

# Planning for MEMS Product Development

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AMFITZGERALD  
& ASSOCIATES

# Overview

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- **About AMFitzgerald**
- **MEMS industry infrastructure – yesterday and today**
- **Planning for successful MEMS development**

# Mission

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## MEMS Product Development

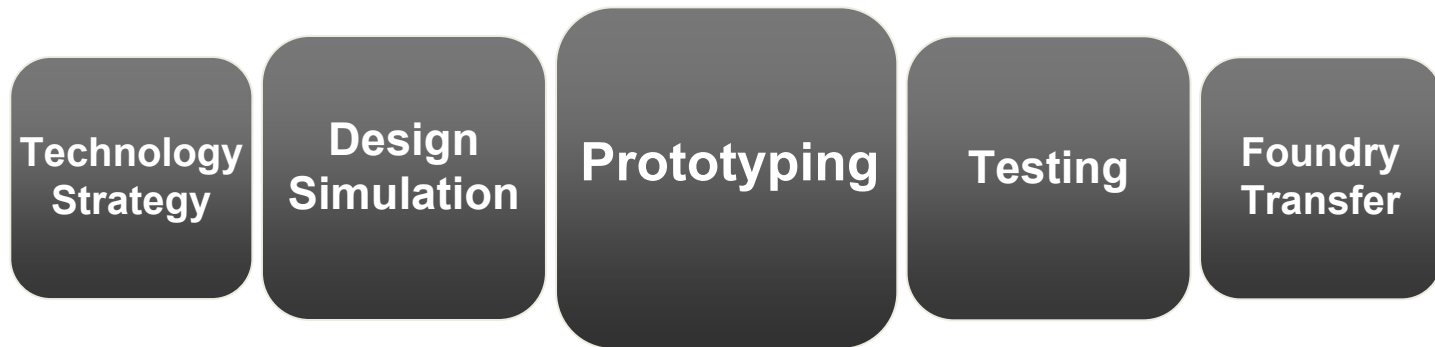


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**We turn your ideas into silicon.**

# Fully integrated services: concept to production

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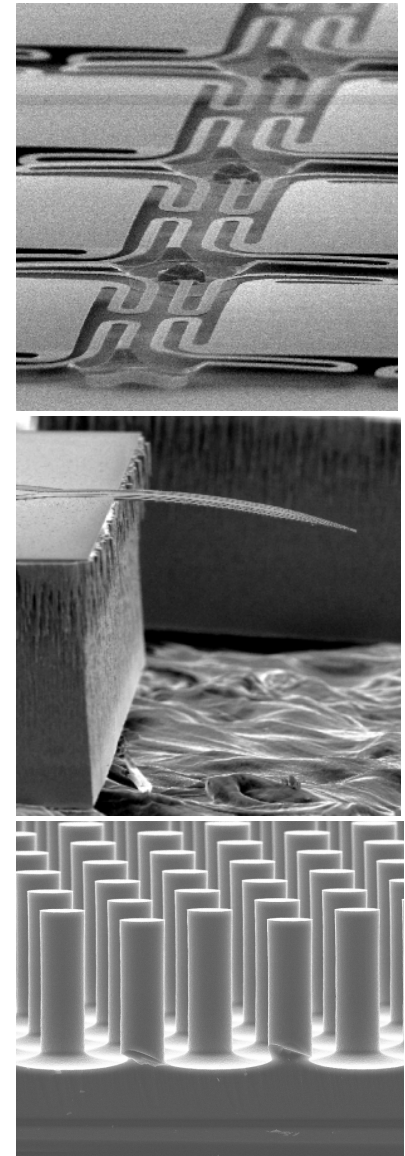


- **Multi-disciplinary engineering team**
  - Skilled at managing development risk and uncertainty
  - Small batch prototype fabrication (150 mm wafers) by engineers, not operators
  - Design optimization using simulation
- **Complete project management**
- **Smooth transition to production**
- **A supplier ecosystem to address all MEMS needs**

# Our Value

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- **First time developing MEMS?**
  - With our expertise and supplier ecosystem, we can provide the complete solution
- **Improving your MEMS product?**
  - Leverage expert analysis and deep process knowledge to optimize your design
- **Our competitive advantage**
  - In MEMS, design and process are inseparable
  - Our engineers are experts at both

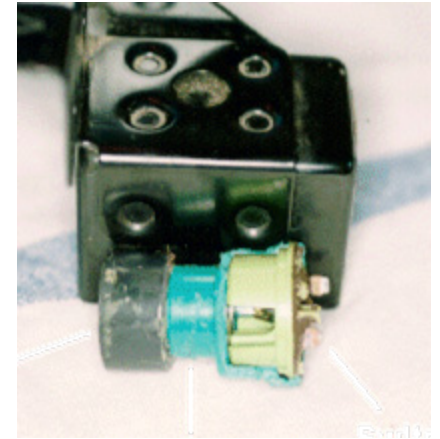
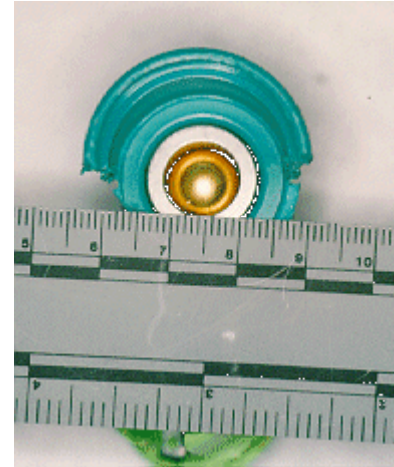


# What are MEMS?

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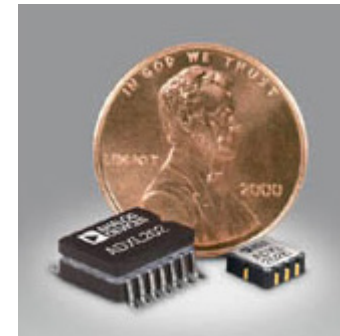
- **Micro Electro Mechanical Systems**
  - Not a platform *device* technology
  - But a powerful manufacturing technology for miniaturization
- **Semiconductor process heritage**

Airbag sensors (1980)



Source: Ed Phillips

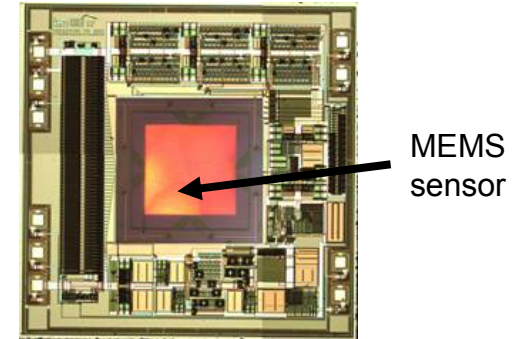
Airbag sensors (2005)



# Why MEMS are exciting for so many applications

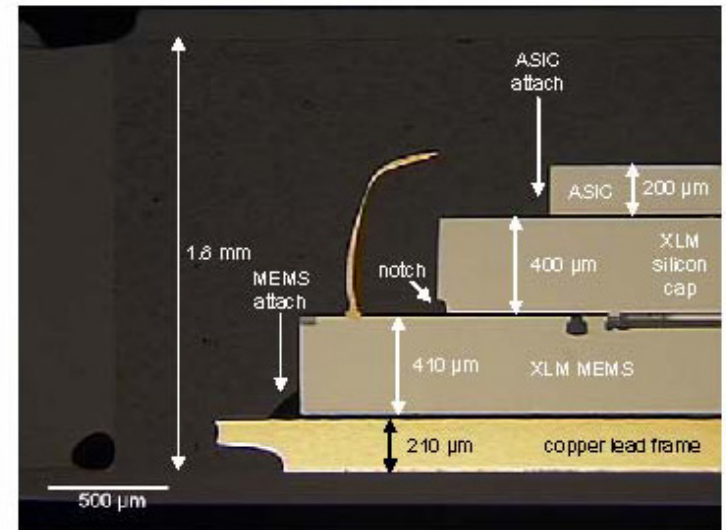
- **Smaller, better, cheaper**
  - But not always all three
- **Sophisticated capabilities in small form factor:**
  - Multiple sensors
  - Signal processing and analysis
  - Telemetry capability
  - Low power

