

# Industry/Academia Collaboration for Mfg. R&D

A University perspective

Bahgat Sammakia

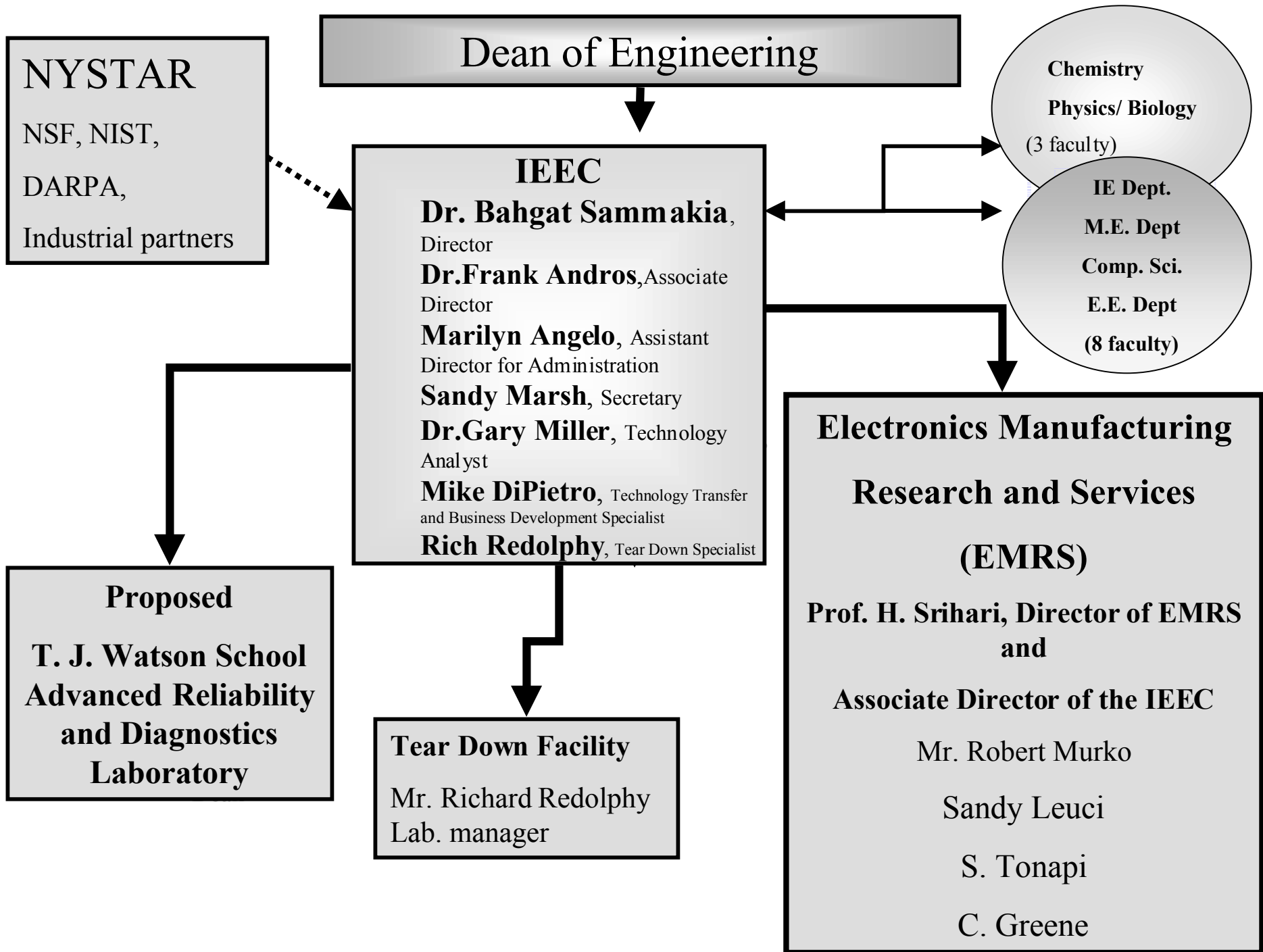
Director IEEC, Professor of Mechanical Engineering

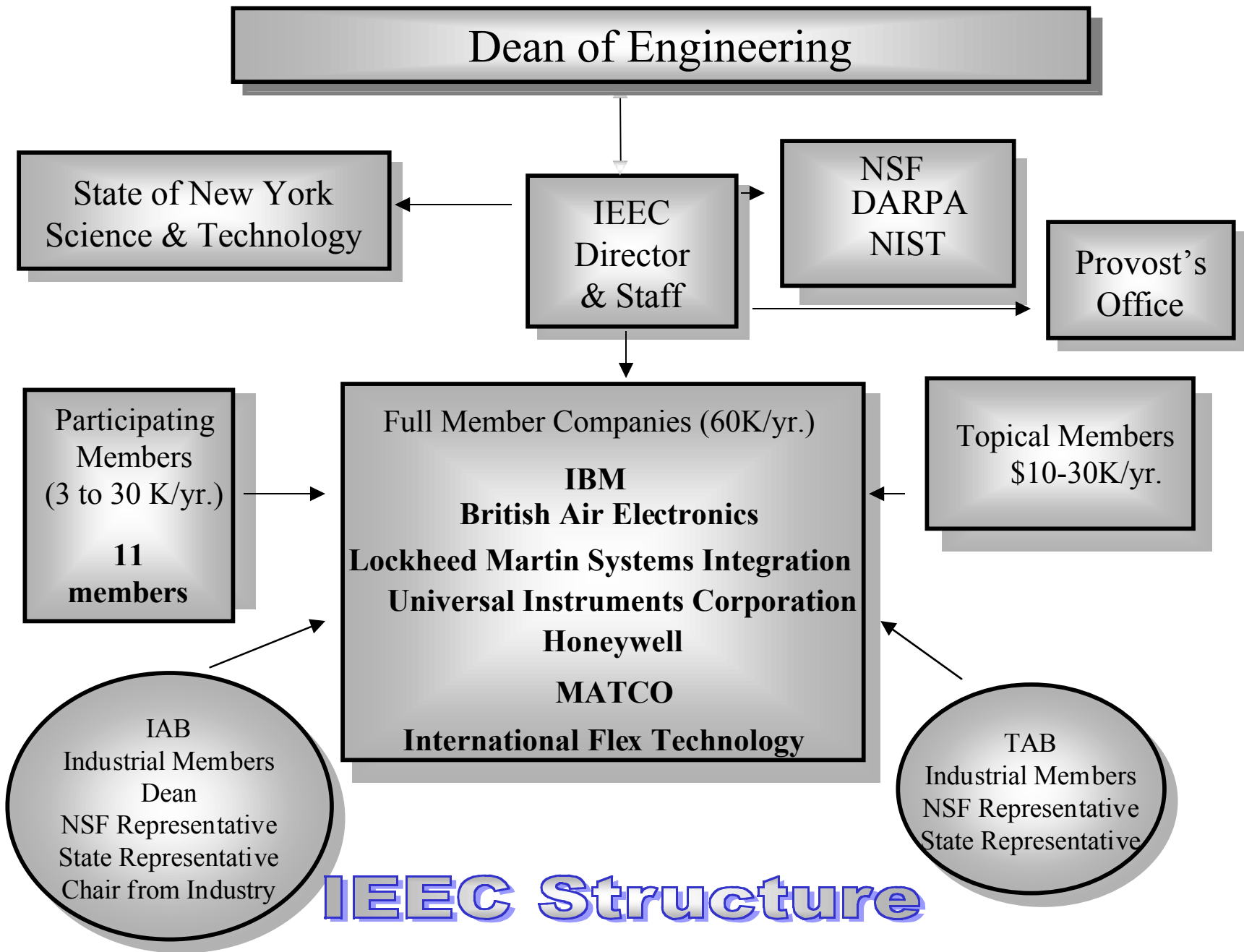
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- Introduction to the IEEC
- OEM to EMS shift
- Impact of R and D shift from an academic perspective
- Some Key areas for Academic participation
- Summary and Conclusions





