

The MEMS Supply Chain: Challenges and Opportunities



Mike Pinelis, Ph.D.
Founder and CEO

iNEMI MEMS Workshop
"Driving Next Level Results Through Collaboration"
May 10, 2012

- **Introduction**
- **The “big picture”**
- **Ongoing major trends**
- **Challenges**
- **Collaboration Opportunities**

Goal for today's talk – stimulate discussion around the topic of **MEMS supply chain**

Key questions:

- where is it strong and not so strong?
- opportunities and gaps that could be filled through collaboration?

Introduction



About MEMS Journal, Inc.

- founded in 2003; published over 8,500 stories, interviews and articles; reviewed more than 22,000 patents and patent applications
- 35 full-time and part-time staff; HQ in Detroit, Michigan; currently 4 employees in Silicon Valley
- largest MEMS publication worldwide; 21,200+ subscribers; growing quickly
- services include -- **recruiting** (220+ recruiting searches; assisted 1,400+ professionals), **market research** (developed a library of 25+ reports and databases on MEMS and related topics), **events** (sponsor 20-25 events and organize 4-5 events per year), **consulting** (strategy, marketing, operations), **IP brokerage** (buy, sell, license MEMS and sensors patents)

- Introduction
- **The “big picture”**
- Ongoing major trends
- Challenges
- Collaboration Opportunities

What is the MEMS supply chain?

