How Open-Access Fabs Enable MEMS Entrepreneurship

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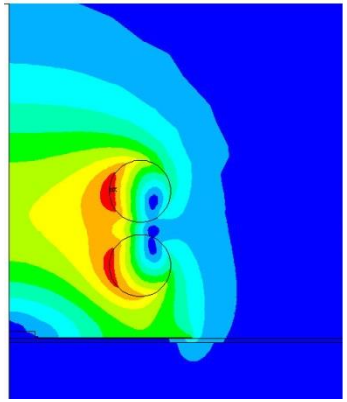
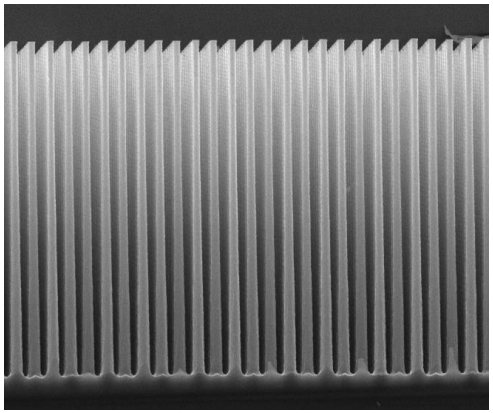
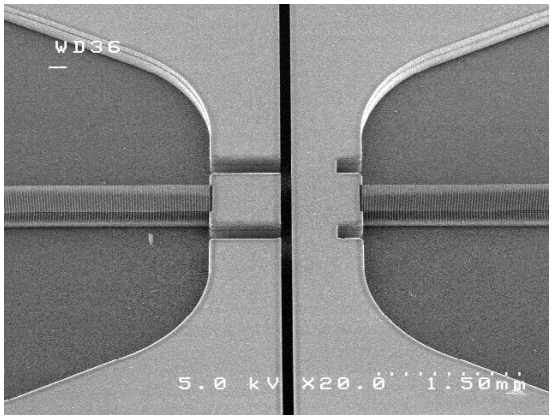
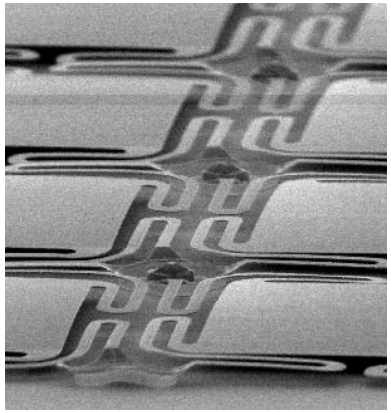
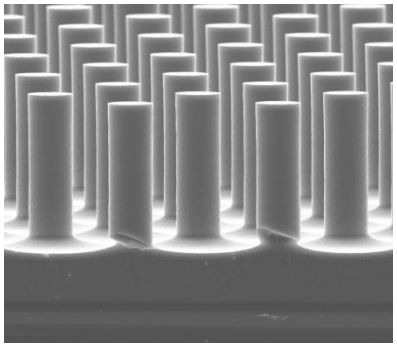
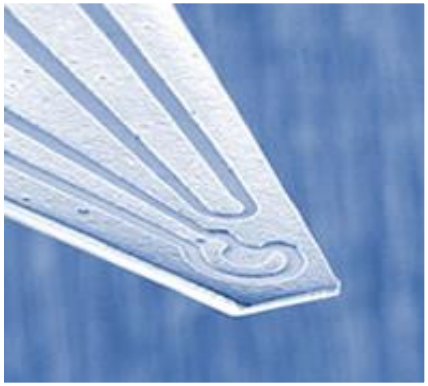
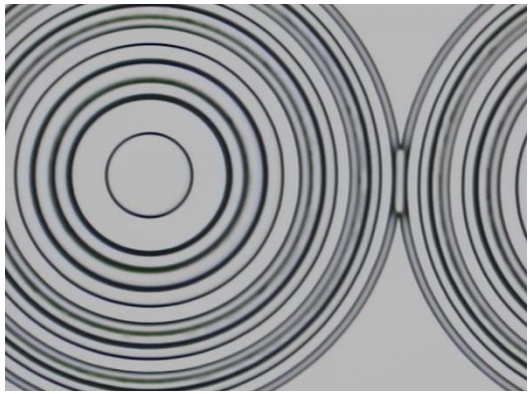
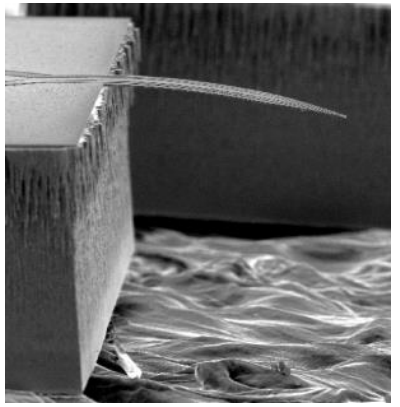
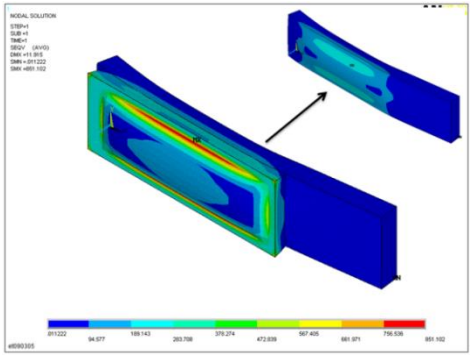
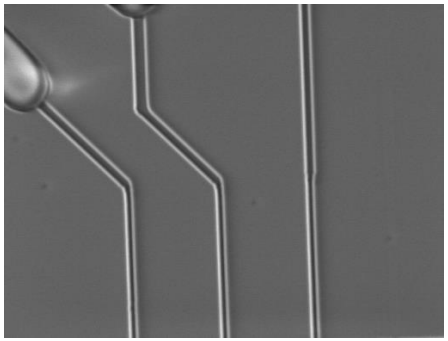
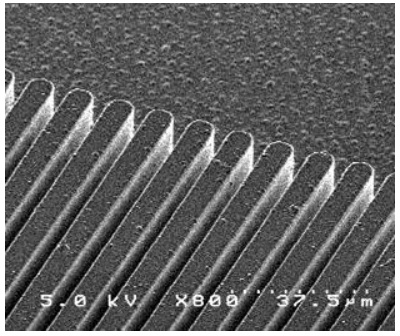
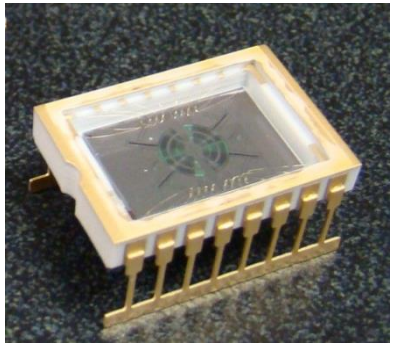
Overview

- About AMFitzgerald
- The commercialization of MEMS is difficult
- Open-access fabs are necessary for MEMS entrepreneurship
- Other open-access manufacturing facilities