## Integrated Pressure Sensor



Source: IMD

**Stacked  
MEMS and  
ASIC chips,  
wirebonded**



Source: Chipworks/Kionix

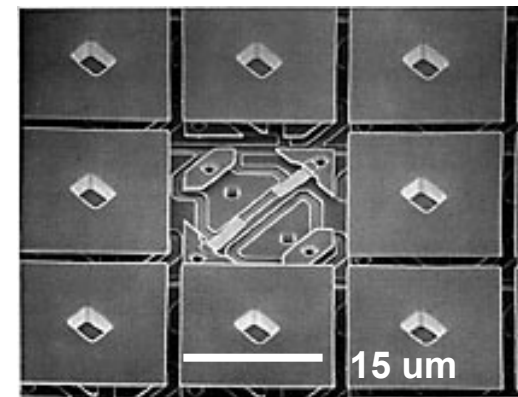
# Challenges of MEMS product development

- **Business operations complexity**
  - Development of a supplier ecosystem ... specific to your technology
- **High technical complexity**
  - Coupled physics
  - Moving parts
  - Environmental exposure
  - Test and packaging challenges

Microvision Pico-P



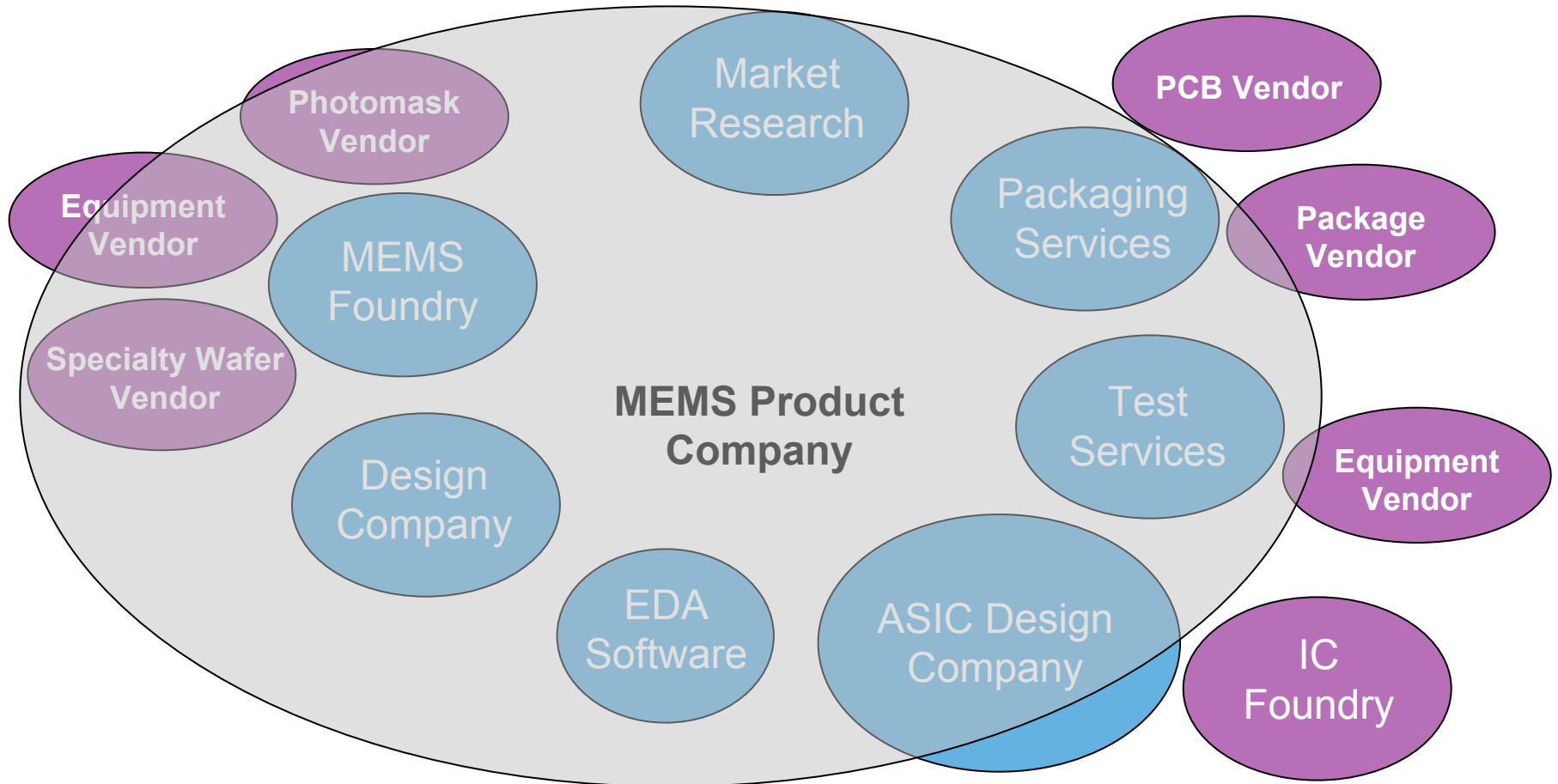
TI DLP pixels



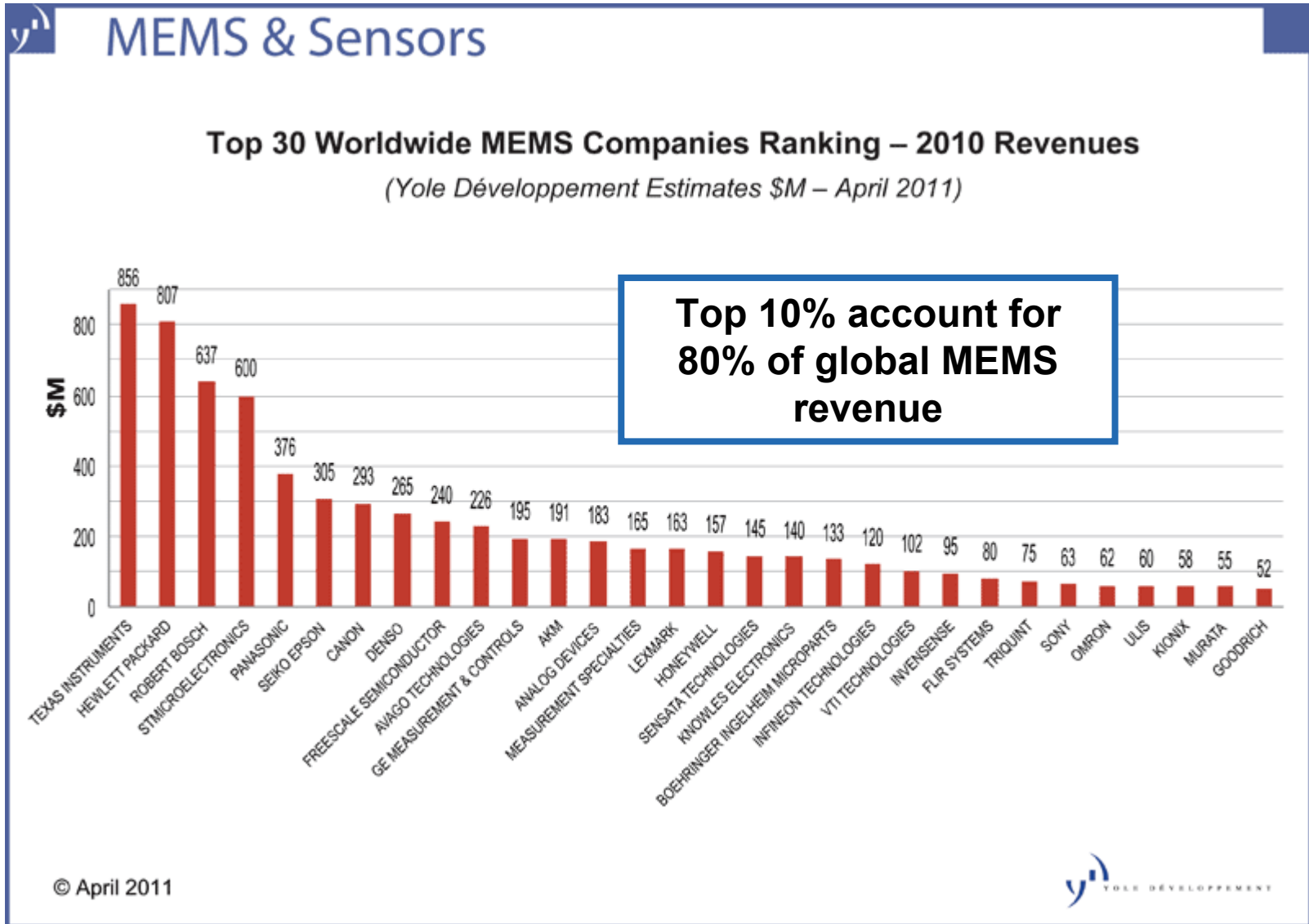
*Wildly different approaches to image projection*

