



International Electronics Manufacturing Initiative

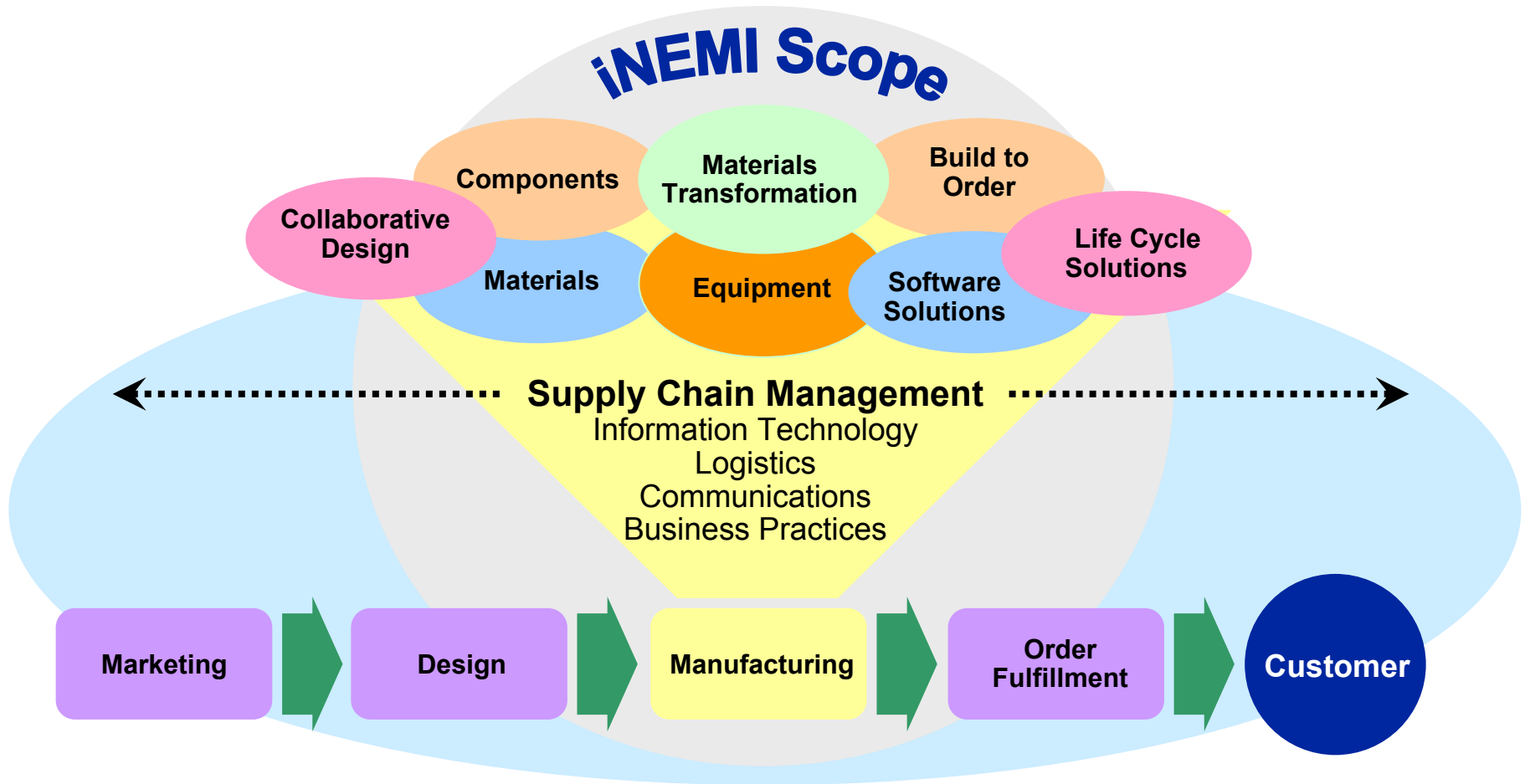
***iNEMI 2007 Roadmap Processes /  
Medical PEG (Product Emulator  
Group) Sector Overview***

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*Chuck Richardson – iNEMI Staff Manager,  
Roadmapping  
Arizona State University  
9/21/06*

- **What is iNEMI?**
  - Mission, Regulatory Environment, Value, Members
- **The iNEMI Roadmap**
  - Roadmap Definitions, Methodology / Output
  - 2004 Roadmap Demographics, Size, Results
- **The 2007 iNEMI Roadmapping Process**
  - 2007 Roadmap Priorities, Leadership, Makeup
  - The 2007 Roadmap Schedule
  - Why Do Companies Participate?
- **Medical TIG/PEG Overview**
  - Medical Product Drivers
  - Technology Gaps
  - Project Examples

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



- **Organization:**
  - 501 (c) (6) not-for-profit, R&D Consortia
  - Collaboration framed by organization by-laws, intellectual property policy, and project agreements.
- **Anti-trust Considerations:**
  - All members registered with US Justice Dept. under National Cooperative Research and Production Act
  - Anti-trust guidelines used to bound collaboration between competing firms.
- **Capabilities/services:**
  - Support to help organize & manage projects
  - Teleconference & WebEx
  - Project specific Information (web/ftp sites)
  - Monthly Member Newsletter
  - Project meetings at appropriate industry venues
  - Project report publication
  - Relationships with other Organizations
    - Roadmapping
    - Standards
    - Joint projects

***“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.



SANMINA-SCI





Agilent Technologies



EVERETT CHARLES TECHNOLOGIES  
Testing the Limits



NIHON SUPERIOR CO., LTD.