# ELECTRONICS MANUFACTURING SERVICE PROVIDERS

## An Analysis

*A concise assessment of key issues*



MANUFACTURERS'  
SERVICES



THE **FUTURE** IN CONTRACT  
ELECTRONICS MANUFACTURING



SANMINA



State University of New York



Electronics Manufacturing Research And Services

# Our Goal

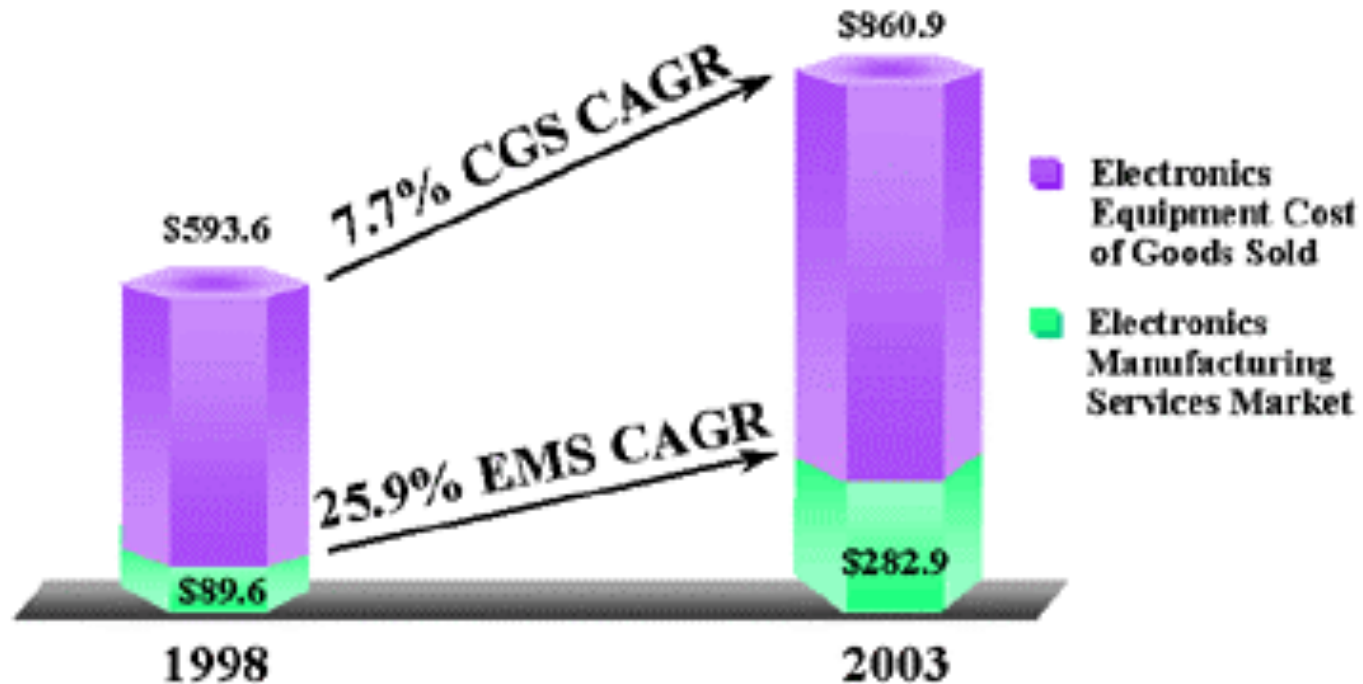
EMS Providers Should Increase their  
Competitiveness

It could be:

- Increasing Throughput
- Enhancing Yield
- Reducing Set-up Times
- Etc

# Outsourcing Trends

## The Outsourcing Trend Continues (US\$ in Billions)



Sources: Dataquest, December 1999

Technology Forecasters, Inc., September 1997\*

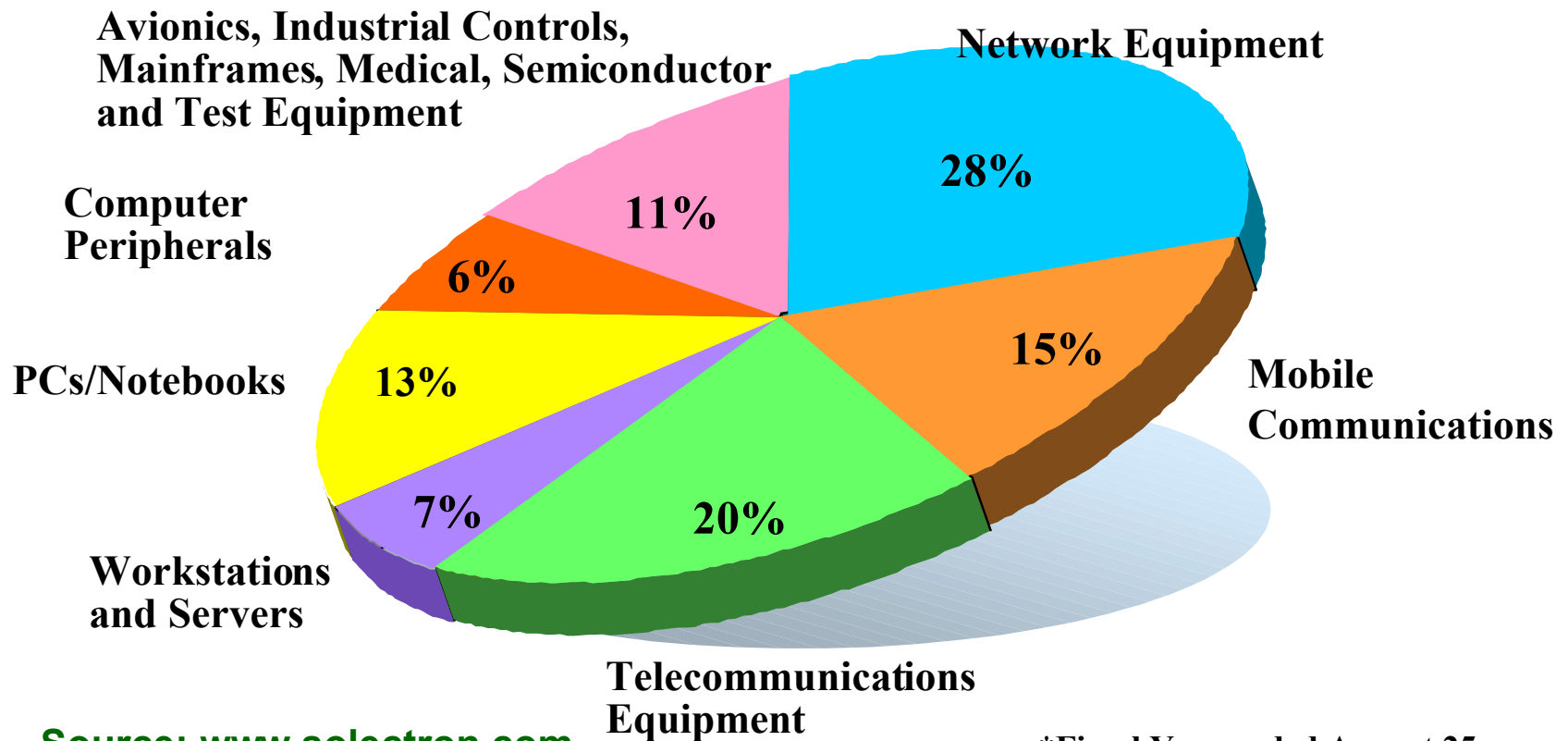
\*TFI has released an updated forecast which is under review.

Source: [www.solectron.com](http://www.solectron.com)

# Market Segments - Solectron

Serving a Broad Base of Demand

*Solectron Revenue Mix - Q4 Fiscal 2000\**

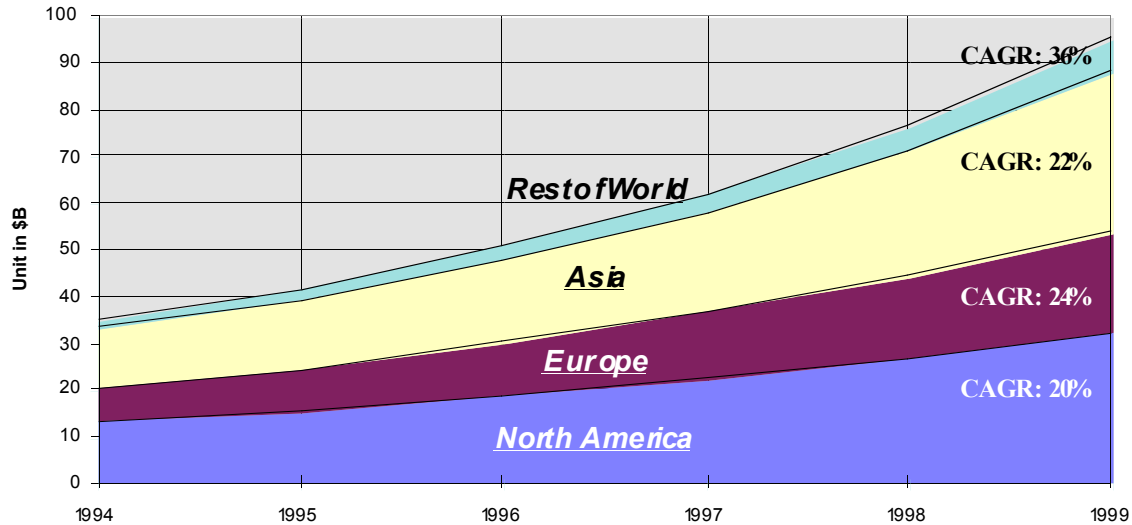


Source: [www.solectron.com](http://www.solectron.com)