Mission: Your Partner in MEMS Product Development



Company background

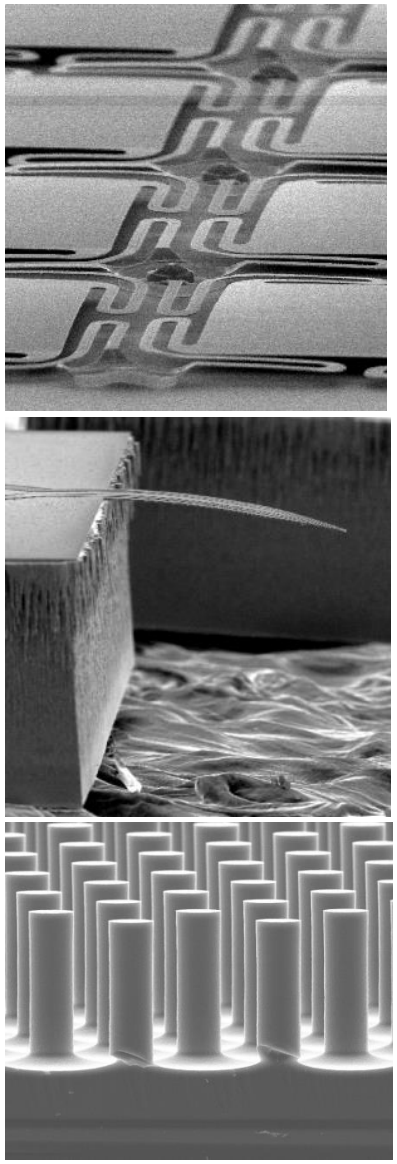
- **Founded 2003 by Alissa M. Fitzgerald, privately held**
- **Burlingame, CA: near SFO and Silicon Valley**
- **Goal: become the premier MEMS product development firm**
- **Consistent growth**
  - **Over 110 clients served to date**
- **Active member of the MEMS Industry Group**

Headquarters in Burlingame, CA

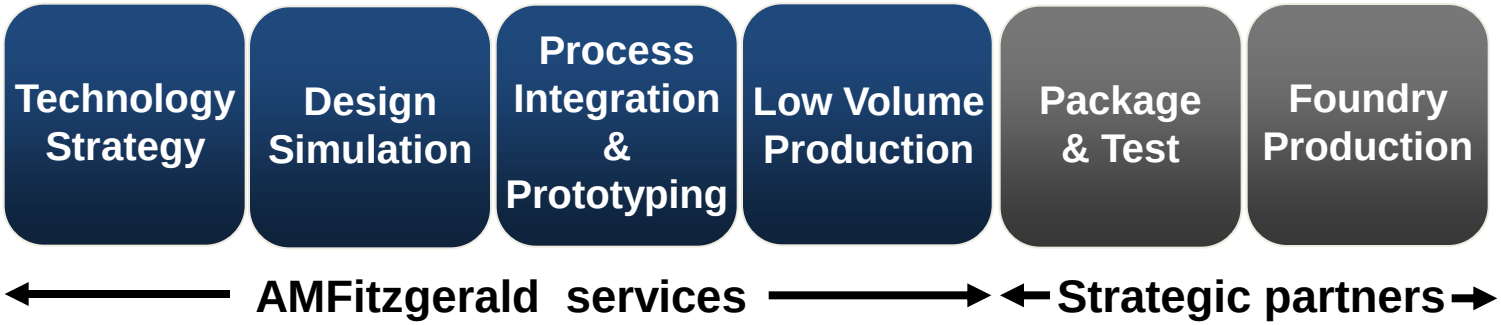
Fab operations at UC Berkeley Marvell Nanolab

Our value

- **First time developing MEMS?**
  - **We can provide the complete solution**
- **Improving your MEMS product?**
  - **Let us optimize your design**
- **Investing in MEMS?**
  - **Valuable insight from expert practitioners**
- **Our competitive advantage**
  - **A complete MEMS solution**
  - **Expert design and process engineers**



A complete solution from concept to production



Solutions beyond R&D

A menu of production options for different customer needs

Full custom low volume

AMFITZGERALD

Open search for foundry partner

Full custom high volume

Open search for foundry partner

Fast time to market with foundry-specific design

micralyne

silex MICROSYSTEMS

Faster time to market with semi-custom sensors

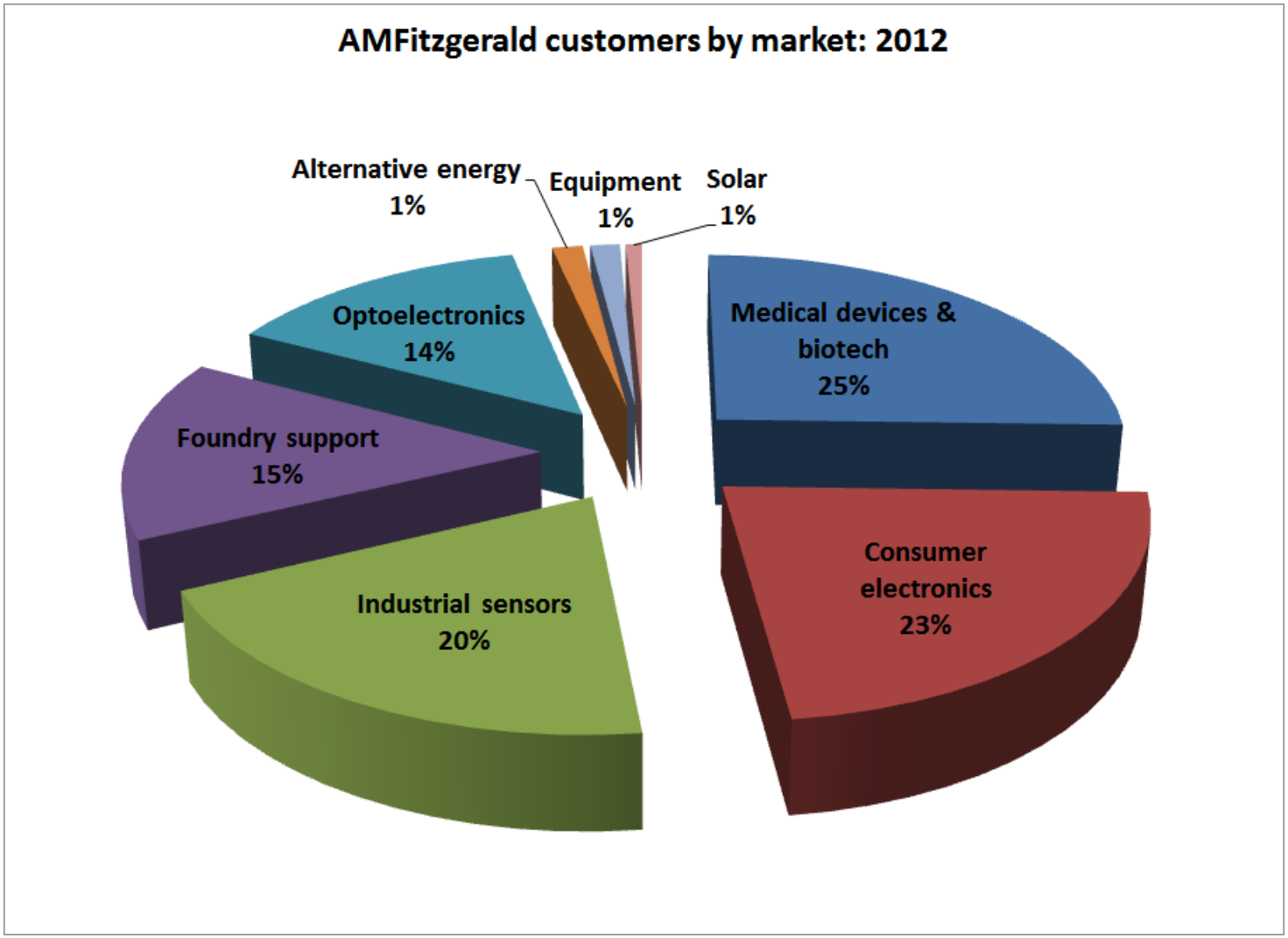
Fastest time to market with standardized 200mm process