ELECTRONIC MATERIALS



## Consultants, Government, Organizations & Universities



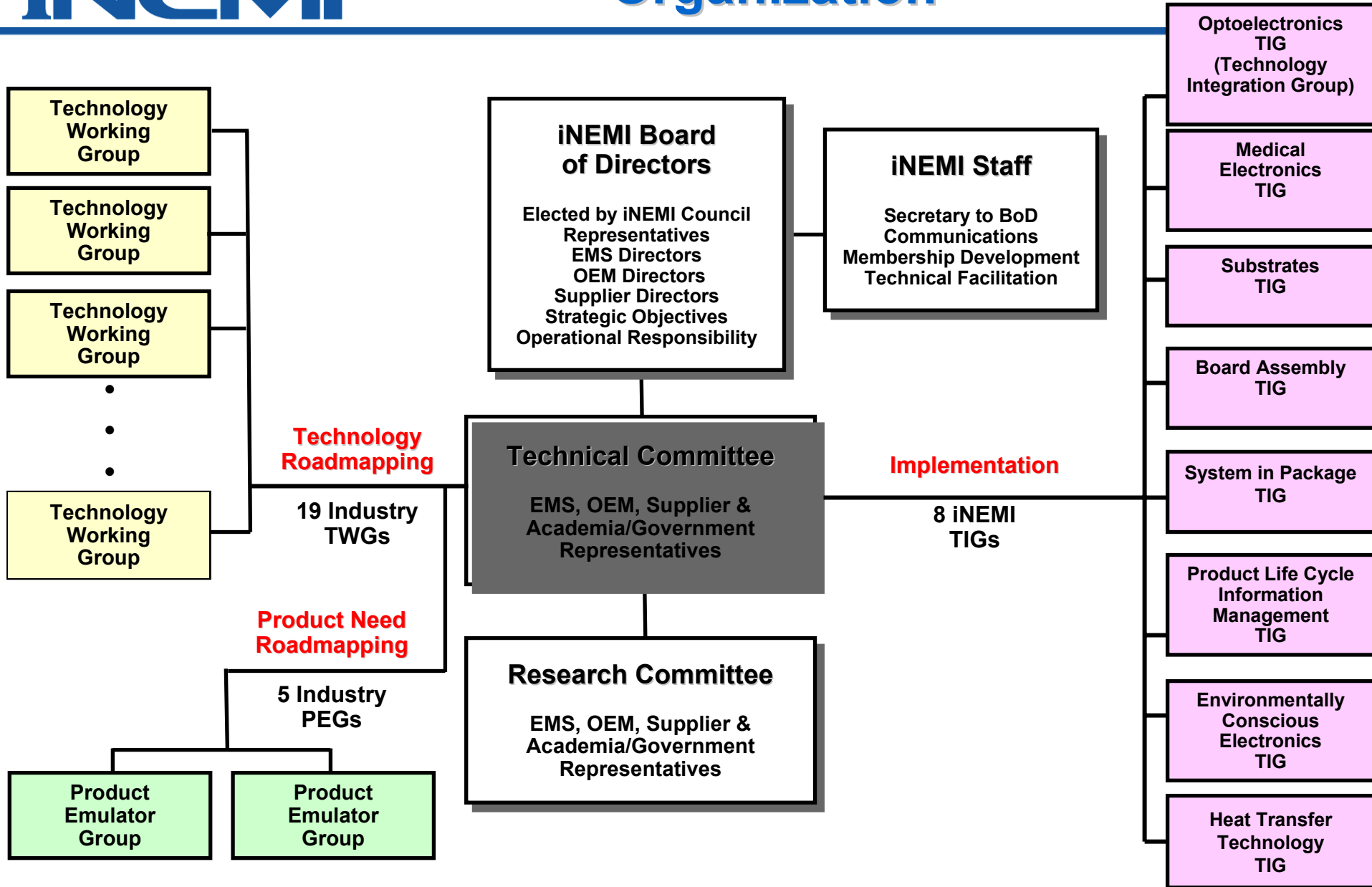
ASSOCIATION CONNECTING  
ELECTRONICS INDUSTRIES®