Design

Make

Sell

Key Players

Fabless companies
IDMs
Design houses
Universities
Government labs
Corporate R&D

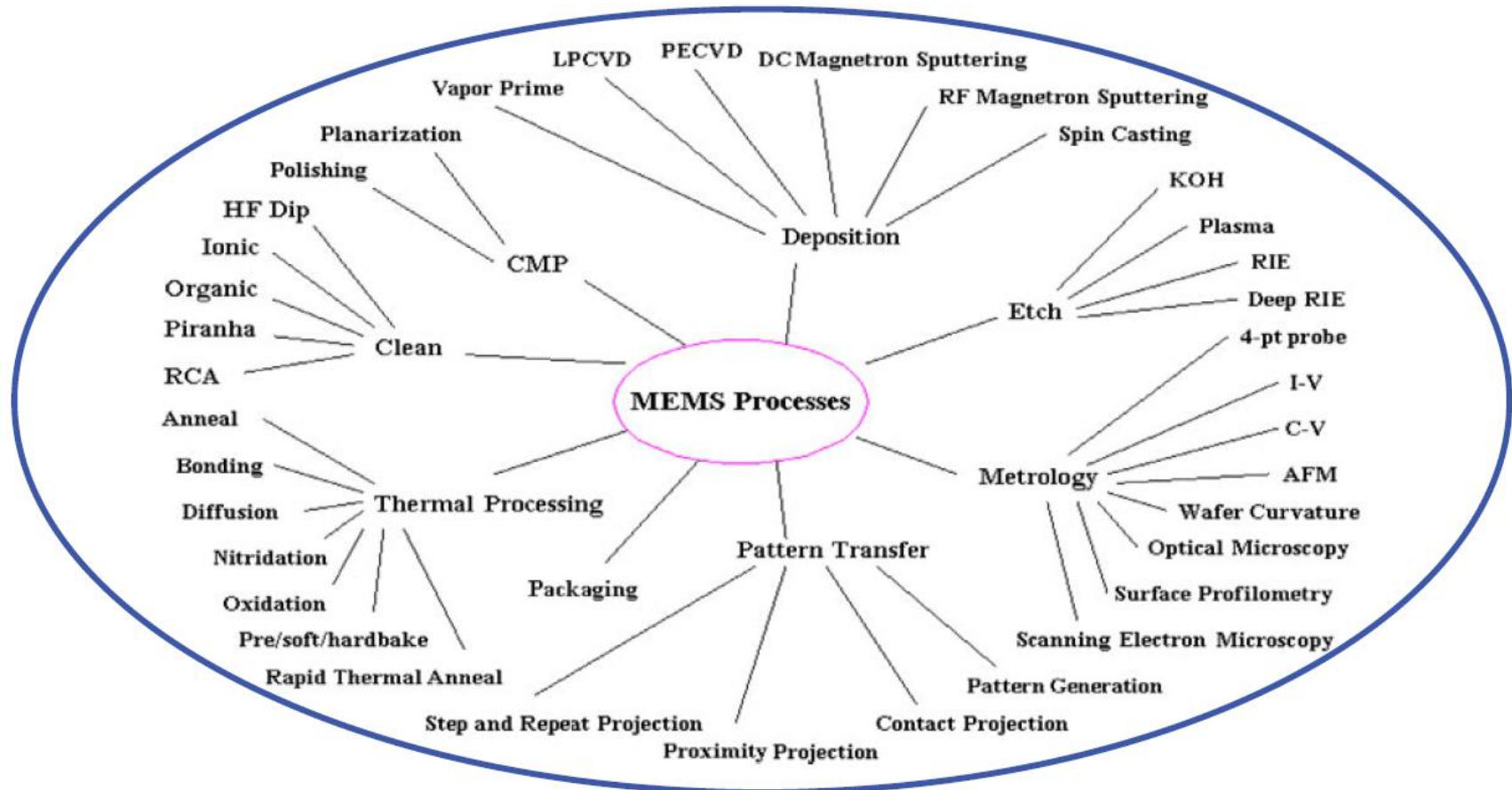
MEMS and IC fabs
IDMs
OSATs

Fabless companies
IDMs
Distributors
Sales reps

Key Questions

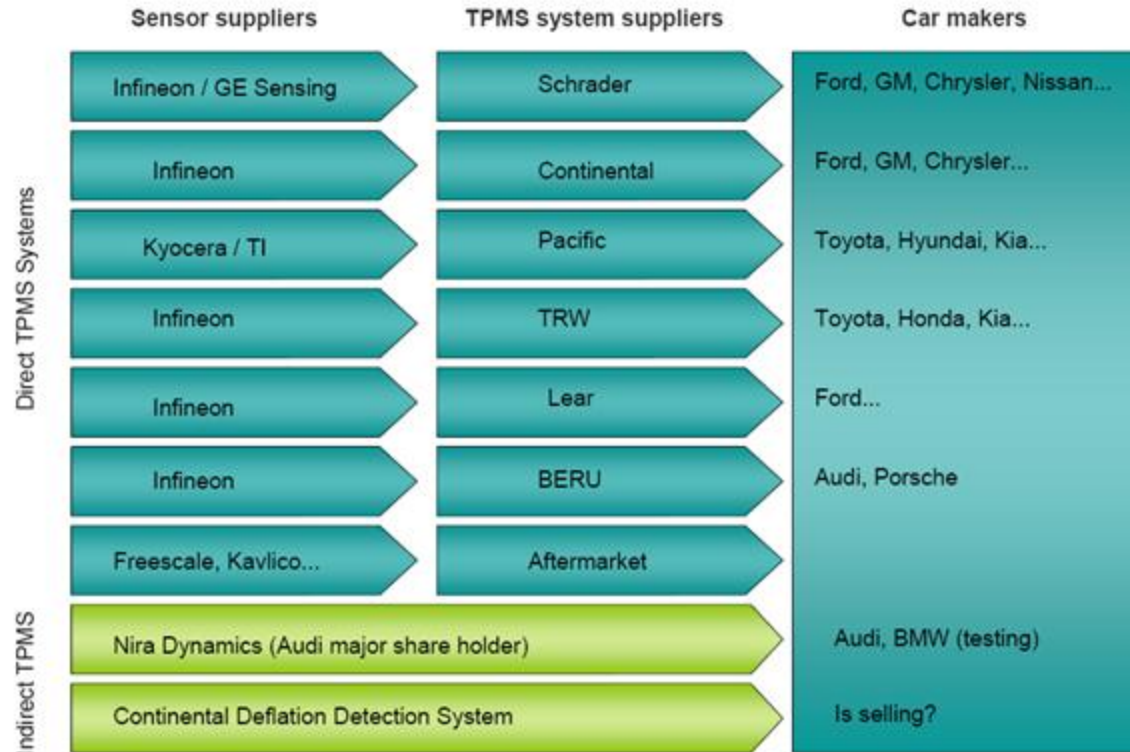
- 1) What do design? Which technologies to develop?
- 2) How to make? How much and when?
- 3) How to sell? To whom?

