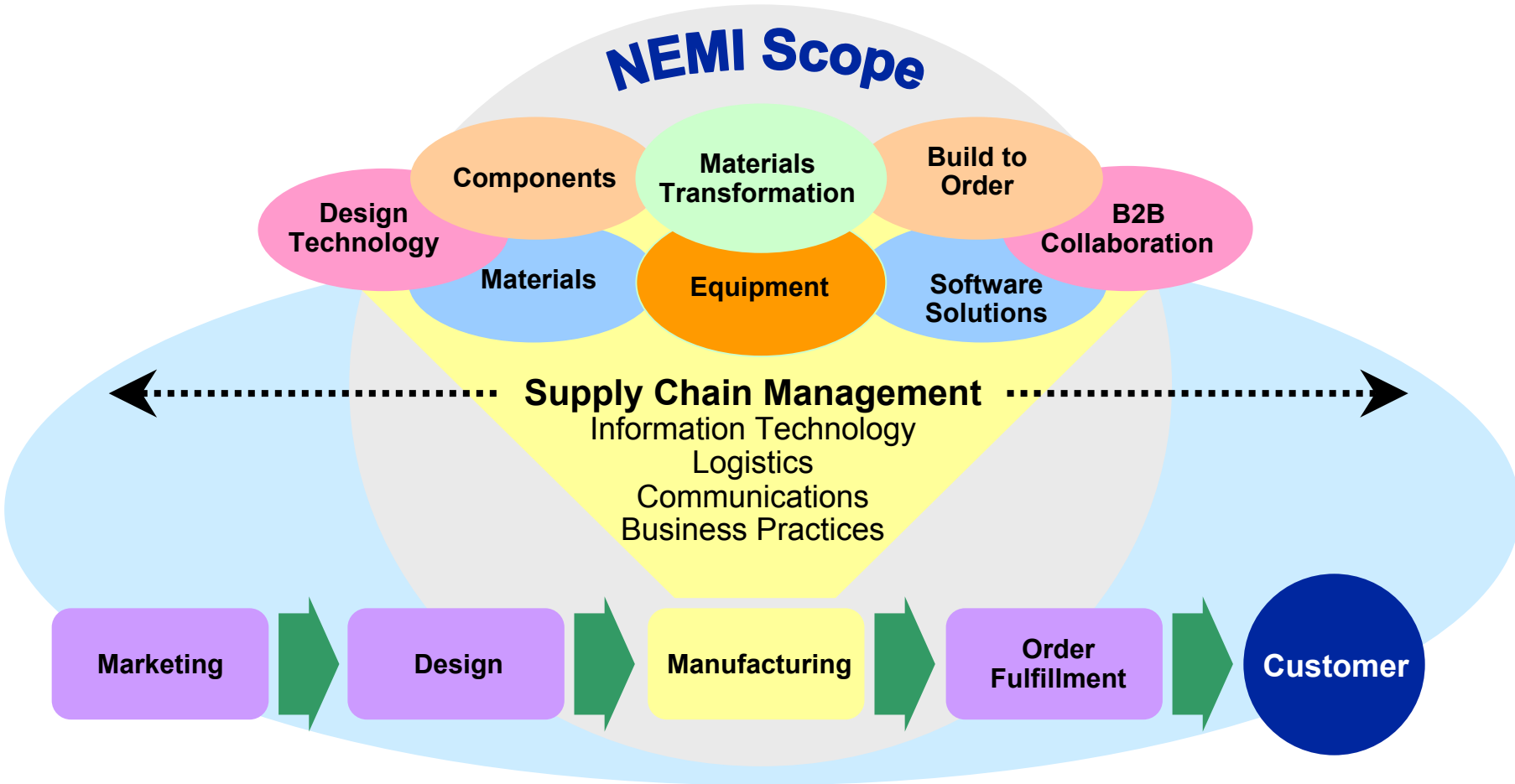


Improving Optoelectronics Manufacturing Infrastructure

Jim McElroy

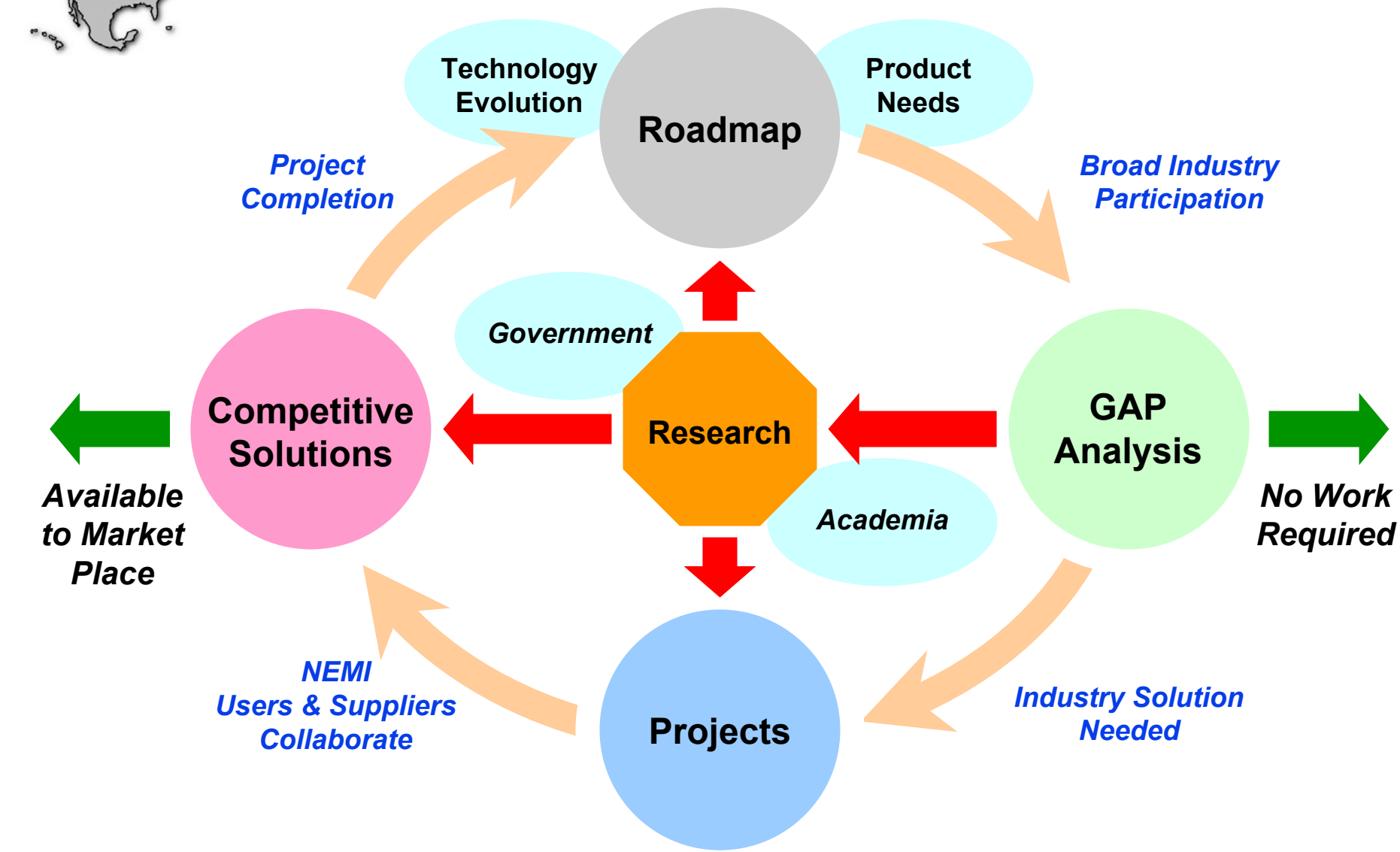
NEMI Mission

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



Connect with and Strengthen your Supply Chain

NEMI Roadmap Cycle



NEMI Implementation Cycle

Connect with and Strengthen your Supply Chain

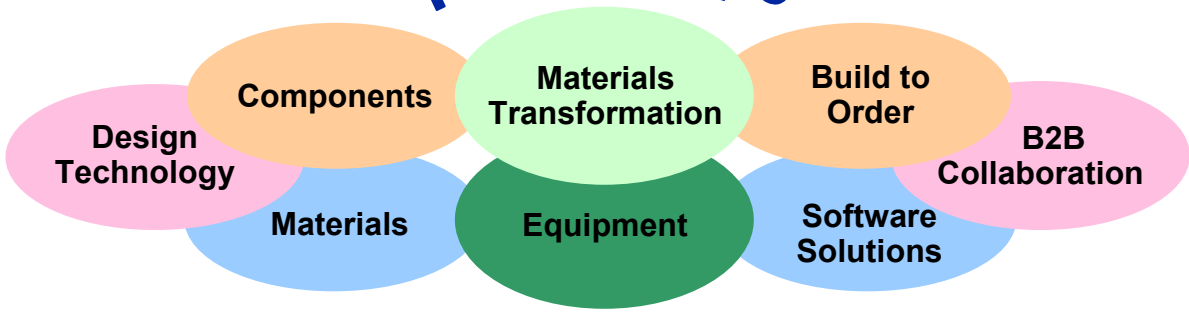
Roadmapping vs. Deployment

- NEMI roadmaps technology in 18 different areas.
- Each roadmap chapter is created by a Technology Working Group (TWG).
- NEMI has technology deployment activities in 5 different areas.
- Each project area is organized by a Technology Integration Group (TIG).
- Business Topics being addressed by Business Leadership Team (BLT).
- Roadmap and project groups are made up of industry people (including leadership).