\*Fiscal Year ended August 25

# Worldwide Outsourcing Trends

Contract Manufacturing Performed in Regions



	19 94	19 95	19 96	19 97	19 98	19 99
<b>North America</b>	13.2	15.2	18.6	22.3	26.6	32.1
<b>Europe</b>	7.4	9.3	11.6	14.3	17.7	21.8
<b>Asia</b>	12.7	14.9	17.8	21.7	27.1	34
<b>ROW</b>	1.6	2.2	2.9	3.8	5.2	7.2
<b>Total</b>	<b>34.9</b>	<b>41.6</b>	<b>50.9</b>	<b>62.1</b>	<b>76.6</b>	<b>95.1</b>

Source: Dataquest

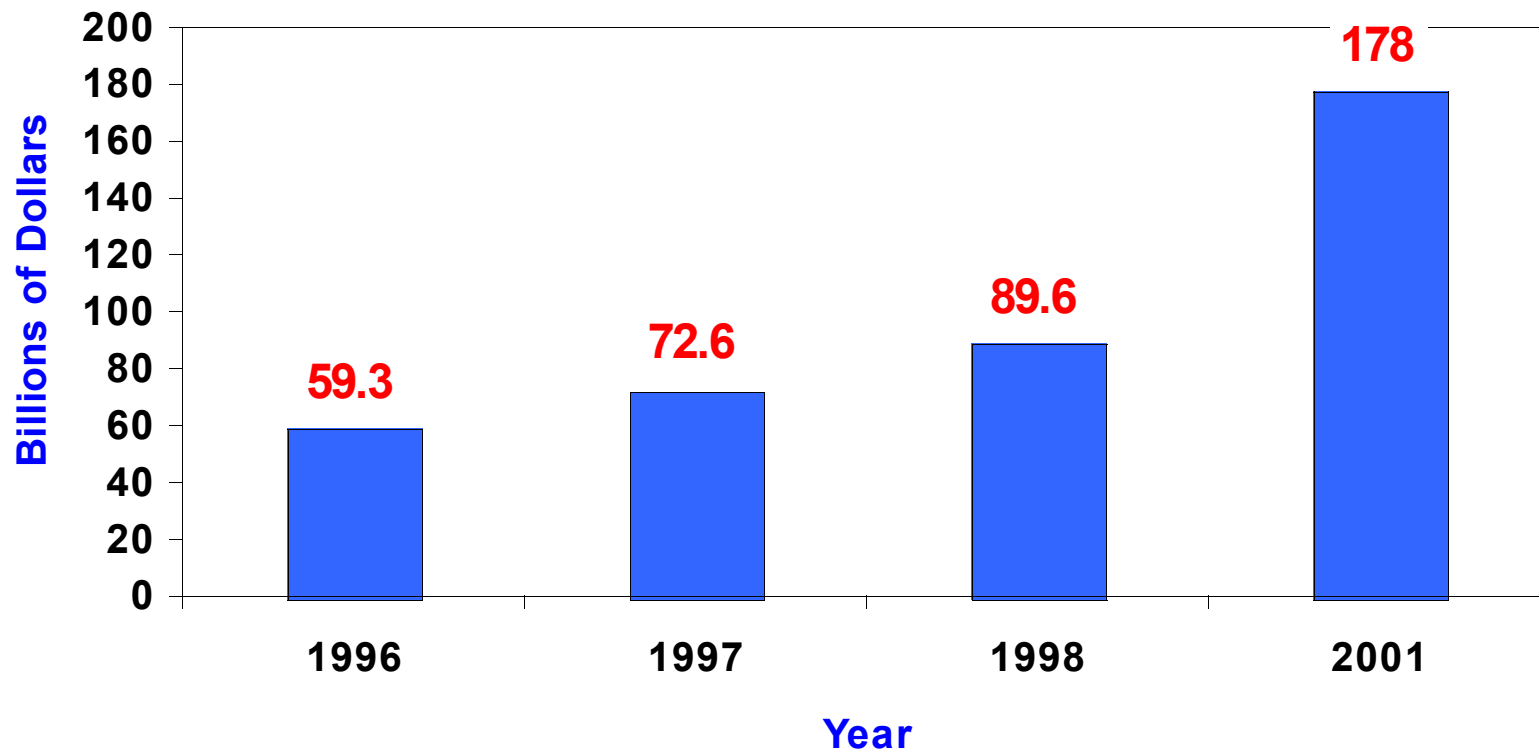
Source: NEMI Presentation, 1998

# Importance of EMS Providers

- Reducing Production Costs
  - Competitive environment for OEMs
  - OEMs require low-cost manufacturing solutions
  - EMS providers - manufacturing expertise and infrastructure
- Accelerating the Time-to-Market
  - Rapid technological advances
  - Shorter product life cycles
  - Reduce NPI time frames
  - Shortens product introduction cycles

