Planning for MEMS Product Development

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AMFITZGERALD
& ASSOCIATES

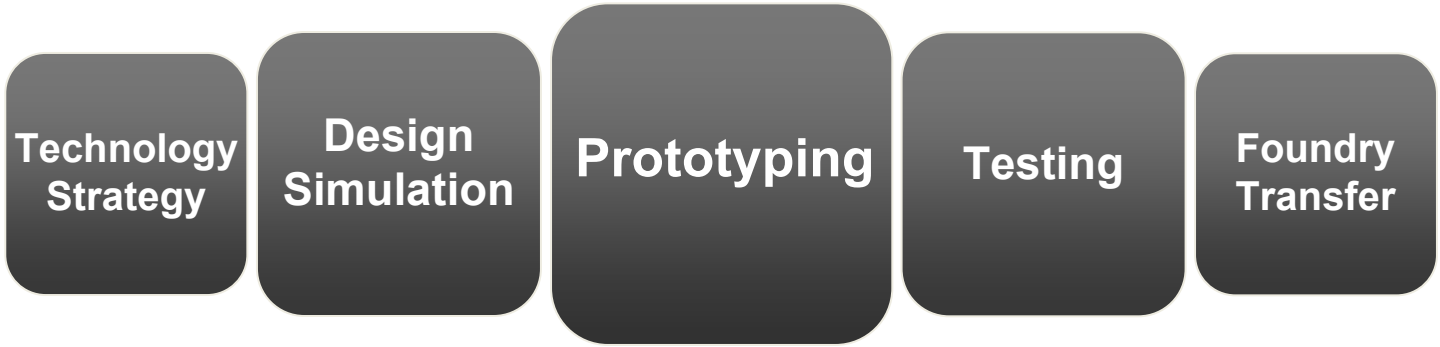
Overview

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

Mission

We turn your ideas into silicon.

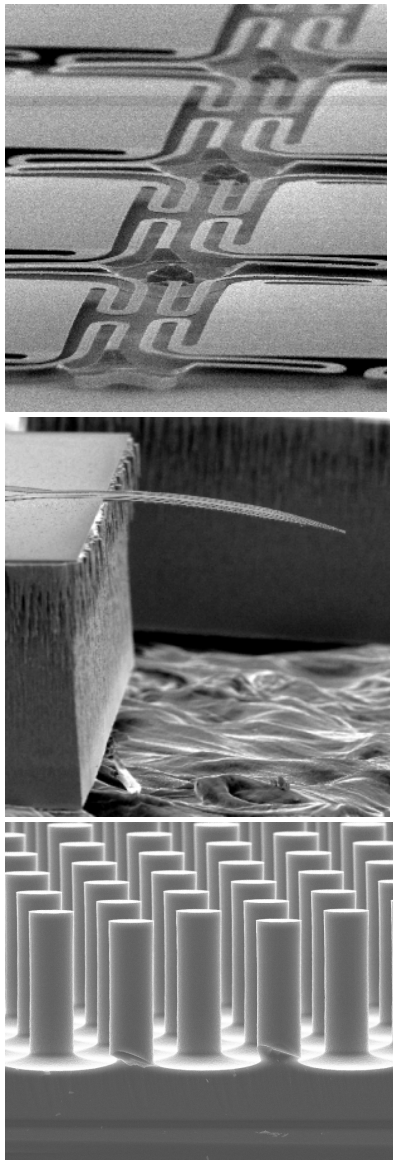
Fully integrated services: concept to production



- **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

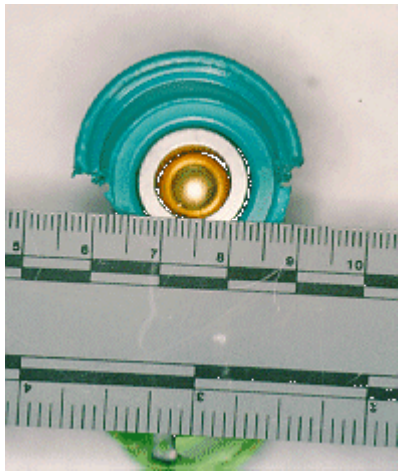
- **First time developing MEMS?**
  - **With our expertise and supplier ecosystem, we can provide the complete solution**
- **Improving your MEMS product?**
  - **Leverage expert analysis and deep process knowledge to optimize your design**
- **Our competitive advantage**
  - **In MEMS, design and process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

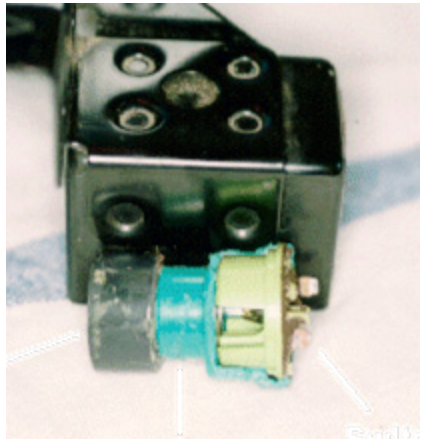


What are MEMS?

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

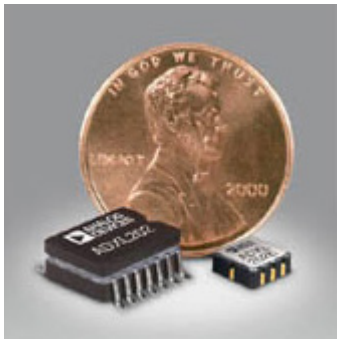
Airbag sensors (1980)





Source: Ed Phillips

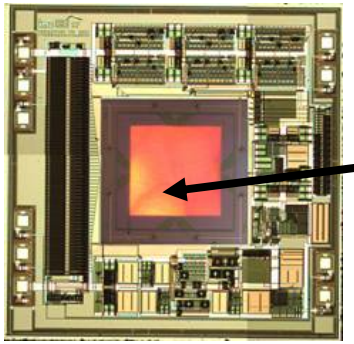
Airbag sensors (2005)



Why MEMS are exciting for so many applications

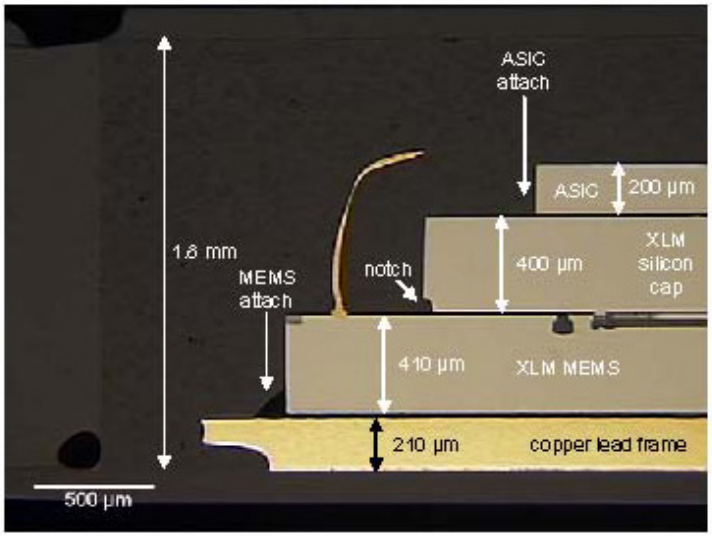
- **Smaller, better, cheaper**
  - **But not always all three**
- **Sophisticated capabilities in small form factor:**
  - **Multiple sensors**
  - **Signal processing and analysis**
  - **Telemetry capability**
  - **Low power**