Optoelectronic Gaps – NEMI 2000 Roadmap

- Need for faster, higher performance, miniaturized lower cost packaging solutions.
- Need to incorporate increased levels of optical/electrical integration into packages.
- Ability of Optoelectronic devices/packages to survive assembly environment (e.g. lead free reflow).
- Integration of Optoelectronics assembly into standard electronics manufacturing processes:
  - Package standardization
  - Fiber handling
  - Standard assembly processes

NEMI Scope



Substrates TIG Projects:

- High Frequency HDI Materials
- Advanced Embedded Passive Technology (managed by NCMS)
- Integral Passives Testing

Board Assembly TIG Projects:

- Test Strategy
- DPMO
- Fiber Optic Splice Improvement
- Optoelectronics Solder Automation
- Flip Chip & CSP Underfill

Factory Information Systems TIG Projects:

- Virtual Factory Information Interchange
  - Product Data Exchange (PDX) Standards
- Data Exchange Convergence Project
  - Technical Structure
  - Industry Adoption

Optoelectronics TIG Projects:

- Fiber Handling Processes
- Fiber Optic Signal Performance
- Optoelectronics for Substrates

Environmentally Sustainable Electronics TIG Projects:

- Lead-Free Assembly
- Tin Whiskers HAST
- Tin Whisker Modeling
- Lead-Free Assembly & Rework

Business Leadership Team:

- Perfect Bill of Materials (BOM)
- Engineering Collaboration

Member Collaboration Efforts

NEMI Projects and Standards Overview

NEMI, Board Assembly Technology Integration Group (TIG)

Paul Williams, Intel / Aichyun Shiah, Solectron Corp (Chair/ Co-Chair)

- **Optoelectronics Solder Automation Project <LEVEL 1,2>** Prashant Chouta, Cookson Electronics
- **Fiber Optic Splice Improvement Project <LEVEL 2,3>** Peter Arrowsmith, Celestica, Inc.

NEMI, Optoelectronics Technology Integration Group (TIG)

Alan Rae, Cookson Electronics (Chair)

- **Fiber Handling Project <LEVEL 1,2,3>** Dan Nelson, JDS Uniphase
- **Fiber Optic Signal Performance Project <LEVEL 1,2,3>** Dave Silmser, Alcatel Canada, Inc. / Tatiana Berdinskikh, Celestica
- **Optoelectronics for Substrates <LEVEL 1,2,3 >** Jack Fisher, NEMI Consultant

Standards Activities

IPC-STD-040 Standard Series:

- Addresses the implementation of optical and optoelectronic packaging technologies
- Identifies 23 areas for standardization - Fiber Handling, Splicing, Cleaning, Testing, Hermetic Sealing, Etc.

NEMI Contribution to Series:

- Optoelectronic Fiber Handling Project, IPC-3841 Specification for Process Carriers Used to Handle Optical Fibers in Manufacturing (IPC - Proposal – Standard)
- Future Contributions:
  - Optoelectronics Fiber Assembly Project , IPC-STD-040 , section, 10.2 Fiber splicing and test
  - Fiber Optic Signal Performance Project, IPC-STD-040

Fiber Handling

- **Optoelectronic Fiber Handling Project, Joint NEMI/IPC Effort: (Chair Dan Nelson)**
- **Status: Project Start, September 2001 - Completed June 2002, (With hand-off to IPC of IPC-3841 Standard, draft proposal)**
- **Project objective:**
  - **Objective: Define a standard for handling and carriers for optical fiber in fiber optic component manufacturing**
  - **Facilitate process automation with reduced engineering**
  - **Define enough specifications to create a carrier standard but still allow for industry innovation and process evolution.**
  - **Developed jointly with IPC**
- **Project Results:**
  - **Set standards for fiber handling: buffer jacket protection, bend radius limit, handling stress**
  - **Set standards and guidelines for fiber carriers: size, weight, frame of reference and alignment features, working envelop, carrier ID, fiber end locations, mating with other carriers, process requirements**