# MEMS supplier ecosystem: circa 1995

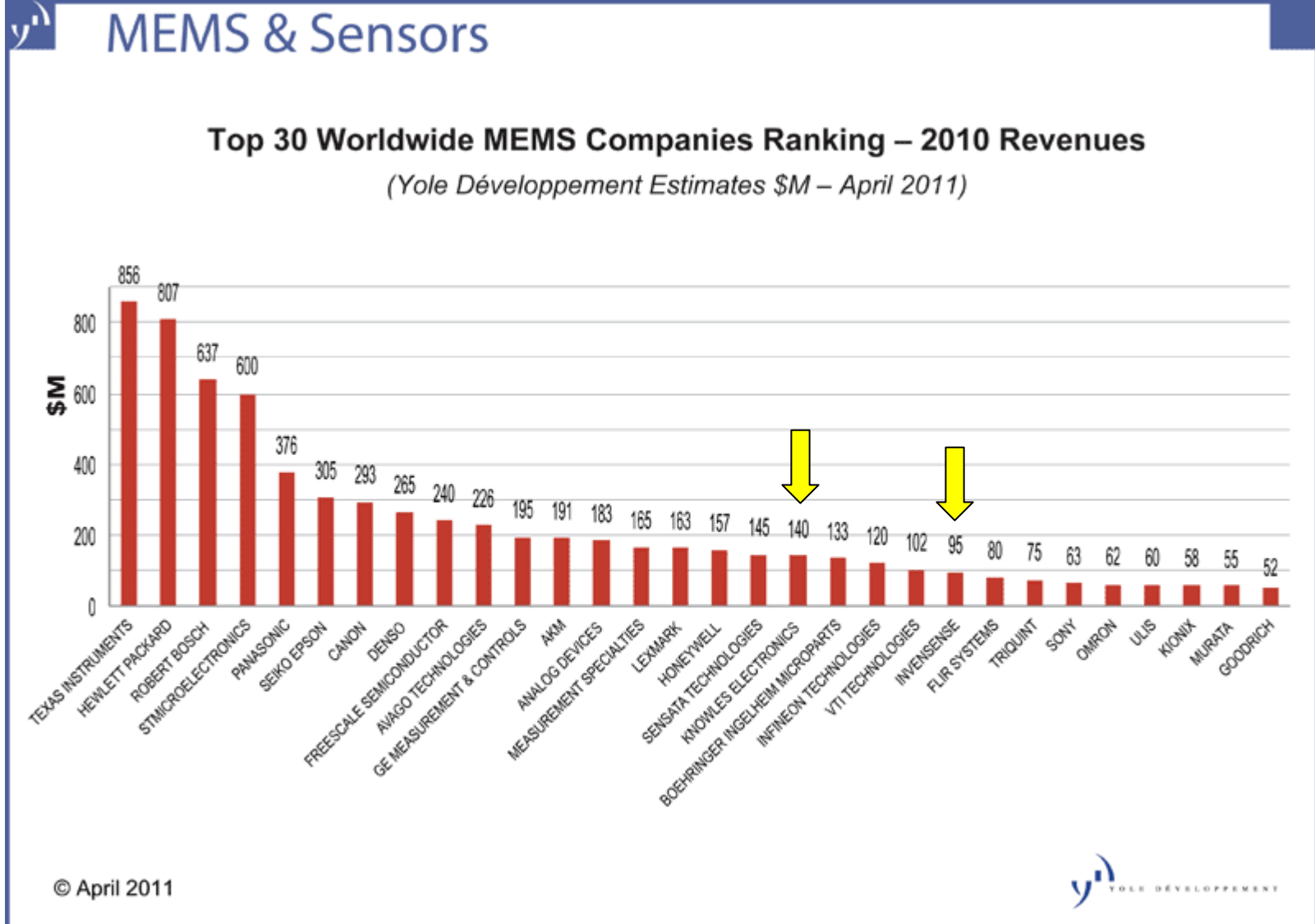
- Only large, vertical companies can do this (and did)