Example: Process Selection



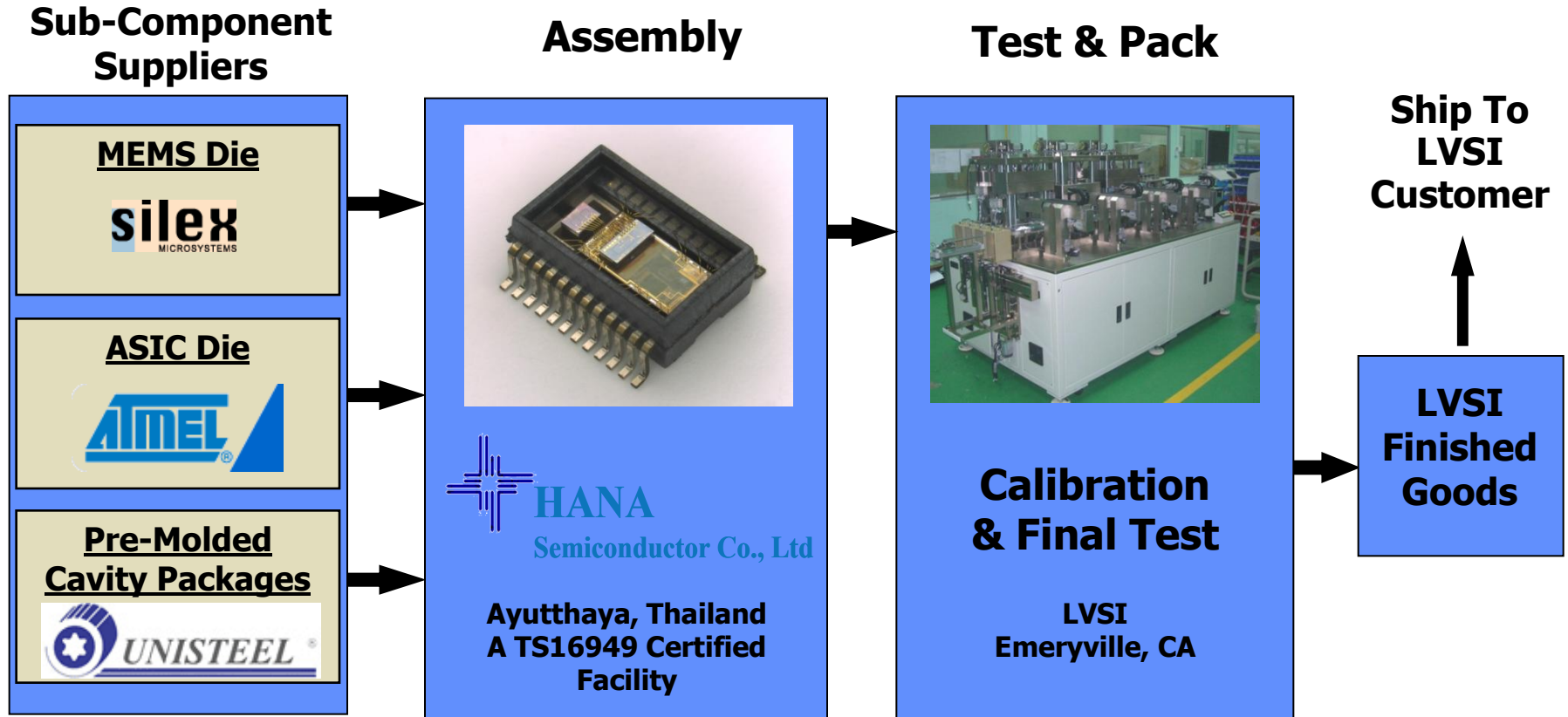
Source: Xuan Zha et al, Singapore Institute of Manufacturing Technology, 2003