Integrated Pressure Sensor



Source: IMD

Stacked MEMS and ASIC chips, wirebonded



Source: Chipworks/Kionix

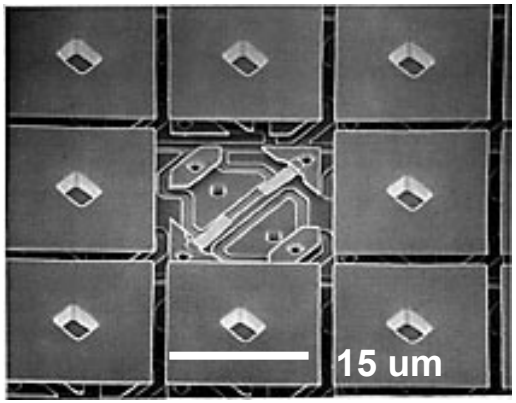
Challenges of MEMS product development

- **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

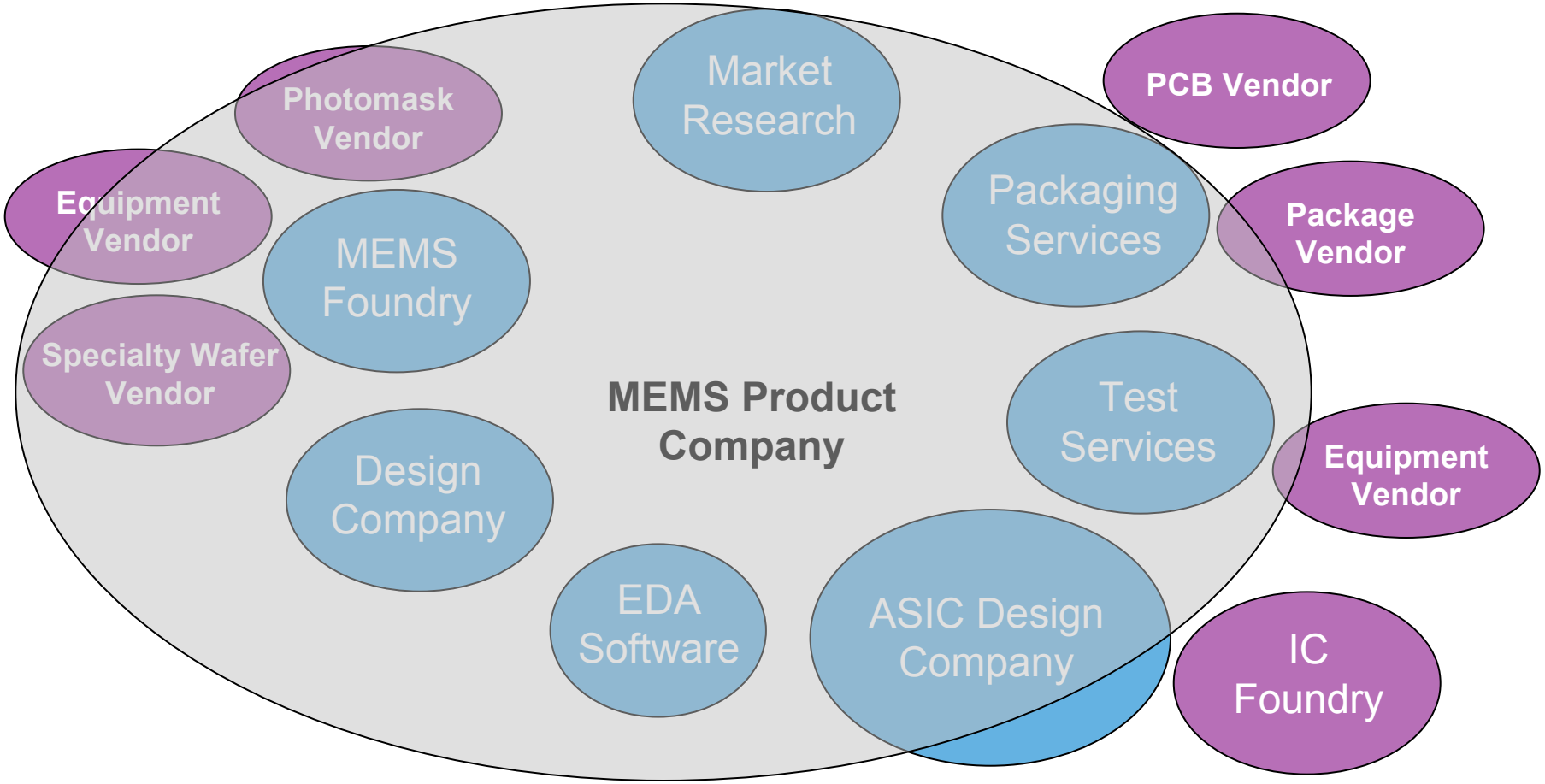
TI DLP pixels



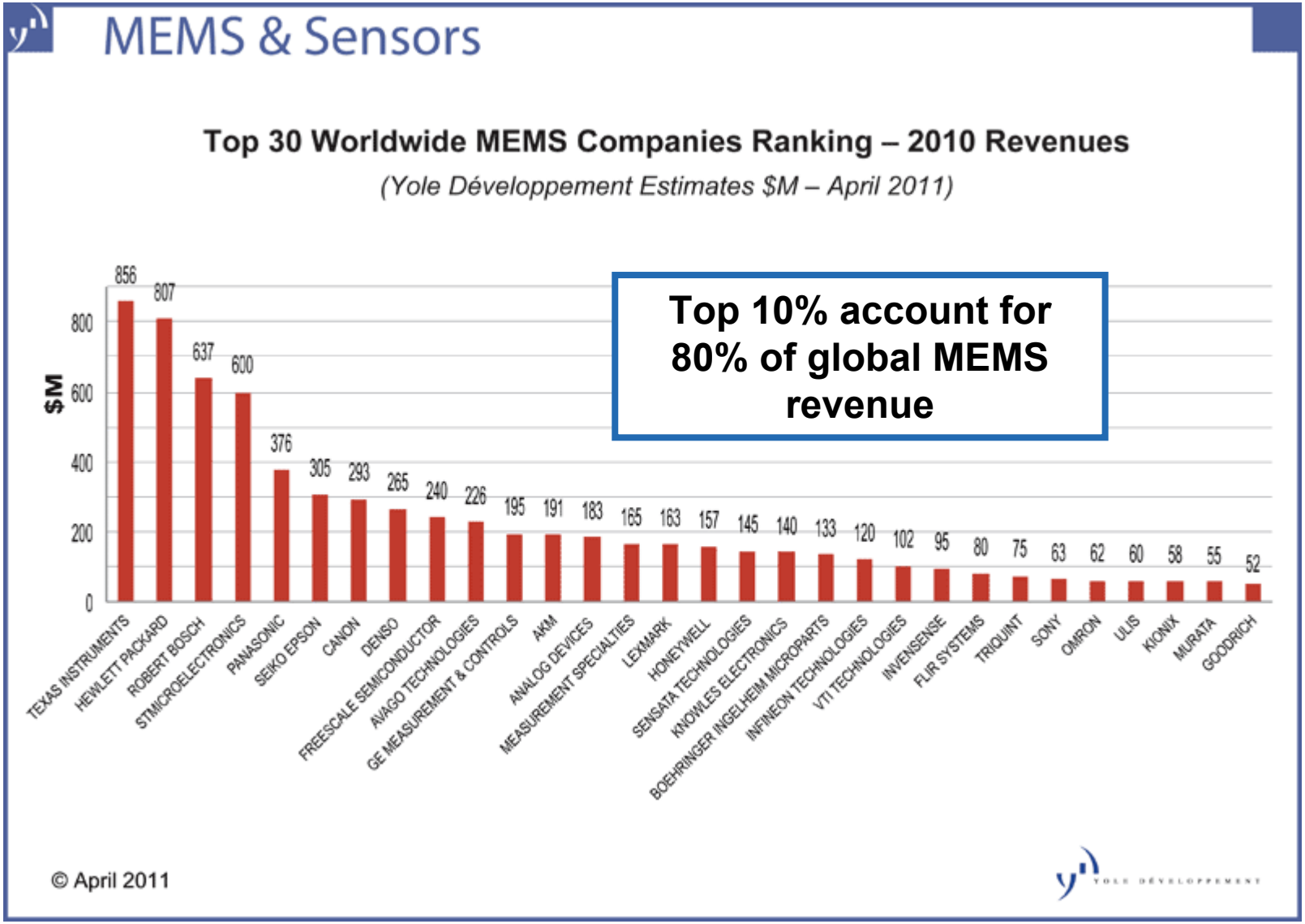
Wildly different approaches to image projection

