



A Showcase for New Technologies



How The Petroleum Industry Can Benefit From External Technology

Too Busy to Care About External Technology?



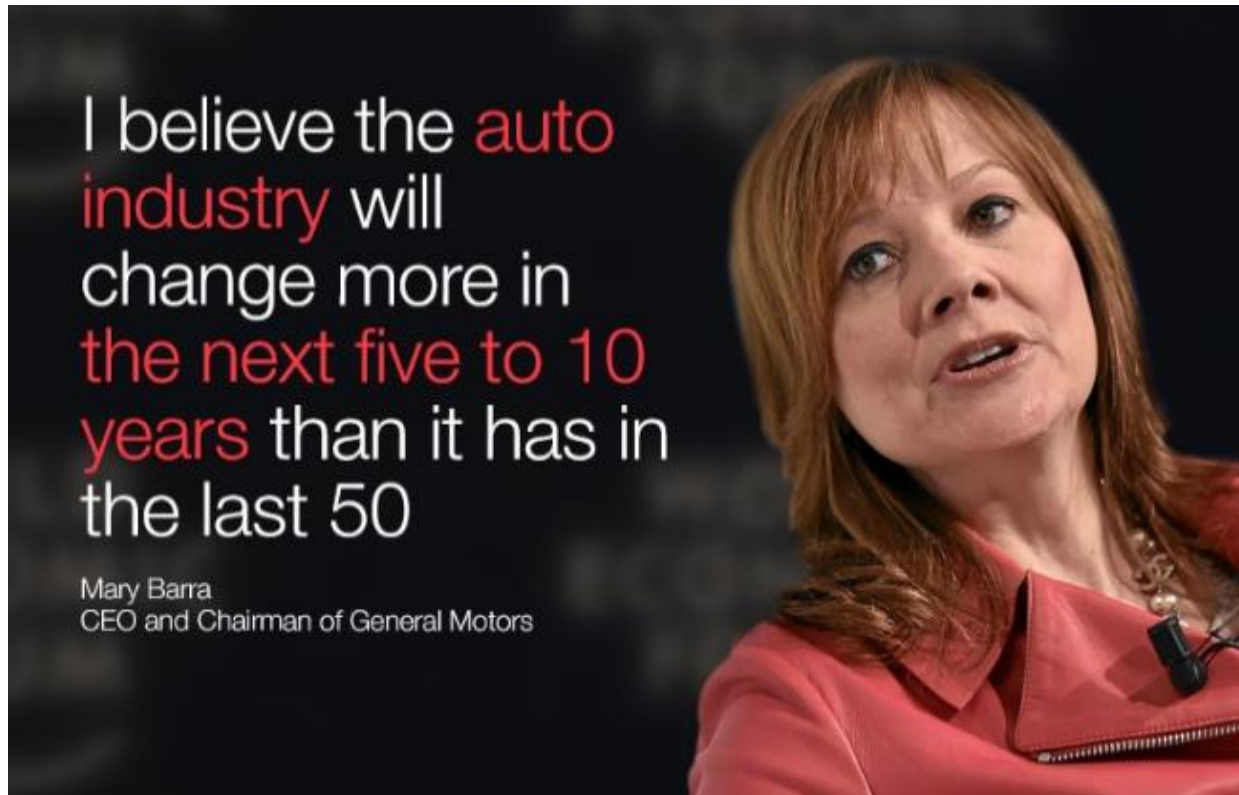
External Technology Why Should You Care?

- Innovate or fall behind
- Innovations are new for about 6-12 months
- Leverage R&D expenditures by others
- Looking externally spurs creative thinking internally
- Accessing innovation before your competitors yields a competitive advantage