InvenSense
Innovation in MEMS

Process flexibility

Speed to market

Our diverse customer base

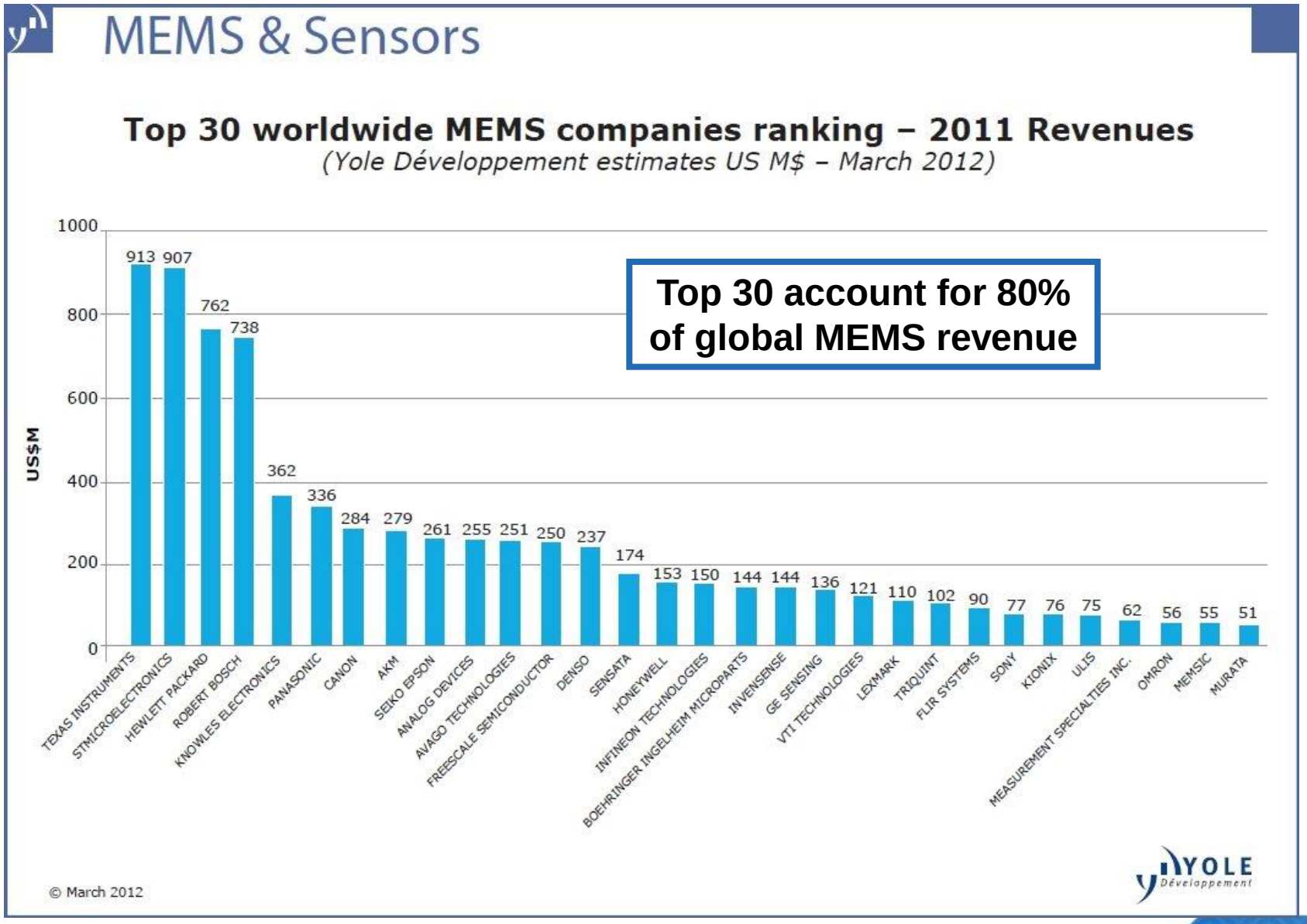


Types of MEMS developed in 2012:

- Optical switch
- Microfluidics
- Microphone
- Timing
- Microtexture
- Inkjet
- Radiation
- Motion
- Pressure
- Micro-mirror
- Cantilever
- IR imager
- Fuel cell
- Display
- Chemical

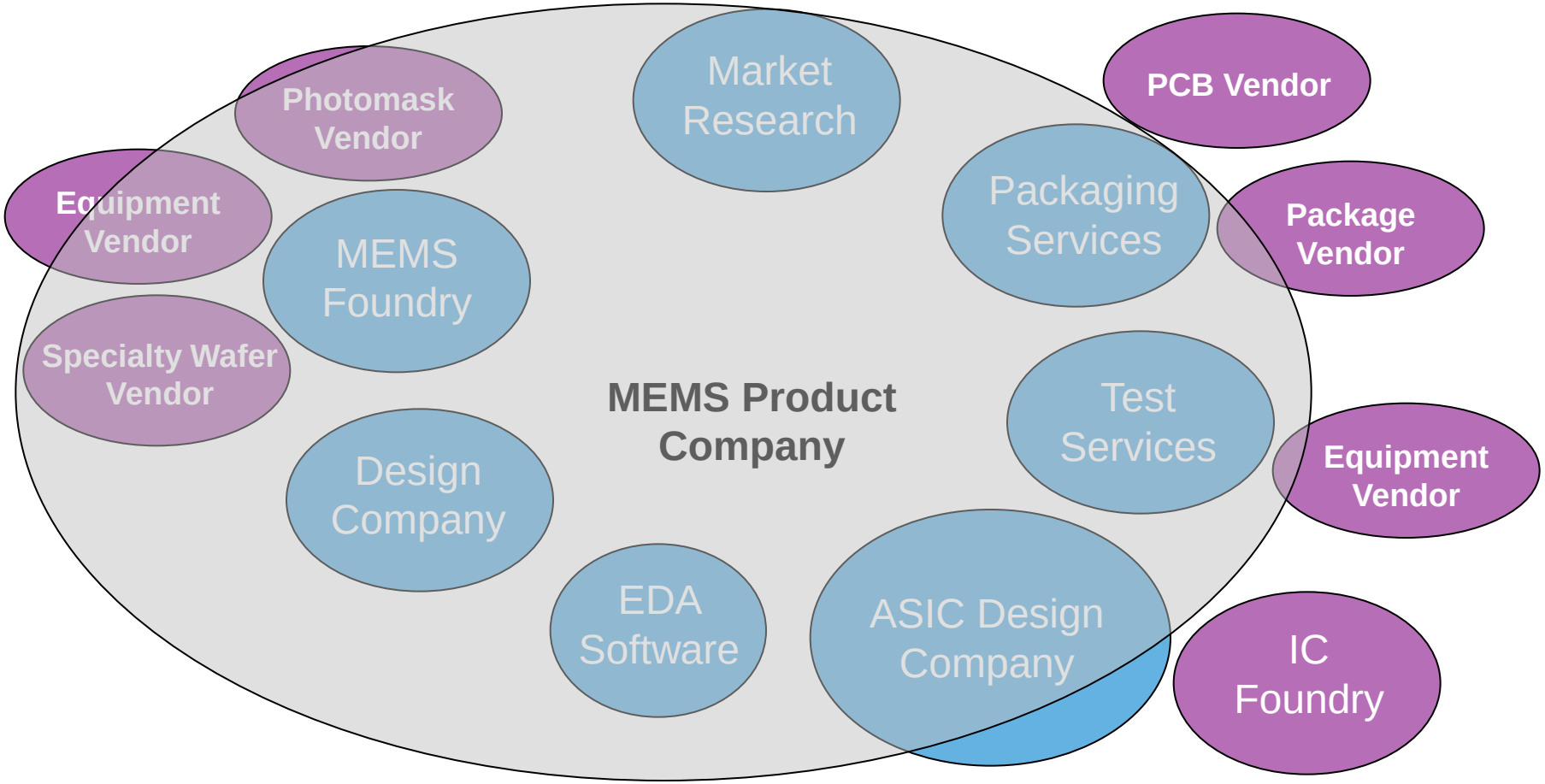
The commercialization of MEMS is difficult