Example: TPMS Supply Chain



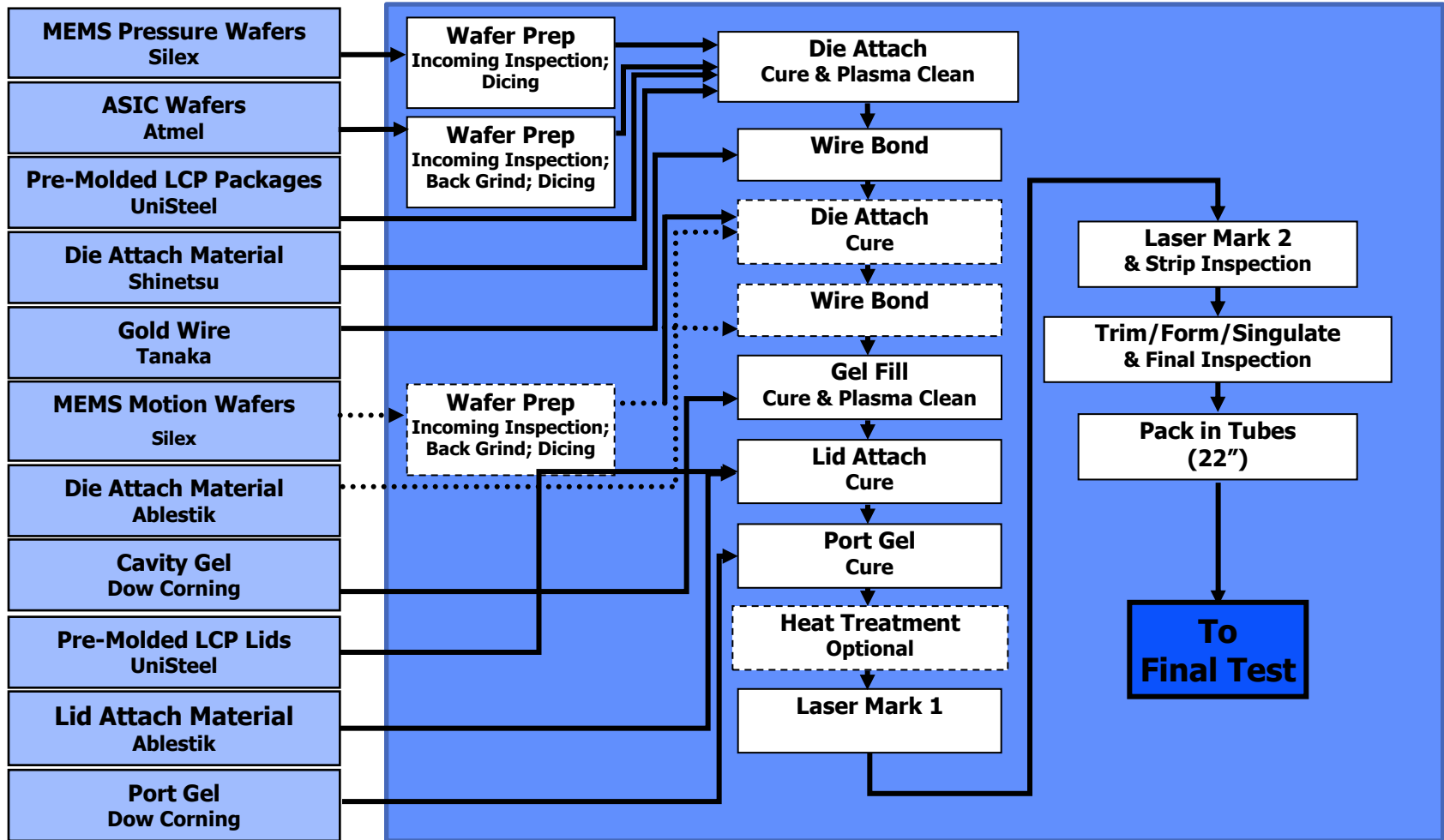
Source: iSuppli, 2008

Example: LV Sensors



Source: MEMS Journal, 2011

Example: LV Sensors



Source: MEMS Journal, 2011

- Introduction
- The “big picture”
- **Ongoing major trends**
- Challenges
- Collaboration opportunities

Major Trends



- Globalization
- Increasing pace of innovation (for new products)
- Price erosion (for mature products)
- Increasing product complexity
- Consolidation

Partially based on analysis from Oracle and Global Semiconductor Alliance conducted in 2010