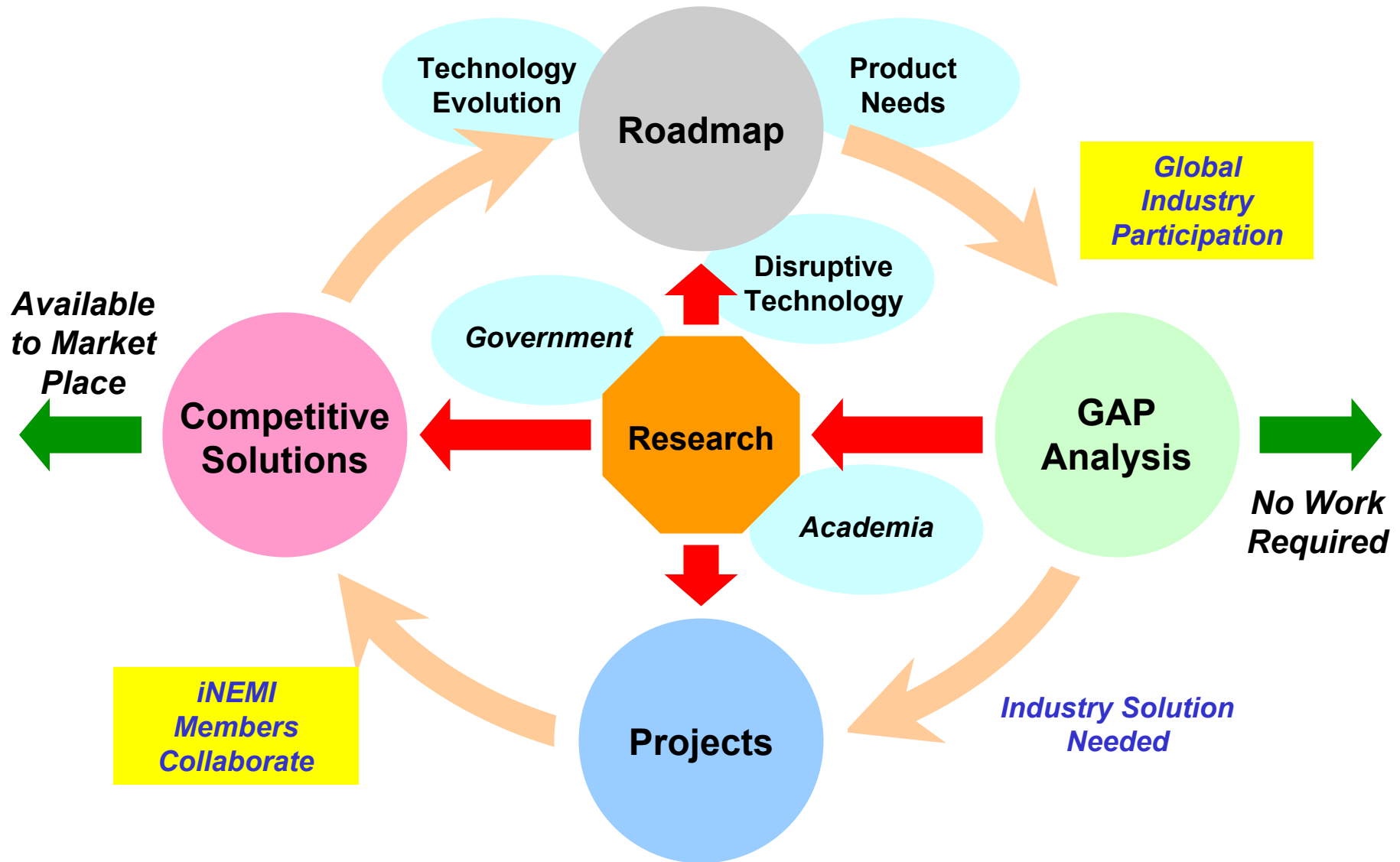


Développement  
économique  
et régional



- **TWG - Technical Working Group**
  - Develops the roadmaps
  - Presently 19 groups
  - iNEMI membership optional
  
- **TIG - Technology Integration Group**
  - Develops technical/strategic Plan
    - Identifies research priorities:
      - Based on roadmap findings and gap analysis meetings
  
- **PEG – Product Emulator Group**
  - “Virtual Product”: future product attributes plus key cost and density drivers
    - Portable / Consumer
    - Office Systems / Large Business / Communication Systems
    - Medical Products
    - Automotive
    - Defense and Aerospace





- **> 470 Participants**
- **> 220 Companies/organizations**
- **11 Countries from 3 Continents**
- **19 Technology Working Groups (TWGs)  
(added Sensors)**
- **7 Product Emulator Groups (PEGs)**
- **Over 1200 Pages of Information**
- **Roadmaps the needs for 2005-2015**



International Electronics Manufacturing Initiative

2005  
Technical Plan  
Research Priorities  
Projects

*Mining the 2004 Roadmap*

- **Gap analysis completed**
- **10 year priorities created**
- **Distributed to members & others**
- **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**



- Gap analysis completed
- 5 year plans created
- Basis for future projects
- Distributed to iNEMI members