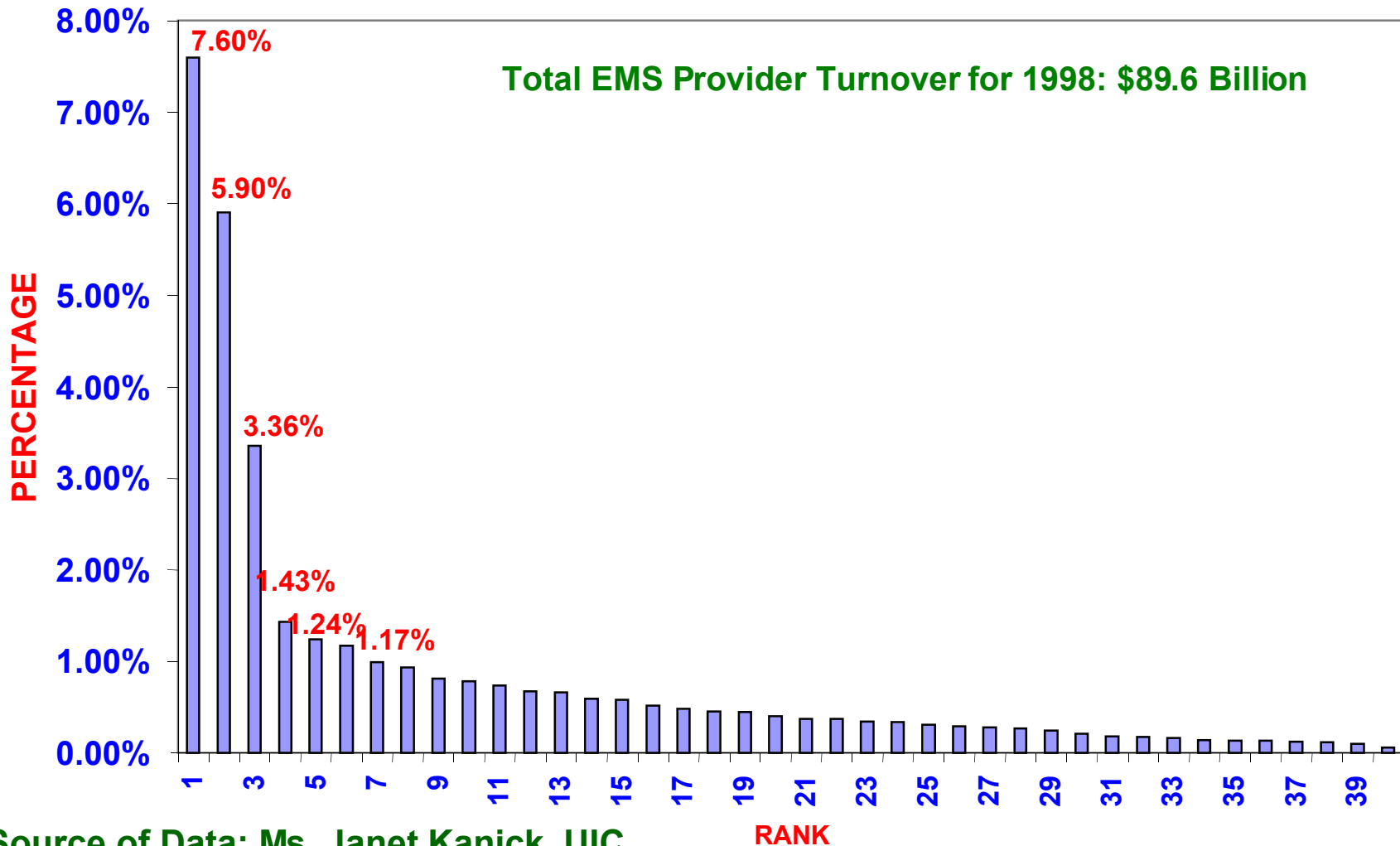
# FINANCIAL ANALYSIS

# Revenue of EMS Provider Industry



Source of Data: Ms. Janet Kanick, UIC

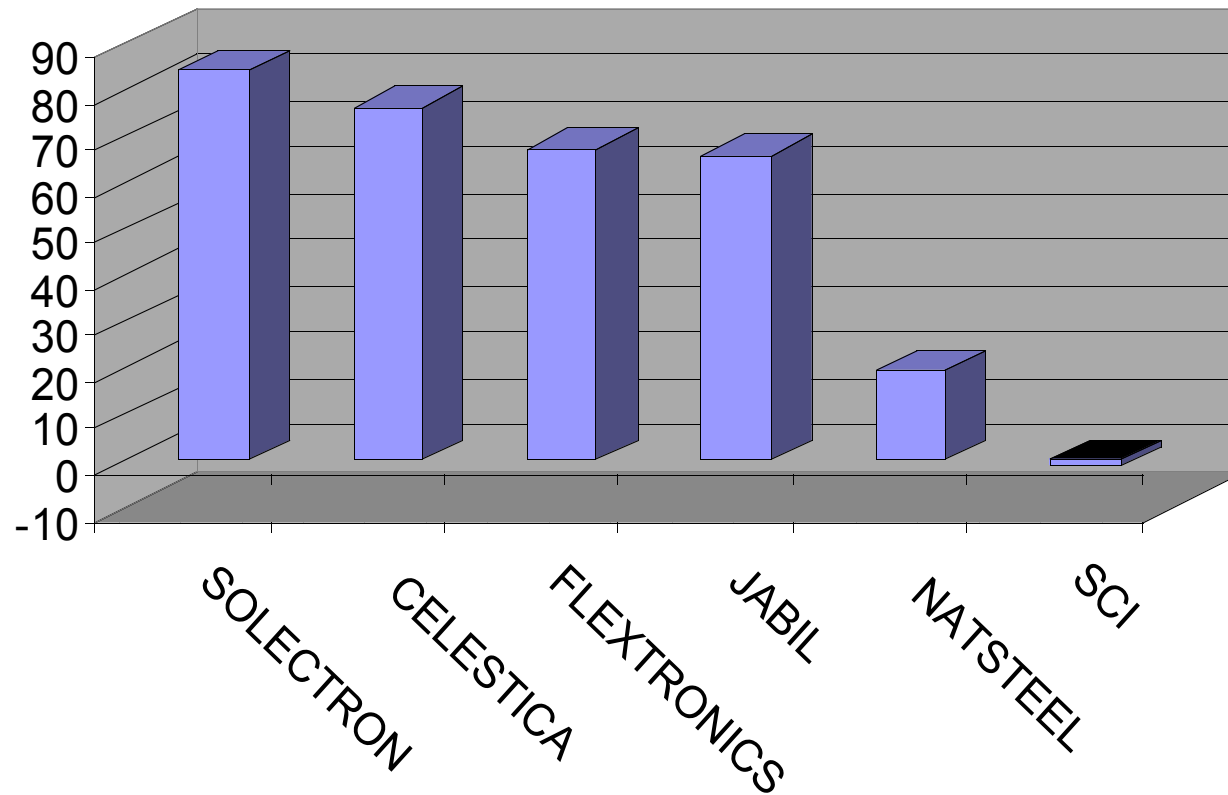
# Percentage Revenue of 'Top Forty' EMS Providers in 1998



