Empowering Tomorrow's Precision Medtech with Sensor Solutions

Webinar hosted by SEMI - MSIG

Andrew Fung, Ph.D. | May 7, 2025

AMFITZGERALD & ASSOCIATES

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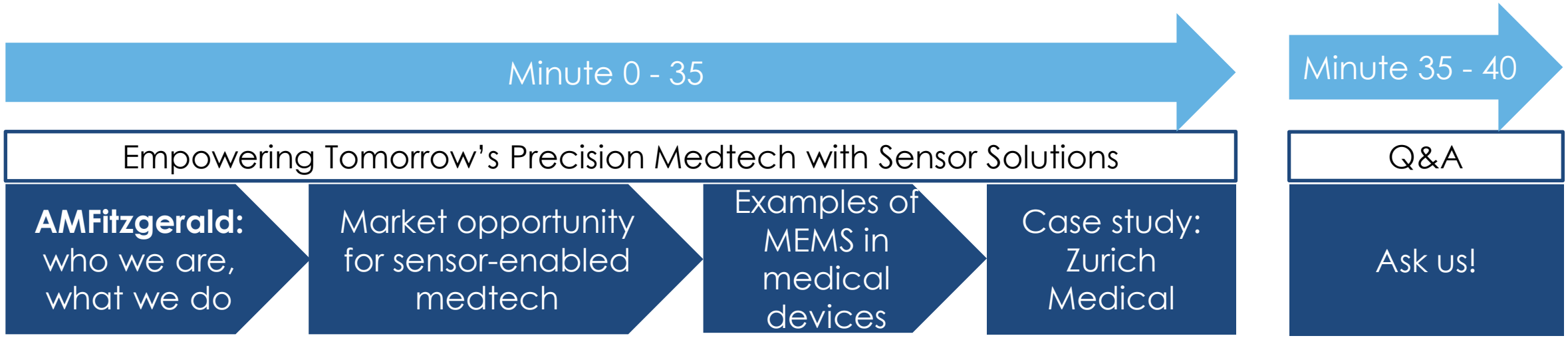
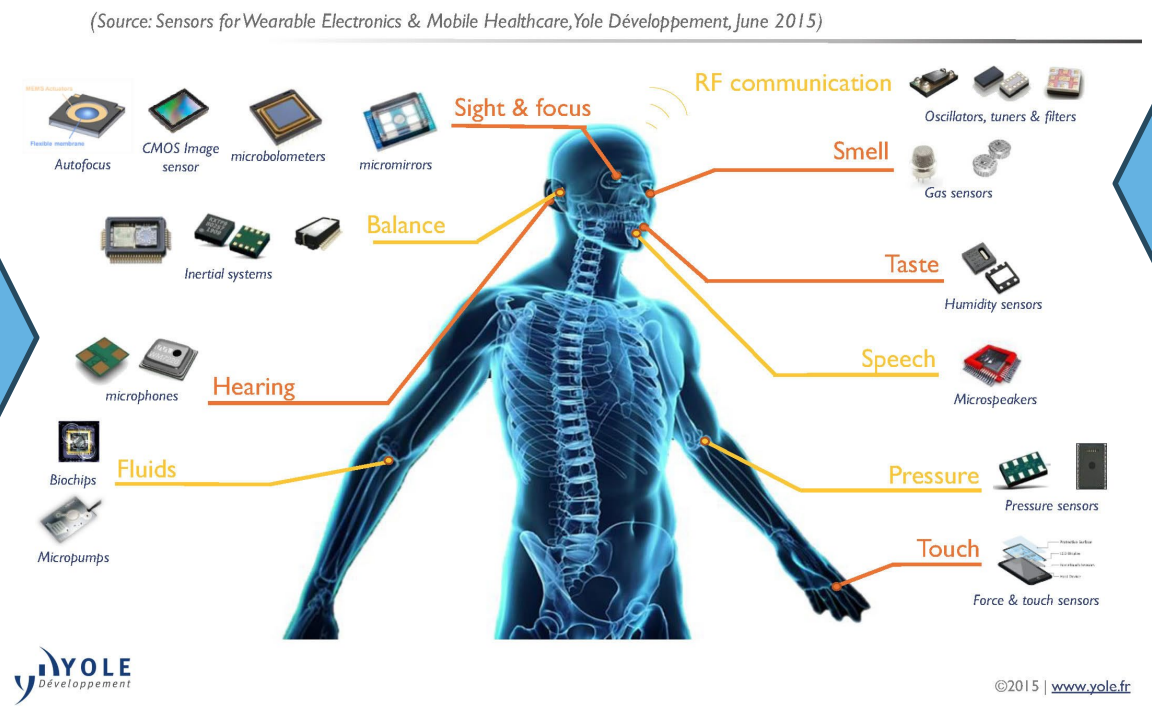
Get ready for 40 minutes of expertise that will inspire future medtech



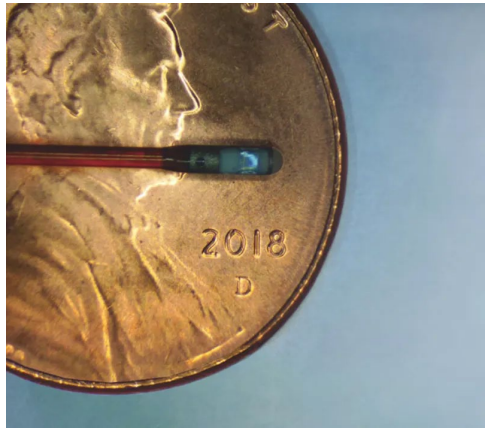
Smarter medtech needs smarter sensors

Wearable health monitoring

Microfluidics for Dx and Tx



Intelligent implants



MEMS Matter in MedTech

- **MEMS (Micro-Electro-Mechanical Systems) bring high performance at low power in a compact form factor.**
- **MEMS enables cost-effective mass production, critical for scalable healthcare solutions.**
- **Unprecedented data collection in situ**