Benefits of Accessing External Technologies

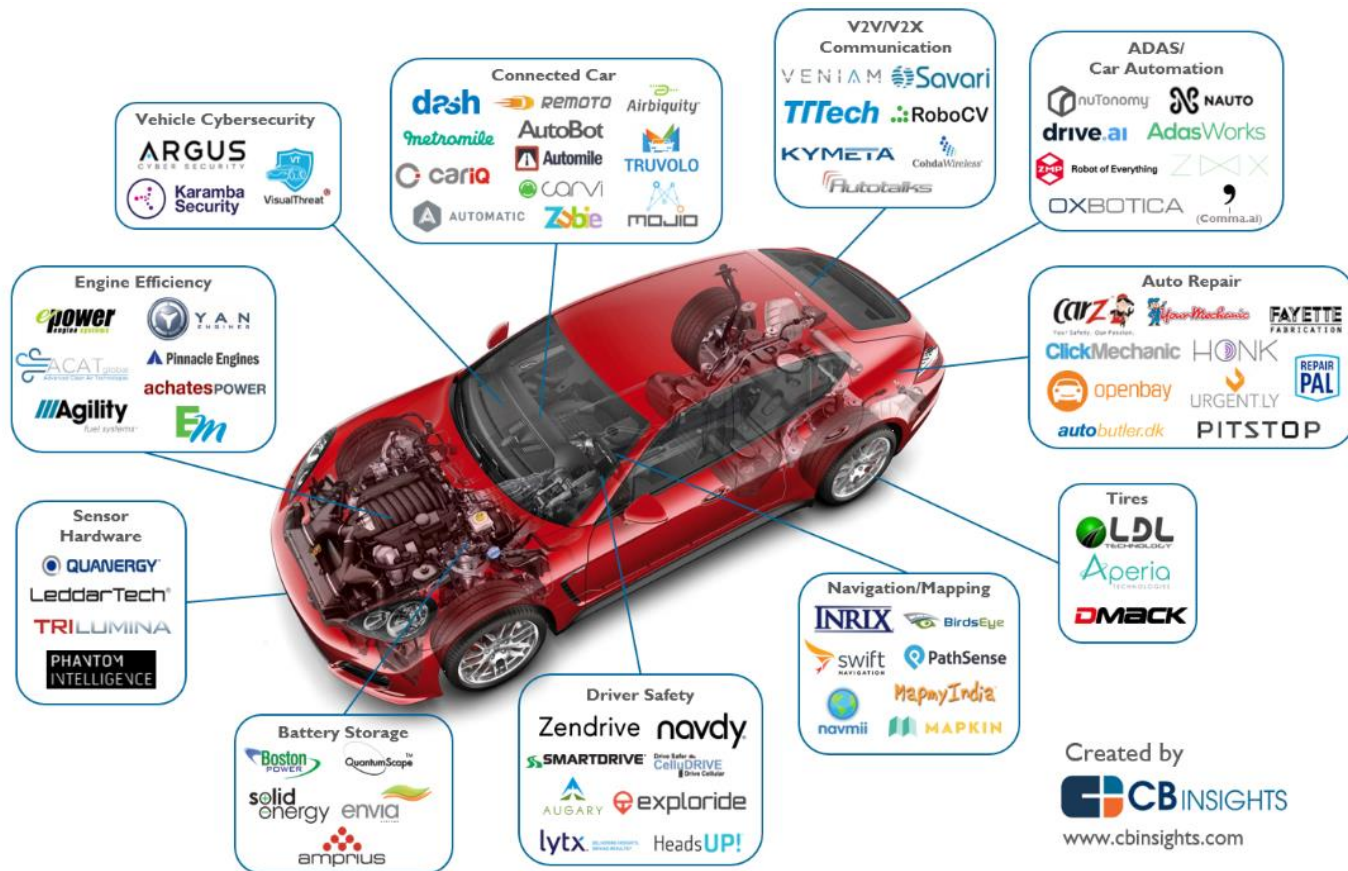
- Avoid the substantial time and cost of developing new technologies in-house
- Improve efficiencies and become more profitable
- Establish technology relationships outside of this industry
- Develop new product suppliers
- Gain lasting competitive advantages

Ignoring External Technologies May Not Be Viable



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Ignoring External Technologies May Not Be Viable



Examples of External Technologies

- High vibration fastener (medical and aerospace)
- Water cooled channels in motor stator (electric vehicles)
- High-power ultrasonic fouling removal (mining)
- Advanced underwater imagery (deep sea expeditions)
- Real-time analysis of colloidal solutions (pharma)
- Terahertz spectrum for NDT (automotive, security)

High Vibration Fastener

- Initially developed for medical and aerospace (Boeing Helicopter, Gulfstream, etc.)
- Remains locked in very high vibration environments (1+ million vibration cycles)
- Removable and scalable for different size applications
- Commercially available
- Oil & Gas deployments – shale shakers, downhole tools

High Vibration Fastener

ACCEPTANCE IN OIL & GAS INDUSTRY

Solution

- ✓ Fully reversible and reusable
- ✓ Highly vibration resistant
- ✓ Accurate preload determination
- ✓ Fastener remains locked with loss of preload
- ✓ Blind / 1-sided approach for reinstallation
- ✓ Permanent lock