International Electronics Manufacturing Initiative

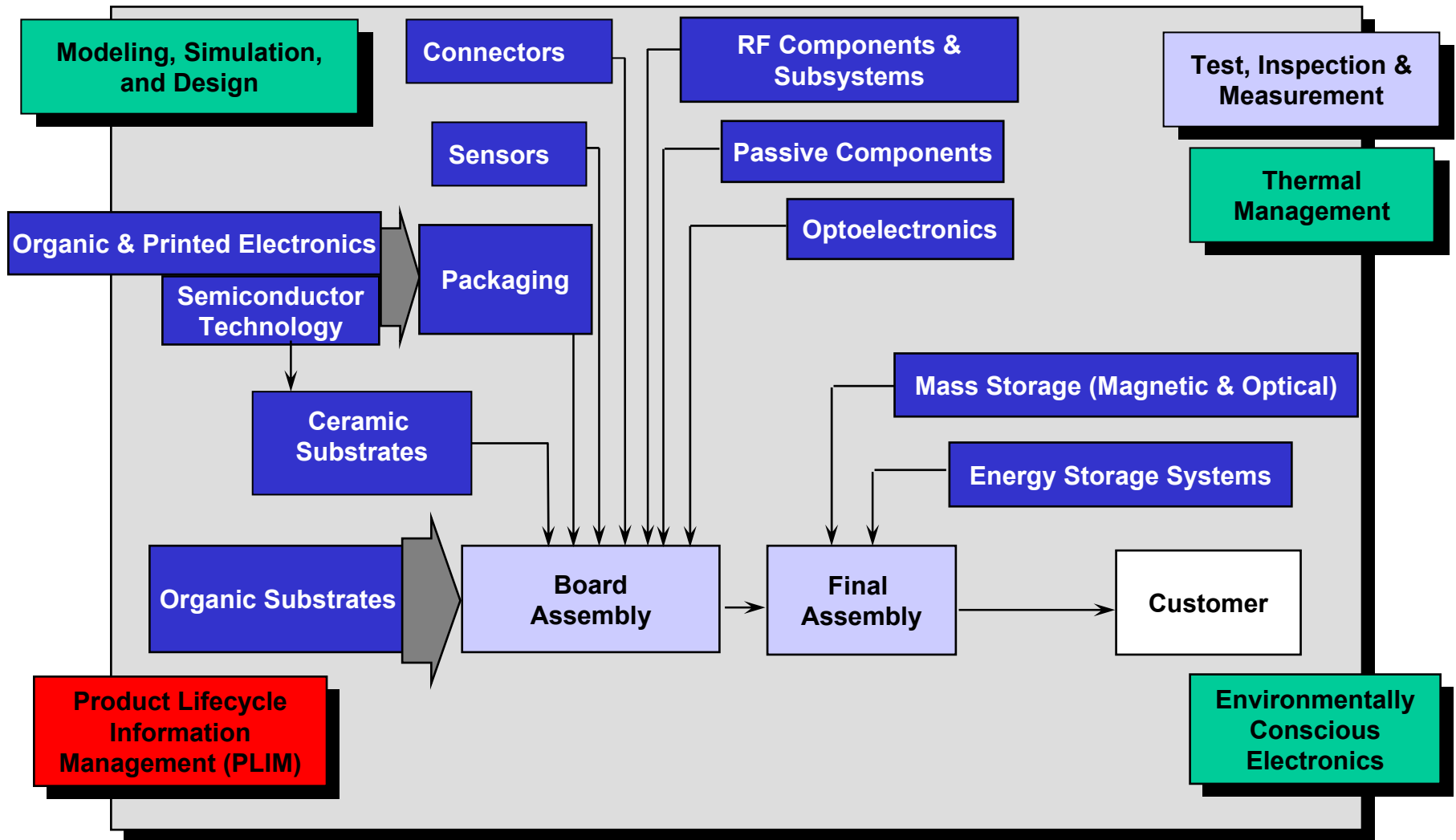
2007

iNEMI Roadmap Process Overview

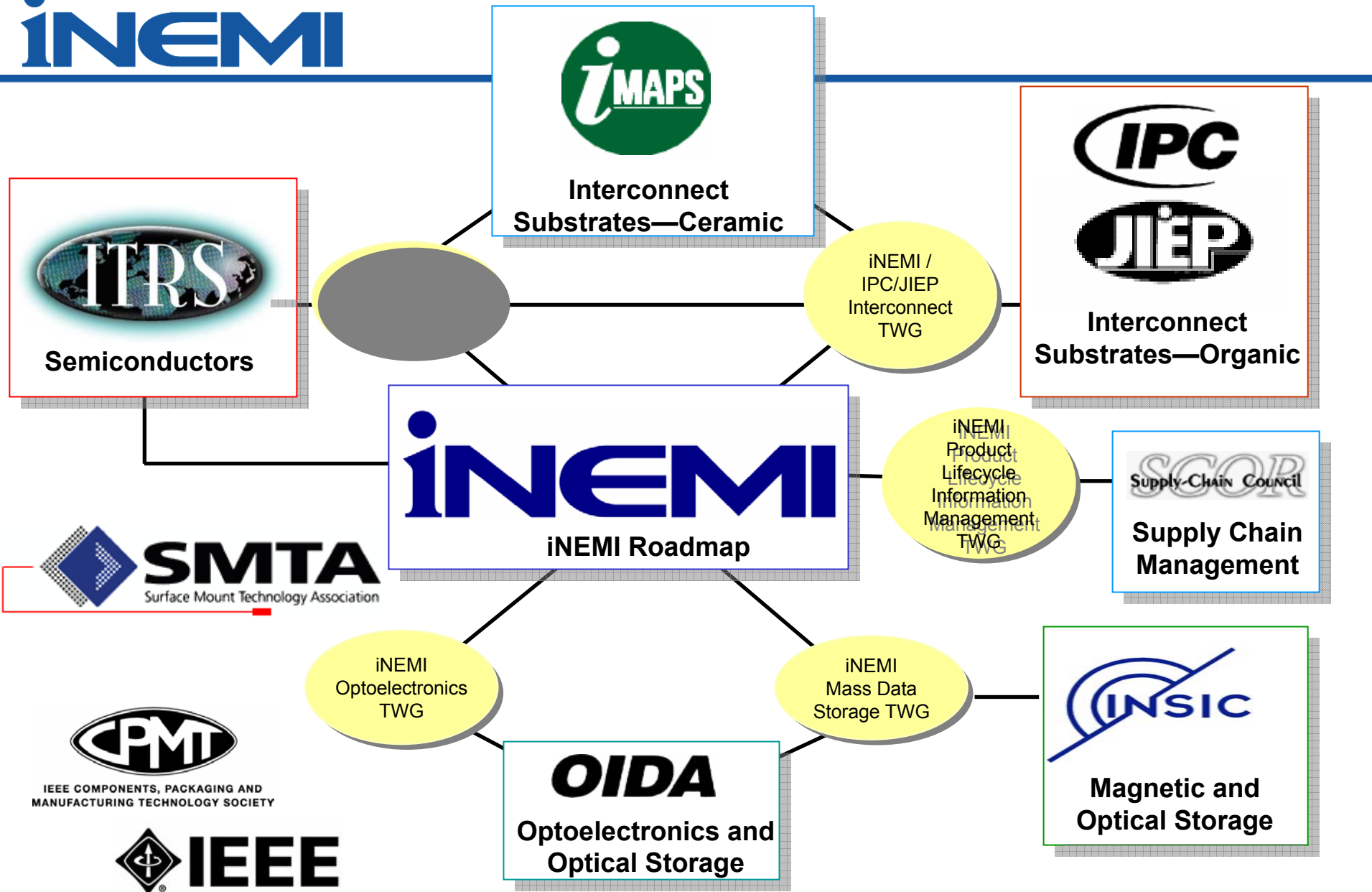
*Driving Continuous Improvement*

- **Change Name to Better Reflect Year of Release.**
- **Maintain strong linkages with other roadmaps.**
- **Begin European / Asian regional roadmap meetings.**
- **Maintain emphasis on disruptive events (business & technical).**
- **Maintain emphasis on identifying market needs and business situations.**
- **Increase quantification of needs.**
- **Prioritize Research and Deployment needs.**
- **Increase strategic vision of the roadmap: 2011-2017**
- **Improve and expand sensors chapter**

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



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



<b>Product Emulator</b>	<b>Chair(s) 2004</b>	<b>Chair(s) 2006</b>
<b>Automotive Products</b>	<b>Jim Spall, Delphi</b>	<b>Jim Spall*</b>
<b>Aerospace/Defense Products</b>	<b>William E. Murphy, Lockheed Martin</b>	<b>William E. Murphy*</b>
<b>Medical Products</b>	<b>Terry Dishongh, Intel</b>	<b>Anthony Primavera, Guidant Terry Dishongh, Intel</b>
<b>Consumer / Portable Products</b>	<b>Gerry Bird, 3M</b>	<b>Susan Noe, 3M*</b>
<b>Office/Large Business System Products</b>	<b>Tom Pearson, Intel George Katopis, IBM Erich Klink, IBM</b>	<b>Erich Klink, IBM Europe Tom Pearson, Intel</b>
<b>Network, Data, Telecom</b>	<b>Mike Schabel, Lucent</b>	<b>Rolled Into Office/Large Business Systems for 2007</b>

Need Co-Chair\*

<b>Business Processes / Technologies</b>	<b>Chair(s)</b>	<b>Co-Chair(s)</b>
Product Lifecycle Information Mgmt.	Eric Simmon, NIST	Joanne Friedman, Connecktd