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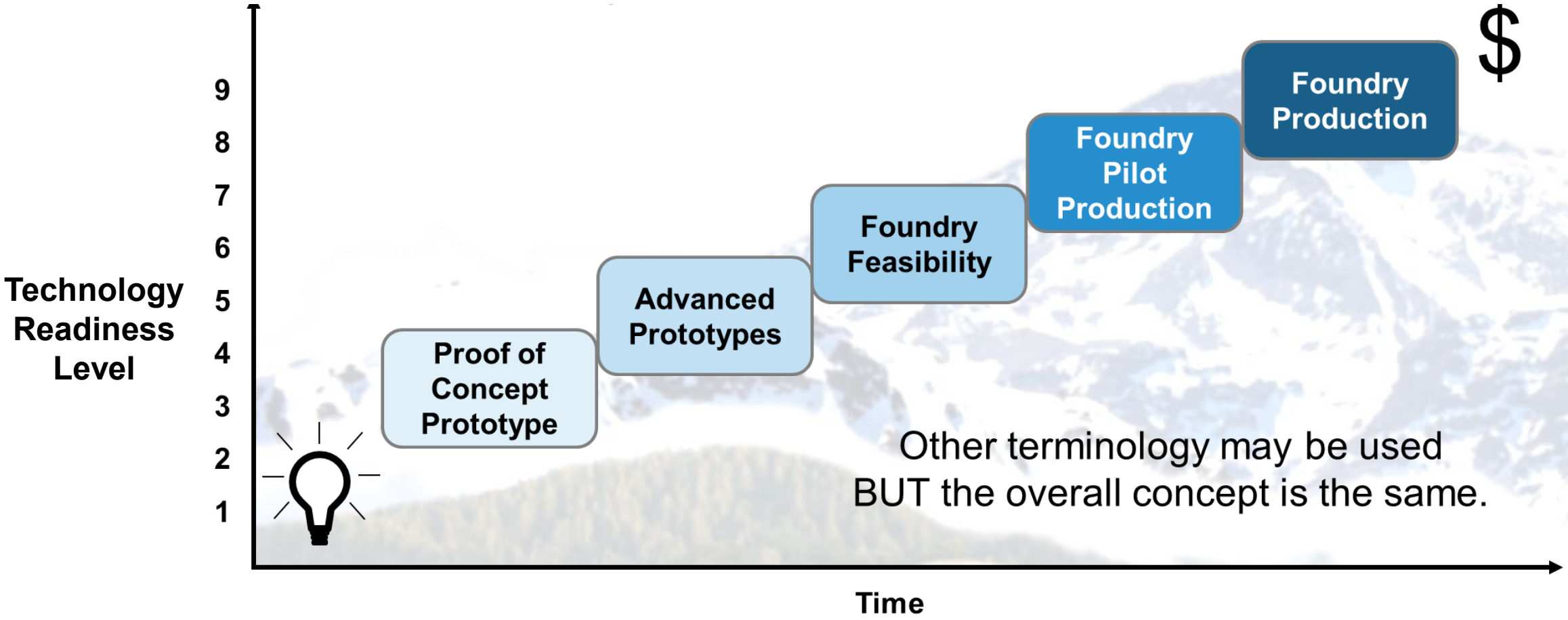
Accelerate your MEMS journey with AMFitzgerald



Adapted from Figure 3.1 *MEMS Product Development*

Where are you today on your MEMS development journey?

- Ideation: generating valuable concepts
- Proof of concept: showing by building
- Advanced prototyping: designing for manufacturing
- Foundry feasibility: looking for a manufacturing partner
- Pilot production: setting up the manufacturing line
- Production: on the market and making components at scale

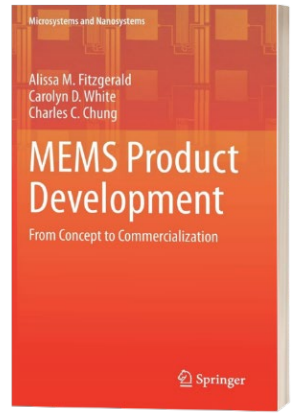
Join the poll

AMFitzgerald: Innovator in MEMS Product Design and Development

- **Founded 2003 in Silicon Valley, California**
  - Hundreds of clients: startups to Fortune 100
  - Custom and emerging MEMS for high-value markets: medical, industrial, scientific, aerospace
  - Recognized experts in MEMS product development

- **Full MEMS development services**
  - Custom chip designs validated by prototypes in-house
    - 150mm wafer process development and prototyping at rented fab
    - Class 100 cleanroom for MEMS test and measurement
  - **Transfer to foundry for production**

- **Global reach and strategic partnerships**
  - MEMS Infinity selects AMFitzgerald for PZT-MEMS integrated design service
  - Ecosystem partner of Silicon Catalyst, premier incubator for startups



INTERNATIONAL SEMICONDUCTOR EXECUTIVE SUMMIT


Prototyping at Marvell Nanolab


In-house cleanroom for test

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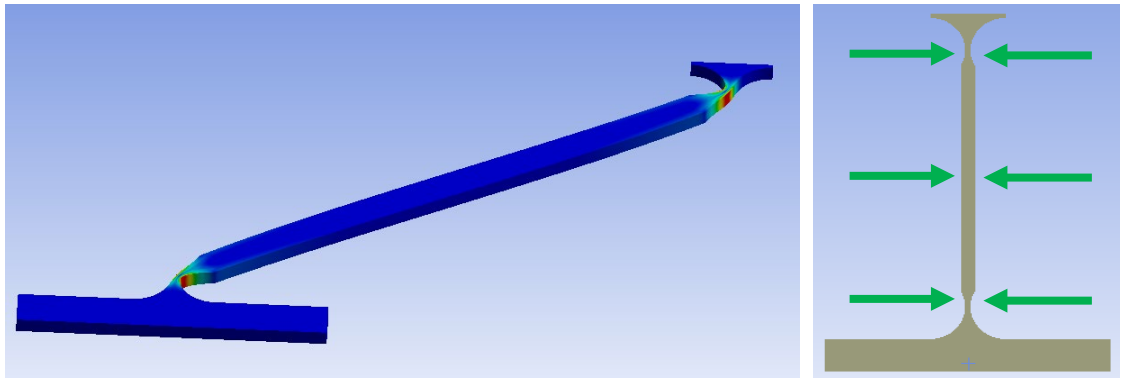
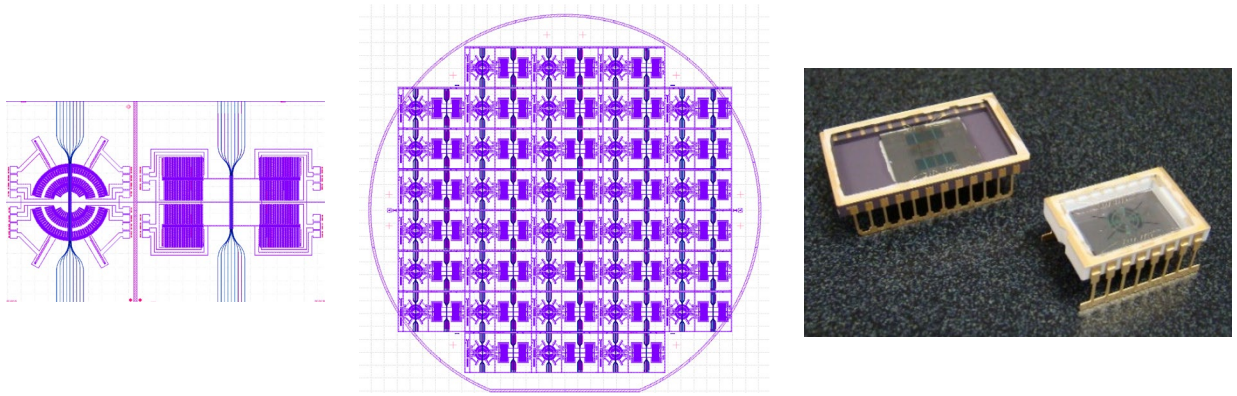
Design and prototyping success: Our proven approach