# Large companies dominate the MEMS industry today

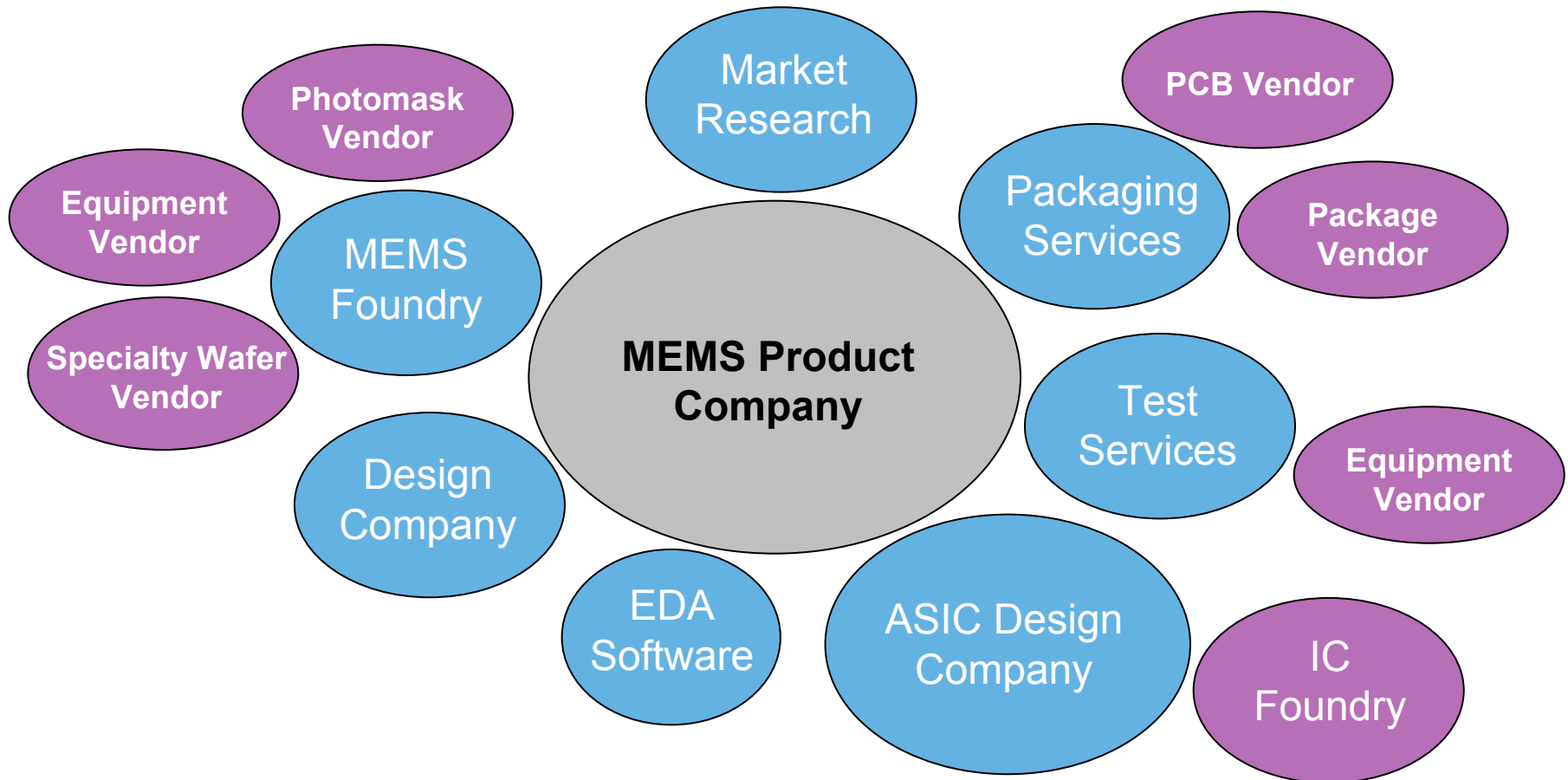


# Only two of Top 30 companies are totally fabless

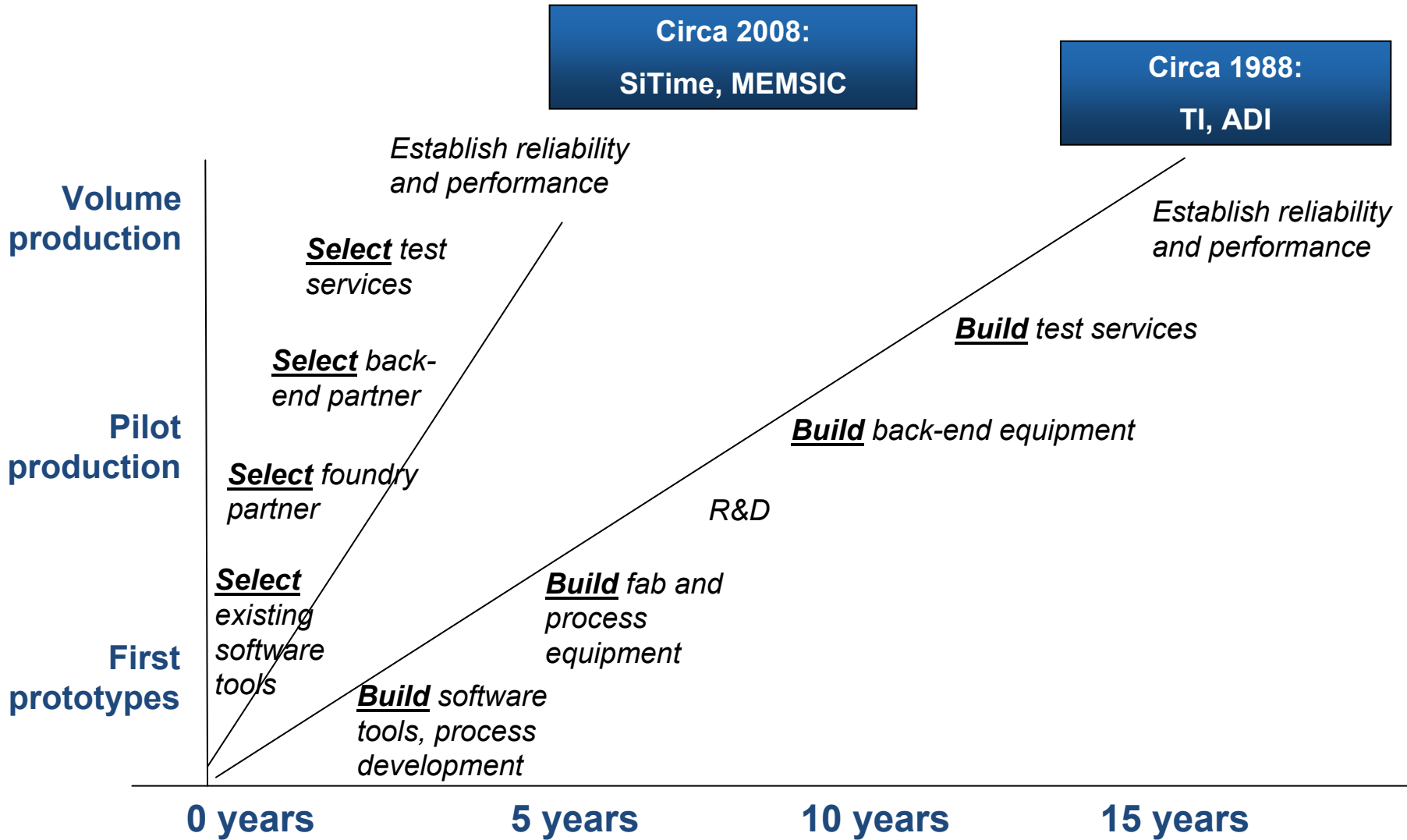


# MEMS supplier ecosystem today – much improved

- **Specialization reduces resource requirements**

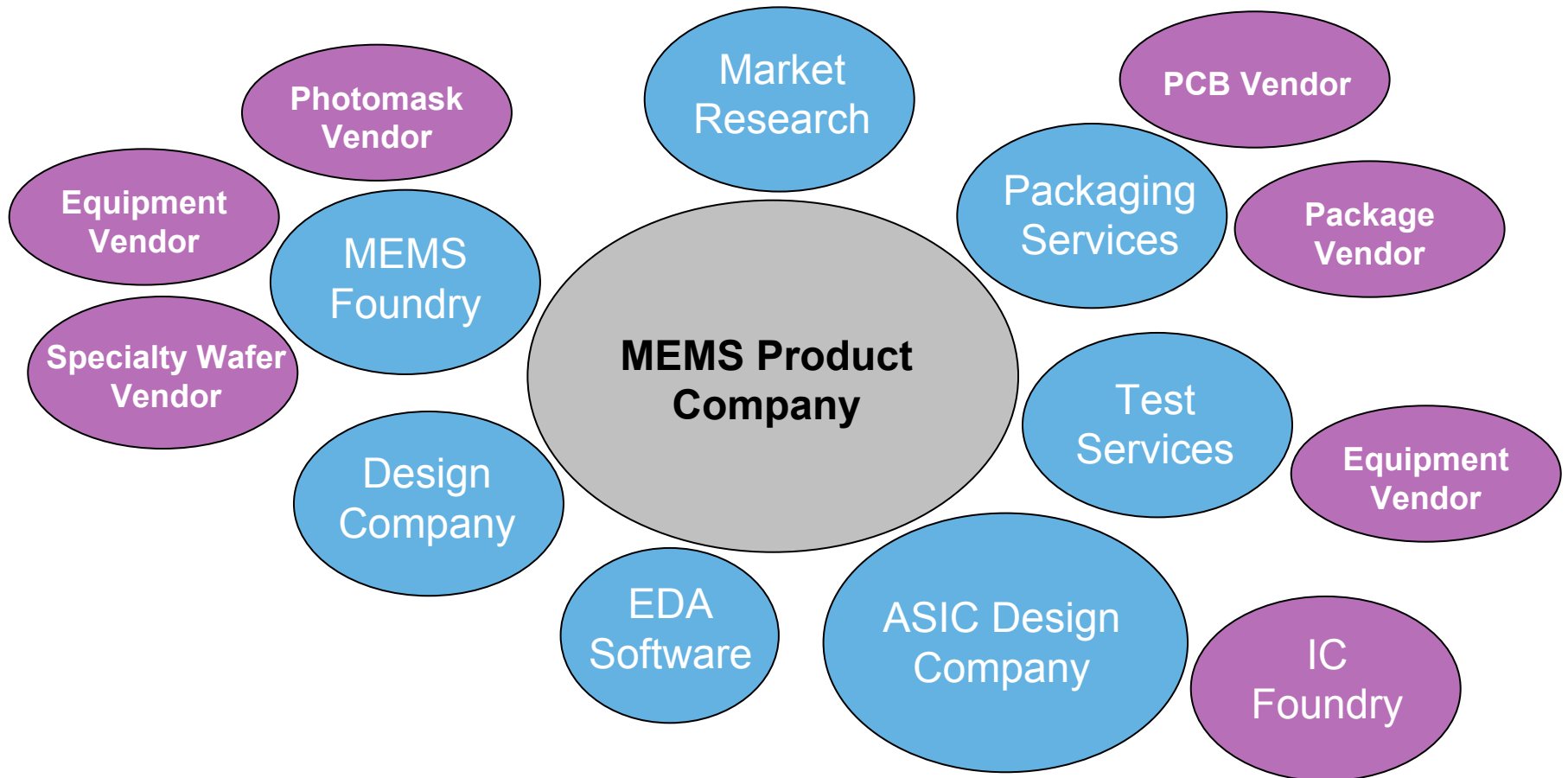