<b>Design Technologies</b>		
Modeling, Simulation & Design	Sanjeev Sathe, SAE	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	
<b>Manufacturing Technologies</b>		
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

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

- 3Q2005: Select Product Sector Champions, teams and refine data charts
- 3/4Q05: Product Sector Champions Develop Emulators
  - September 6, 2005 – Teleconference with P.E. Group Chairs
  - **September 30, 2005 Roadmap Kick-off with PEG/TWG/TC at SMTAI**
  - **November 16, 2005 European Kick-off at Productronica**
  - December 2005 review meeting with TC on PEG Emulators
- 2004 chapter, format, Exec. Summary mailed to each TWG chair 1/4/2006
- Organizing Teleconference with TWG Chairs 1/11/2006
- **February 2006 PEG Workshop/TWG Kick-off at APEX Meeting in Anaheim:**
  - Product Sector Tables Complete – Chapters Written
  - Cross cut issues addressed
- **April 5, 2006 – Roadmap Workshop Europe in Munich, Germany**
- **May 8, 2006 Telecon With TWG Chairs**
- **May 17, 2006 – Roadmap Workshop in Herndon, VA**

- May 18, 2006 – TC Roadmap Highlights Meeting in Herndon
- **June 27-30 Roadmap Workshop HDP '06 Shanghai**
- July 1, 2006 – TWG Drafts Due for TC Review
- August 9, 2006 – TC Face-to-Face Review with TWG Chairs in Kokomo, Indiana
- September 27, 2006 – Council Review of RM Status & Key Issues and Preliminary Executive Summary @ SMTAI, Final Roadmap Chapters Due 9/22/06
- October 31, 2006 – Edit, Prepare App. A-D, Exec. Summary
- November 20, 2006 – Go To “Press”
- December 4, 2006 – Ship to Members
- Feb, 2007 – Industry Release at APEX