MEMS supplier ecosystem: circa 1995

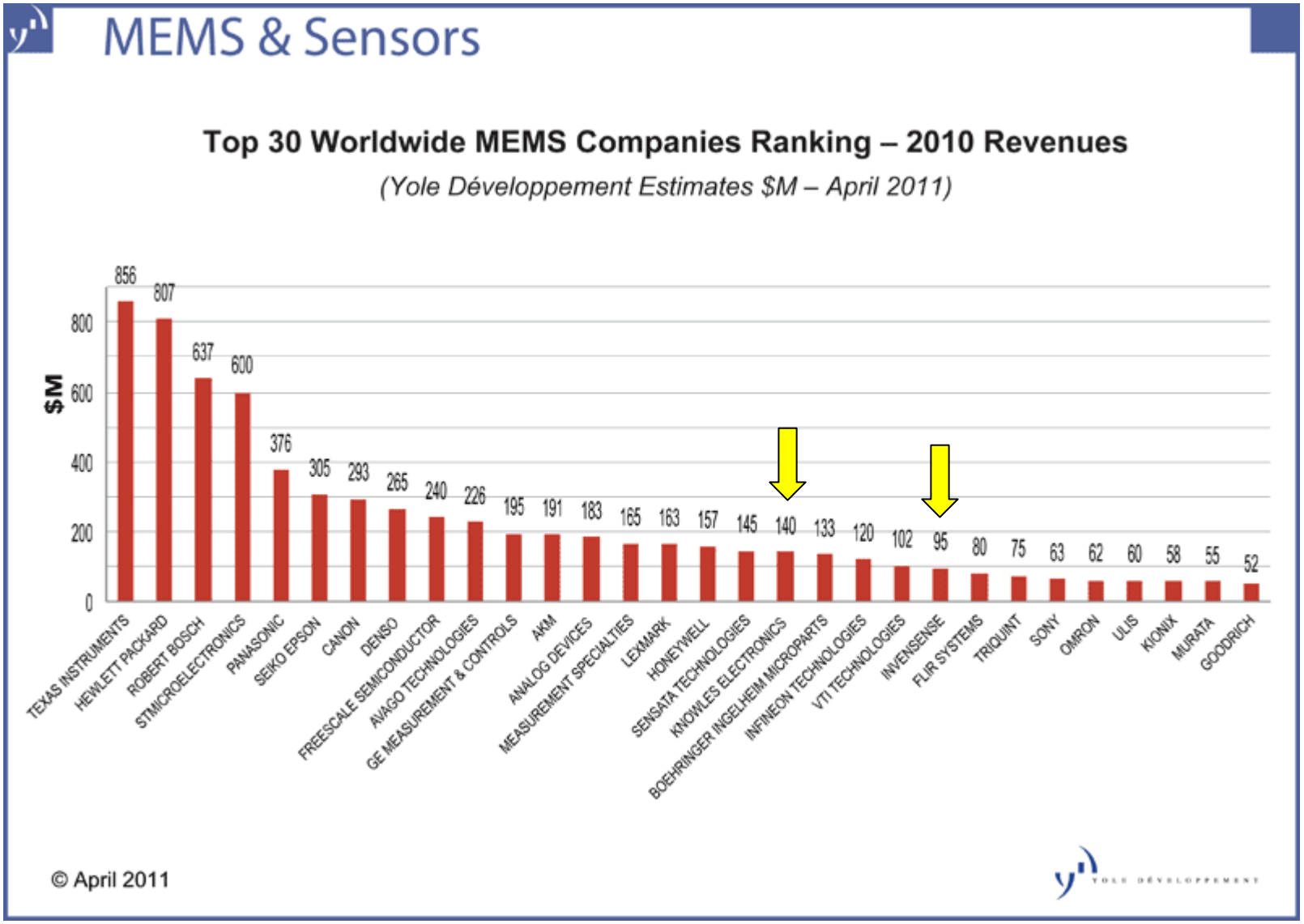
- **Only large, vertical companies can do this (and did)**