Fiber Handling Project History

- Need identified - May 2001
- Project team formed - September 2001
- Content survey completed - December 2001
- Standard outline determined - February 2002
- First draft ready for approval - June 2002
- Final proposal approved - October 2002
- Standard approved – March 2003

Fiber Handling Project Highlights

- Involved team with broad perspective
- Survey to guide us (used to focus on key issues)
- Did not strive for perfection
  - Created outline from incomplete survey data
  - Began writing with incomplete outline and incomplete input
- Weekly conference calls to get to finished draft
- Created and tracked action items for accountability
- Made use of existing IPC standard format
- Using existing IPC standard approval process

Fiber Handling Project Key Lessons

- A committed team of experts is essential
- One knowledgeable person to integrate draft
- Frequent meetings to insure rapid progress
- Use as much existing material and as many existing processes as possible
- Doesn't have to be perfect the first time. Recognize that there will be revisions to the standard
- Excellent support from sponsors is essential

Improving Fiber Splice Processes

- **Fiber Optic Splice Improvement Project: (Peter Arrowsmith, Celestica)**
- **Status: Project Started, July 2002 - Project duration 18 Months**
- **Project Objectives:**
  - **Develop industry-wide splice quality criteria and test methods that will allow for systematic investigation of variability and comparison of equipment and procedures**
  - **Improve yield and lower costs**
  - **Development and validation of test methods for insertion loss, strength and extinction ratio**
  - **Testing of splices made, using different equipment; and identification of major causes of splice variability**
- **Expected Results:**
  - **To use and validate existing methods of fiber splicing and, as appropriate**
  - **Develop and submit to standards-making bodies drafts for:**
    - » **Splice acceptance and performance**
    - » **Fiber handling and reliability**

Fiber Splice Background

- First working meeting held June 2002
- Involvement from many industry viewpoints (materials and component suppliers, equipment suppliers, EMS providers, OEMs)
- Good participation from OEM, EMS, and equipment companies
- Several other Companies considering participation
- Discussed sharing activities and partnering with IPC, PMA, and TIA.

Fiber Splice Areas of Interest

- Surveyed members to rank possible activities by expected benefit, likelihood of success and level of enthusiasm
- Survey Included a wide range of topics relevant to the manufacture of spliced optical assemblies
- Top Ranked Areas of Interest:
  - Revue Existing Standards (Telcordia, TIA, IEC, IPC etc)
  - Test method(s) for insertion loss of dissimilar splices
  - Splice acceptance metrics (IL, strength...)
  - Estimated IL accuracy (compare methods, splicer vs actual measured, identify which loss mechanisms are included, potential improvement
  - Test method for strength (strain rates)
  - Test method for extinction ratio for PM fiber (fiber stressing for worst case vs non-stressed for repeatability, etc)
  - Splice reliability

Fiber Splice New Participants

- **Project will accept new members by 3/4 majority vote**
- **Welcome additional members, particularly OEMs & equipment Companies**
- **Contacts:**

  Chair: Peter Arrowsmith, parrowsm@celestica.com

  Standards: Eric Mies, emies@vytran.com

  Measurement: Rob Suurmann, rsuurman@celestica.com

  NEMI: David Godlewski, dgodlewski@nemi.org

Optical Connection Performance

- **Fiber Optic Signal Performance Project: (Chair Dave Silmser, Alcatel Canada, Co-Chair: Tatiana Berdinskikh, Celestica)**
- **Status: Project Started, June 2002 - Project duration 18 Months**
- **Project Objectives:**
  - **Learn the effects that various anomalies have on the performance of a fiber optic signal**
  - **Quantify the severity of optical signal loss due to the most common hazards found in the manufacturing processes.**
  - **The investigation will cover insertion loss, return losses, bit error rate, etc., over a range of transmission speeds and power levels**
- **Expected Results:**
  - **Define criteria and specifications for fiber connector end-face inspection as a precursor to the development of standards**
  - **Develop guidelines for cleaning procedures and contamination prevention.**

Fiber Optic Signal Performance Project

Dave Silmser, Alcatel Canada, Inc. / Tatiana Berdinskikh, Celestica

- Recommended fiber optic cleaning practice established for the manufacturing environment;
- A benchmarking exercise was completed to evaluate team members' capabilities for end- face inspection;
- Different test methods (IL, RL, BERT) were evaluated;
- The main fiber anomalies (loose contamination-particles, scratches, finger prints) were identified;
- Contaminated and damaged fibers were evaluated at three different facilities (pre-DOE).