# Development timelines have improved significantly



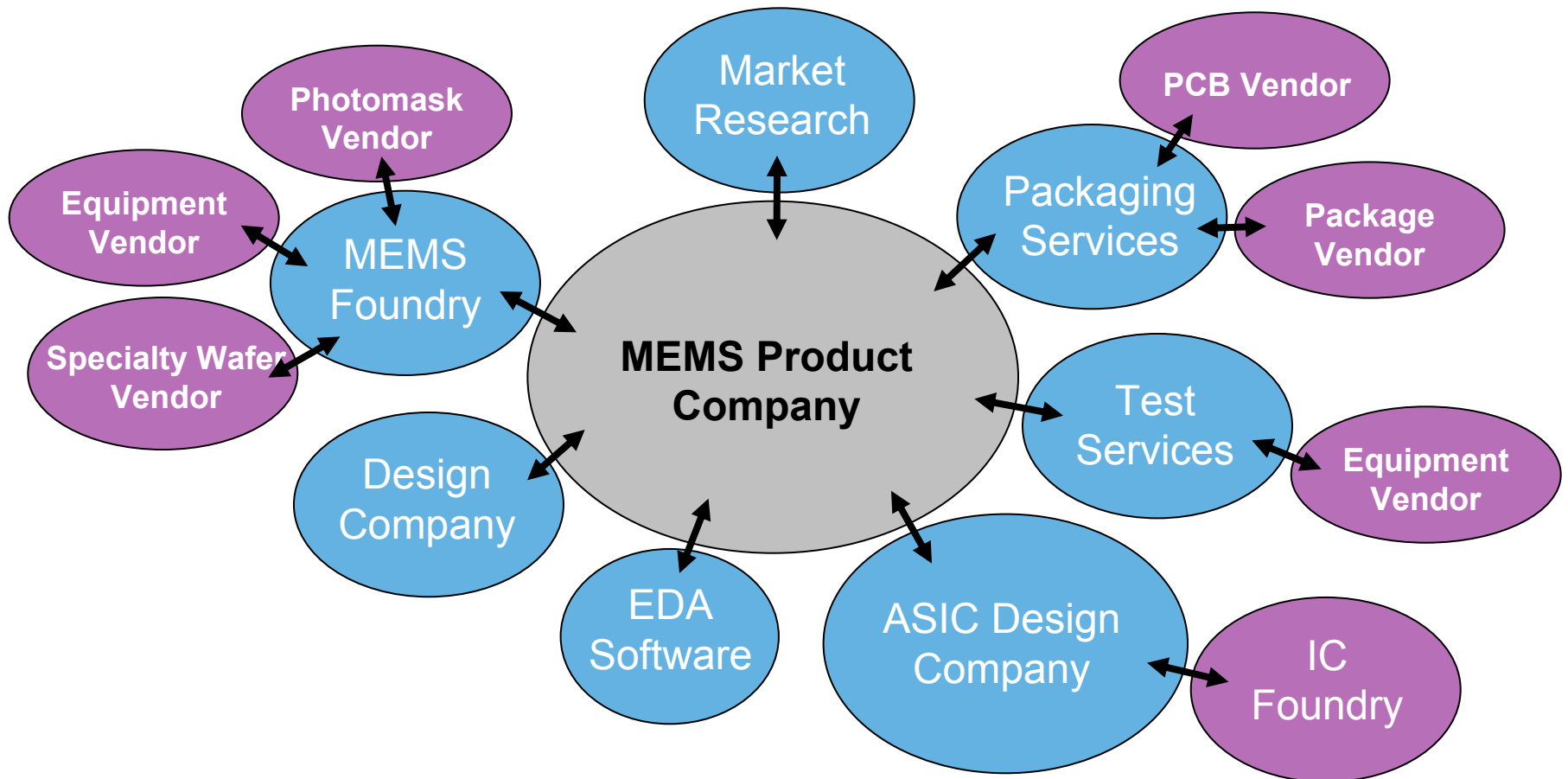
# Assembling an ecosystem takes time

- **Diversity of MEMS: no two ecosystems will be identical**
- **Pick your team carefully**



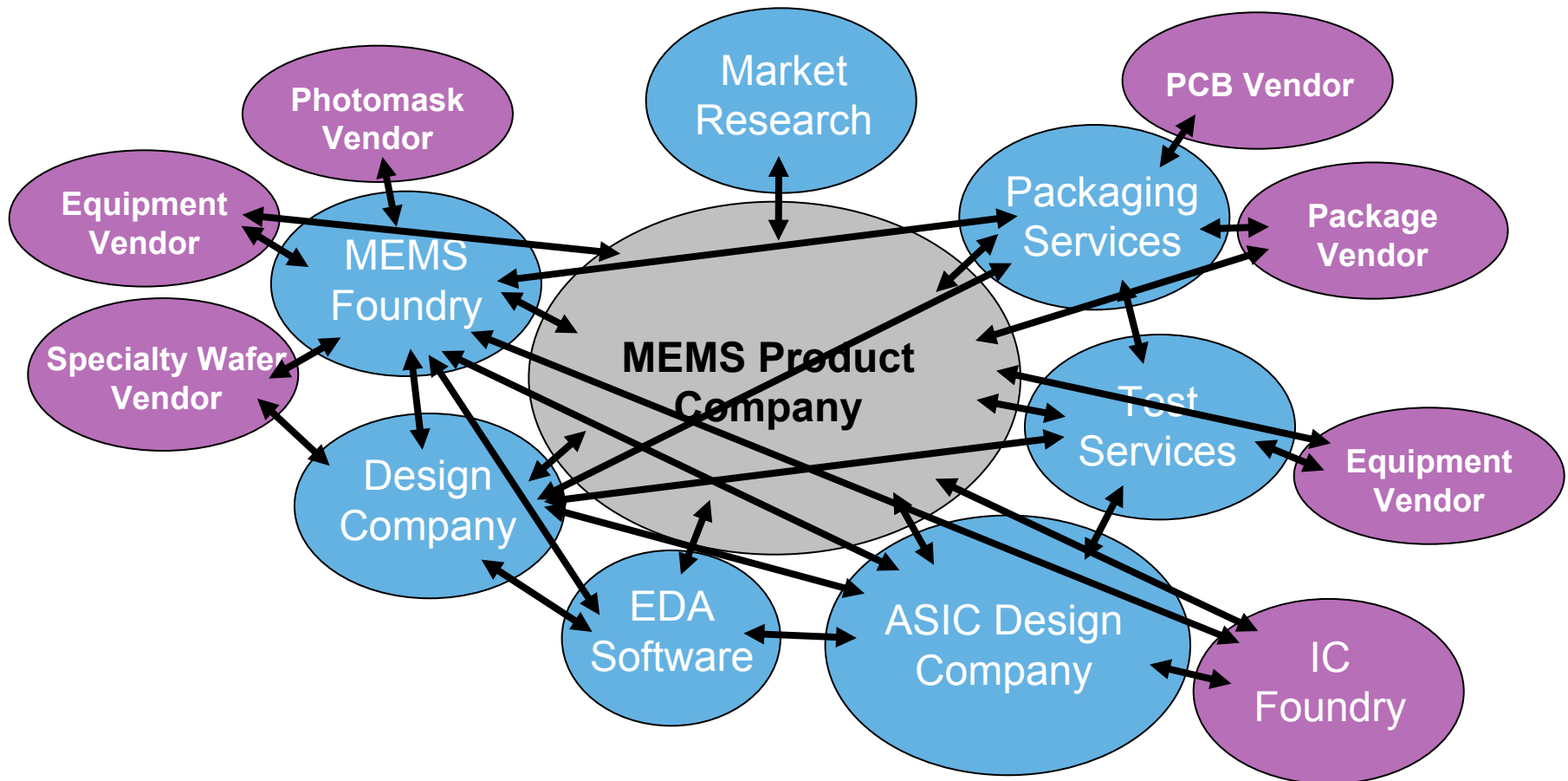
# Information exchange between parties is critical to success