- **Excellent opportunity to “test the iNEMI collaboration waters” without committing to membership.**
- **The experience leads to a better understanding of the “state of the art” in those areas of participation.**
- **Early access to the roadmap chapter’s technical and business information for the participating company.**
- **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 and benchmark their company against the user needs.**
- **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”.**



## iNEMI Medical TIG Review

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*Recent Medical TIG Projects and Drivers*

**Co-Directors of Planning: Leslie Guth, Lucent Technologies; Bill Barthel, Plexus**

- **Board Assembly**
- **Environmentally Conscious Electronics**
- **Heat Transfer**
- **Medical Electronics**
- **Product Lifecycle Information Management**
- **System in Package (SiP)**
- **Substrates**
- **Optoelectronics**

- **Co-Chairs: Anthony Primavera – Boston Scientific and David Erhart – Medtronic**
  - **Large Working Group**
    - 3M, Barbara Birrell, Bill Ballard, Denny Aeschliman, Tom Johnson
    - Biotronik, Andreas Schweinzer
    - Boston Scientific, David Yonce, Eric J.Peterson, Louis Skarda, Matthew Stonehouse, Ron Reimann, Anthony Primavera
    - Cochlear, Ltd, Edmond Capcelea
    - Dyconex, Mark Hauer, Pavlin Sabev, Thomas Jacob
    - FDA, Mitchell Shein, William Regnault
    - GE Research, William Burdick
    - iNEMI, Chuck Richardson, David Godlewski
    - Intel, Celeste Null
    - MEDEL, Dominik Hammerer
    - Medtronic, Scott Savage, David Erhart
    - Micro Systems Engineering, INC., Ravi Subrahmanyam
    - NIST, Barbara Goldstein, Dennis Leber, Perry Wilson, Ron Goldfarb, Liz Drexler
    - Plexus, Michael Tendick
    - Sanmina-SCI, Fikreta Jusufagic, Robert Kinyanjui
    - St. Jude Medical, Brian Greig, Stephen Meeks
    - Tyco Healthcare / Kendall, Jim Theodorou
    - Universal Instruments Corporation, Peter Borgesen
    - Vishay, Clark Smith, Roger Roberts

- **Impact to national economy on healthcare will force the need for less expensive systems.**
  - **74 Million elders in US, 1.2 Billion world wide by 2025**
  - **US spending is currently 15-16% of federal budget on health care.**
  - **By 2025, there will be 1 retiree for every 3 workers.**
  - **Higher spending will be required if current model is continued to be followed.**
    - **long term impact is an international trend toward home health technologies and preventive health care**

## Fastest-growing occupations 2002-2012

(projected)

	GROWTH	# OF NEW JOBS
Medical assistants	59%	215,000
Network systems, data communications analysts	57%	106,000
Physician assistants	49%	31,000
Social and human service assistants	49%	149,000
Home health aides	48%	279,000
Medical records and health information technicians	47%	69,000
Physical therapist aides	46%	17,000
Computer software engineers, applications	46%	179,000
Computer software engineers, systems software	45%	128,000
Physical therapist assistants	45%	22,000

Source: BLS

Of the the 10 fastest-growing occupations, medical related jobs are growing the fastest.

However, there is a short supply of qualified medical professionals.

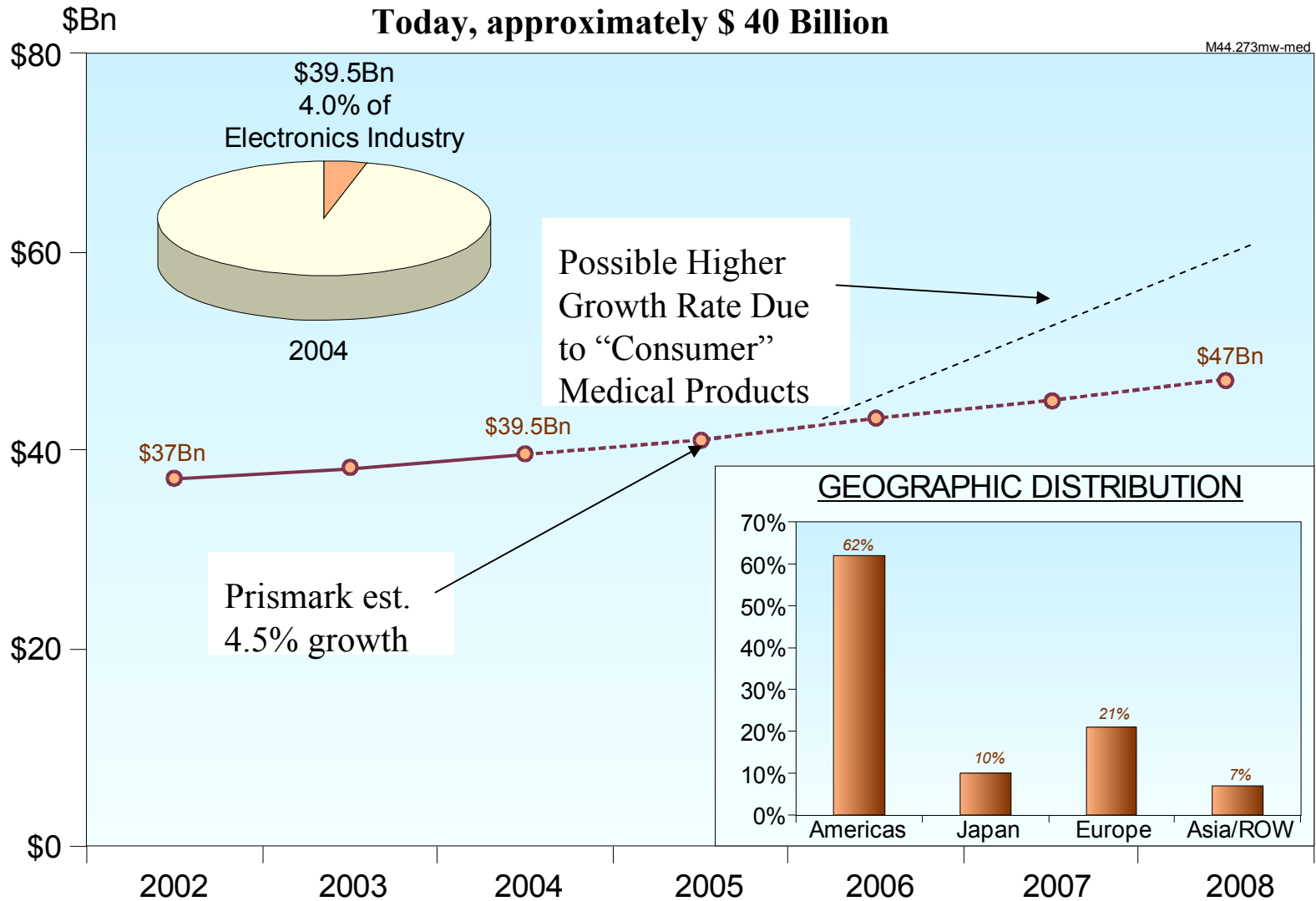
In addition, rising hospital care costs, escalation in the number of un-insured, rise in HMO providers, and other factors contribute to shorter healthcare giver – patient interaction time.