Globalization

Existing Players

US, Canada,
Europe, Japan,
Taiwan, Korea,
Singapore

Emerging Players

China, India, Russia,
Malaysia, Brazil,
Vietnam, Middle
East



Existing Players

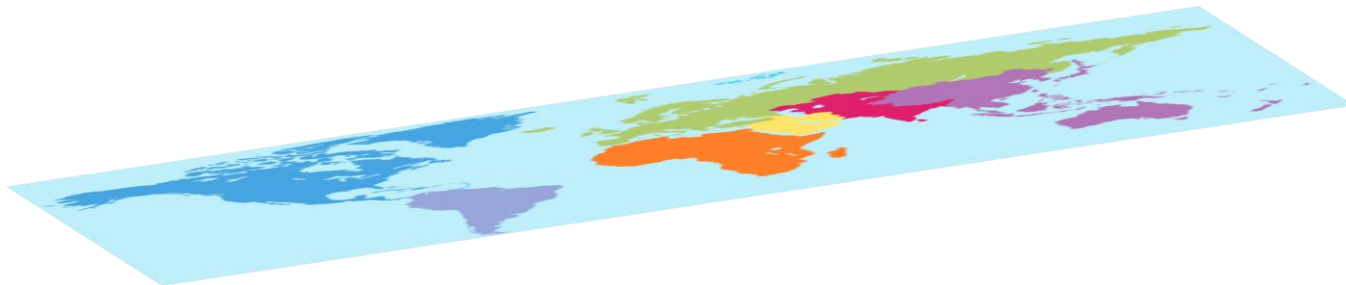
US, Canada,
Europe, Japan,
Taiwan, Korea,
Singapore

Emerging Players

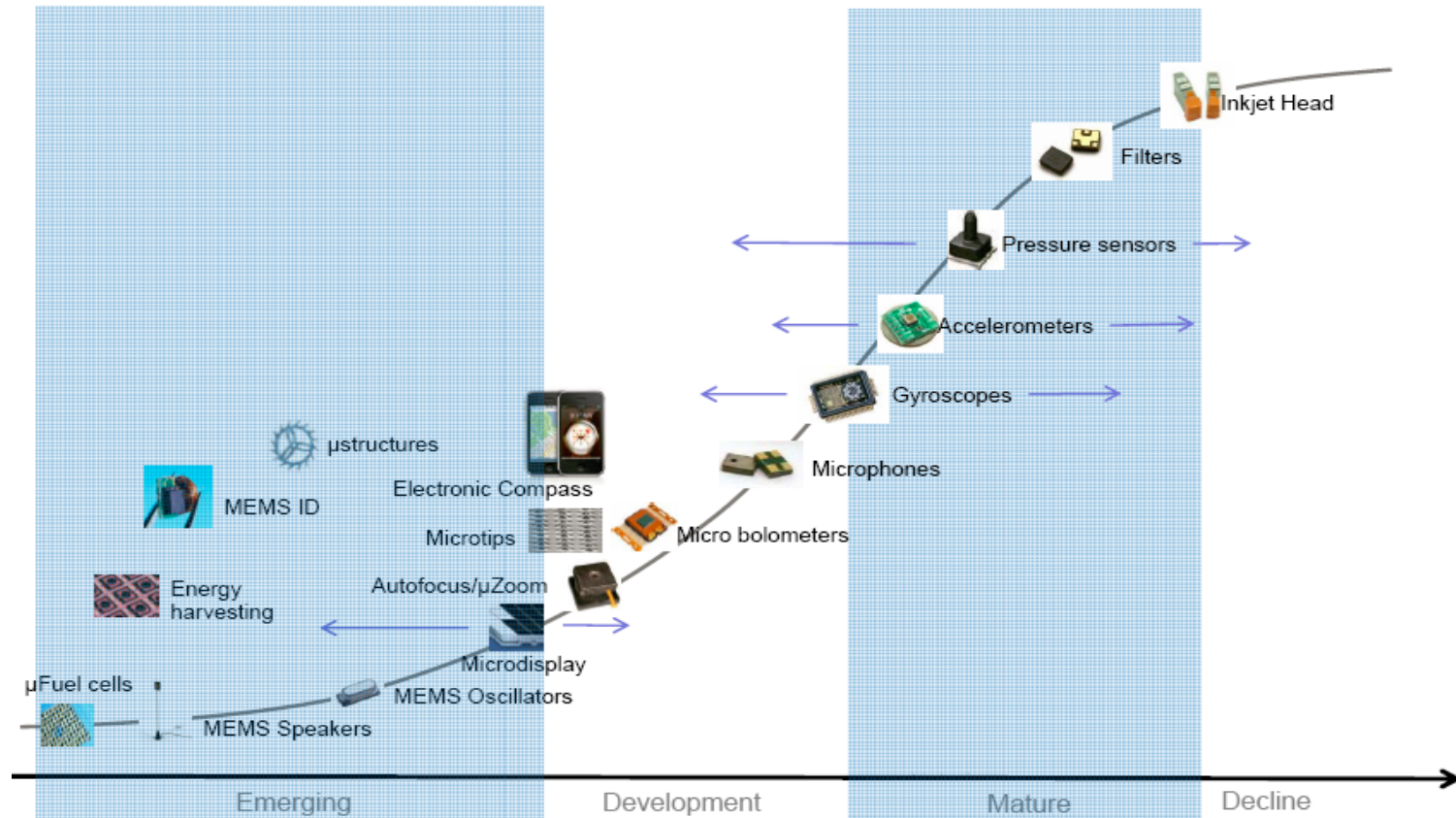
China, India, Russia,
Malaysia, Brazil,
Vietnam, Middle
East