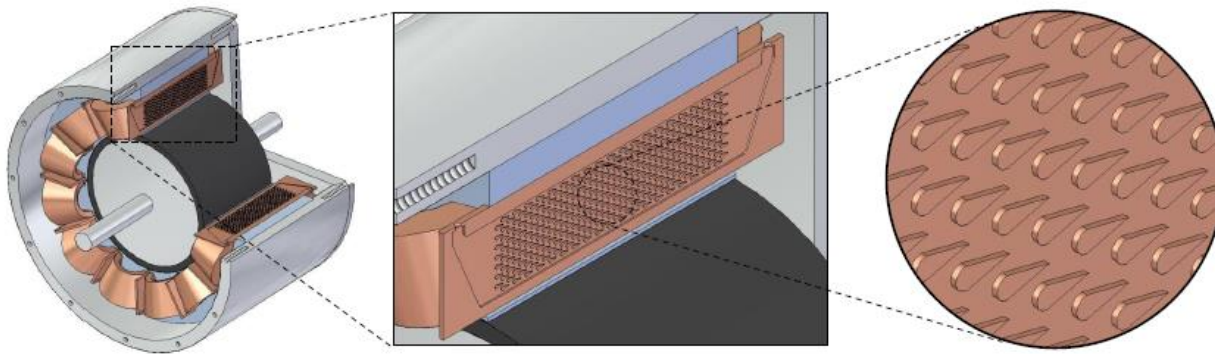


Key Benefits

- ✓ In vibration testing, survived 300,000 cycles, 10x aerospace industry standard
- ✓ In oil & gas specified testing, survived 1 million cycles
- ✓ No custom tooling – compatible with standard 6-point socket

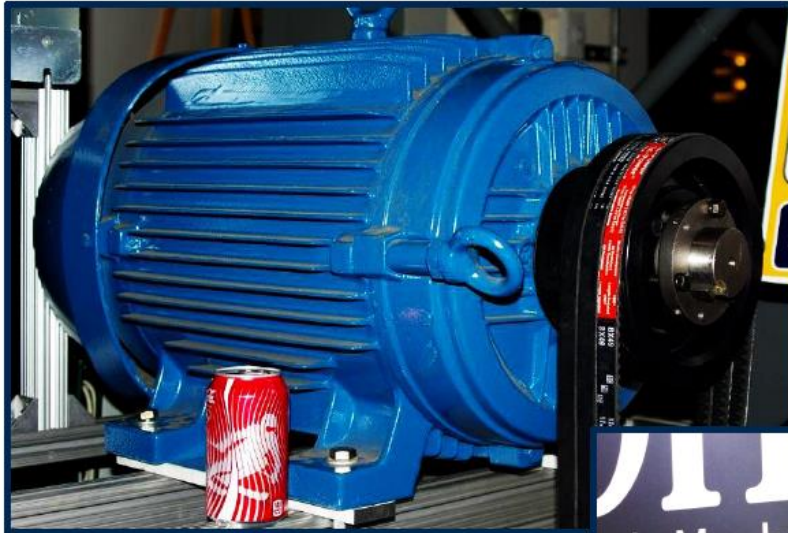
Water Cooled Channels in Motor Stator

- Increased heat removal & 4X more torque per volume
- Same torque in a much lighter motor or substantially more torque in the same sized motor
- Oil & gas – downhole drilling, submersible pumps



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Water Cooled Channels in Motor Stator