Modeling and simulation



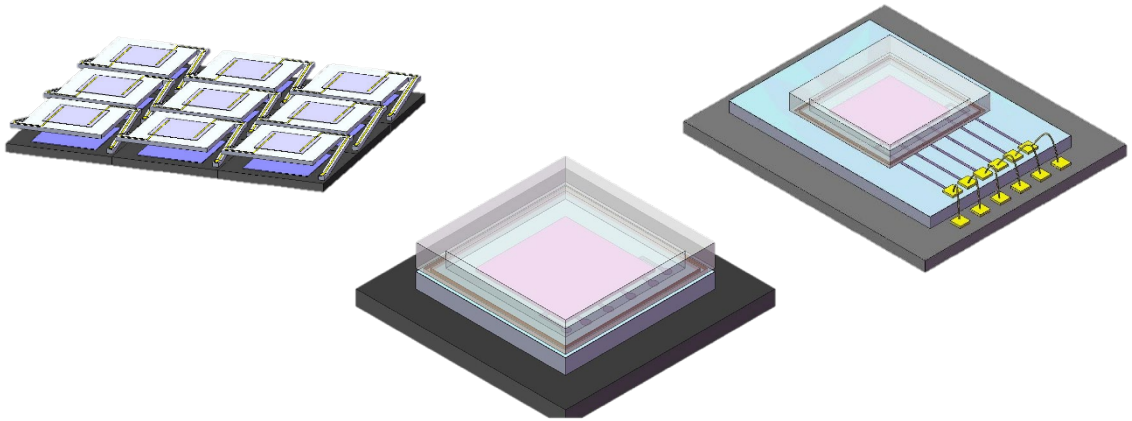
Mask layout and prototyping



Process integration and runsheet

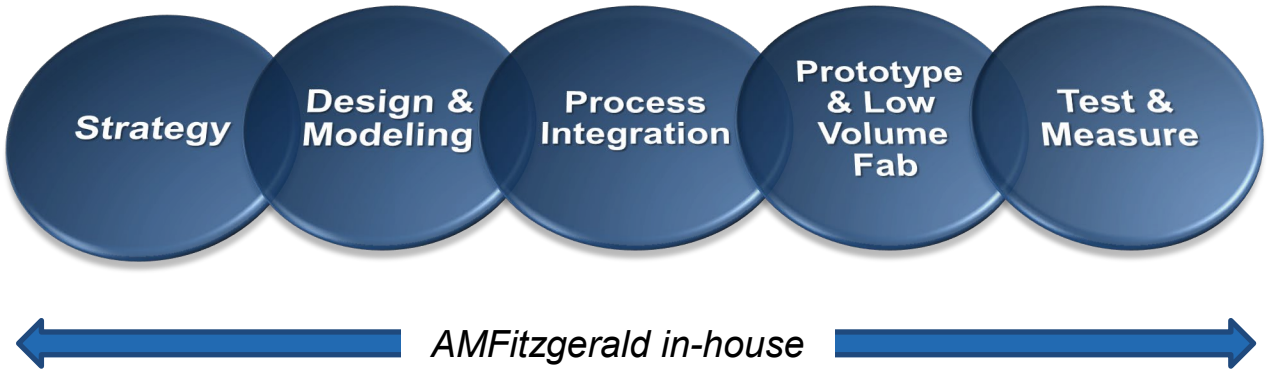
Step	Name	Tool	Description/Recipe
	Setup		
1.1	Process design	Engineering	
1.2	Mask layout	Engineering	Rcomb, 36dpw
	Photolithography		
2.1	Wafer dehydration	Oven	150C 10 min
2.2	Prime	HMDS oven	YG25d
2.3	Coat PR	Track	TC24
2.4	Expose	CS2 Mask aligner	150mJ 20s

Design for manufacturing and integration



AMFitzgerald's unique value: in-house prototyping of our designs

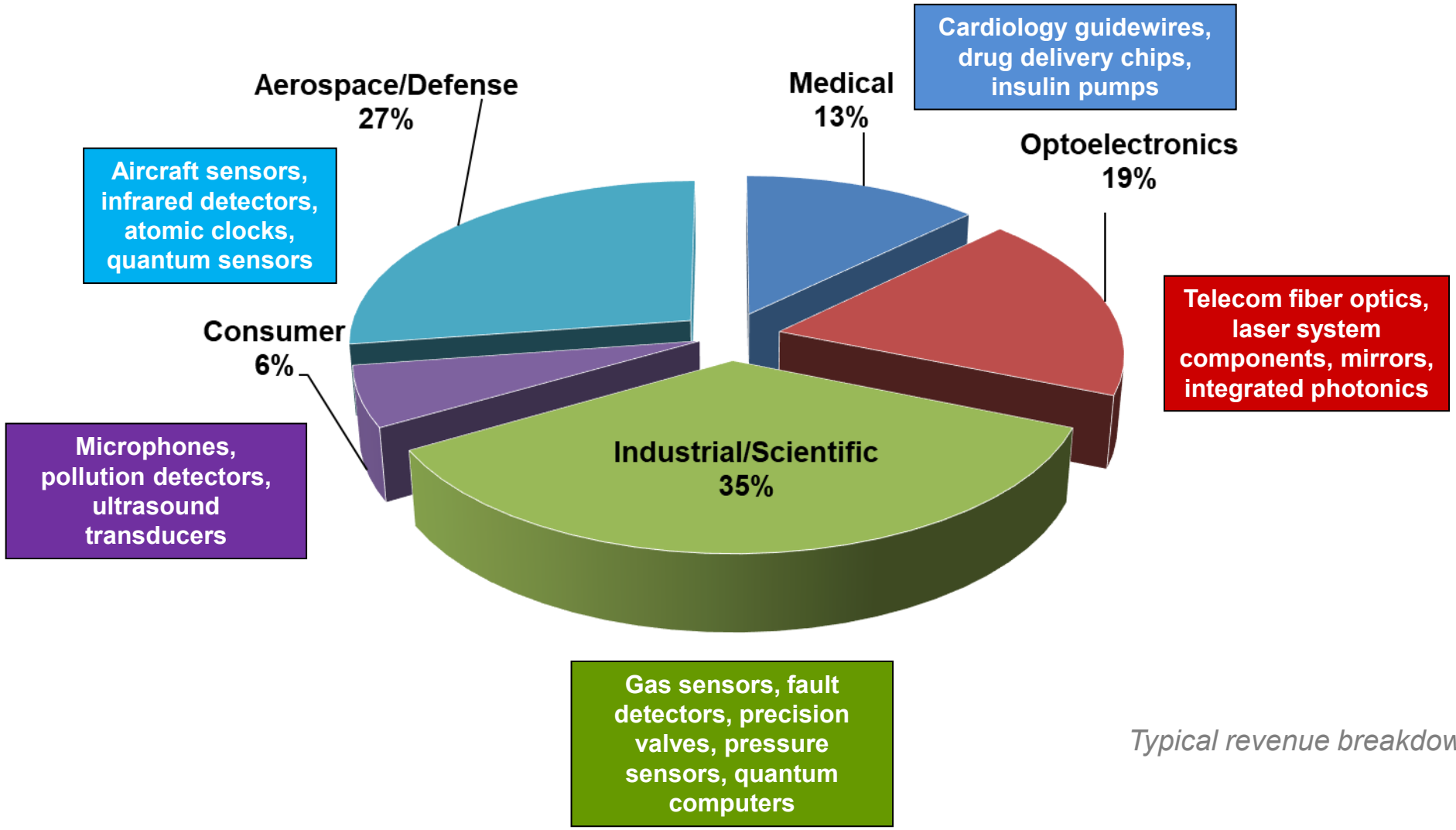
We plan MEMS development to support client's roadmap to market