Large companies dominate the MEMS industry today

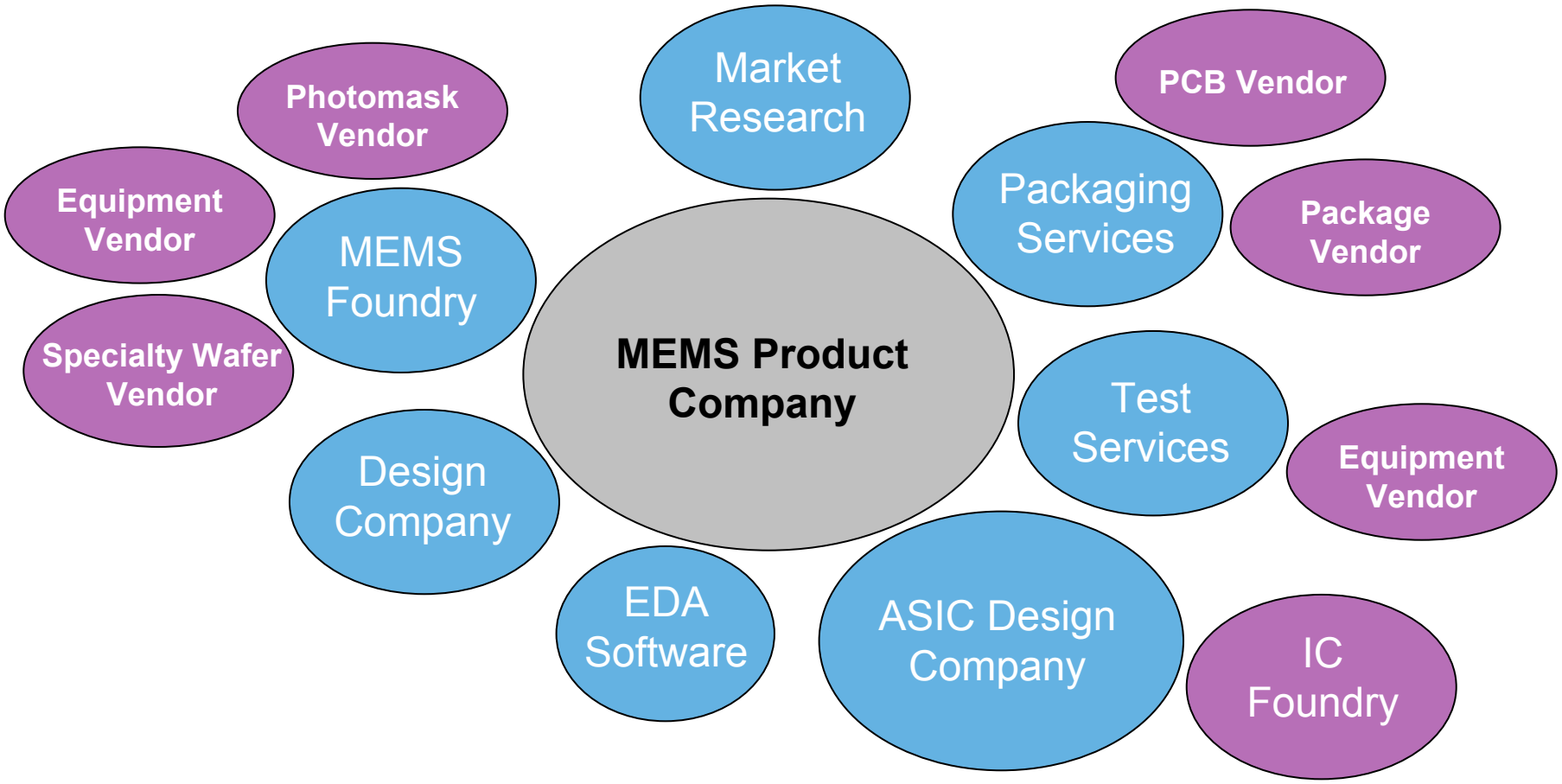


Only two of Top 30 companies are totally fabless

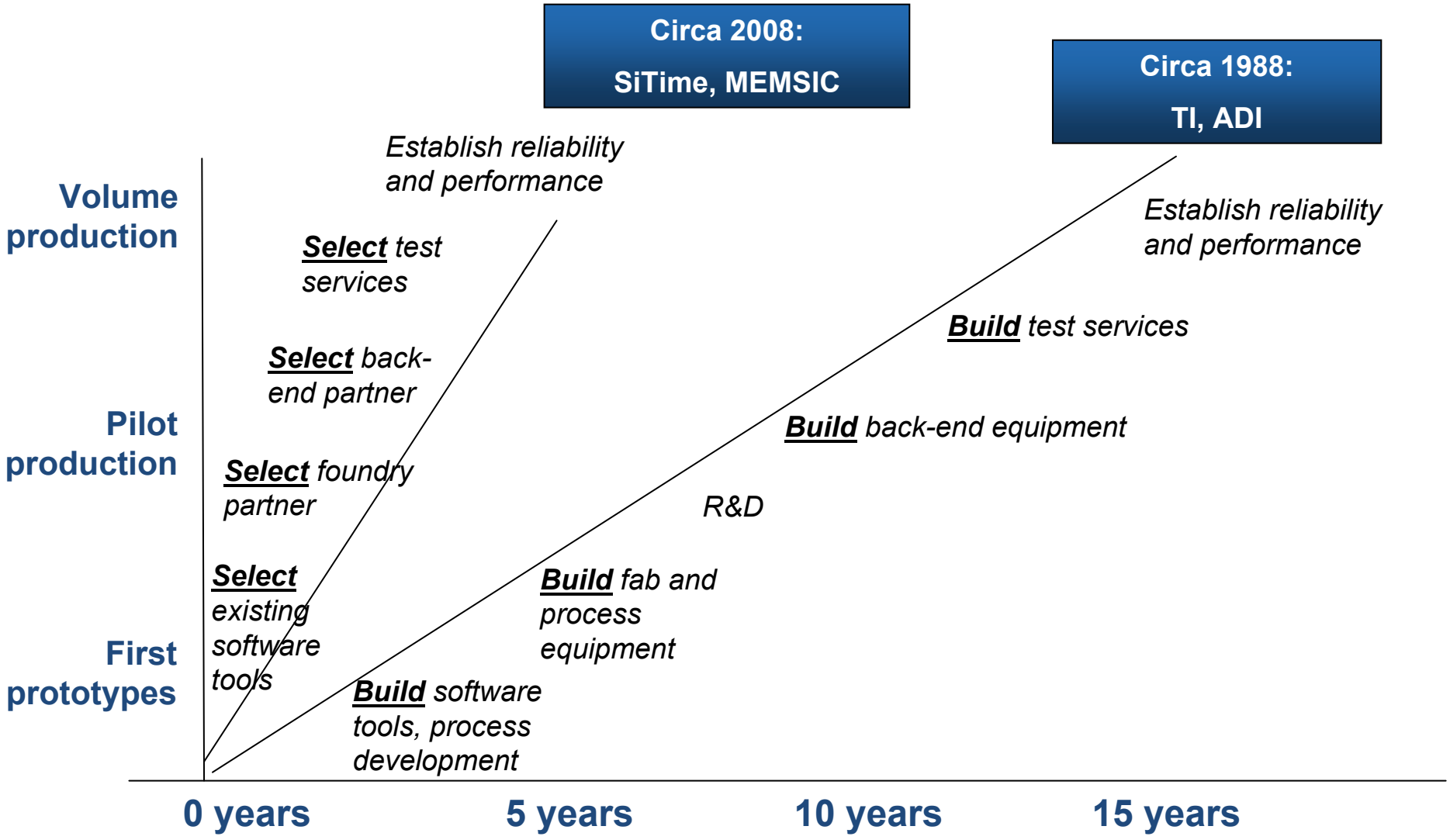