30hp IM
230V, 3 ϕ
90.4%
330lbs

30hp SMPM
230V, 3 ϕ
94%
25lbs

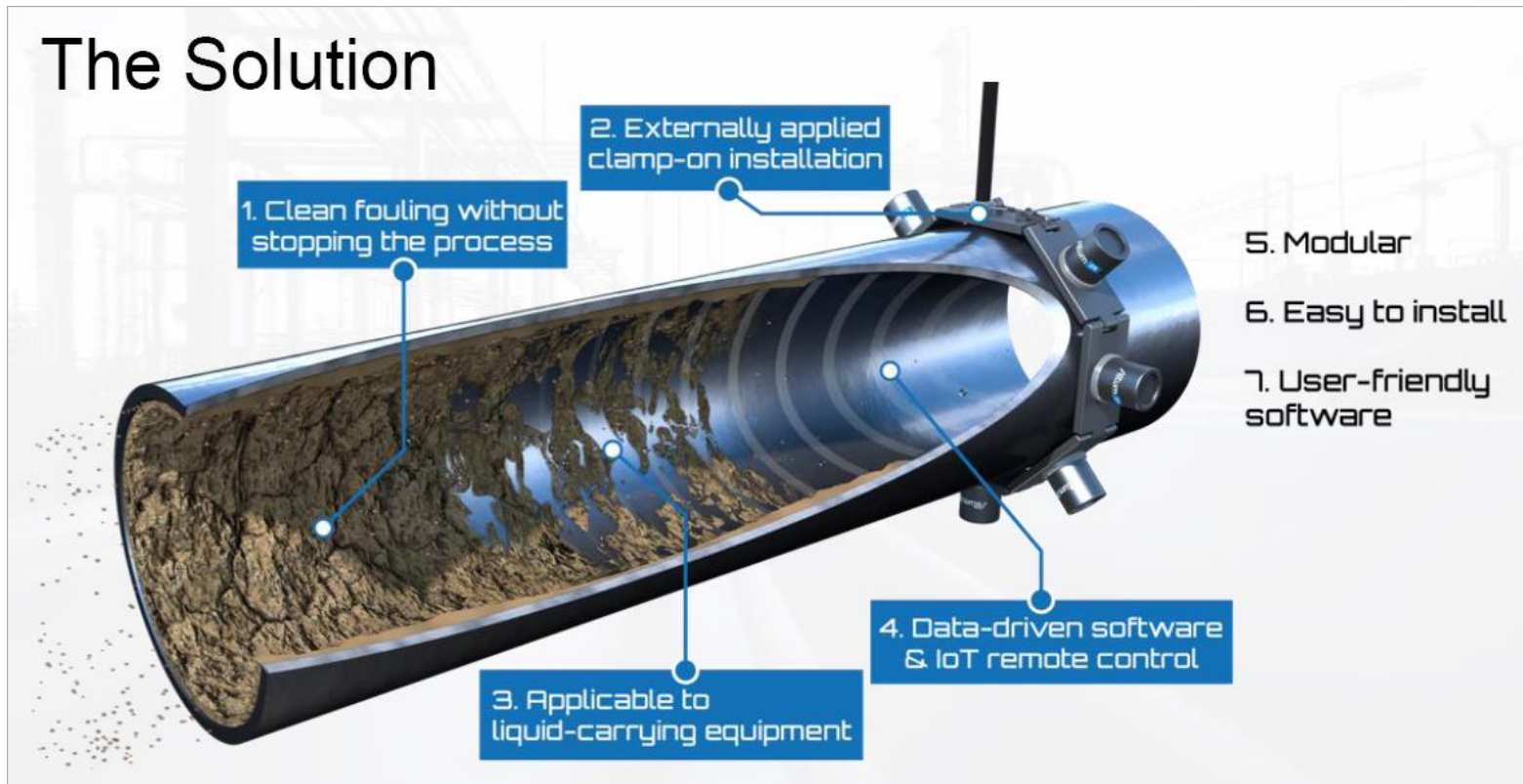


High-Power Ultrasonic Fouling Removal

- Focused ultrasound to clean fouled pipelines, heat exchangers, pressure vessels, tanks, etc.
- No process stoppage, no dismantling, no chemicals, no holes
- Ultrasound transducers are mounted externally
- Specialized software to pinpoint the cavitation cloud
- Oil & gas – toxic / hazardous fouling inside pipes, separators, tanks

High-Power Ultrasonic Fouling Removal

The Solution



Advanced Underwater Imagery

- High fidelity underwater imaging in turbid conditions
- Combine sonar, LIDAR, visual, etc.
- Geo-tagging for change detection over time
- Satellite style representation of an entire asset
- Corrosion, cracks, biofouling
- Oil & Gas – inspection of MODU mooring chains in lieu of dry docking, underwater pipeline surveys