- **Prototyping by our expert staff enables discovery of key IP, rapid cycles of learning and manufacturable design**
- **Engineering team with decades of hands-on experience**
- **Clients own all the design and process IP that we create**
- **Our mature, de-risked prototype will get you to production faster and cost less**

> **AMFitzgerald provides top-notch MEMS consulting expertise. Whether analysis, design, fabrication, or hands-on test and characterization, they have always delivered value in helping us achieve our goals.**
>
> — Harry Rowland, Ph. D. CTO, Endotronix.

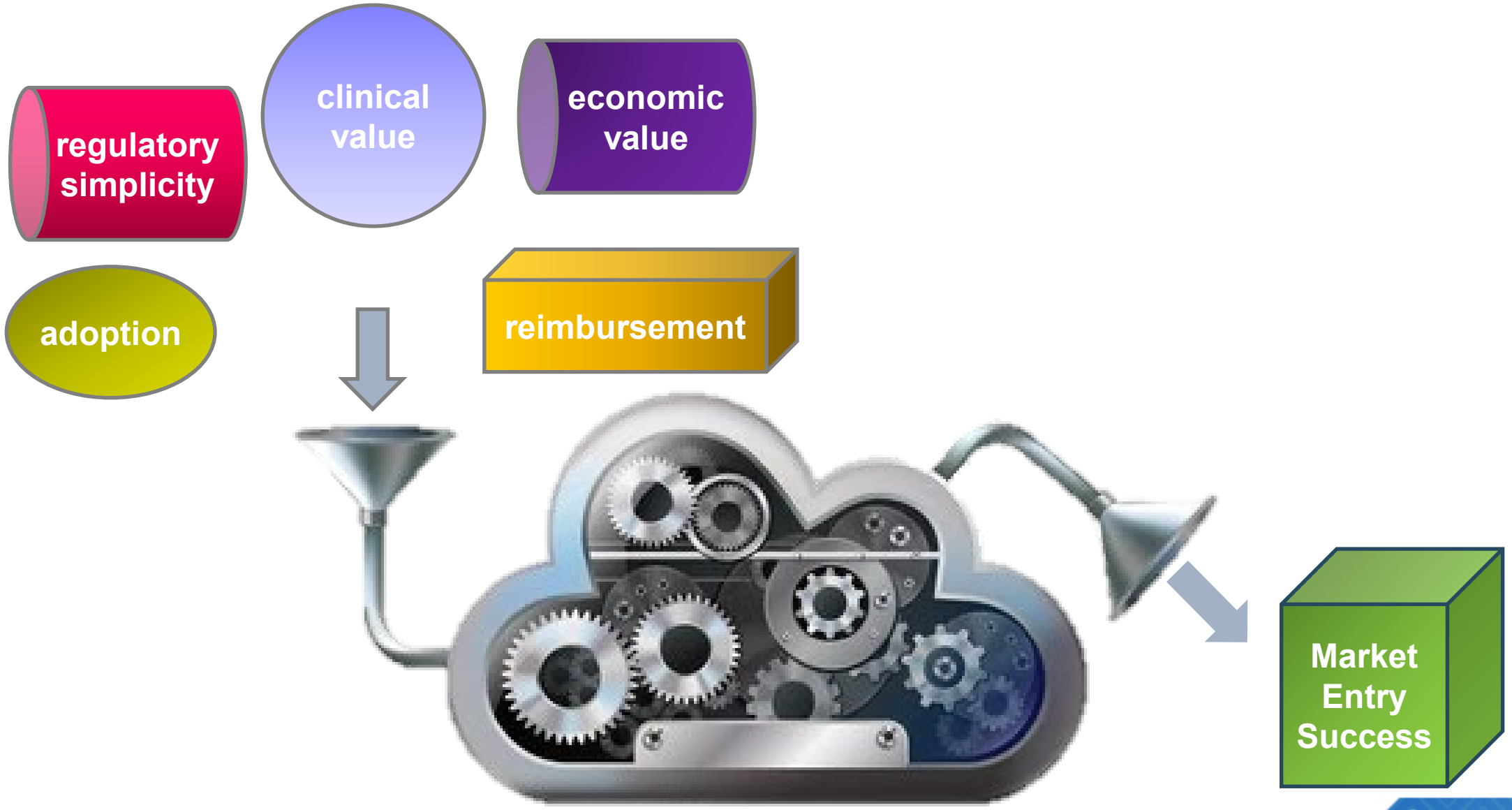
Our custom MEMS designs enable products in high-value markets