Questions

Labor costs and currency differentials
IP and patents
Vertically integrated vs. global/fragmented
Education and training



MEMS products phase of development



Source: Yole Developpement, 2010

Increasing Pace of Innovation



Main drivers

- “one device – one process” paradigm becoming obsolete
- MEMS foundries increasingly developing standardized process modules
- better collaboration tools
- faster information exchange
- open (free) design tools more available
- more developed talent pool
- economic slowdown and globalization have resulted in productivity gains

Outcomes

- MEMS device design cycles are now 6-12 months (vs. 2-5 years a decade ago)
- Cost to launch fabless MEMS company now \$2-3 million (vs. \$15-50 million a decade)
- **MEMS 2.0 Startups** – faster product shipments, revenues, exit events

Source: MEMS Journal, 2012

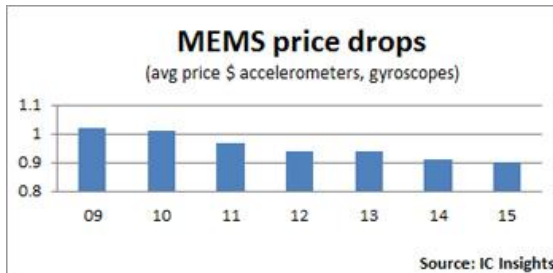
Price Erosion

Main drivers

- higher volumes
- larger substrate sizes
- automation
- process integration
(CMOS MEMS, 3D packaging)
- “canned” process modules
- die size reduction

Sensor Type	Cost Range	Suppliers
MEMS gyro (2 or 3 axis)	< \$0.70 per axis	ST Micro InvenSense Epson
MEMS accelerometer (3 axis)	< \$0.20 per axis	ST Micro VTI ADI Freescale
Magnetometer (3 Axis)	< \$0.70 per axis	Honeywell AKM
MEMS pressure sensor	< \$1.50	Bosch

Copyright 2011 MEMS Journal, Inc.



Price Erosion

Main drivers

- higher volumes
- larger substrate sizes

Sensor Type	Cost Range	Suppliers
MEMS gyro (2 or 3 axis)	< \$0.70 per axis	ST Micro InvenSense Epson
		ST Micro VTI ADI Freescale
		Honeywell AKM
		Bosch

MEMS price drops
(avg price \$ accelerometers, gyroscopes)