Large companies dominate the MEMS industry today



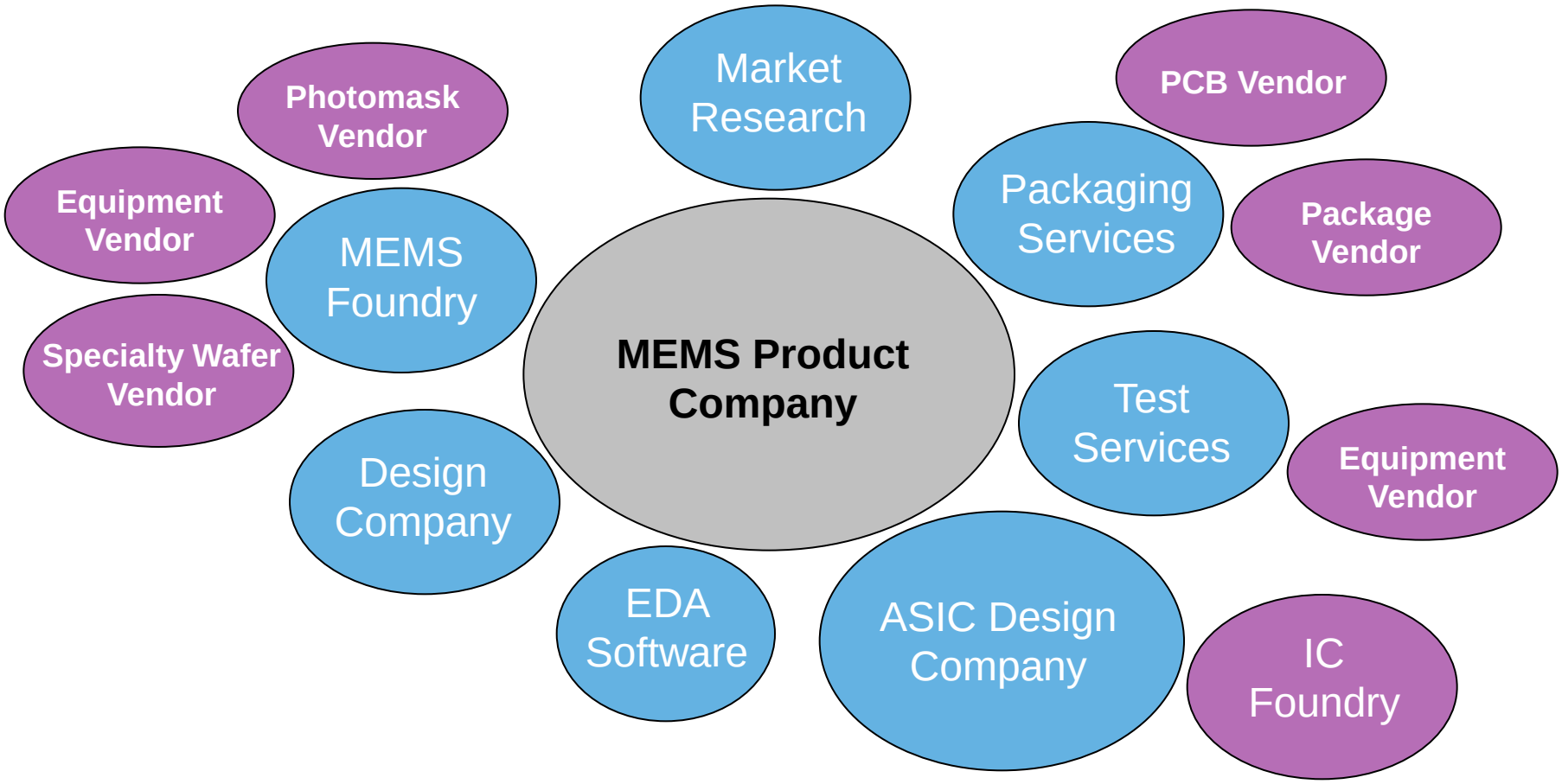
MEMS supplier ecosystem in 1995

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

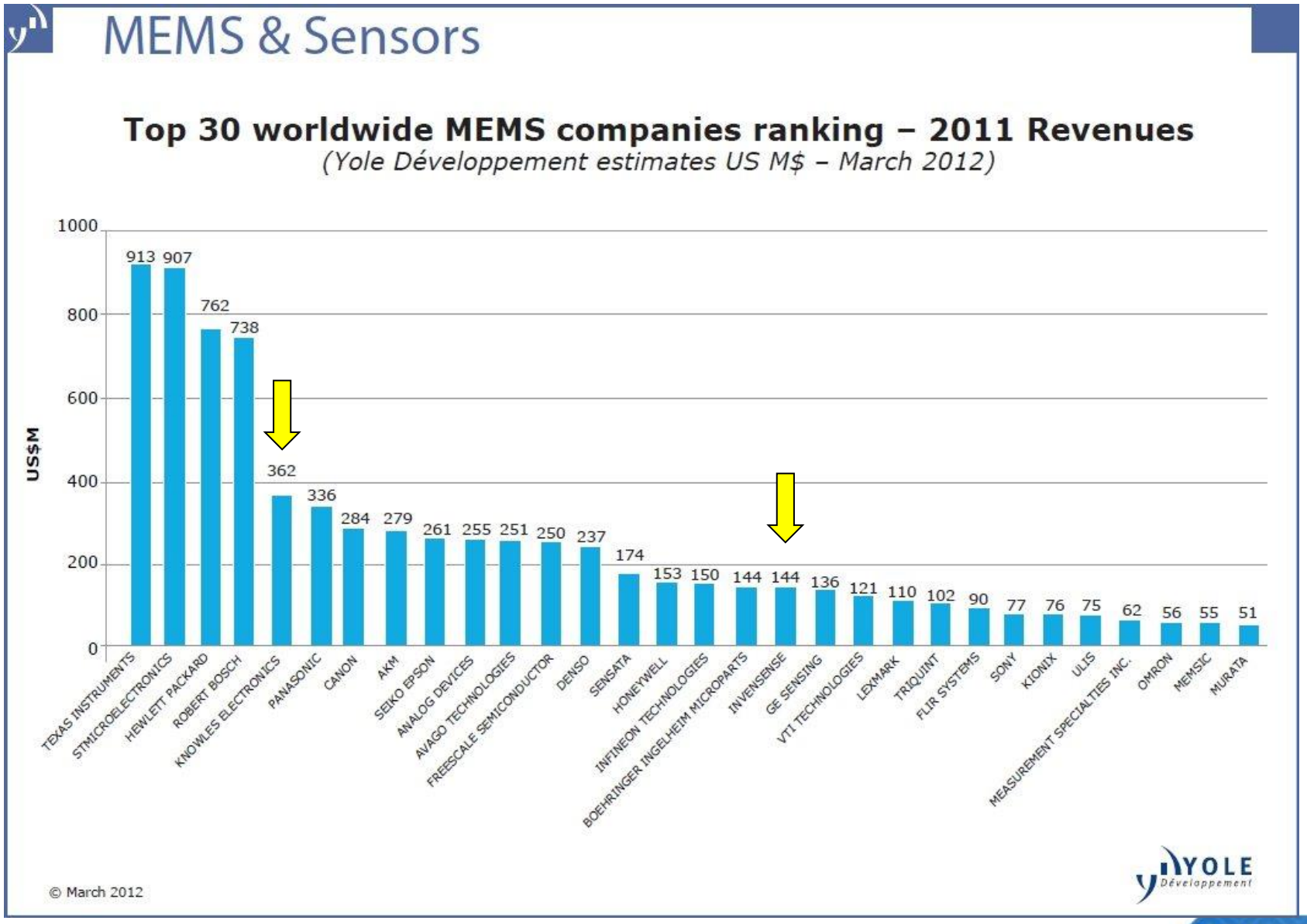


MEMS supplier ecosystem today – much improved

- **Specialization reduces resource requirements**
- **Fabless MEMS companies now possible**