Typical revenue breakdown, by market

Market Opportunity for MEMS-enabled Medtech

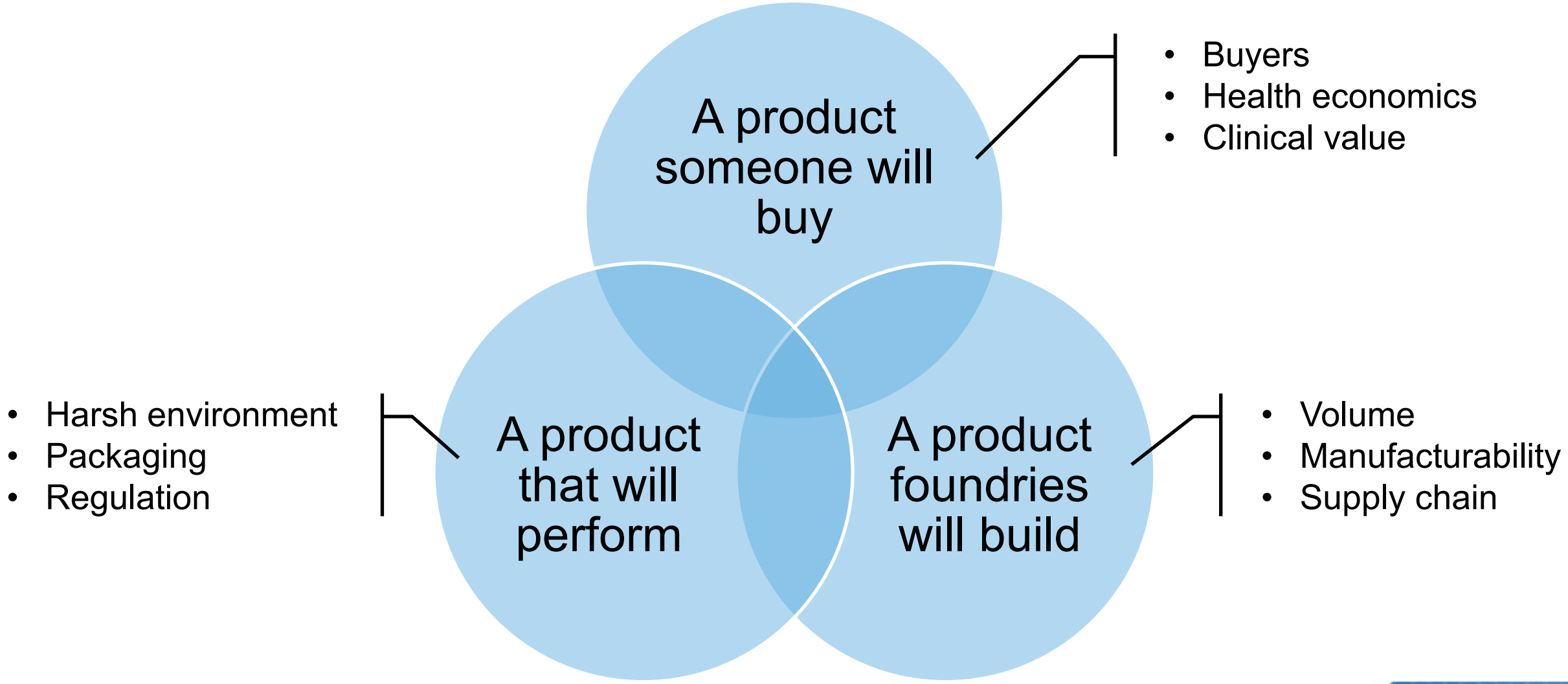
Market entry: Think like a medtech business leader, not just an engineer



High-growth medtech areas are ready for MEMS breakthrough

Sector	CAGR	MEMS/Microsensor Role
Pulsed Field Ablation (PFA) *PFA Market Size and Share Analysis (2025-2032), CoherentMI*	**40.3%**	pressure sensors, impedance sensors, mapping arrays for ablation control
Percutaneous Revascularization Devices *Percutaneous Coronary Intervention (PCI) Devices, MarketResearch* *PCI Devices Segment Forecast, 2020 –2027, Polaris*	**23.6%**	ultrasound transducers, microfluidic sensors for arterial therapies
Transcatheter Mitral Valve Replacement (TMVR) *Transcatheter Mitral Valve Devices Market Snapshot 2024-28, LSI*	**23.3%**	strain sensors for valve performance, biosensors for hemodynamics monitoring
Telehealth & Virtual Care *Global Virtual Health Service Market 2023-2032, market.us*	**22.4%**	Wearable sensors for monitoring mobility, speech, vitals
Renal Denervation *Renal Denervation Devices Market Snapshot 2024-2028, LSI*	**22.0%**	RF sensors for precision nerve ablation, pressure monitors for vascular integrity

Bridging the gap from sensor integration to scalable manufacturing



What is your biggest development challenge right now?

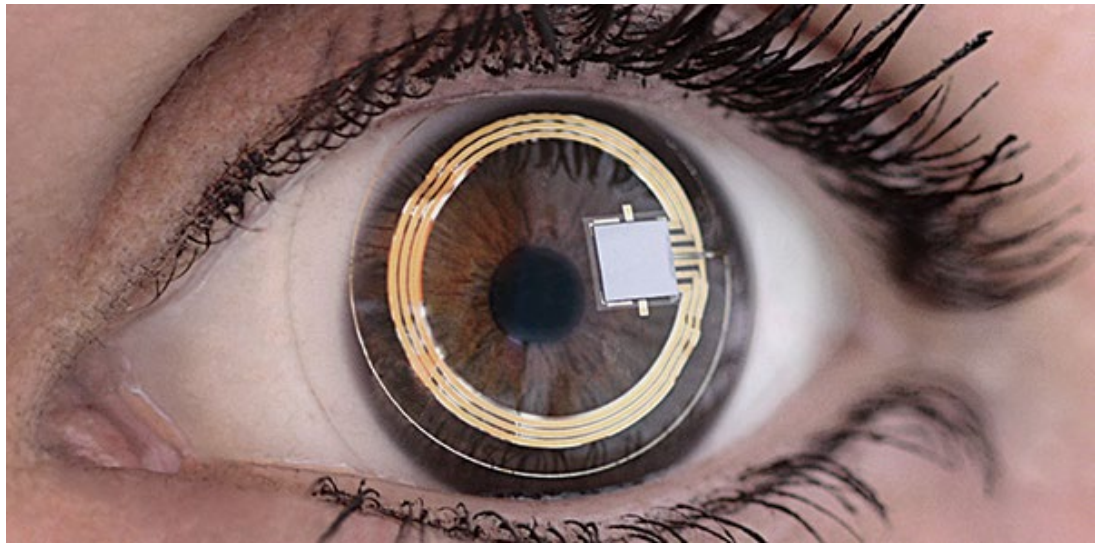
- Miniaturization: fitting components into smaller, implantable or wearable formats
- Manufacturing readiness: designing for safety, yield, scale, or supply chain constraints
- System integration: combining sensors, electronics, firmware, and packaging into a functional system
- Regulatory approval: navigating FDA/CE approval with device testing, validation, and documentation
- Funding or budget: securing the resources needed to move from prototype to product