MEMS supplier ecosystem today – much improved

- **Specialization reduces resource requirements**

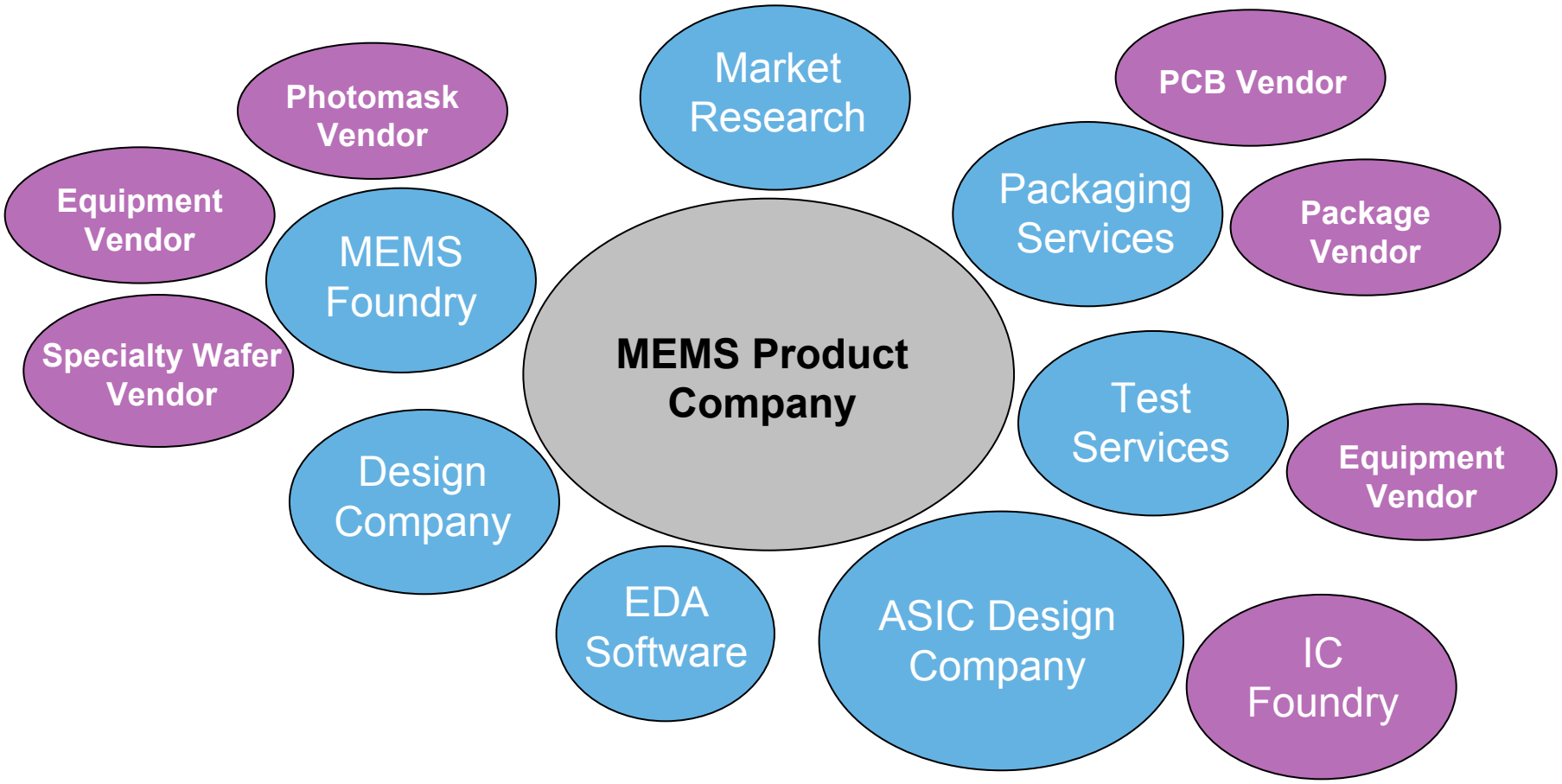


Development timelines have improved significantly



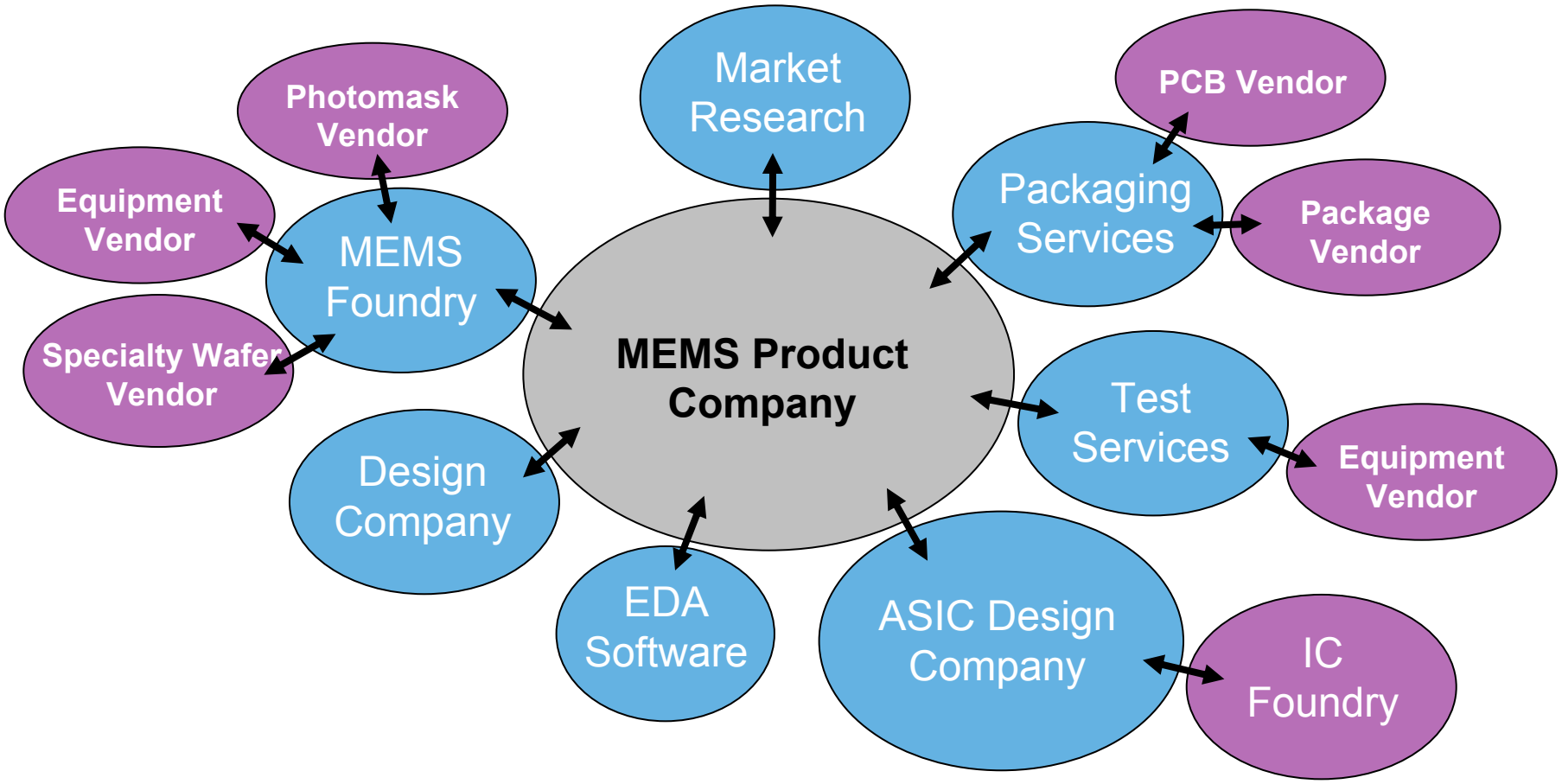