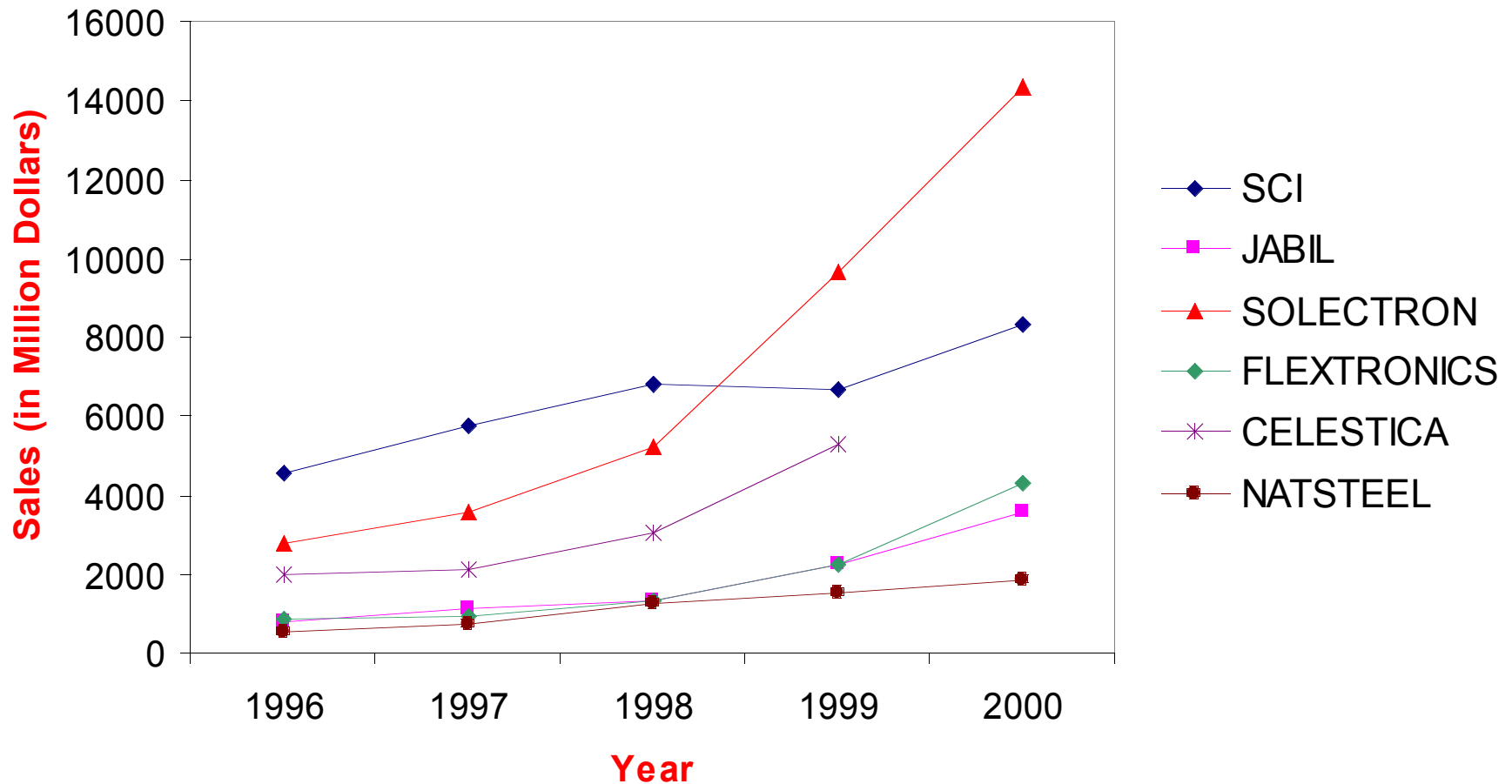
Source of Data: Ms. Janet Kanick, UIC

# Analysis of EMS Providers

Percentage Increase in Revenues of 1999 as Compared to 1998

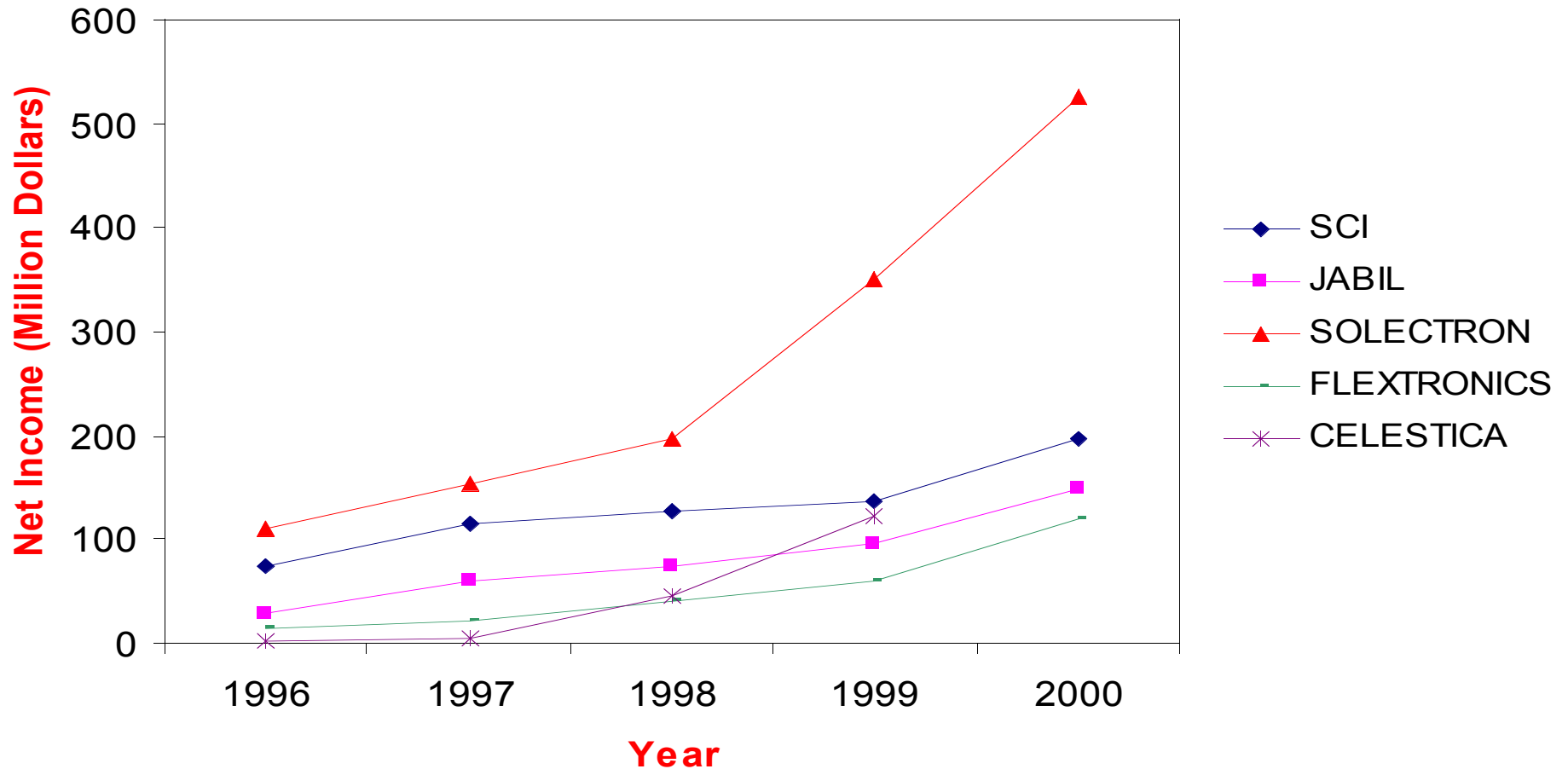


# Sales of 'Top Six' EMS Providers



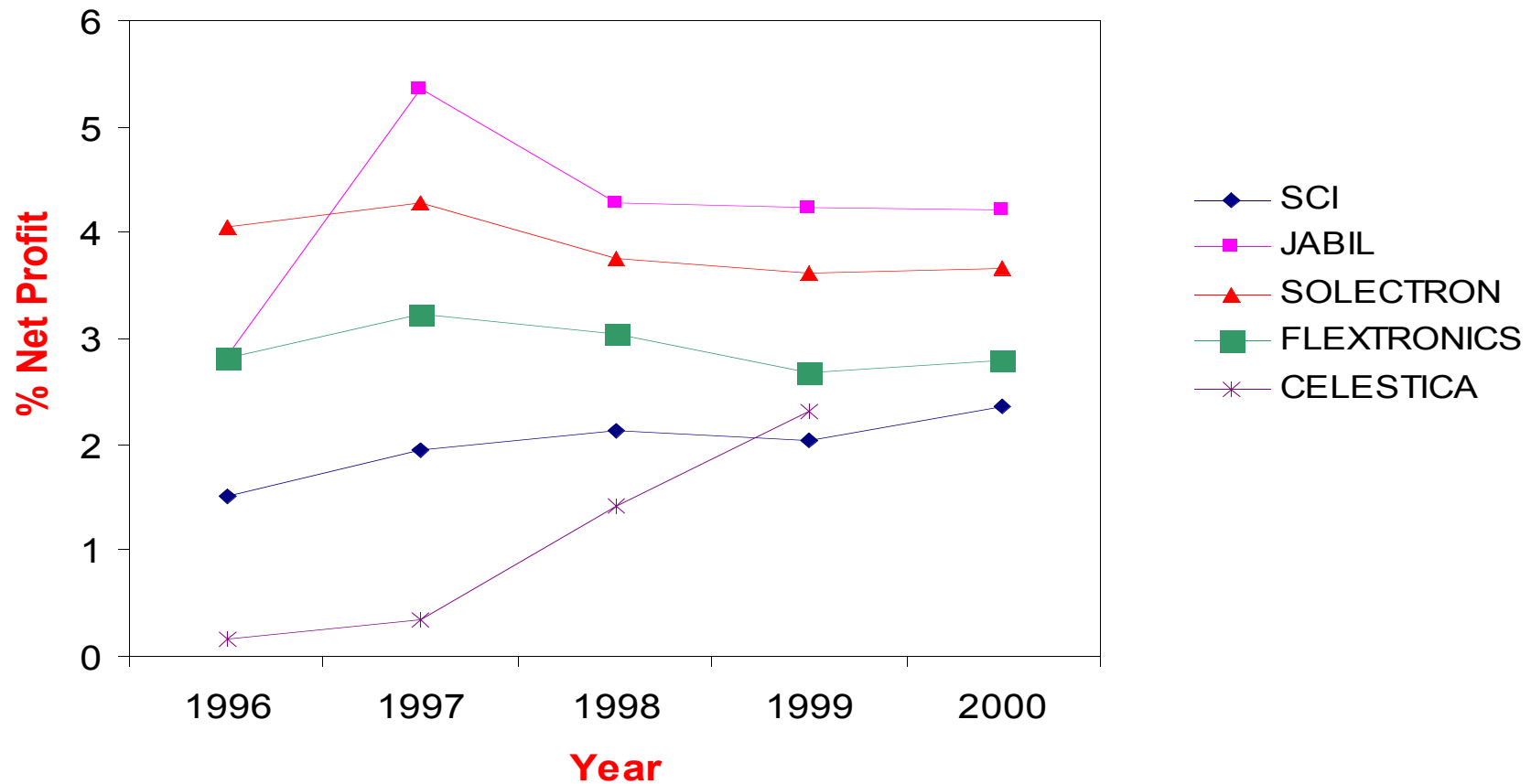
Source of Data: Ms. Janet Kanick, UIC

# Net Incomes of 'Top Six' EMS Providers



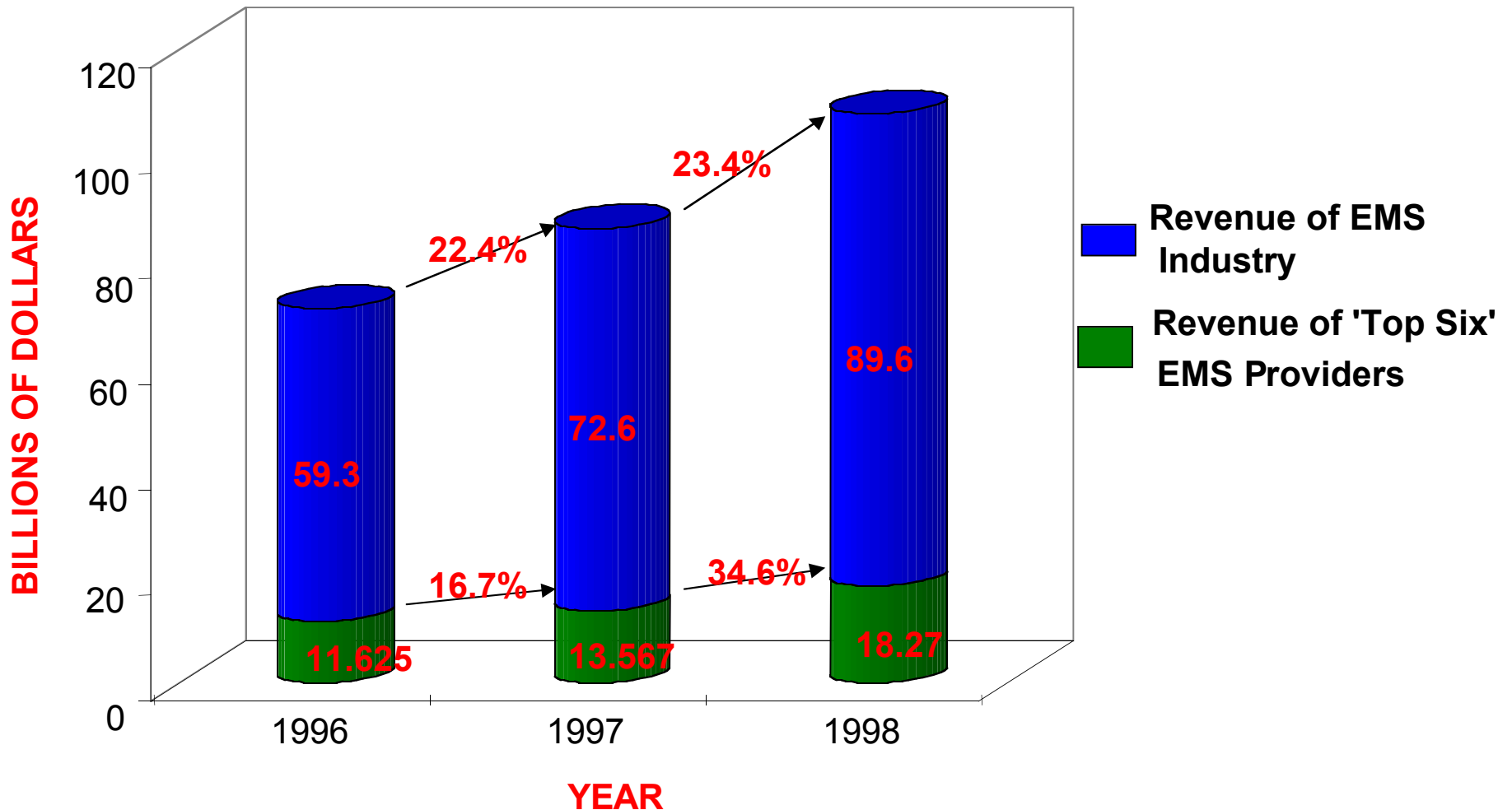
Source of Data: Ms. Janet Kanick, UIC

# Percentage Net Incomes of 'Top Six' EMS Providers



Source of Data: Ms. Janet Kanick, UIC

# Revenue of 'Top Six' EMS Providers versus the EMS Industry



Source of Data: Ms. Janet Kanick, UIC

# Inferences

- 'Top Six' EMS Providers - More Than 20% Growth in Sales in Last Three Years
- 'Top Five' EMS Providers - More Than 50% Growth in Sales in 1999 as Compared to 1998
- Share of the 'Top Six' EMS Providers - Growing Faster Than the Rate of Growth of the Total EMS Industry
- Growth of Other EMS Providers - Not as Rapid

# Key to Success

**‘Manufacturing Efficiency’**

# Critical Success Factors

**Rapid Time to Market & First to Market**

**Manufacturing Capacity**

**Yield Improvement & Time to Asymptotic Yields**

**Research and Development**

**Assembly Processes**

**Global Presence**

**Breadth of Services**

**Rigorous Quality Systems**

**Flexibility**

**New