Join the poll

MEMS Outside: Non-Invasive Medical Devices

Commercial Examples

Tiny, low-power MEMS enable wearable health monitoring



www.sensimed.ch

Sensimed Triggerfish: continuous monitoring of intraocular pressure (IOP) for glaucoma management

- MEMS strain gauge detects curvature
- Wireless telemetry to data recorder
- Inductive power coupling

www.ouraring.com

Oura ring: analyze sleep stages, physical activity

- 3D MEMS accelerometer for motion
- MEMS temperature sensor
- Smart algorithms + sensor fusion
- LEDs for blood oxygen, heart rate

Ultrasmall ultrasound puts powerful imaging in your palm

Conventional Tech

Control panel

Specialized transducers
~1 – 18 MHz

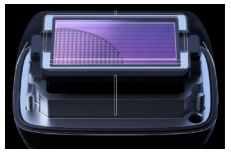
Pulser-receiver
Beamformer
Signal processing
Data storage
Power management
(~100V+)

5x transducer connectors

zoncareglobal.com

MEMS Tech

CMUT array



PMUT array

Butterfly iQ+ and eXo Iris: handheld ultrasound that goes wherever you go

- **Versatile transducer with MEMS + ICs replaces multiple conventional probes**
- **Chip-scale integration for AI-assisted imaging**
- **Semiconductor economies of scale**

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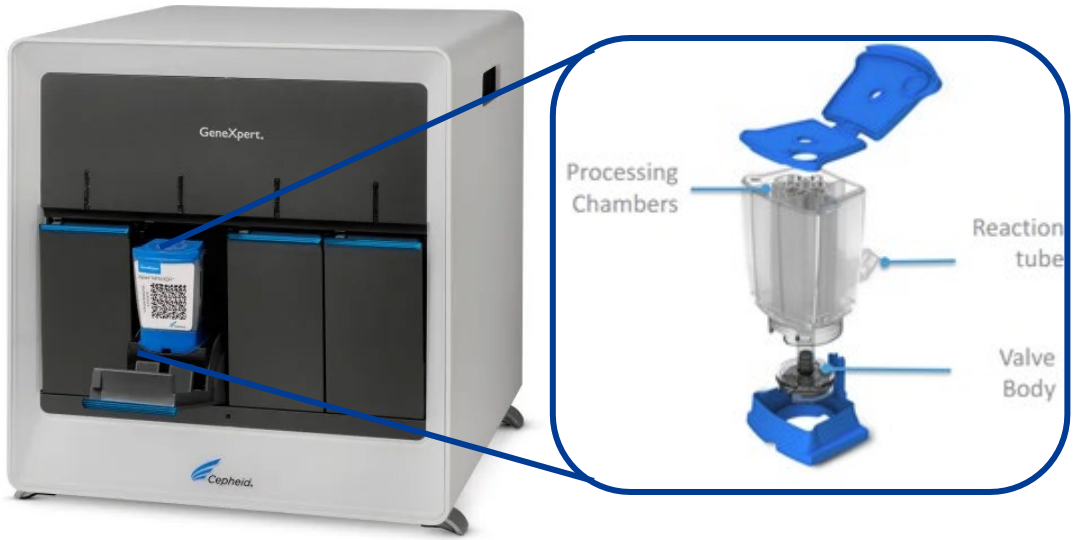
Microfluidics have shrunk an entire lab workflow into a cartridge

Cepheid GeneXpert: PCR workflow in a cartridge

- **Market entry: Anthrax detection (2001). More recently COVID-19**
- **Sample prep: MEMS microvalves and micropumps**
- **DNA Extraction: Microfluidic channels for nucleic acid purification**
- **PCR Amplification: Micro-heaters and thermal sensors enable precise cycling**
- **Detection: Optical MEMS multiplex fluorescence detection**

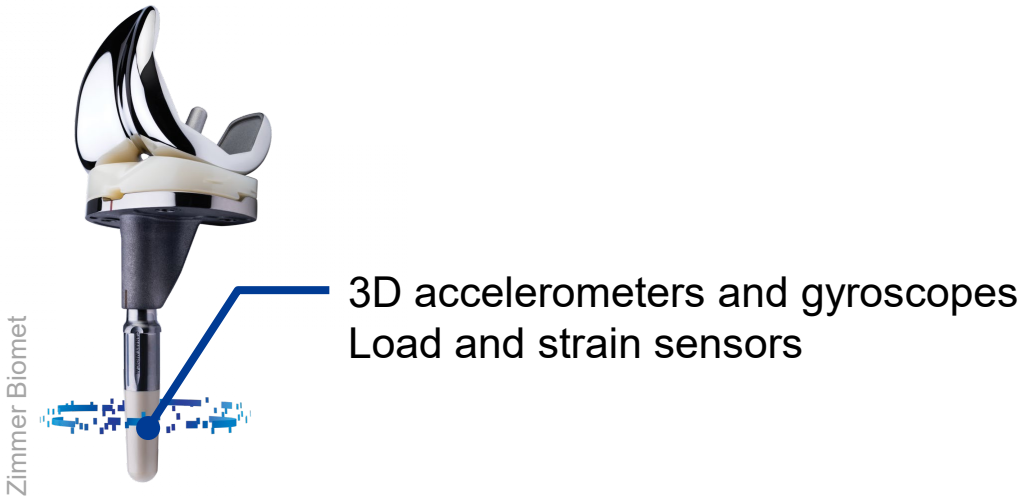


Cepheid

MEMS Inside: The Rise of Intelligent Implants and Tools

Commercial Examples

Intelligent implants become remote patient monitors



Opportunity:

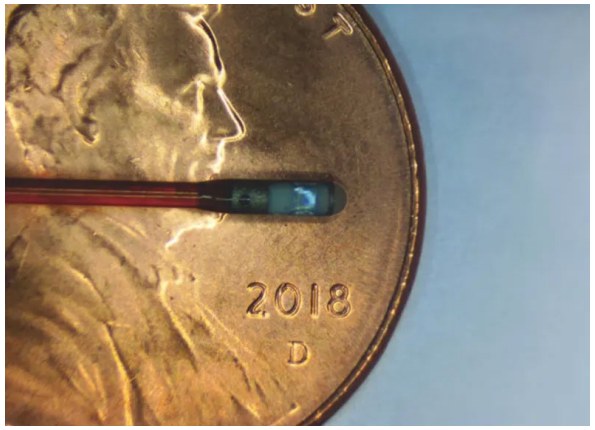
- **Total knee arthroplasties performed in US (2024): 1.3M**
- **Est. cost follow-up appointments: $1.72B**