Assembling an ecosystem takes time

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



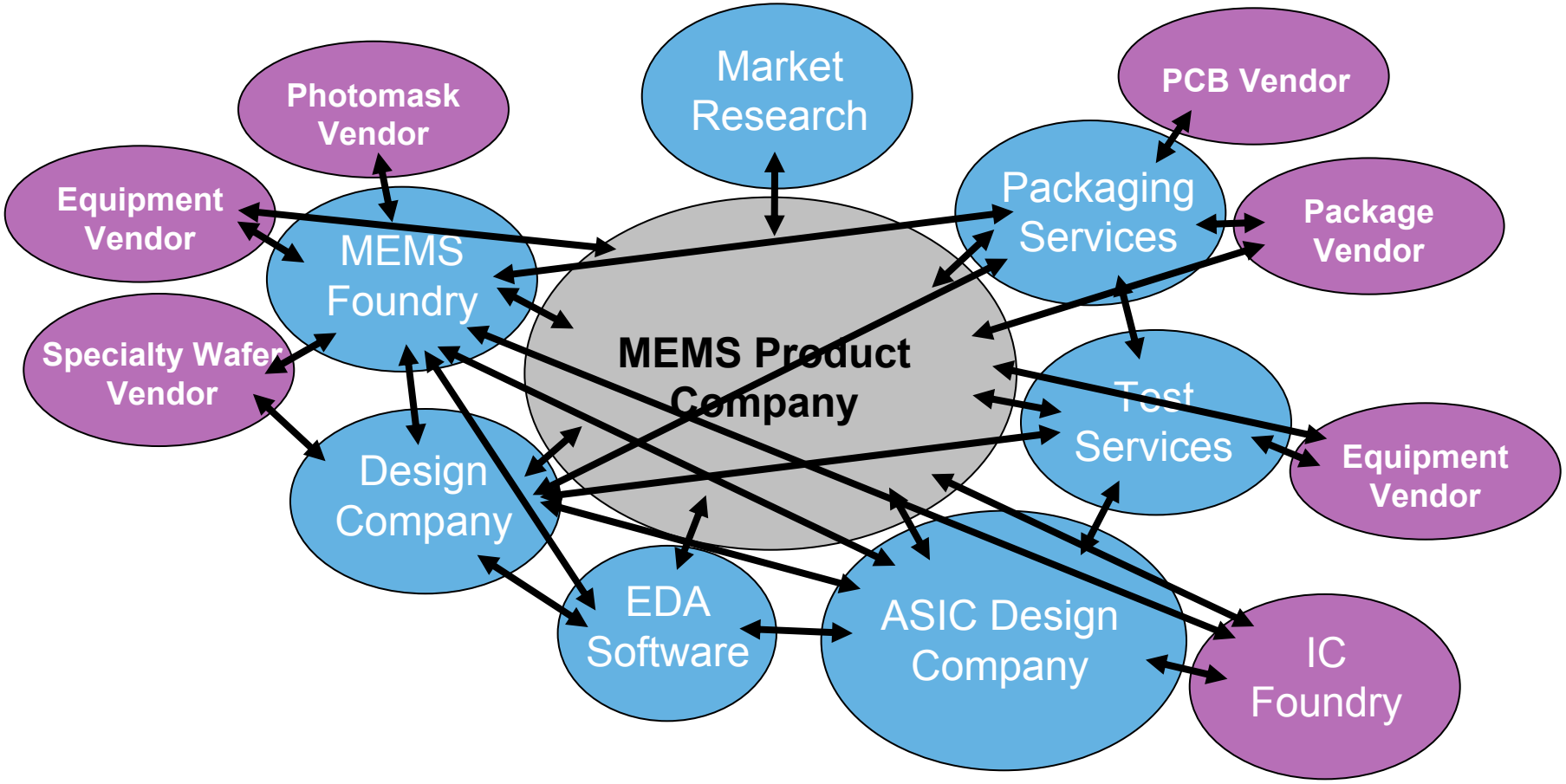
Information exchange between parties is critical to success