Product Introduction Centers**

**Factory Information Systems**

**Supply Chain Management**

**Modeling and Simulation**

**Box Build Capabilities**

**One-Stop Shop**

# Rapid Time-to-Market & First-to-Market

- Short Product Life - Product Life was 36 Months or More; Today - Product Life is Three to Six Months
- Product Demand - Few Weeks to Months Instead of Years
- Reason for Intel's Copy Exactly and/or Functional Equivalent
- Need to Meet Constraints Imposed by Market Window
- New Product Introduction Centers

# Yield Improvement & Time to Asymptotic Yield

- By 2009, Final Assembly is Looking for < 4hrs to Asymptotic Yield and Board Assembly wants to be there at Start Up
- At the Current Time, Solectron Produces 60,000 units of Completed PCs per month, 20 weeks from the Starting of a Project
- New Product Introduction Center/Product Introduction Center

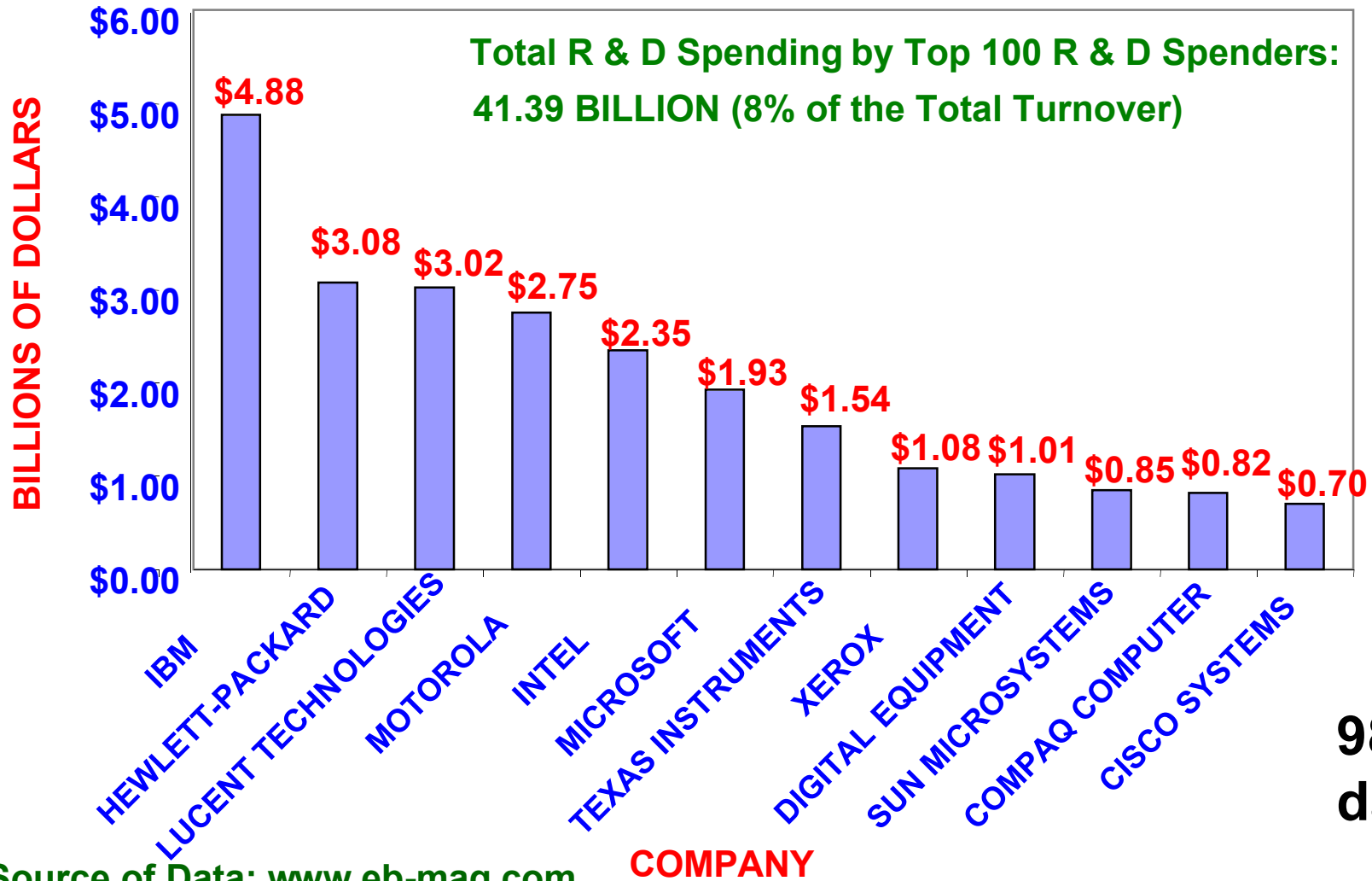
# New Product Introduction Centers

- Locations
  - Solectron at Tokyo,
  - Celestica's Customer Gateway Centers in Santa Clara, CA; Raleigh, NC; Fort Collins, CO; Toronto, ON; and Kidsgrove, UK with future plans for sites in Texas, New England, the Far East and Europe
  - Locations worldwide - 24 hour design
- Insure that New Designs can be Implemented on Production Lines
- DFA/DFM/DFT/Design for Supply Chain Management - DFx