These factors and others are giving rise to a growing “Consumer Medical Electronics Market”

For example, home diagnostic equipment, wearable patient monitoring equipment, etc.

Source: Bureau of Labor Statistics, pub in CNN/Money.com, “Where the jobs will be Greatest employment growth is likely to be in service industries, according to new labor study.” By Jeanne Sahadi, Feb 13, 2004.

- **Current healthcare system is optimized for treating disease; innovation is clinic-and-pharma centric**
- **Industry is starting to focus on preventive and detection medicine. System needs to be created for wellness (prevention, early detection, compliance, caregiver support).**
  - **Some examples are diabetes glucose monitors, Web based medical advice sites, web pharmacy, remote-monitored ICDs.**
- **Technology is being put into patients hands, allowing for offload formal institutions when appropriate while keeping physicians and informal caregivers “in the loop”.**
  - **For example remote monitoring of patients therapy.**
- **Investment and R&D is required to fill the newly formed markets. Opportunities are present for new market applications, however, we need to start now.**



- **For the purposes of the Medical TIG Technical Plan, the product types are too varied to define global trends within the medical sector. Therefore, medical products will be grouped into three general categories.**
  - 1) Implanted products (those devices implanted in a human body)
  - 2) Portable products (those devices that are easily transported)
  - 3) Diagnostic imaging devices and large scale equipment, e.g., Ultrasound, MR, etc.
  - Some product solutions will necessarily consist of combinations of all three categories of devices.
  
- **Main differences**
  - Product size, features and form factor
  - Energy type, source and usage
  - Reliability requirements
  - Regulatory issues

- **Implantable / Life Critical Category**
  - **Small Scale**
  - **Operating conditions – 37C**
  - **Many custom components**
  - **Development cycle on the order of years**
  - **Application / design currently not well suited to EMS environment**
  - **Requires clean room and sterile assembly floor**
  - **Driven by battery life (low power loss) – this limits the use of certain components such as DRAM due to high energy consumption.**
  - **Reliability paramount due to life critical nature of device**

- **Home diagnostics is becoming an increasingly important medical market segment.**
  - Products include blood glucose monitors, blood pressure monitors, cholesterol monitors, and thermometers.
  - These are generally low-cost devices, and likely candidates for production by contract assemblers.
- **The major trends in patient monitoring equipment include portability, miniaturization, and greater use of wireless and wired communications networks to transfer data and reprogram devices.**
  - Although the US and Canada licensed a specific band for wireless medical systems in 2000 (WMTS), industry standards including Wireless LAN and Bluetooth remain common options and enable cost reduction.

- **The adoption of consumer-based portable and often wearable medical products is increasing at a substantial rate due to many factors. Some of the primary drivers for a dramatic increase in consumer medical products are as follows**
  - Relatively inexpensive
  - Widely available
  - New markets and locations to purchase the devices
  - Higher brand equity based on consumer perception
  - Enables better / future care through integrated record management
  - Aligns with patients' desire to manage their own health
  - Aligns with trends to reduce health care costs
  - Increase in preventive medicine
  - Movement of diagnostics & therapies away from specialists/sub-specialists and toward patient
  - Movement of care away from hospitals and toward the home

- **Large Scale Diagnostic Equipment**
  - Larger Scale (Often similar to servers or telecom equip.)
  - Often requires thermal management & heat sinking
  - Utilizes commercial off the shelf components when possible
  - Development cycle much shorter than implantables
  - Application / design often suited to EMS environment
  - Often does not require clean room or sterile assembly floor
- **Medical imaging equipment is becoming more patient friendly, encompassing major trends toward digital versus analog image capture, greater data processing capabilities, and increased acquisition / processing speeds to image large organ volumes.**
  - e.g., image the heart within a few heartbeats.
  - Overall, the trend is also a shift from (reactive) disease prevention to (proactive) disease prediction and prevention.