- **Do you think it looks like this?**

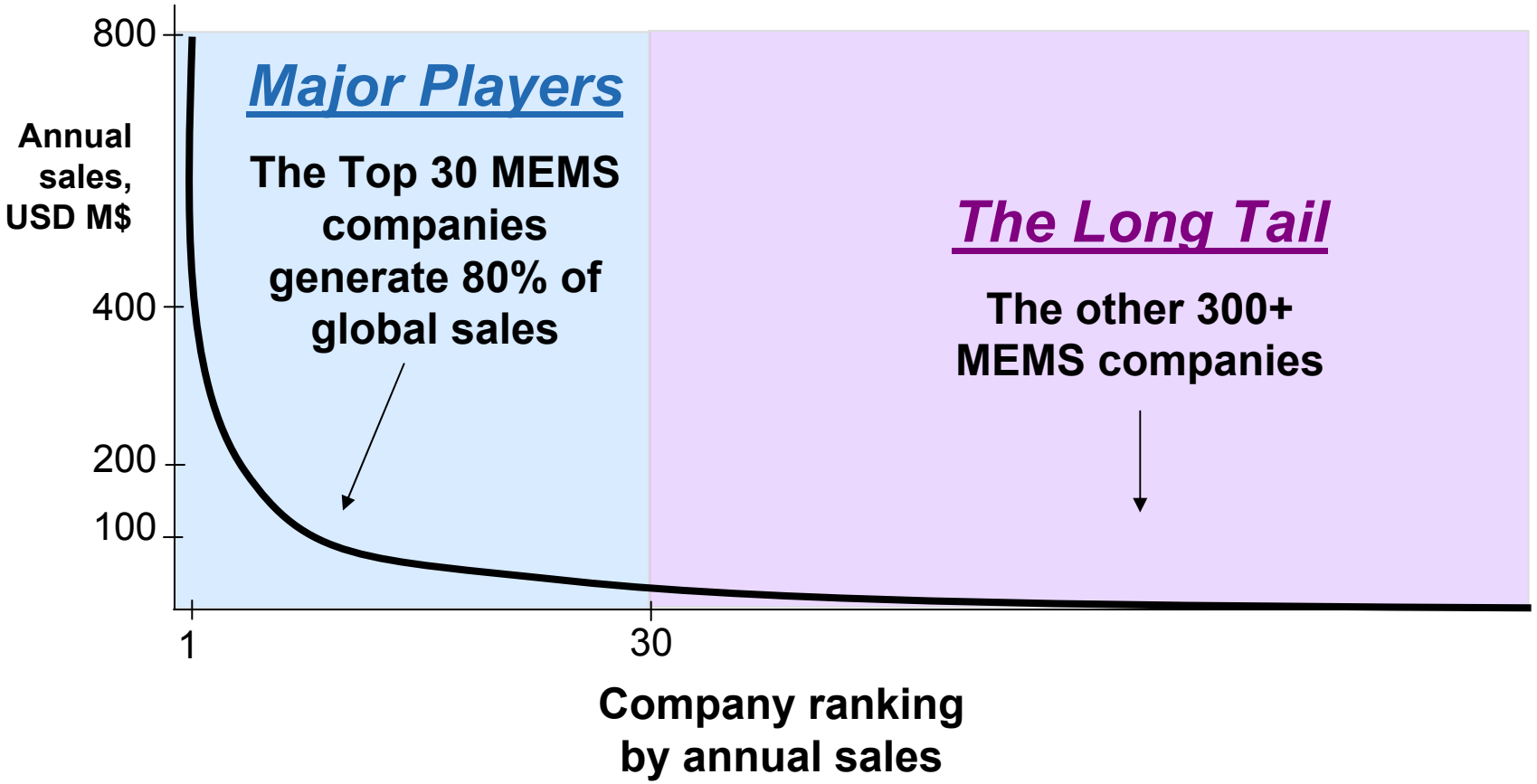


Gaps and lack of standards burden communications

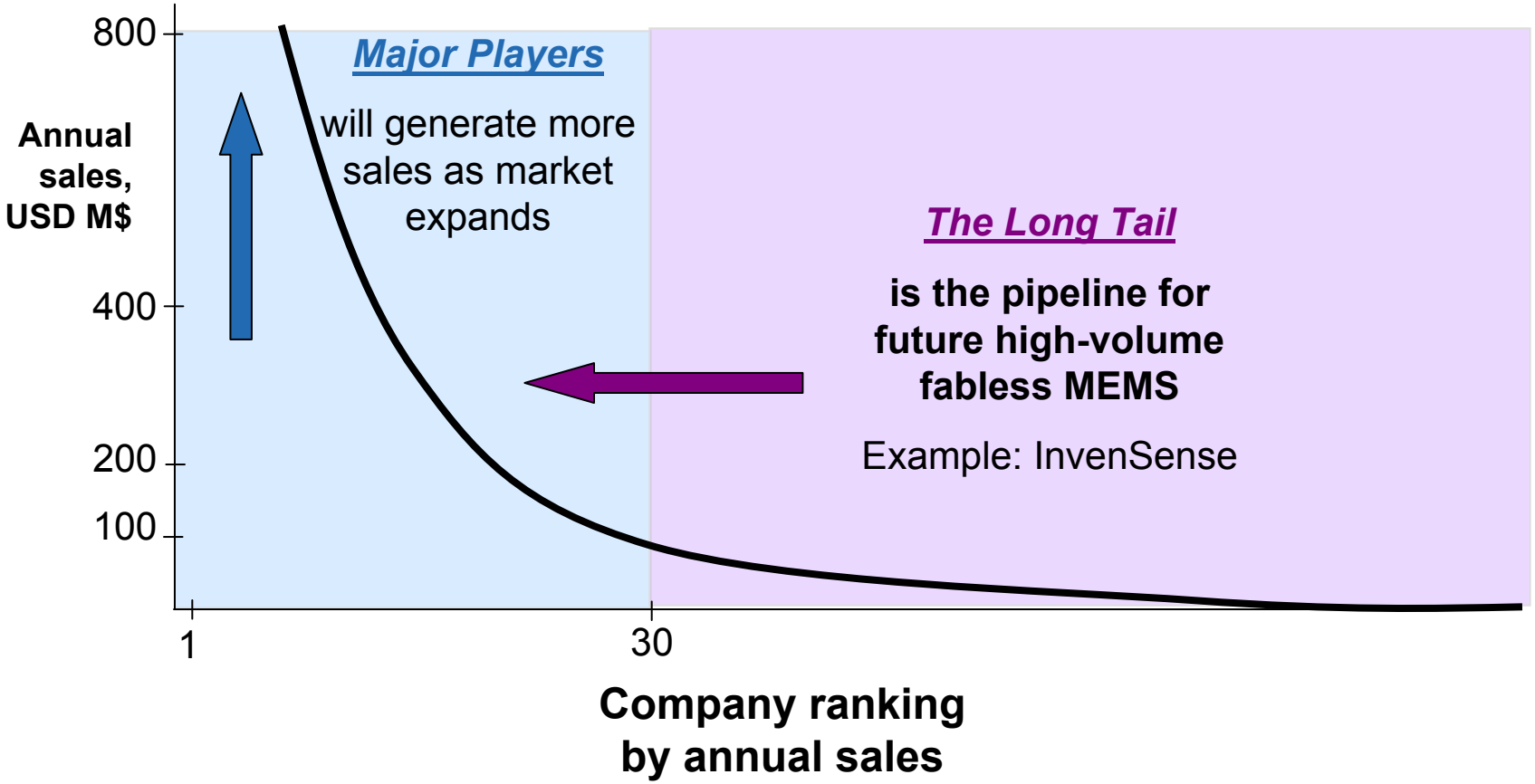
- **Reality: messy and inefficient!**
- **But - the fabless, outsourced model will prevail**



Today, there are two MEMS industries



Companies will move up – and they will be fabless



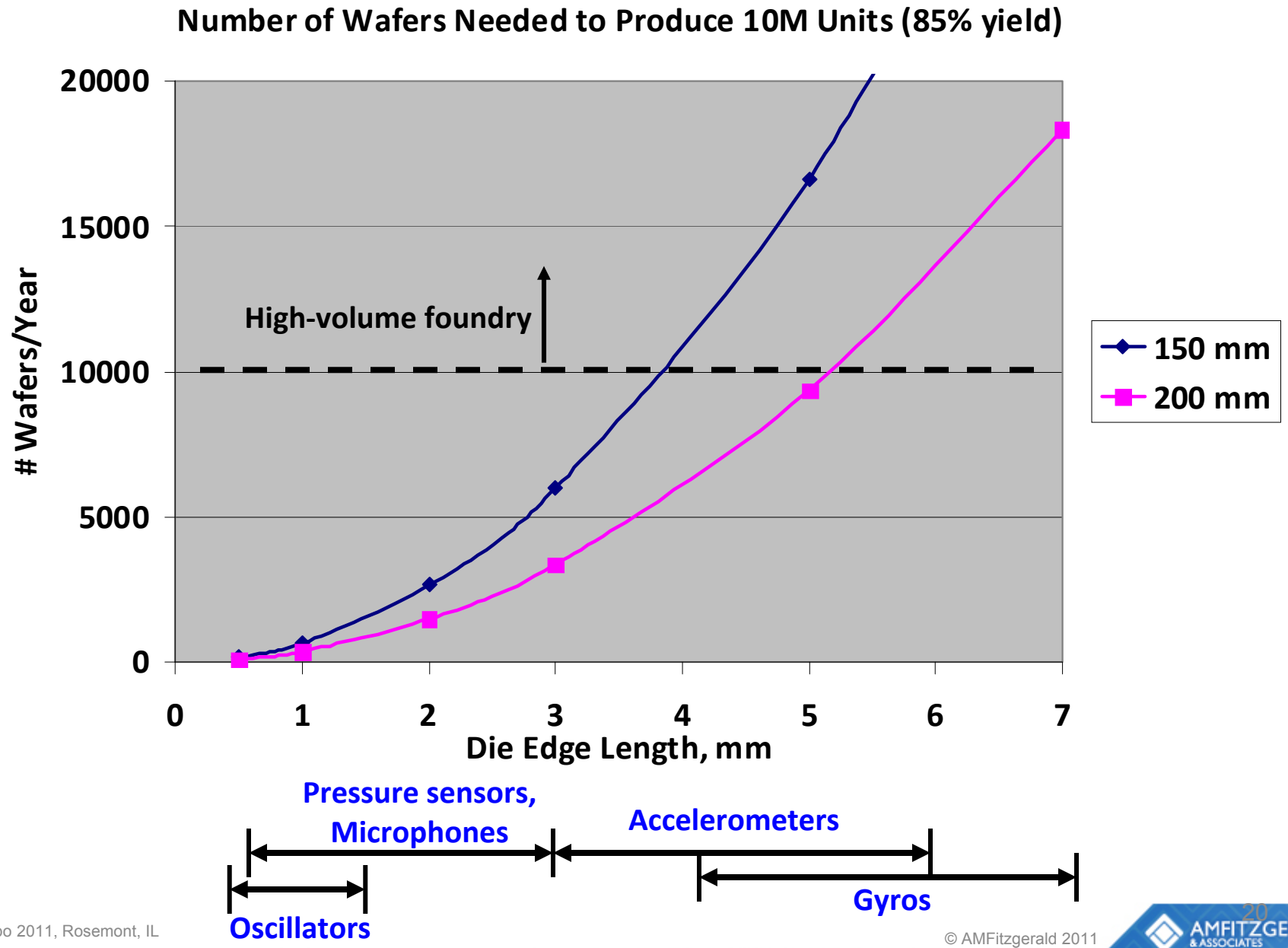
Viable business models for new MEMS companies