Advanced Underwater Imagery

Standard HD Imaging



Canal Wall
30cm from wall
0.5m depth



Dam Wall
30cm from wall
5m depth

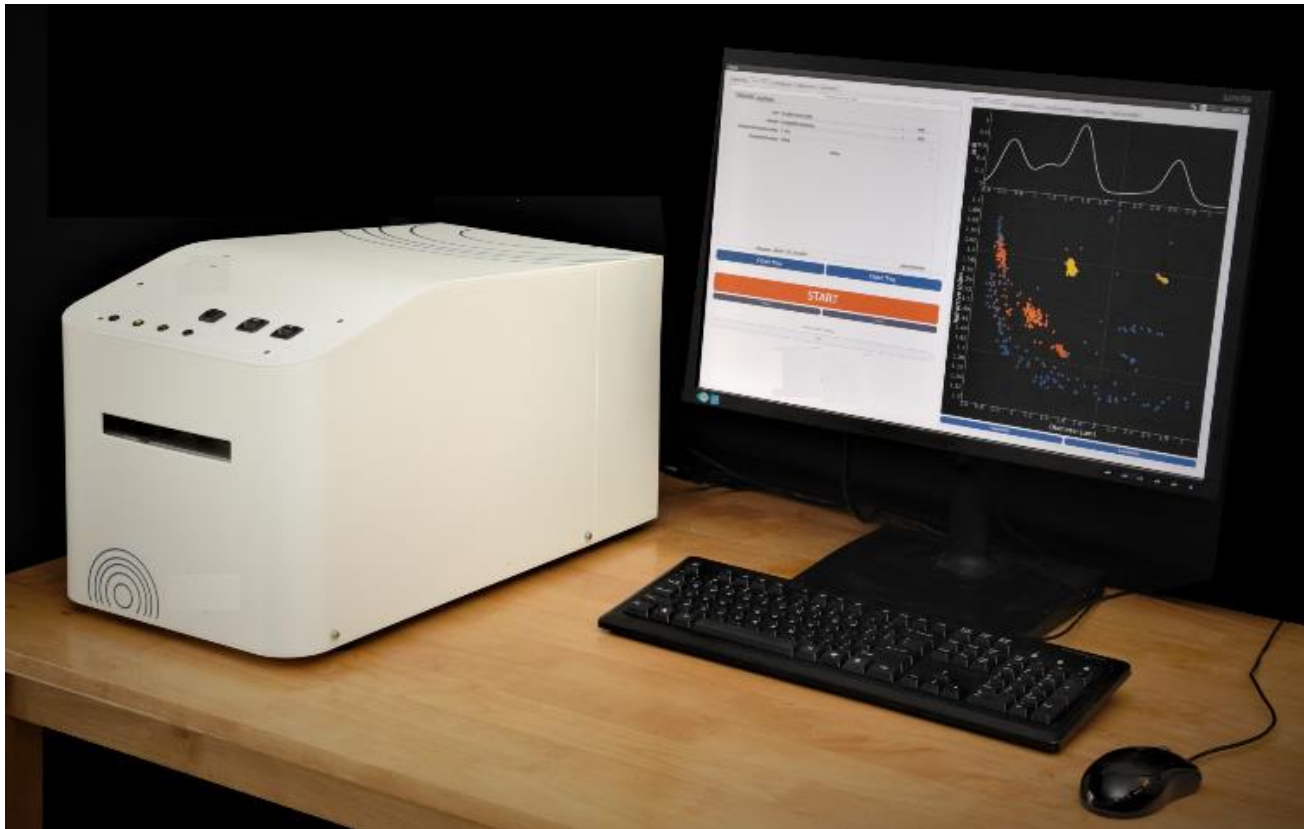
Advanced Imaging



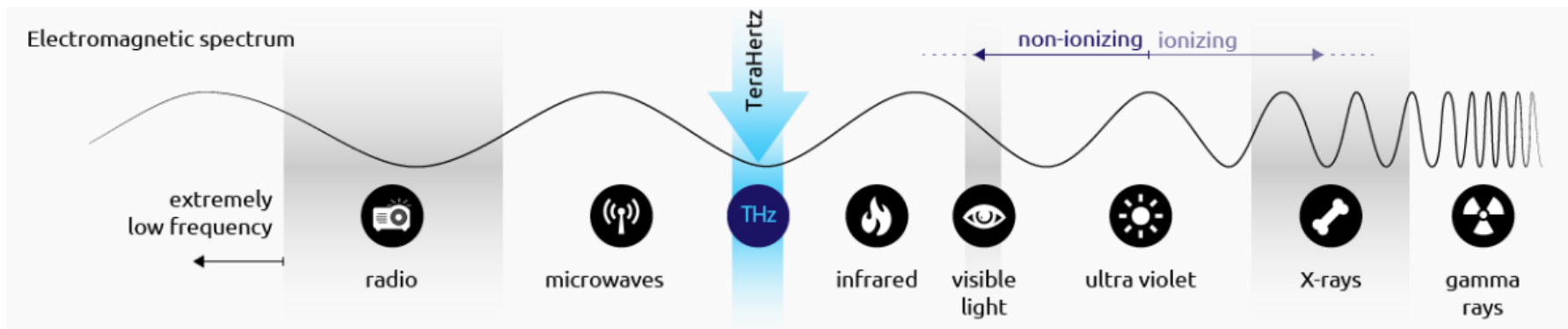
Real-time Analysis of Colloidal Solutions