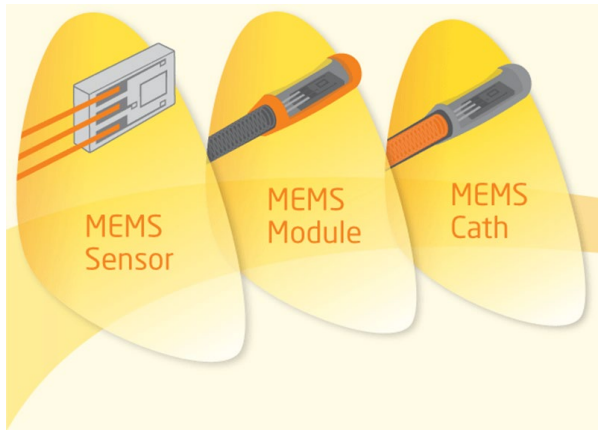
Persona IQ smart knee: Zimmer Biomet Persona® + Canary Canturio™

- **Insights into post-op recovery: gait, stride length, cadence, and overall activity**
- **Remote monitoring, personalized care, early intervention**

Ultraminiature pressure sensors go into the body's tiniest spaces

- **Highly accurate and reliable measurement of pressure in situ:**
  - **heart failure, cardiac assist**
  - **brain injury, neuromodulation**
  - **airway obstruction**
  - **spinal tumor pressures**
  - **implanted drug delivery**

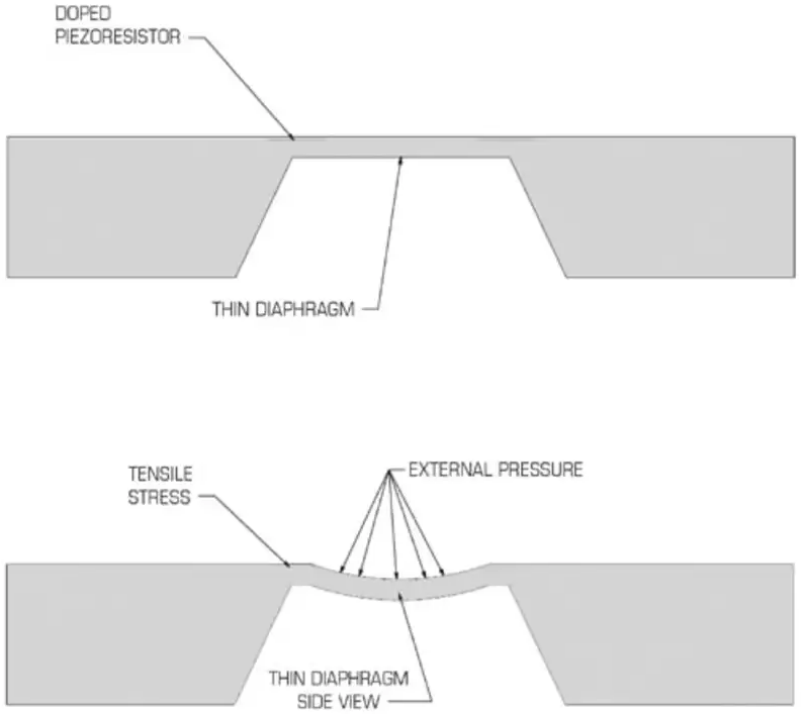




A medical device made by Millar, integrating MEMS pressure sensors into catheters

Source: Medical Design Briefs

- **Sensor converts pressure signals into electrical signals using implanted small strain gages in a thin silicon membrane.**



Piezoresistive membranes convert mechanical strain into a change in electrical resistance.

Which application area interests you most for future projects?

- Wearable health monitoring
- Drug delivery
- Smart implants
- Surgical robotics and tools
- Lab-on-a-chip diagnostics
- Ultrasound for imaging or therapy
- Other: _____

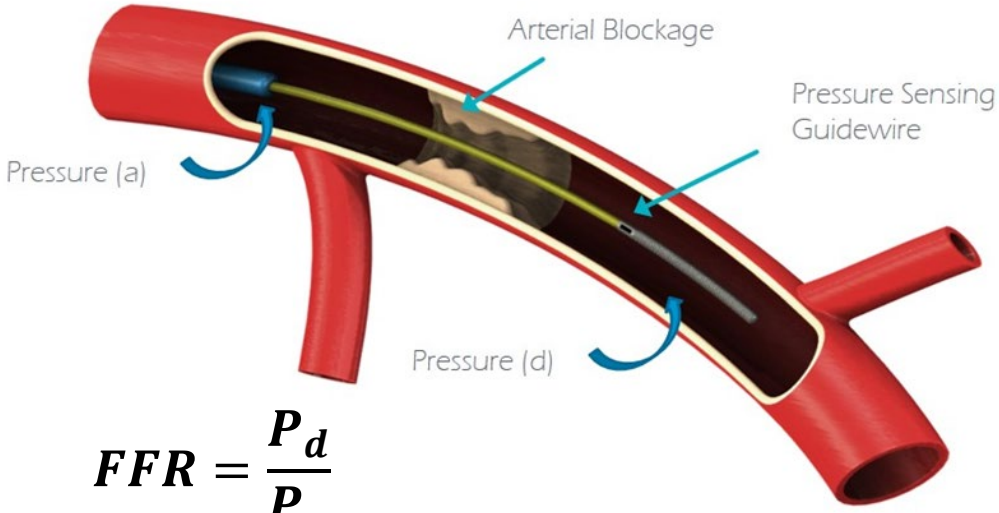
Join the poll

Saving Lives with Tiny Pressure Sensors

AMFitzgerald client case study: Zurich Medical

MEMS in coronary arteries: Why Fractional Flow Reserve (FFR) matters

- **FFR is the gold standard for assessing ischemia-inducing stenoses (blockages)**
  - **Guides PCI decisions, reduces major adverse cardiac events**
  - **Outperforms angiography only, fewer stents used**
- **Procedure measures blood pressure upstream and downstream of a coronary blockage**



$$FFR = \frac{P_d}{P_a}$$

Source: Zurich Medical

MEMS enables pressure measurement in a maneuverable guidewire, preferred by clinicians, that can enter tiny blood vessels

Client Case Study: Enabling FFR for diagnosis of stenosis

AMFitzgerald's Challenge: develop ultra-mini pressure sensors for instrumented coronary guidewire