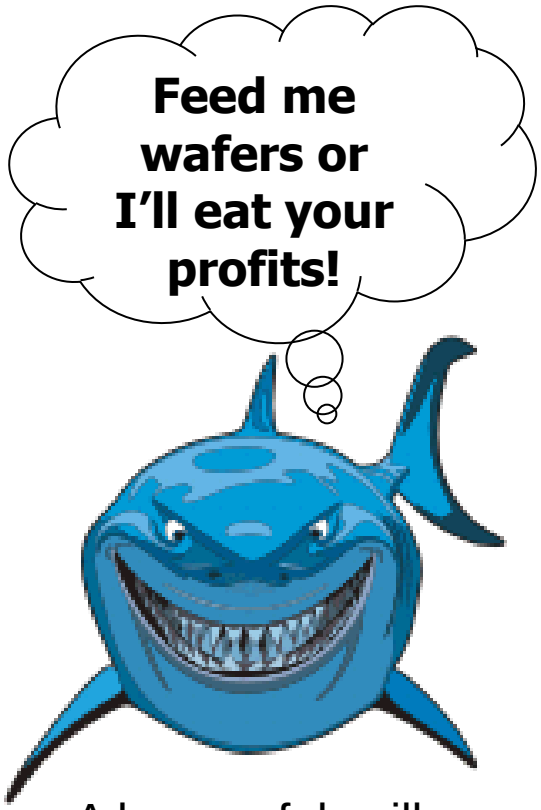


But only two of Top 30 companies are totally fabless



New MEMS companies must be fabless or "fab-lite"

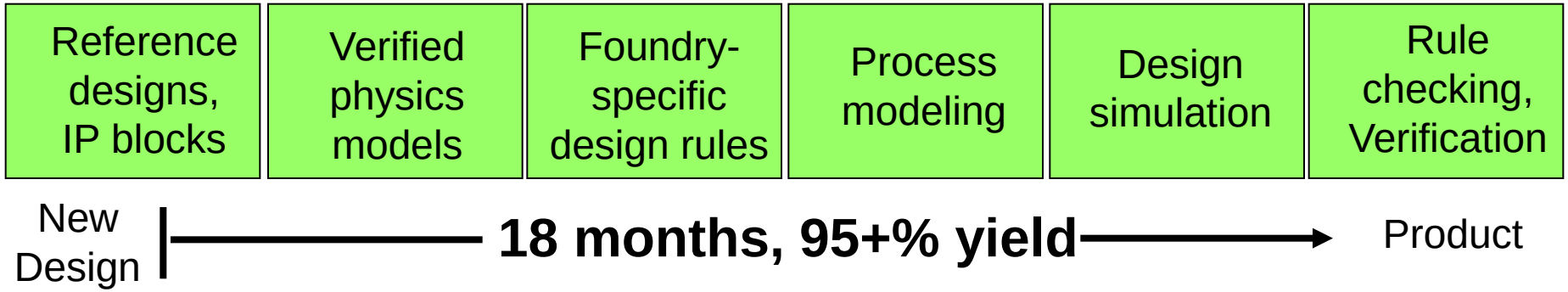
- **Investors don't fund fab construction or operation anymore – too expensive!**
- **Fabless model**
  - **Product company makes designs, foundry makes wafers**
- **"Fab-Lite" model**
  - **Foundry does most of wafer process, but some back-end processes are done at product company**



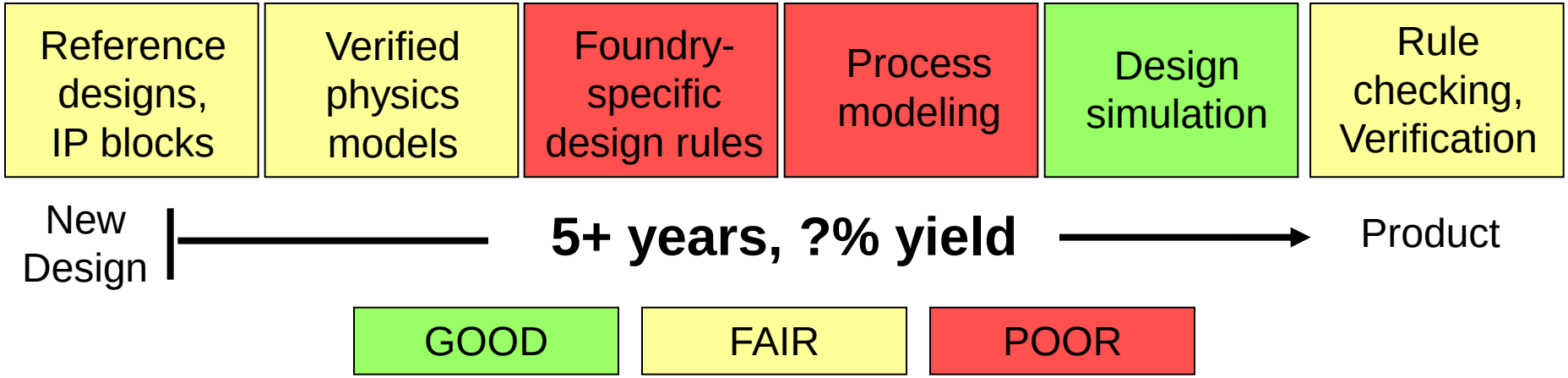
A hungry fab will kill a business

Fabless MEMS companies face a long, risky development

Digital ASIC Development



Fabless MEMS Industry Development



How can a fabless company develop new MEMS?

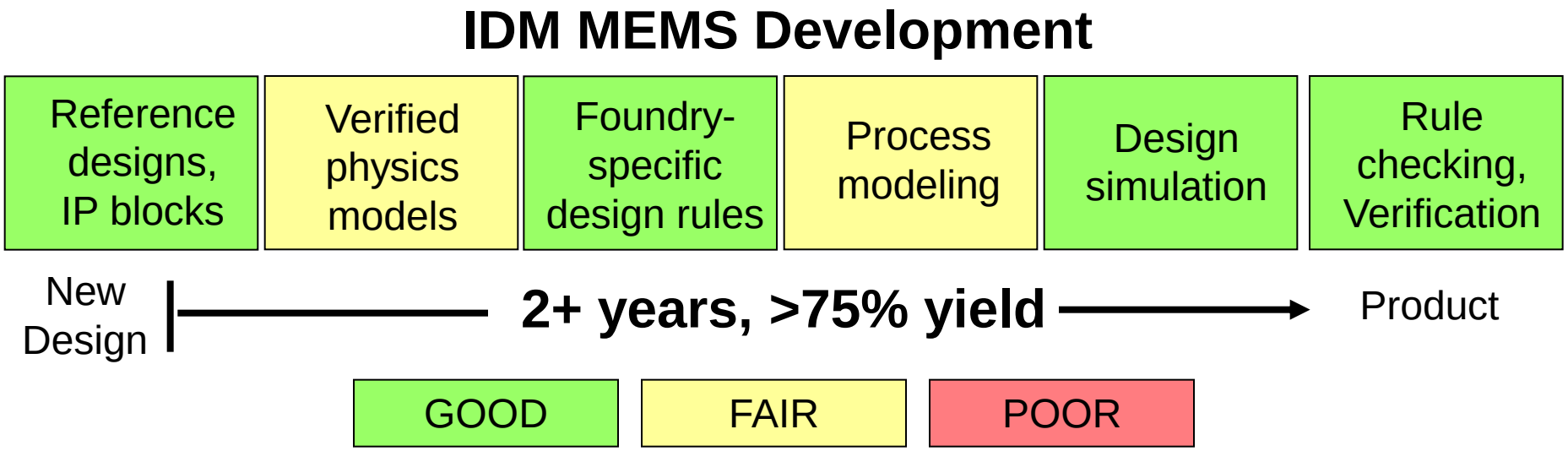
- **MEMS require significant process development**
  - **Process tolerances have dramatic effect on MEMS function**
  - **No foundry standard processes or flows**
  - **Simulation tools can not model everything**