# Research and Development

- EMS Providers are Becoming Responsible for R&D - New Model for Technology Development
  - Old development models will not be effective
  - Technology partnership between OEMs, EMS providers and their supply chain is needed
    - Through horizontal partnership or research consortia
    - Important - In the past OEMs developed 'new technology'
    - EMS providers must take responsibility for applied research
- OEMs have Spent 8% of their Total Turnover on R&D

# R&D Spending by Some OEMs



98  
data

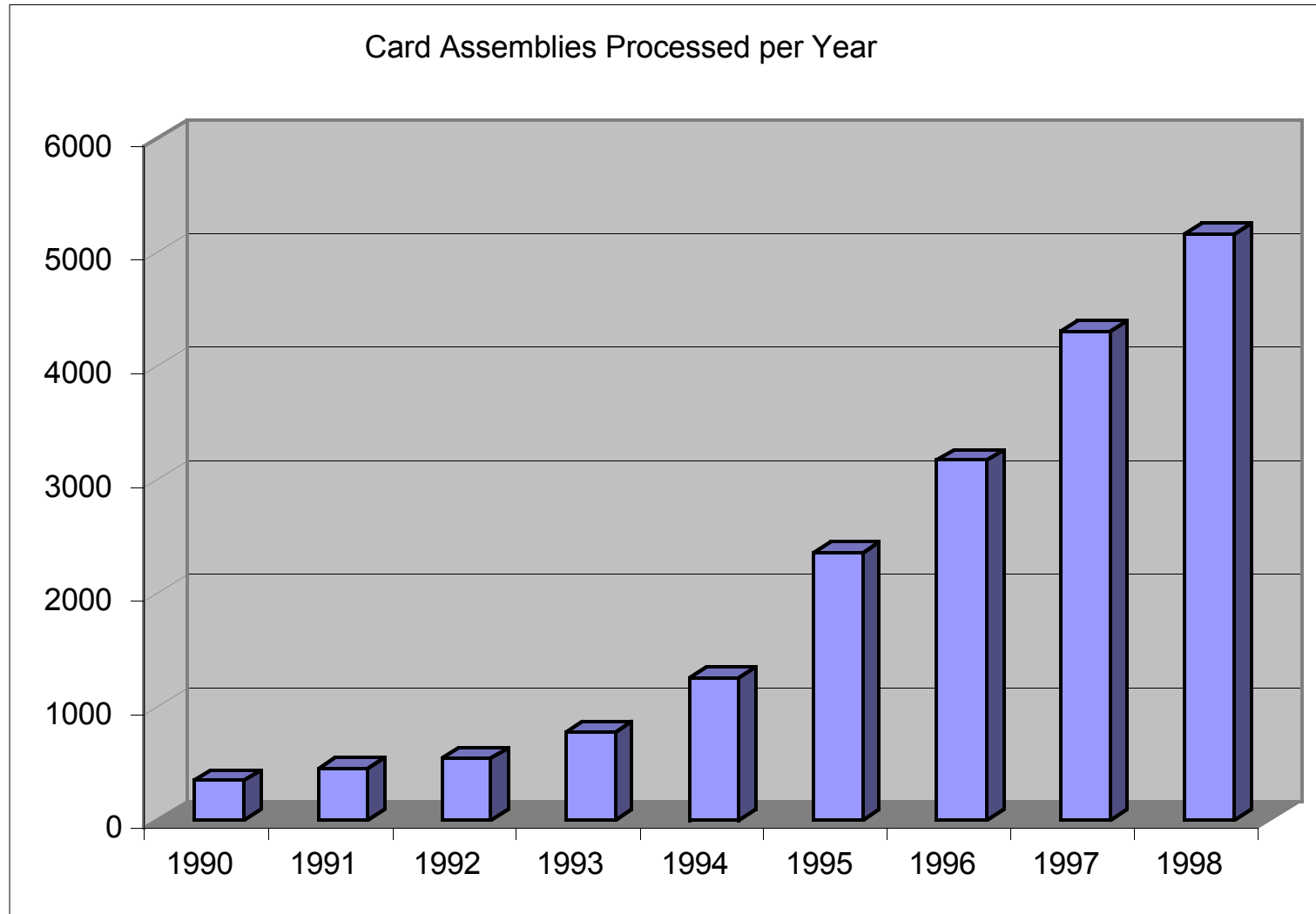
Source of Data: [www.eb-mag.com](http://www.eb-mag.com)

COMPANY

# Research and Development

- At the Current Time, EMS Providers Spend Less than 1% on R&D
- Jabil Circuits Spent \$1.1 Million on R&D out of a Turnover of \$1.2 Billion
- The 'Gap' is Estimated to be in Hundreds of Millions

# Number of Designs - Celestica

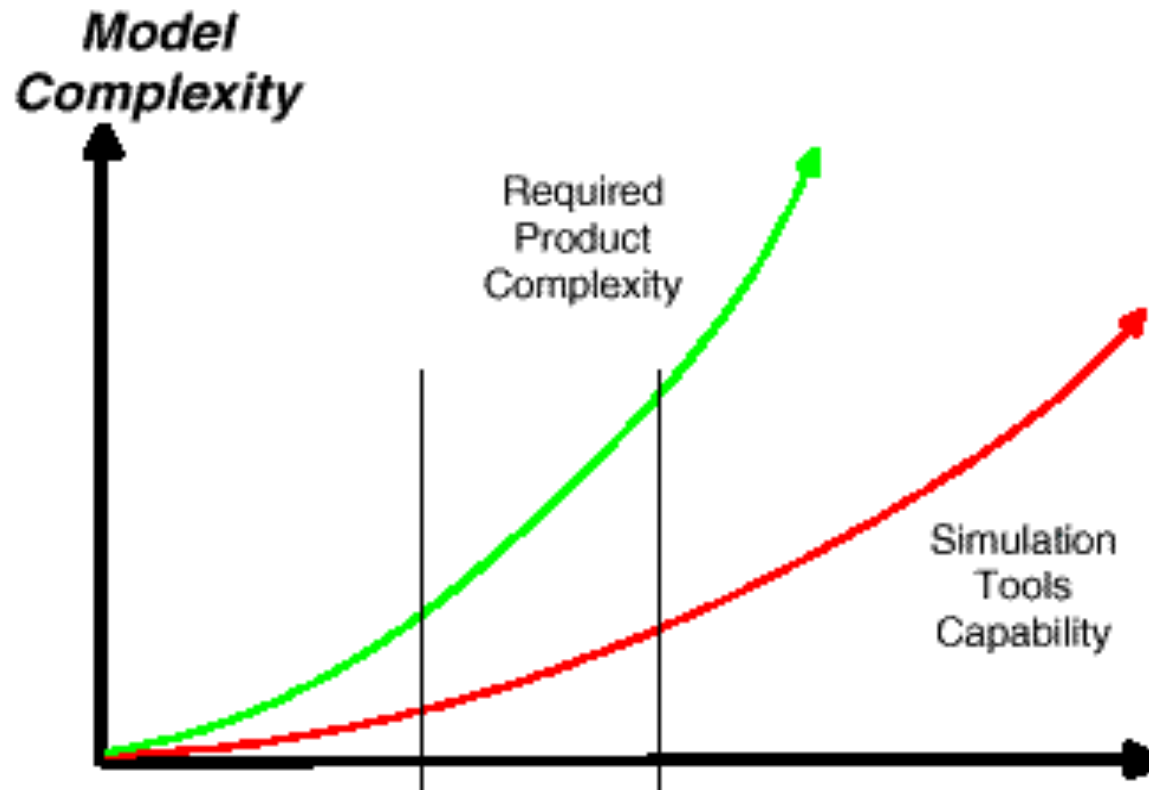


Source: Minchella. J, Celestica

# Modeling and Simulation - Drivers

- Why is Modeling and Simulation Important ?
  - Product complexity - increasing
  - Product size, weight and power consumption are all decreasing
  - Time to market - decreasing
  - Need for ‘virtual prototyping’
  - Product cost must be controlled in initial product design; ‘cost reduction re-designs are scarce’
  - Environmental requirements

# Simulation and Modeling



Source: NEMI Roadmap, 1998

# Modeling, Simulation and Design

- Product Modeling and Simulation
  - Design intent is expressed and design functionality is assessed
- Process Modeling and Simulation
  - Fabrication is expressed and ability to manufacture is assessed
- Enterprise Modeling and Simulation
  - Extended enterprise is expressed and decision hypothesis is assessed