- Do you think it looks like this?

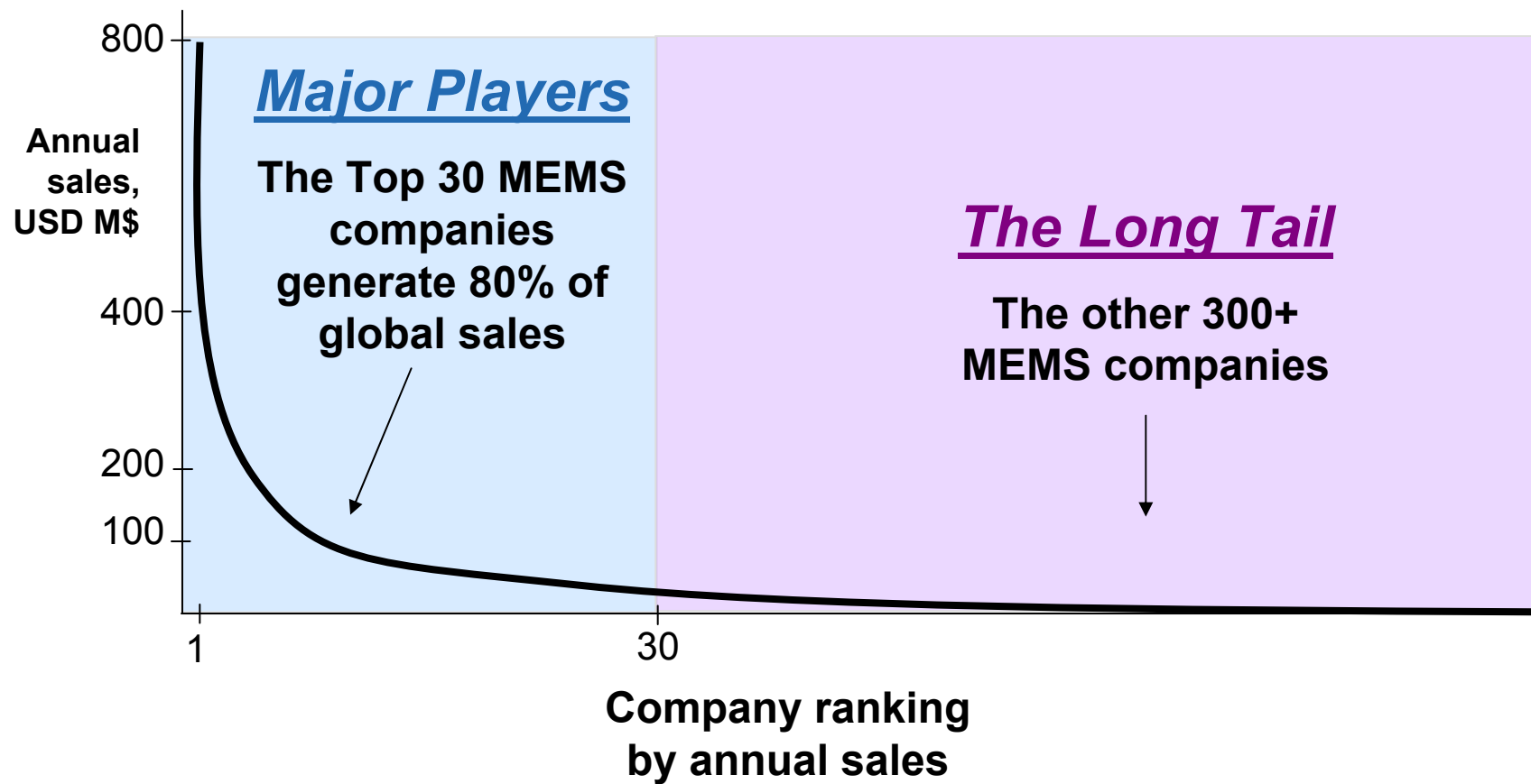


# Gaps and lack of standards burden communications

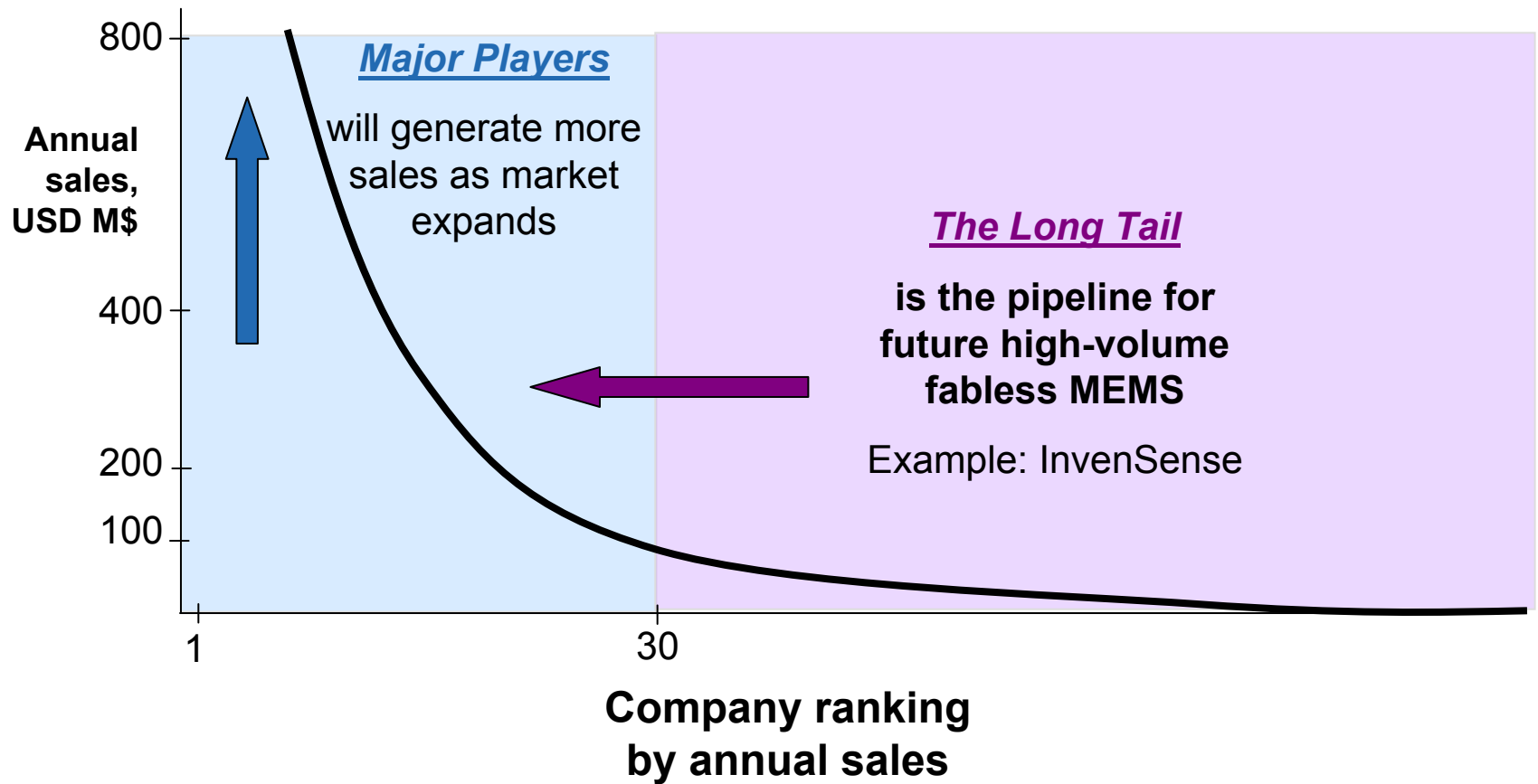
- **Reality: messy and inefficient!**
- **But - the fabless, outsourced model will prevail**