- **Many design-fab-test iterations necessary to stabilize MEMS design**

- **This is a problem with the current MEMS fabless model**

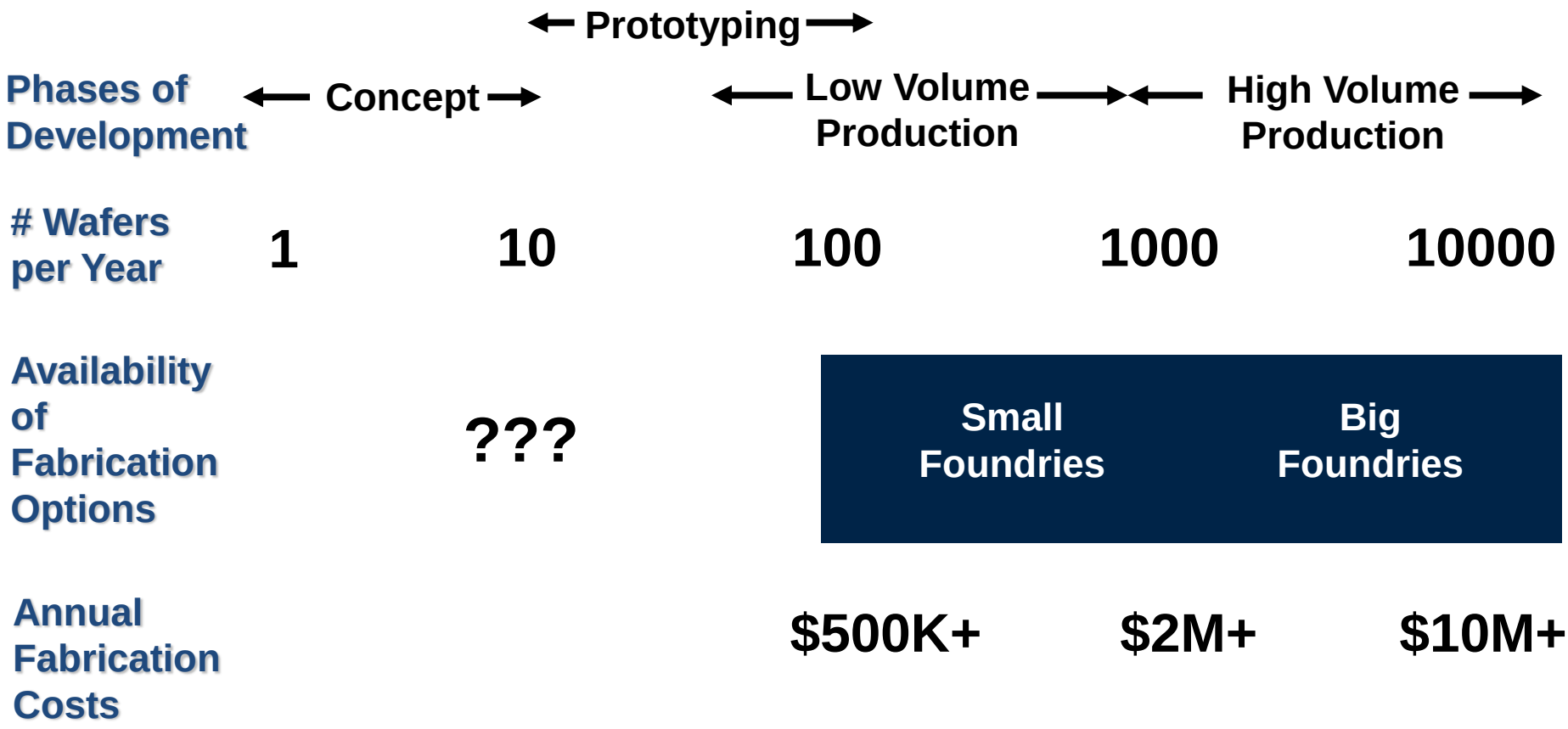
It's a different story for the Top 30 (big) MEMS companies

- **"The rich get richer"**
- **They own their own fabs and have internal resources**



Open-access fabs are necessary for MEMS entrepreneurship

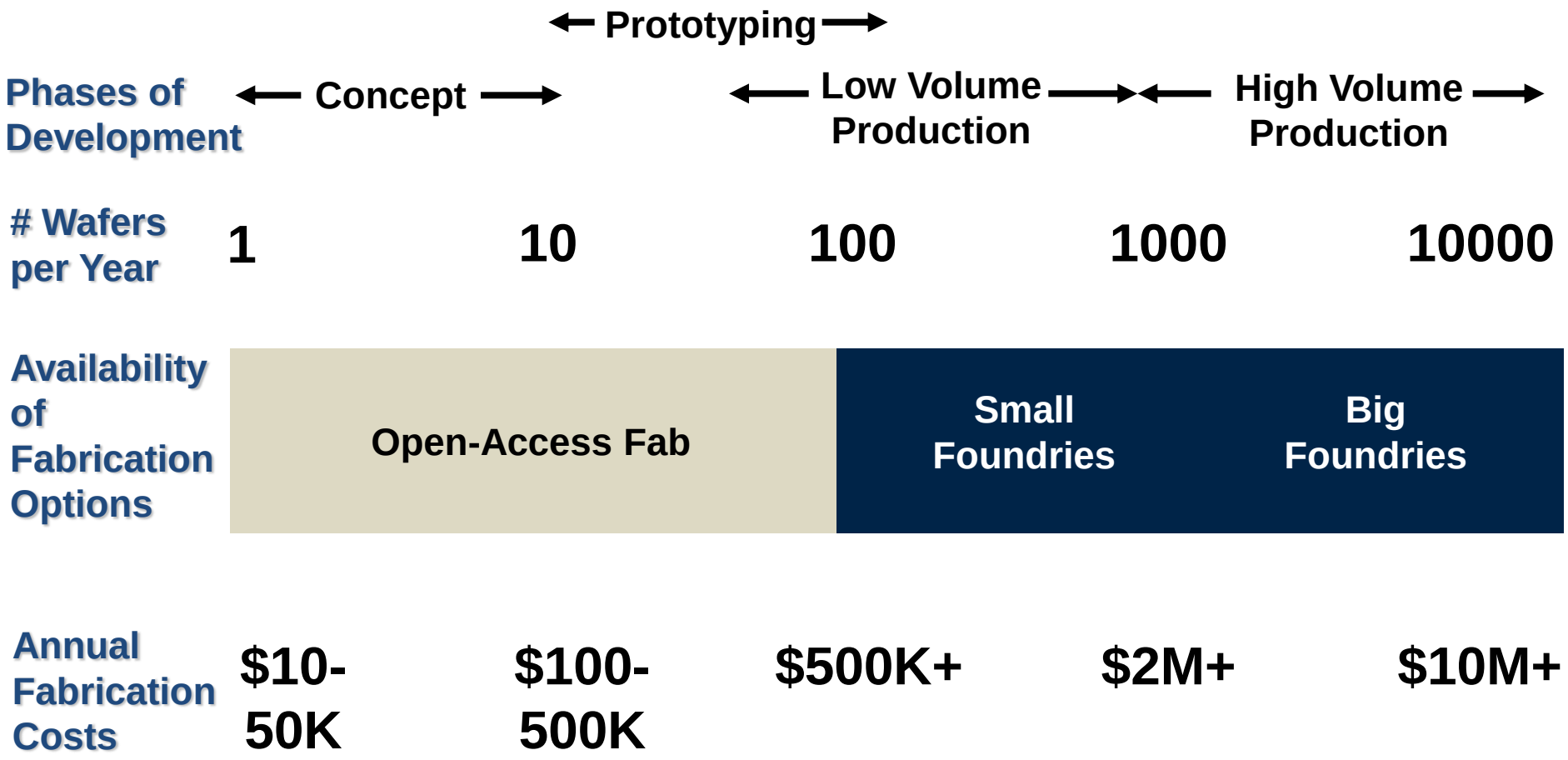
MEMS manufacturing challenge – bridging the gap



Where to do concept-prototype development?