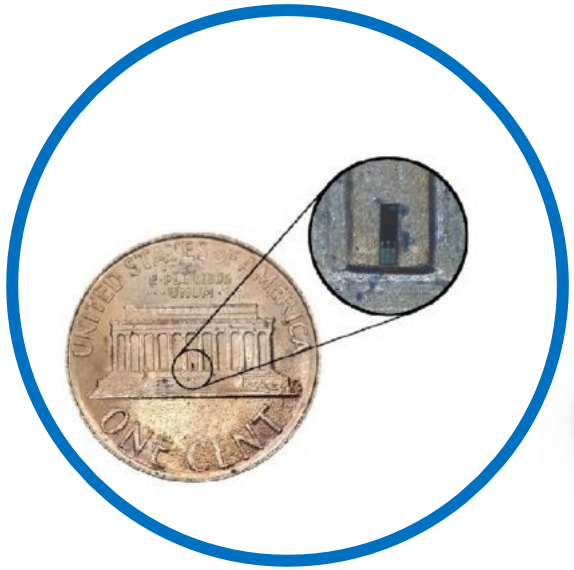
Solution:

- Custom MEMS sensor designed for foundry with ISO 13485
- Supply chain for foundry prototyping
- Mask layout and revisions
- Test, BEOL, 150 mm production run

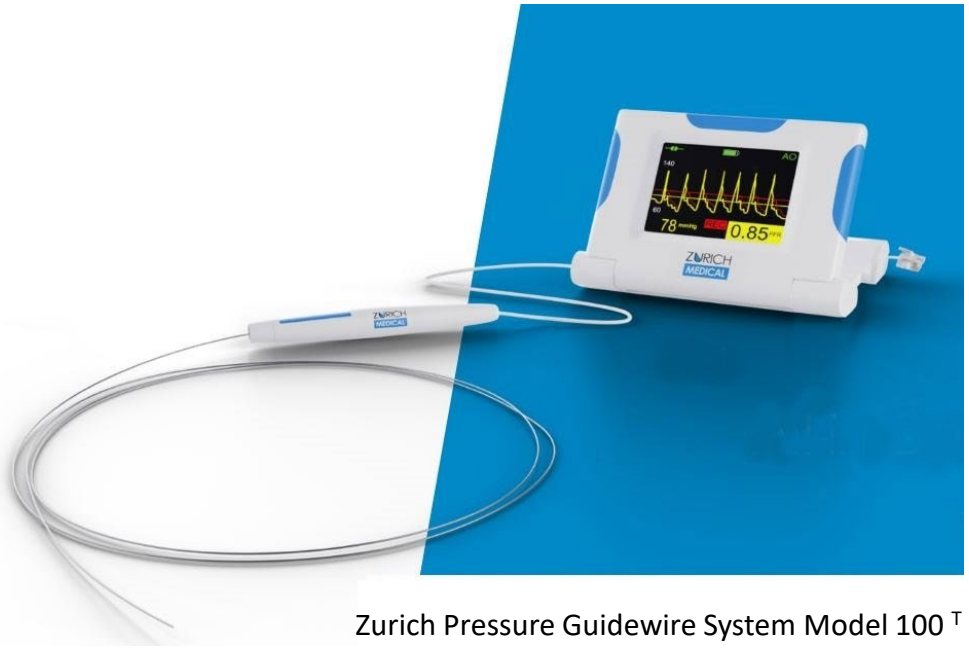
Outcome: Production sensors in under one year

- Support ongoing manufacturing
- Device is now FDA- and CE-approved
- 300-patient clinical study completed

> **AMFitzgerald answered questions that other designers couldn't. They helped us solve problems we hadn't even anticipated.**
>
> — Dr. Kin-Joe Sham
> COO, Zurich Medical



Pressure sensor ≤ 170 µm
for 1 Fr guidewire



Zurich Pressure Guidewire System Model 100 T

Key Takeaways: MEMS Enable Precision Medtech

- **MEMS technology is unlocking smarter, more powerful medical devices for improved clinical outcomes**
- **Custom MEMS design enables breakthroughs across wearables, implants, microfluidics, and imaging**
- **Successful medtech innovation requires aligning sensor development with manufacturability from the start**
- **AMFitzgerald provides deep expertise to navigate the full MEMS product journey—from concept to production**

Your MEMS journey starts here

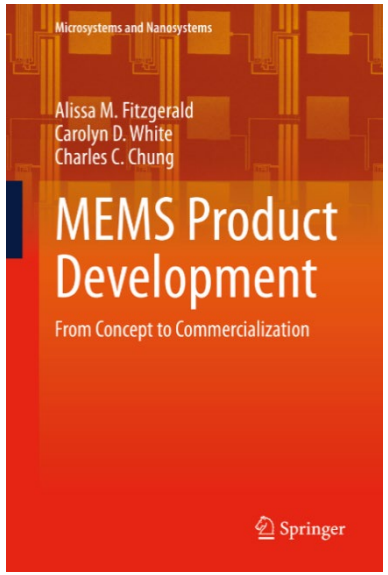
AMFitzgerald empowers your innovative solutions for precision medtech

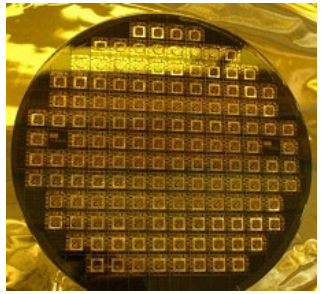
Resources

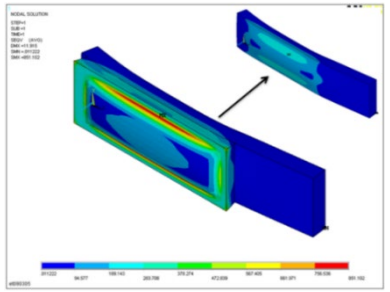
Expertise

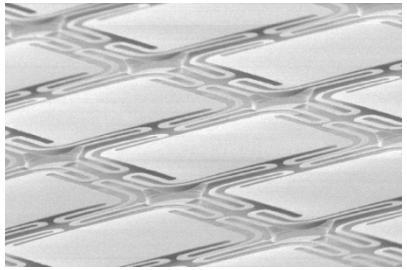
Teamwork

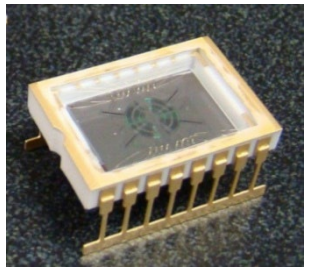
SCAN ME











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MEMS Product Development
available from [Springer]

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What would you find most helpful after today's webinar?

- Access to related case studies
- A sample MEMS development roadmap
- A discovery consultation to explore ideas
- Just keep in touch for now
- Other: _____

Join the poll


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