Fiber Optic Signal Performance Project

Dave Silmser, Alcatel Canada, Inc. / Tatiana Berdinskikh, Celestica

- Currently developing the methods of applying contamination and scratches of defined size at the specific area of the fiber;
- The method of measuring of the size/area of contamination and scratches has to be identified;
- The number of the variable parameters have to be minimized (mating/demating cycles, fiber geometry, different test equipment);
- The conditions of the final DEO have to be defined.

Solder Automation- Assembly TIG (selective solder)

- Heat is the issue with fiber and many opto packages not capable of than 80^0C
- Wave and laser selective soldering are now available
- The main activity currently is cost modeling, justifying automation investment

- Presentation at this meeting – Prashant Chouta, Project Chair

Optical Paths for Substrates

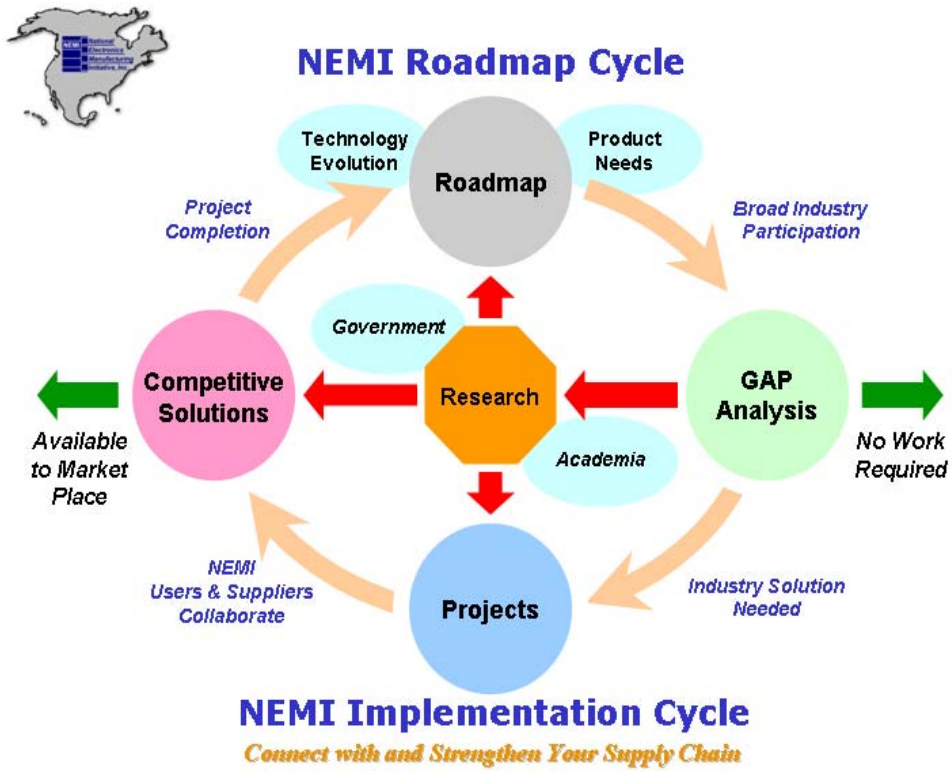
- **Optoelectronics for Substrates Initiative: (Chair Jack Fisher, NEMI/IPC consultant)**
- **Status:**
- **Initiative started January 2002**
- **Objectives:**
  - **To address the implementation of optical and optoelectronic technologies in printed wiring boards (PWBs) used in very high performance applications**
  - **identify future product needs and define areas where NEMI can concentrate member efforts**
- **Expected Results:**
  - **To develop industry-wide requirements, leading to NEMI project definition**

Proposed Topics

- **Adhesives**
  - Group on hold – "participant churn"
  - Need to establish standards for long-term performance and processing
  - Project chair Steve Adamson
- **Testing**
  - Cost and complexity of existing test methods
  - Validity of rapid tests e.g. Q vs BERT
  - Accelerated testing
  - Not pursued due to lack of support in 2000-2001
- **Rework of components**
  - Guidelines for surface mount components
  - Timetable for introduction of pluggable devices

NEMI Methodology Gets Results

- NEMI focused on improving Opto. Supply chain.
- 2000 Roadmap identified gaps in mfg. infrastructure.
- Projects are addressing specific gaps.
- Many opportunities remain.
- May 1, 2002 gap analysis meeting scheduled, Alan Rae, Cookson, Chair
- Here at OMI!



What's next?

- **Gap analysis workshop, Thursday 3-5pm**
- **Please come and air your ideas and concerns. Tell us if we're missing something!**
- **Thanks for your interest and support.**