"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



Planning for efficient MEMS development

- **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

- **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)**

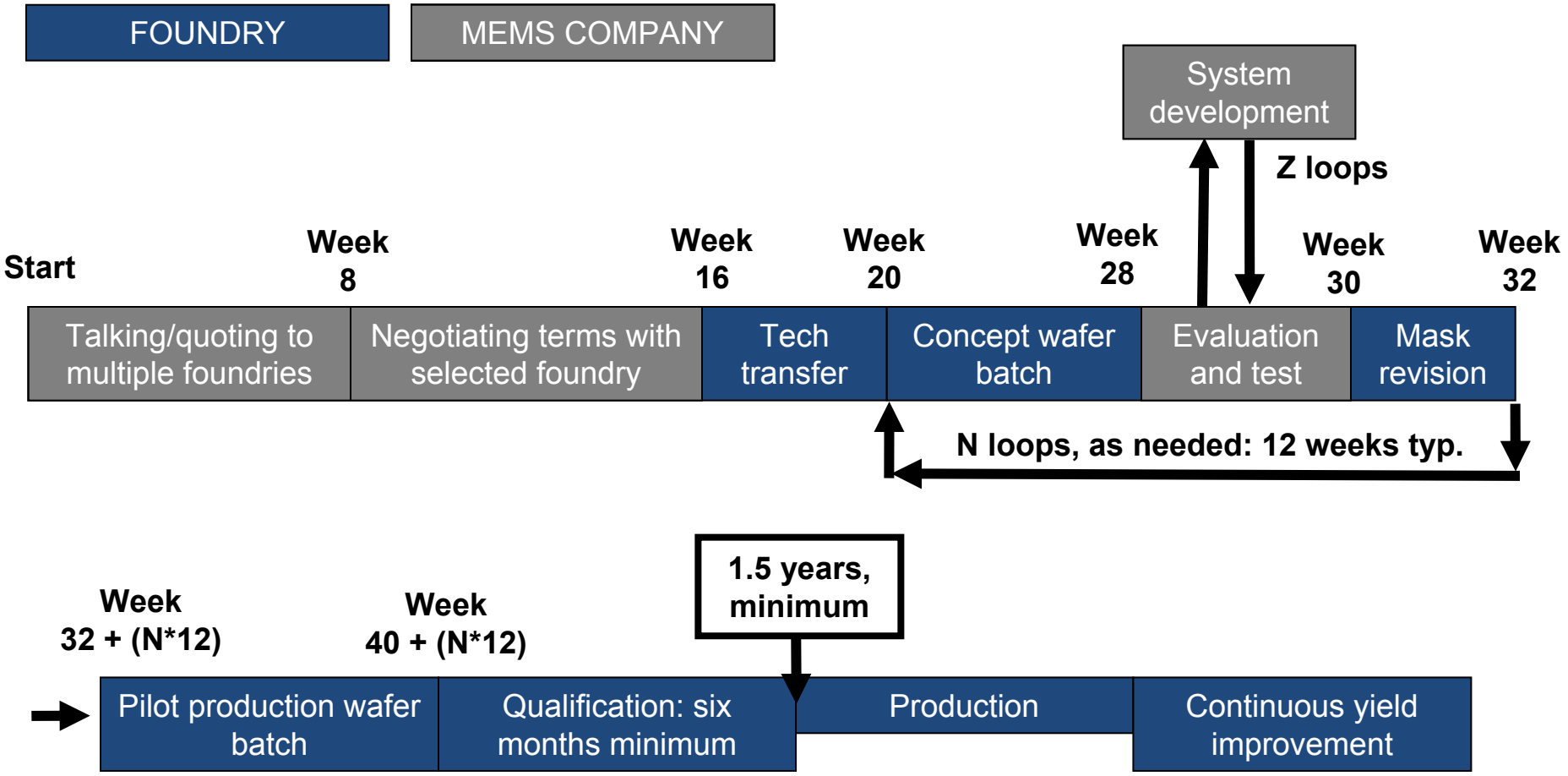
"I think this is the beginning of a beautiful friendship."

Foundry selection

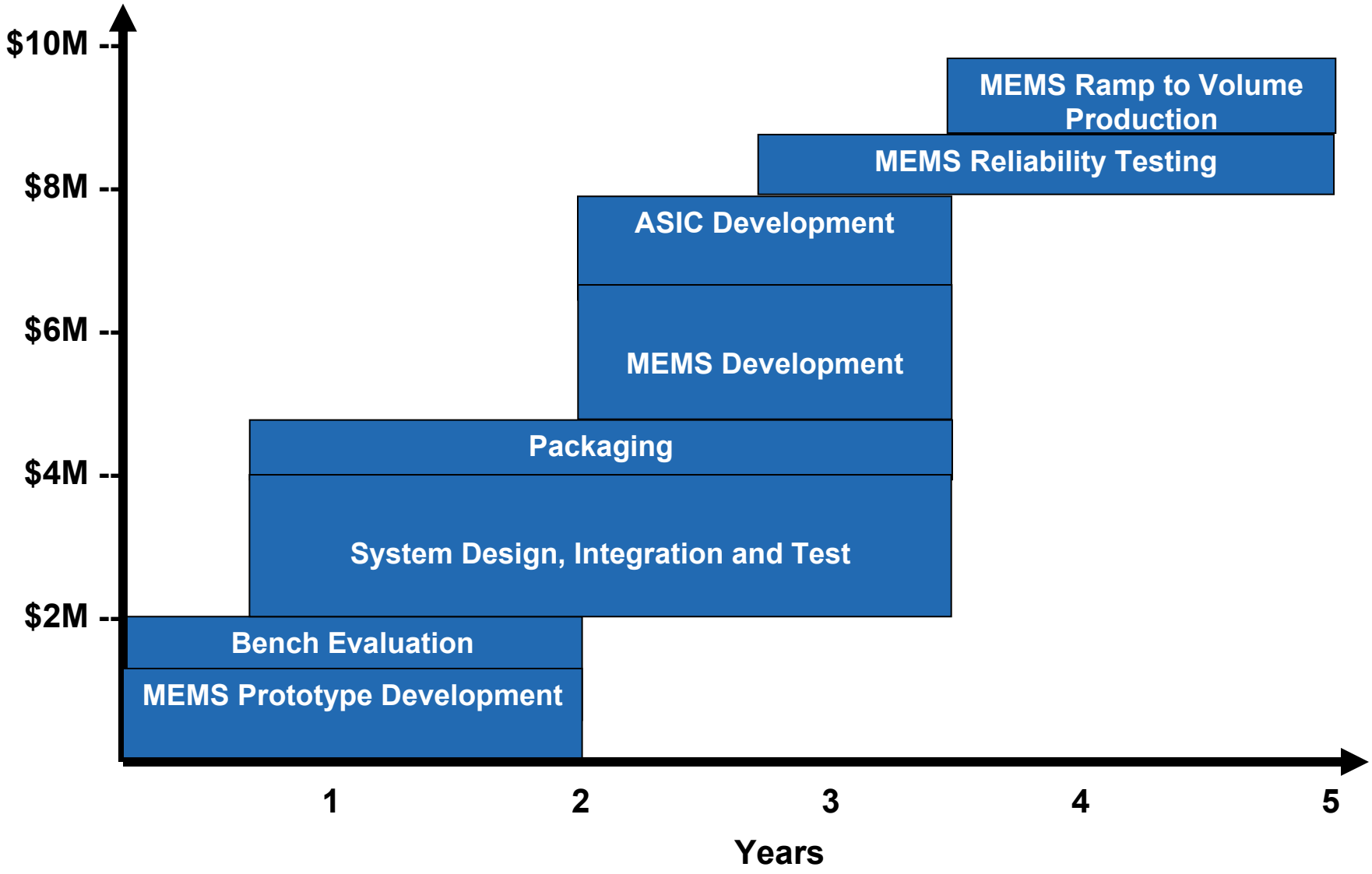
- **Evaluate process capability and experience with your type of product**

- **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

- **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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