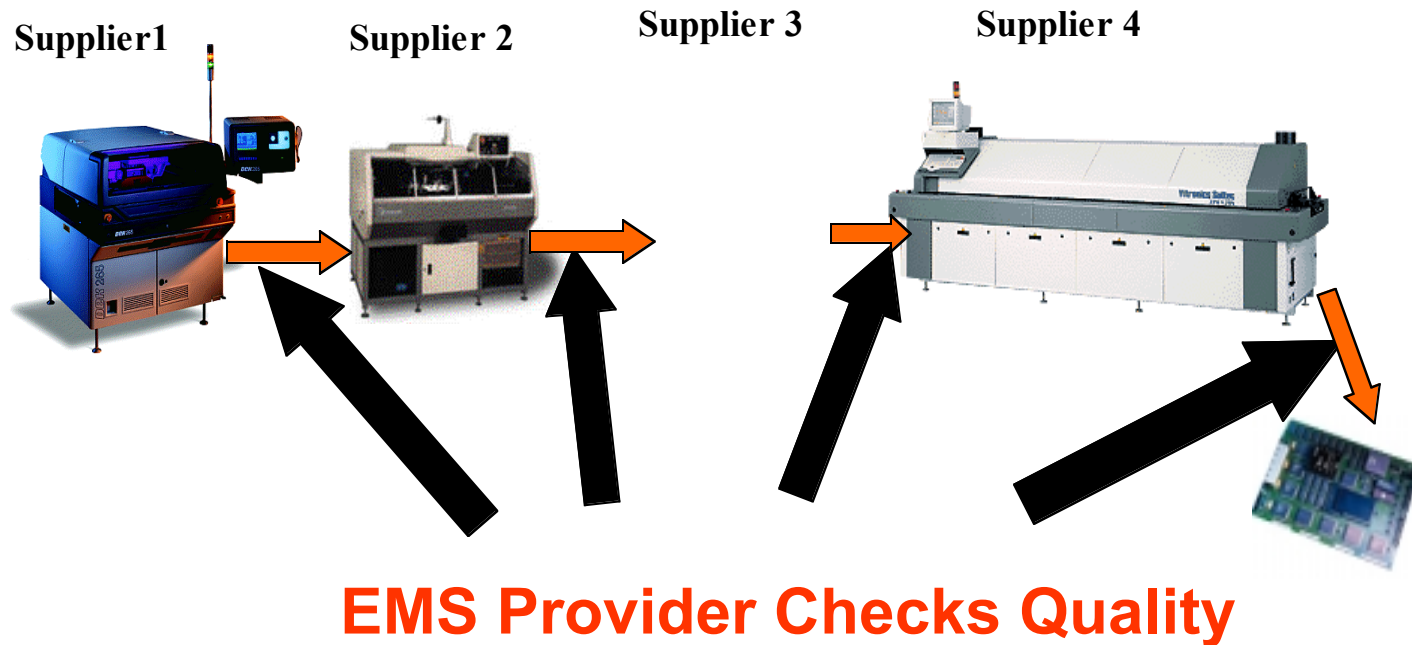
# Simulation

- Manufacturing Systems Simulation
  - Job release and production scheduling
  - Assess the layout of a line and/or facility
  - Predicting personnel allocations
  - Procurement practices
  - Evaluate different options within the placement machine
- Design/Electrical Simulation
  - Component, board, system
- Mechanical Issues
  - Thermal
  - Reliability

# A New Trend

- Modular Manufacturing
  - All suppliers under one roof
  - Suppliers on production line
  - Faster NPI
  - Easy maintenance of cells
  - Cost reduction reported to be significant
  - Examples - Volkswagen, Ford, GM in Brazil

# Modular Manufacturing in EMS Providers



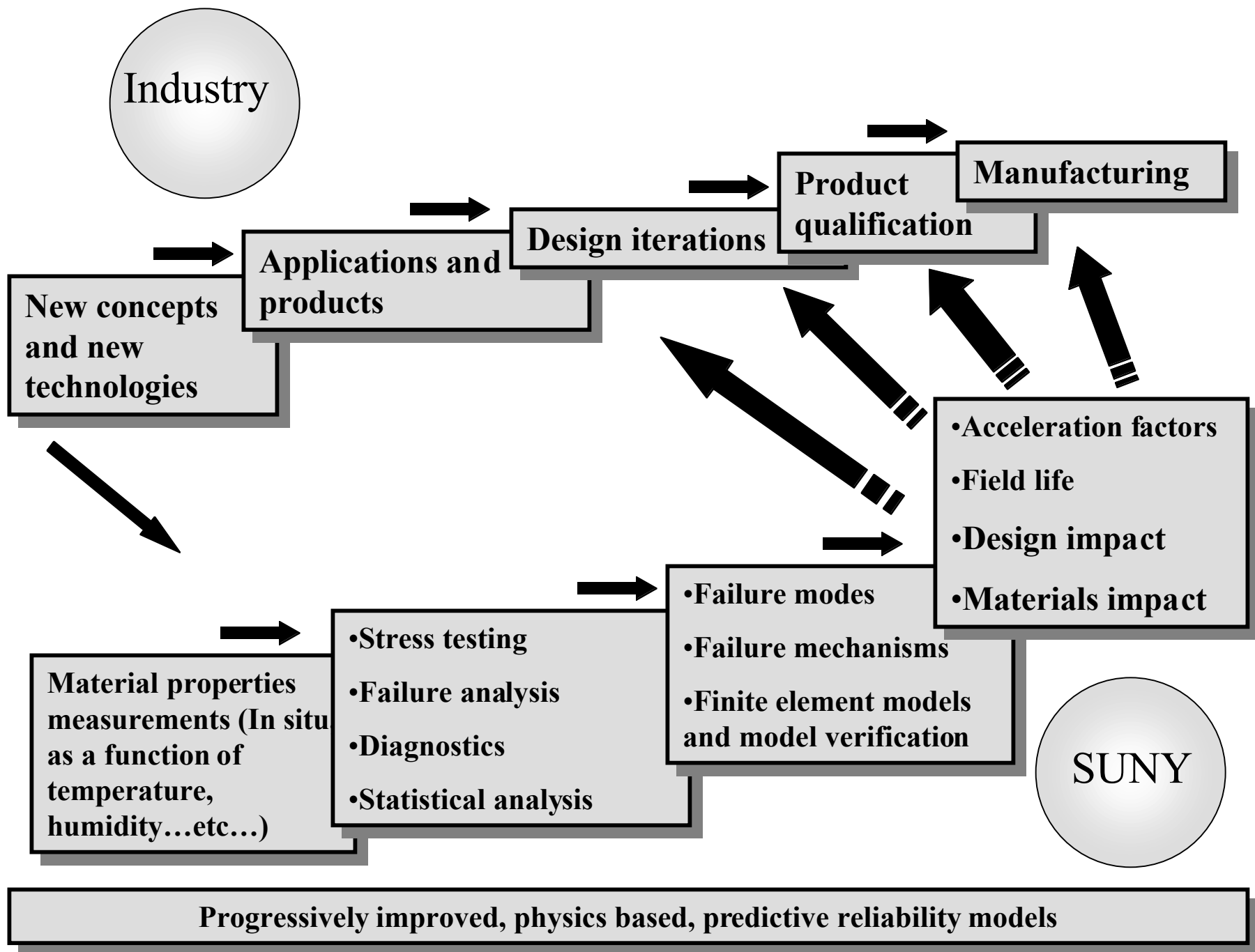
# Modular Manufacturing in EMS Providers



**Product Management and NPI in Modular Organization**

# Conclusion

- Our goal - EMS Providers Should Enhance Their Competitive Position
- CSFs of EMS Providers
  - Several
  - Identify and impact those on which we can make a difference
- Support Services for EMS Providers
  - Focus on strengths and address weaknesses
  - Implement a wide array of support mechanisms



**Current research Thrust areas:**

- Electrical analysis
- Mechanical analysis and testing
- Thermal analysis and testing
- Solder science
- Underfill science
- Micromechanics
- Photomechanics
- Failure mechanisms
- Acceleration factor determination

**Some key research extension areas:**

**MEMS:**

- Packaging
- Failure Mechanisms

**Photonics:**

- Packaging
- Failure Mechanisms

**Biotechnology/Biomedical:**

- Packaging issues
- Failure mechanisms

**Lead free solder:**

- Metallurgical issues
- Failure mechanisms

**Conductive adhesives:**

- Failure mechanisms
- Stress acceleration factors

## Conclusions/Recommendations

- University industry interactions will have an important role in the 'NEW' manufacturing environment
- Nature of the work is multi disciplinary
- Consortia/centers may provide best vehicle
- New approaches: cooperation in a competitive environment
- Academics need to understand business protocols
- Industry needs to understand academic measurements