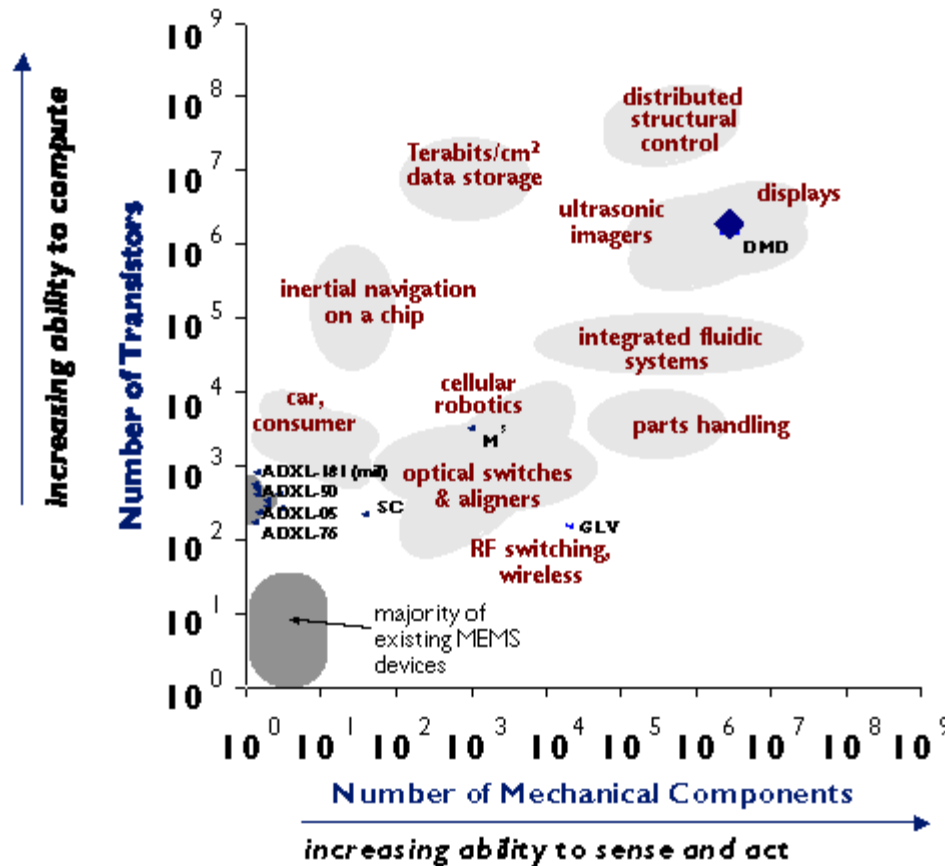


data is from 2011

Source: IC Insights

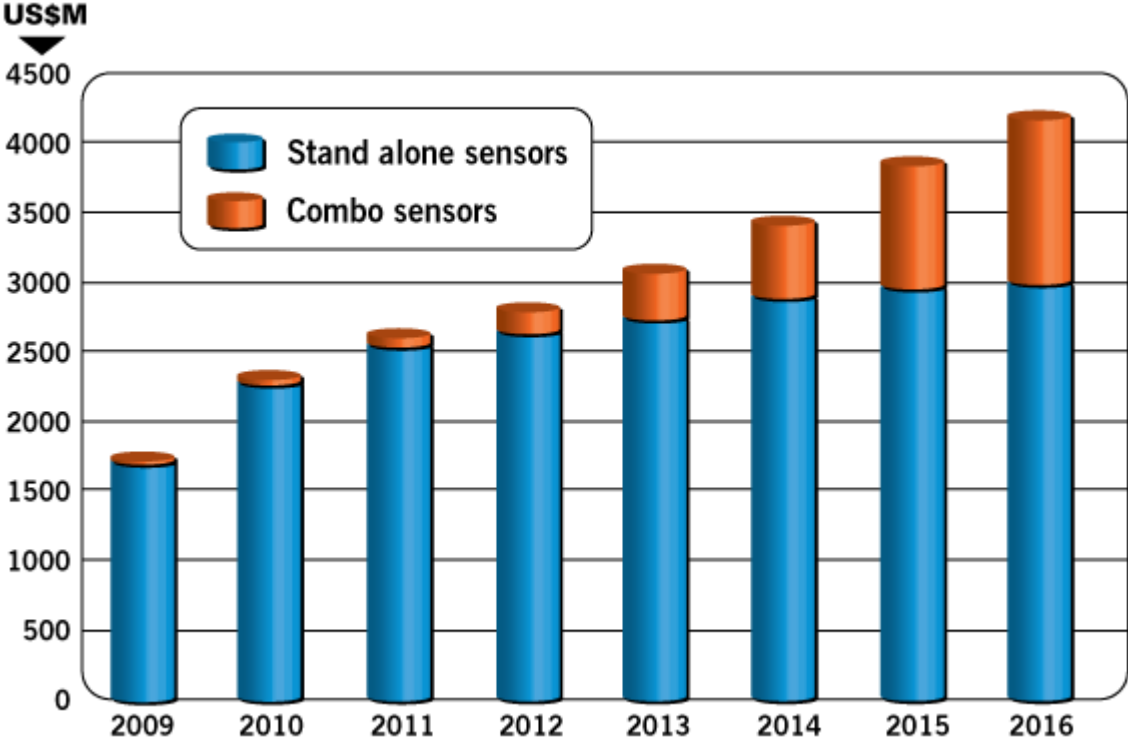
© 2011 MEMS Journal, Inc.