# Today, there are two MEMS industries



# Companies will move up – and they will be fabless



# Viable business models for new MEMS companies

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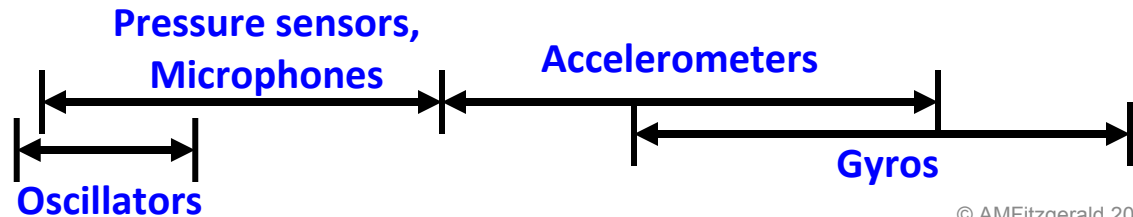
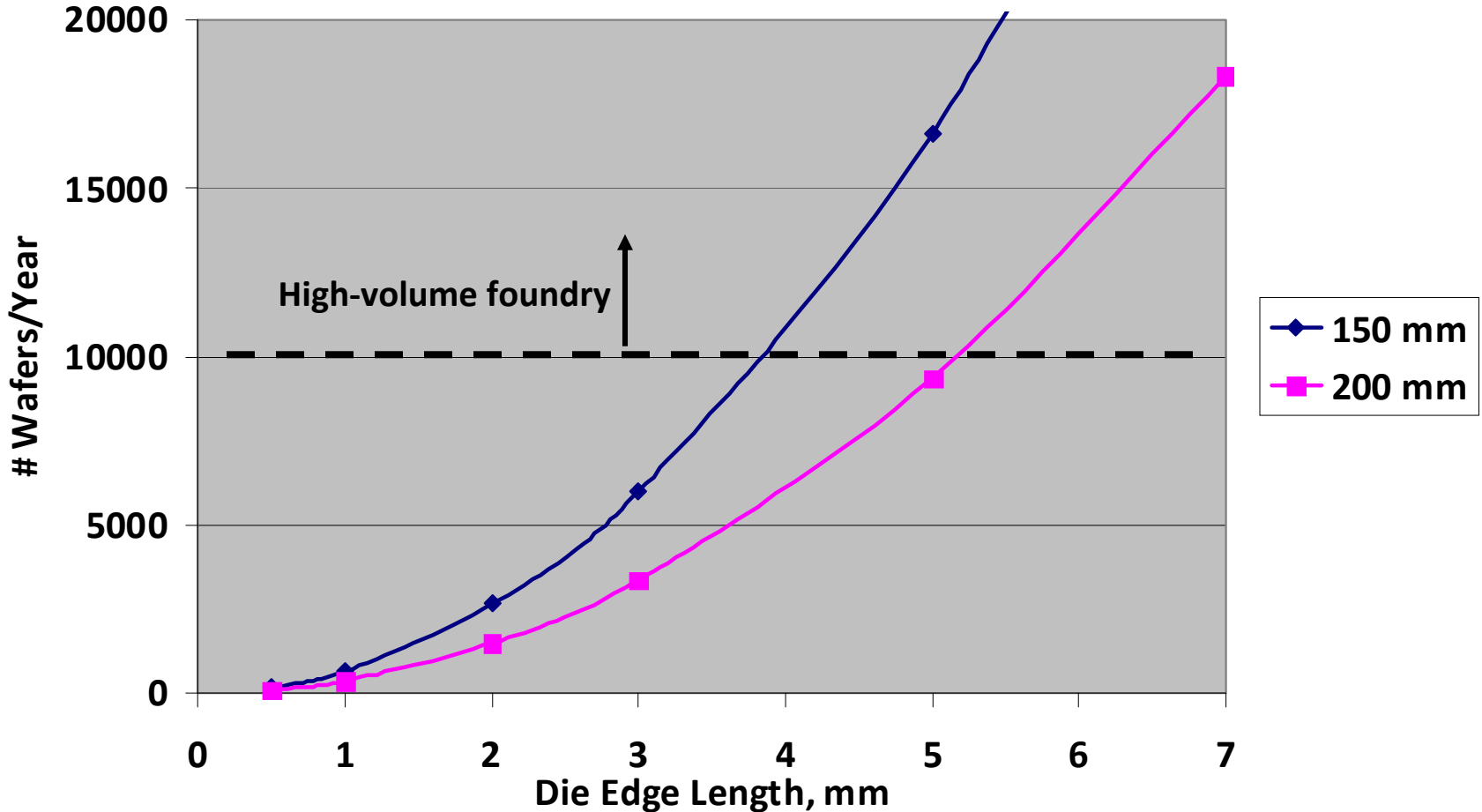
***“Real men have fabs.” – Jerry Sanders, AMD***

**Today: “Smart MEMS companies don’t have fabs”**

- **Fabless**
  - **Plenty of capacity at 150 and 200 mm**
- **Hybrid or Fab-Lite**
  - **Adds value with specialty processes/equipment that are kept in-house**

# Not all MEMS will need 200mm wafers

Number of Wafers Needed to Produce 10M Units (85% yield)



# Planning for efficient MEMS development

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- **Assemble your supplier ecosystem**
  - Foundry partner is a critical choice
- **Consider buying/licensing existing MEMS technology**
- **Due to gaps in infrastructure, still need a team of experienced MEMS engineers**
  - Hire employees or use development firm like AMFitzgerald
- **Plan realistic budgets and timelines**

# Working with foundries

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- **The foundry is your partner in a long-term relationship**
- **Cannot just throw MEMS designs “over the fence”**
- **Plan for constant interaction**
- **Switching foundries = starting over (\$\$\$ and time)**