- **Foundries do not want this work**
  - **Profitability depends on high tool utilization = processing many wafers**
  - **Can not easily mix R&D runs with production (work flow problems)**
  - **Do not have the right type of engineers on staff**
  - **Need to support their large customers' production**
  - **Too expensive for new startups**

Solution: open-access facilities for MEMS development



Open-access facilities fill this development gap

- **Qualities of a good open-access facility:**
  - **A large organization that can finance, host and maintain the facility**
    - **Provide user training, maintain tools and supplies**
    - **Profit is not a priority (non-profit or subsidized)**
  - **Allow users to rent expensive equipment by the hour, job or day**
  - **A community of users with diverse (non-competitive) interests**
    - **They can help each other**
- **Fab access is affordable to small companies and startups**

Open-access work models

- **User provides labor**
  - **Send own employees into fab**
  - **Hire development services firm (like AMFitzgerald)**
  - **Best option to preserve IP rights**

- **Facility provides labor, usually as a joint development**
  - **Fraunhofer (Germany)**
  - **Imec (Belgium)**
  - **CSEM (Switzerland)**
  - **C2MI (Canada)**
  - **IME ASTAR (Singapore)**
  - **Facility retains some rights to IP**

AMFitzgerald uses UC Berkeley fab

- **Benefits for us:**
  - **Access to modern facility with 150 mm wafer equipment**
  - **Only pay for what we use – low overhead**
  - **Technical exchange with community, recruiting**
  - **Low business risk**
- **Benefits for our customers:**
  - **Lower cost, rapid prototyping, small wafer batches**
  - **Customer keeps all IP rights**
  - **Can test processes before transfer to foundry – lower risk**

- ***We could not have built our business without an open-access fab!***

The Univ. of California Berkeley Affiliates

- **21 companies**

GROUP4 LABS™
AN EXTREME MATERIALS COMPANY

AMFITZGERALD

RHEOSENSE, INC.

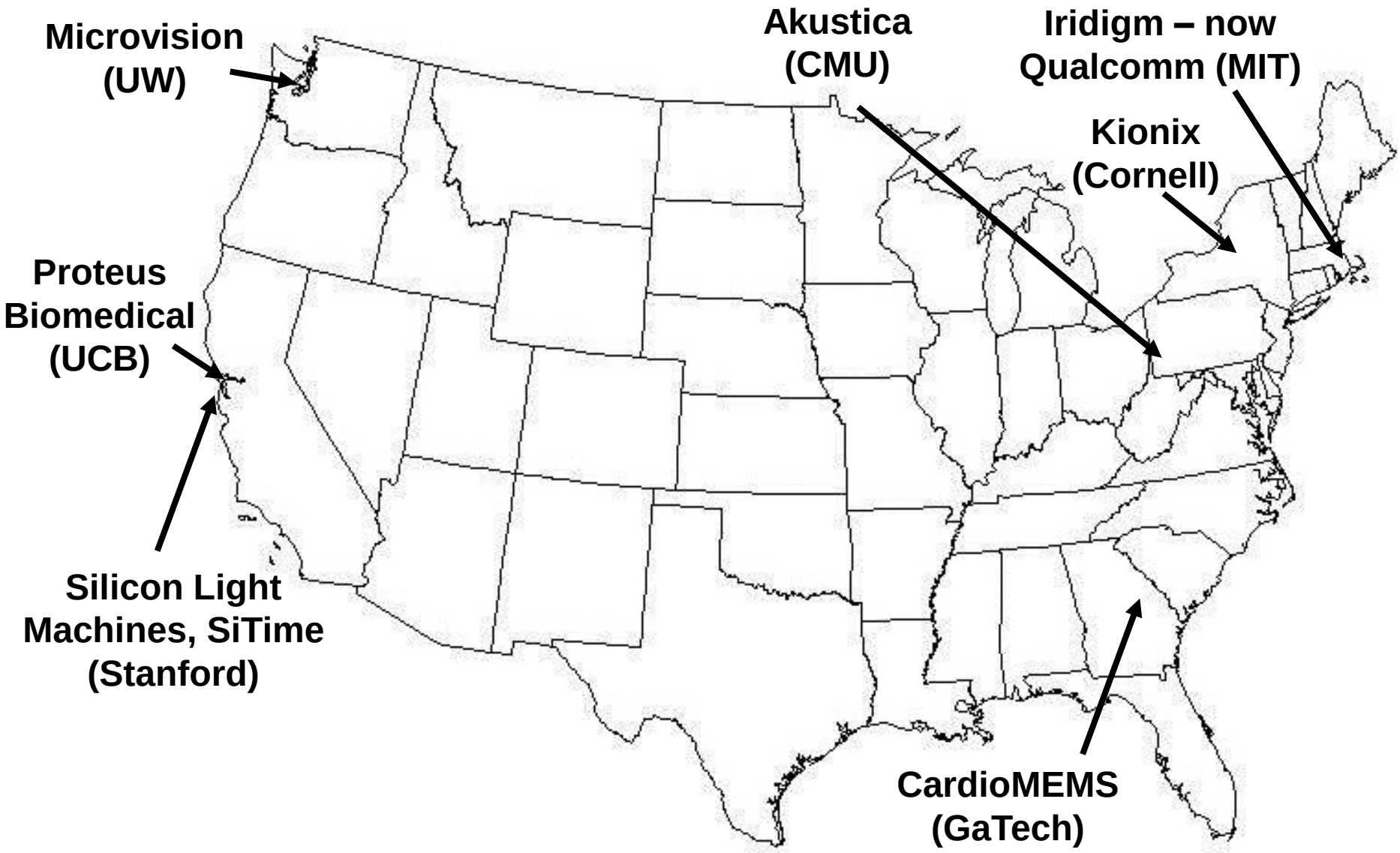
Crossbar

Nano Precision Medical

IRIS AO, INC.
ADAPTIVE OPTICS MADE EASY

Nanoshift

USA companies that used open-access fabs to develop



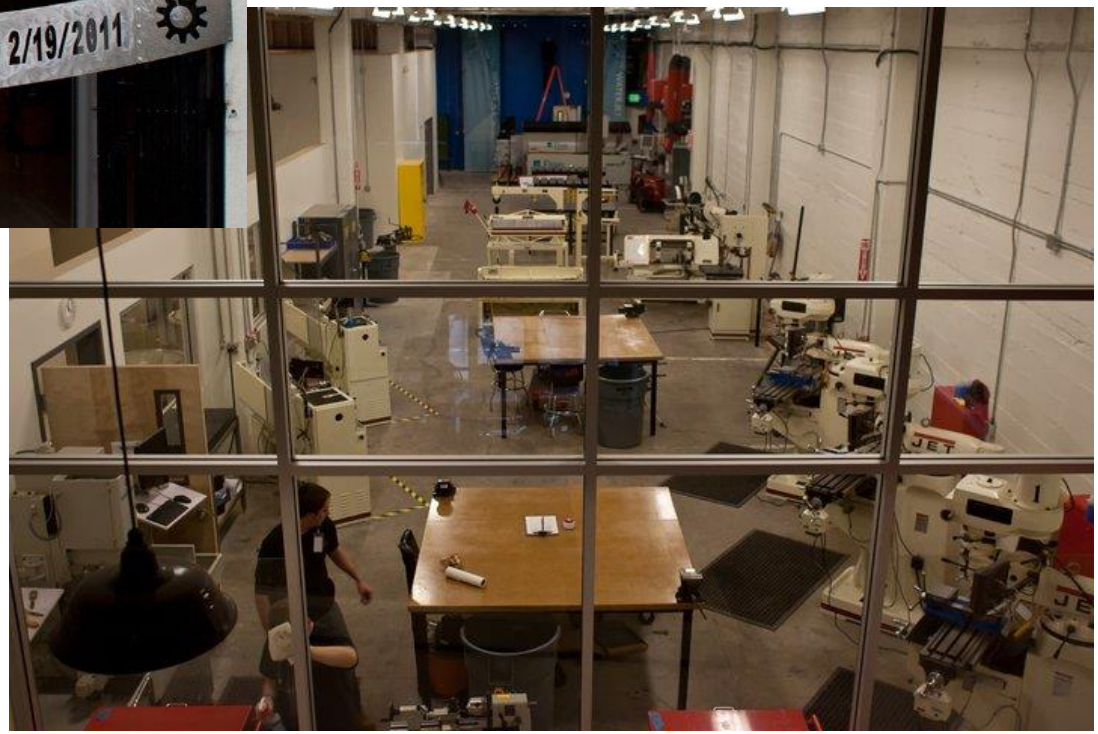
Open-access in Japan

- **Tohoku University μSIC: 100 and 150 mm**
- **Tsukuba Innovation Arena MNOIC: 200 and 300 mm**