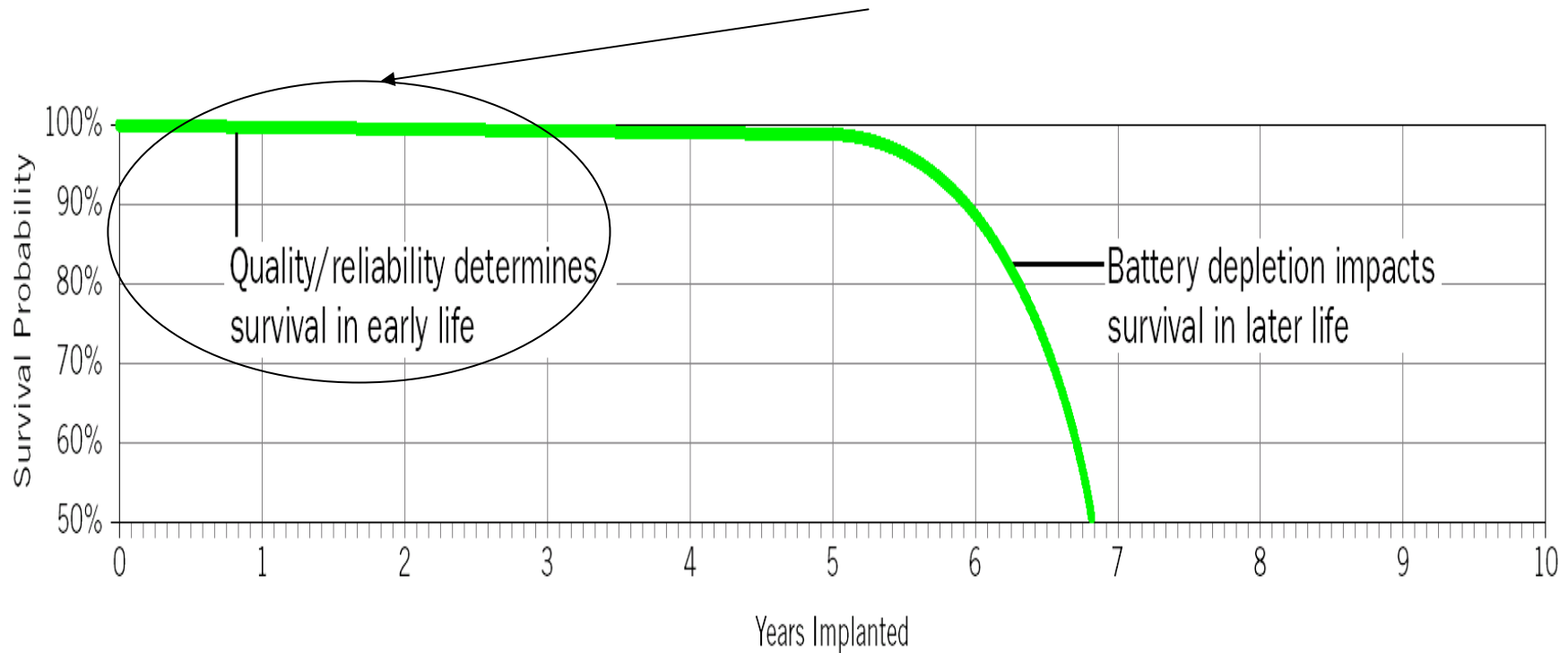
## Diagnostic Imaging Systems



Green = No Gap Issues or Resolved    Yellow = Known Gap Mitigation Techniques    Red = No Known Solution – Development Required

- **1) Component reliability standards and standard test methods that address the unique performance requirements and use environments that characterize the medical products sector.**
  - **Medical Grade Component Specifications Project: The goal of this project is to develop test and extrapolation methodologies leading to non-prescriptive specifications for high reliability medical grade components. Initial focus is on surface mount multi-layer ceramic capacitors with subsequent sub-projects related to substrates, array interconnect components and hybrid electronics.**

In many medical devices, for example Implanted devices, Substantial effort is expended on testing for early failures



**A cumulative survival plot of a typical implanted ICD**

- **Area Array Components**
  - **Scope**
    - Evaluation of test samples for key attributes
    - Destructive electrical, thermal and mechanical testing
    - Evaluation of robustness to cleaning
    - Coplanarity and Warpage
    - Metallurgy – Bump and UBM structure
      - Specifically address Au content on BGA pads
  - **Output from project**
    - Define reliability requirements for “Medical Grade” BGAs
    - Adoption of common testing methods
    - Agreement on minimum test levels for medical grade BGAs
    - Sample size selection
    - Metallurgy recommendations including plating measurement methods, and acceptable finishes.
  - **Final output**
    - Update of current BGA / CSP specifications to include “Medical Grade” requirements

**[www.inemi.org](http://www.inemi.org)**

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