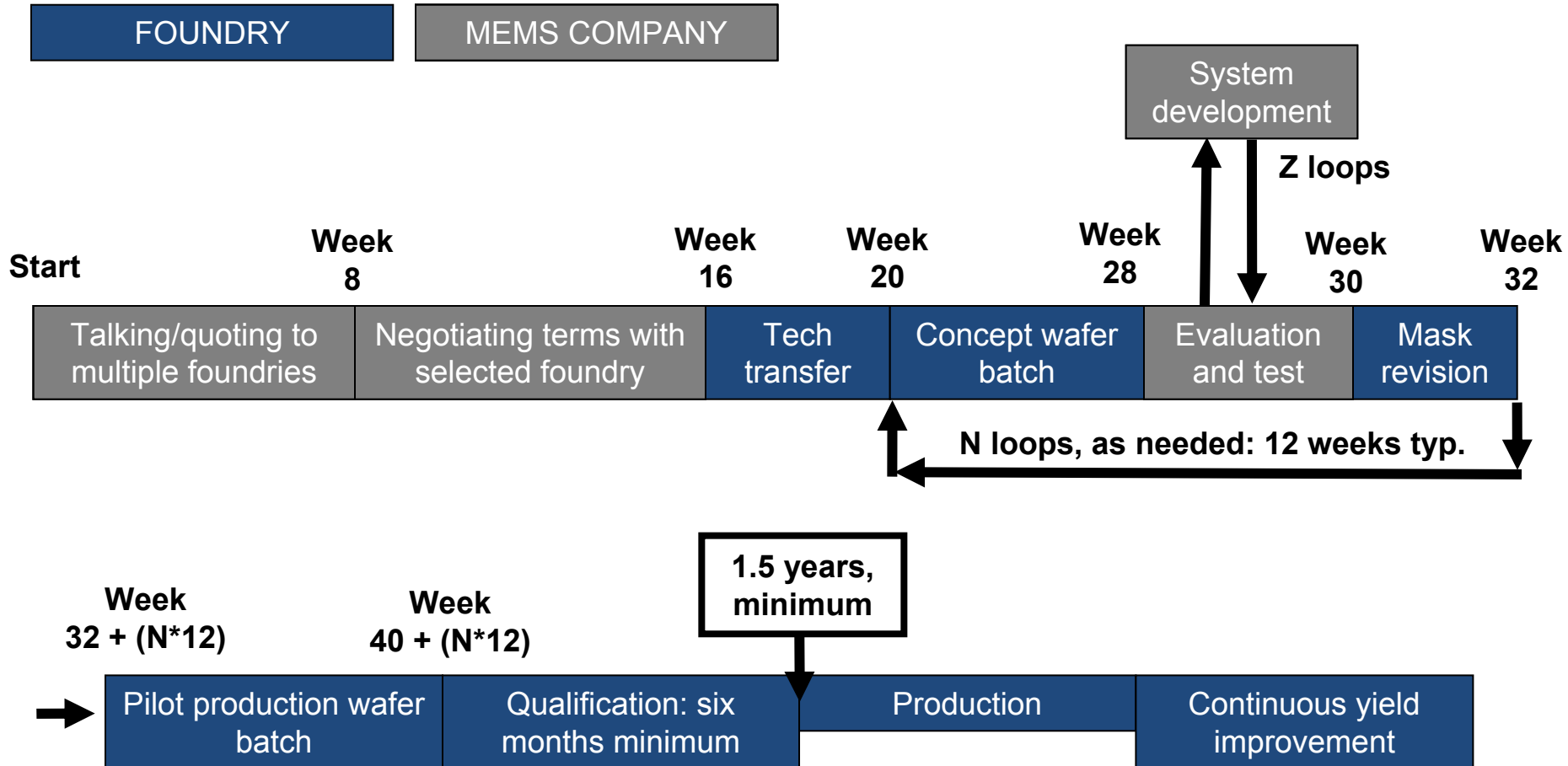
*“I think this is the beginning of a beautiful friendship.”*

# Foundry selection

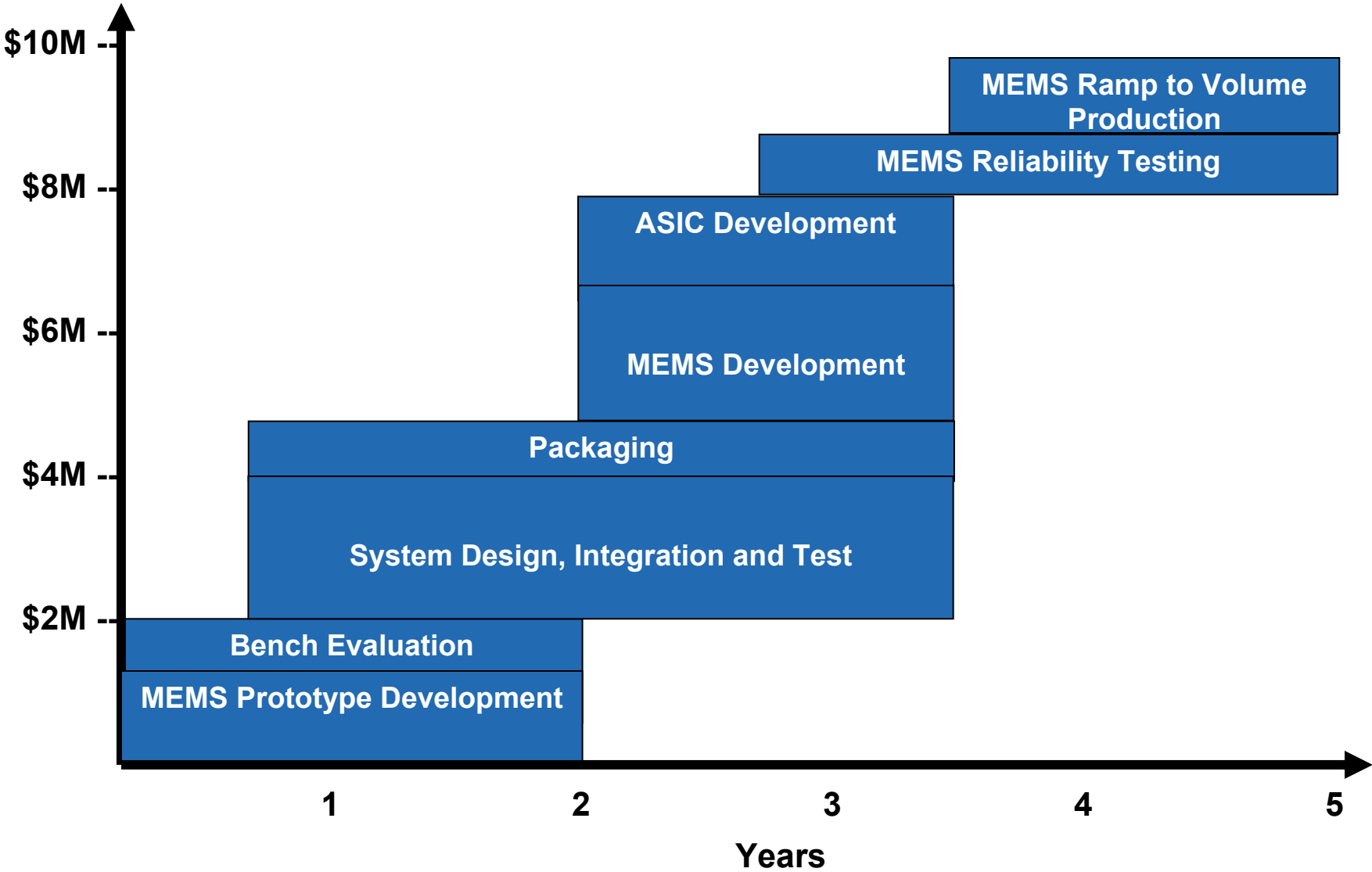
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- **Evaluate process capability and experience with your type of product**
- **Make sure you have compatible:**
  - **Business models**
  - **Timelines**
  - **Expectations**
  - **Quality standards**
  - **Product volumes – ideally, don't want to be smallest or largest customer**

# Ramp to production timeline (with an existing prototype)



# Cost of new device (fabless) development: Minimums



# Conclusions

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- **MEMS infrastructure is improving, but gaps still exist**
- **Successful product development requires both operational *and* technical excellence**
- **Be realistic about funding and timelines**
- **Leverage foundries, standard tools, processes, and methods to the extent possible**
- **Take a shortcut: buy or license existing MEMS technology**

***AMFitzgerald can help you – ask us how!***

***207A in the MEMS Innovation Area***



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