Open-access is good for other technologies, too

Open-access machine shop

A shared machine-shop facility open to individuals and small businesses



Five locations in USA

www.techshop.org

Open-access biotechnology laboratory

A shared biology lab facility open to startups

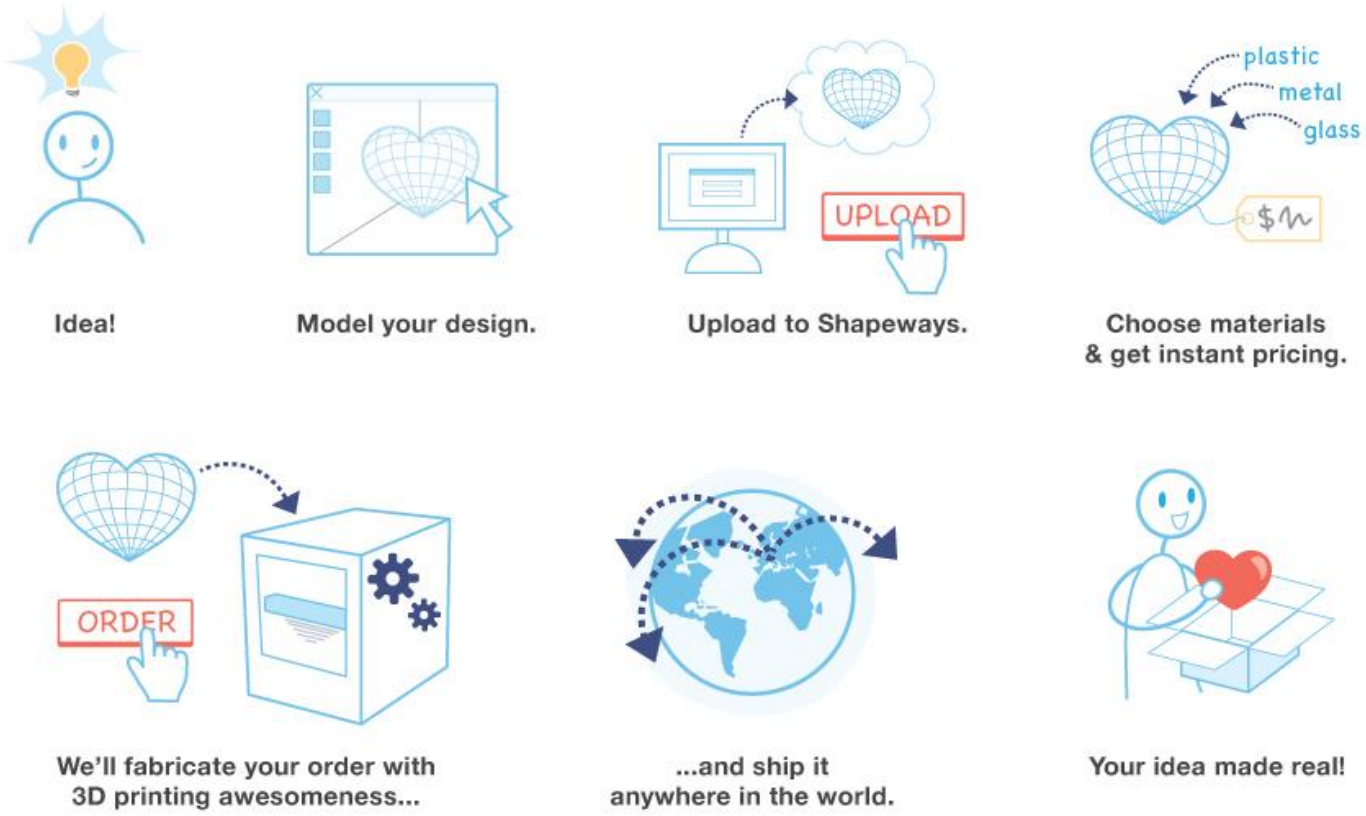
www.qb3.org/startups/qb3-garage

Open-access servers

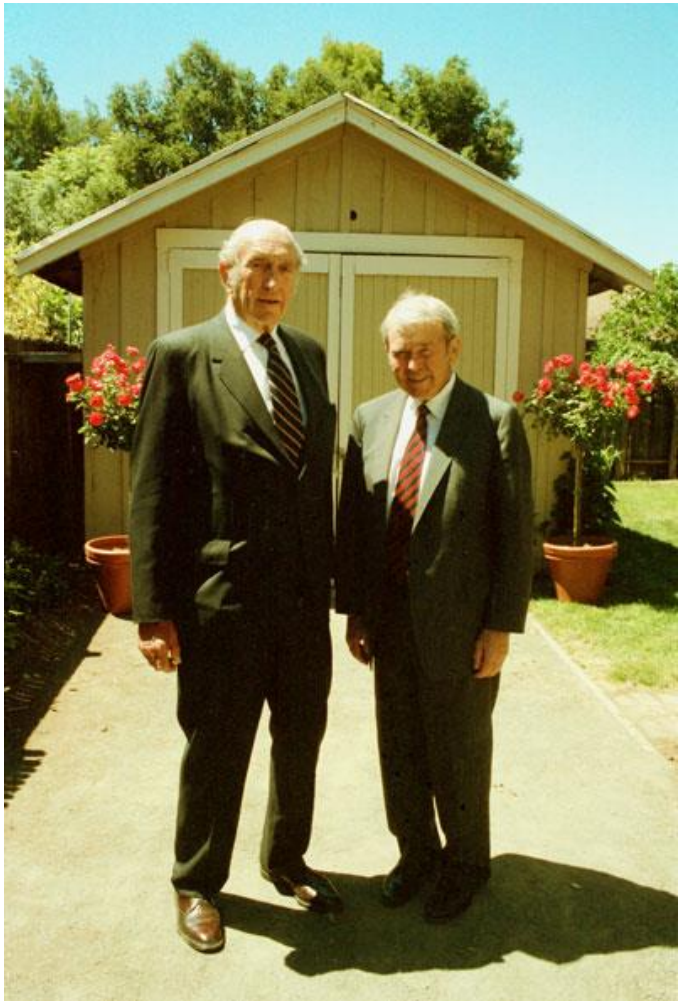
- **Amazon rents server space to software companies**
- **On-demand, scalable computing power and storage**
- **aws.amazon.com/what-is-aws/**

Open-access 3D printing

- **“Democratization” of manufacturing – anyone can make a part**
- **www.shapeways.com**



You can't start a MEMS company in a garage!



Hewlett & Packard at the Palo Alto garage where they started their business

- **High tech businesses are inherently capital intensive**
- **Investors are now risk averse**
- **The era of garage startups is over**
- **Open-access facilities help technology entrepreneurship**

Summary

- **Open-access facilities help MEMS businesses succeed**
- **This model works and should be copied and supported**
- **Future advanced technology development will require open-access facilities**
  - **No one can afford to finance giant private facilities anymore**

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