Increasing Product Complexity



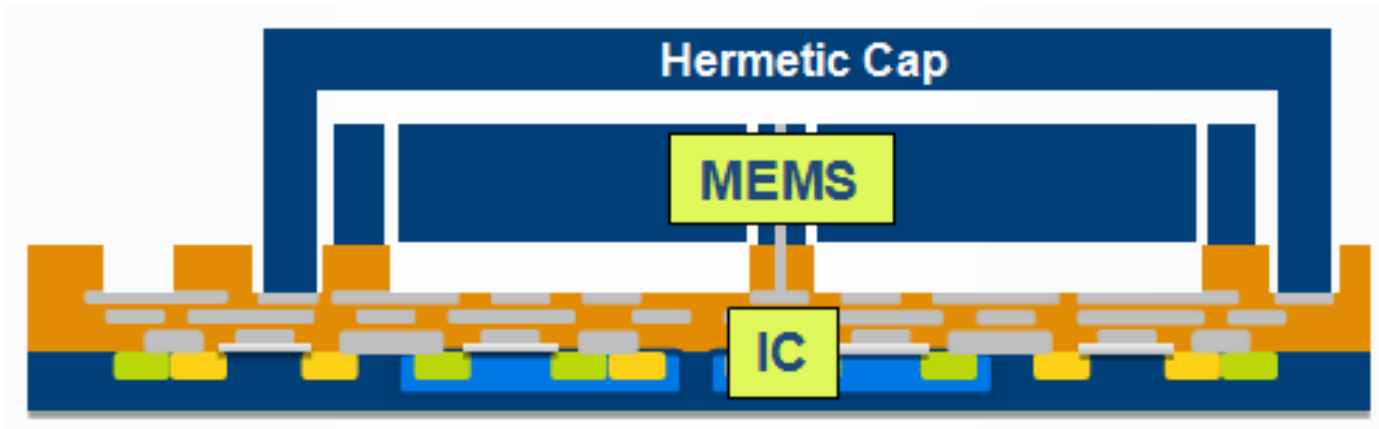
Source: Jiantao Pan, Carnegie Mellon University, 1999

Increasing Product Complexity



Source: Yole Developpement, 2011

Increasing Product Complexity



Source: mCube, 2012

Consolidation



bought



for \$175 million



bought



for \$130 million



bought



for \$233 million

- Introduction
- The “big picture”
- Ongoing major trends
- **Challenges**
- **Collaboration opportunities**

Challenges



- fragmented, global supply chain
- volatile economic cycles
- lack of sufficient visibility for supply and demand
- rising costs for energy, raw materials
- price erosion (for mature products)
- currency fluctuations
- global competition
- emergence of new, well-funded players
- talent and IP “wars”

Collaboration Opportunities



- develop an ecosystem of “adjacent” supply chain players
- share standard processes and technologies
- trade information, market data and resources
- leverage outsourced partners
- increase transparency of supply chain information for vendors and customers
- use IP to collaborate more, compete less
- proactively form “mini-consortia” to address highly specific market segments, technologies or individual applications

MEMS Supply Chain – Challenges and Opportunities Survey

To participate, please email us at sc@memsjournal.com

Participants will receive results of the survey



Sign up at

<http://memsforum2012.com>

Thank you!

Mike Pinelis, Ph.D.
President and CEO

mike@memsjournal.com
248.792.9618 (office phone)
734.277.3599 (cell phone)