- Records and analyzes holograms of every particle in a colloidal sample
- Provides more information about colloidal dispersions than any other competing technology
- Particle size distribution, dispersion composition, particle concentrations – in real-time
- Instrument is portable
- Oil & Gas – drilling fluids, produced fluids, hydrocarbons

Real-time Analysis of Colloidal Solutions

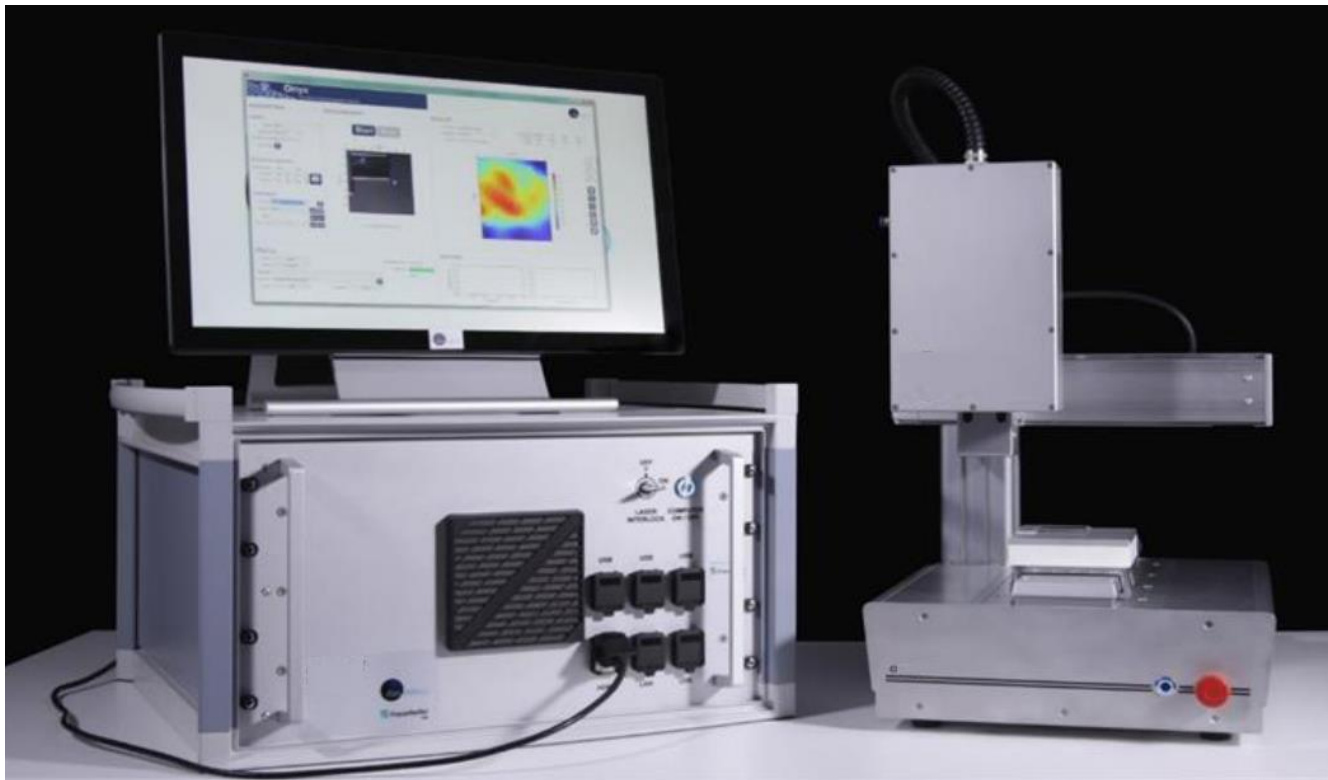


Terahertz Spectrum for NDT



- Terahertz waves penetrate insulation, paint, rocks, etc.
- Human exposure safe, won't damage inspected material
- Oil & gas – real-time core analysis, corrosion under fire proofing

Terahertz Spectrum for NDT



Where Do We Find External Technologies?

- Events Outside the Oil Industry
- Accelerators & Incubators (over 2,000 worldwide including private & corporate)
- Maker Spaces (over 1,300 worldwide)
- Venture Funding (corporate and private)
- Crowdfunding Sites (Kickstarter, Indiegogo, etc.)
- Angel Investors
- Referrals

Makerspaces Worldwide

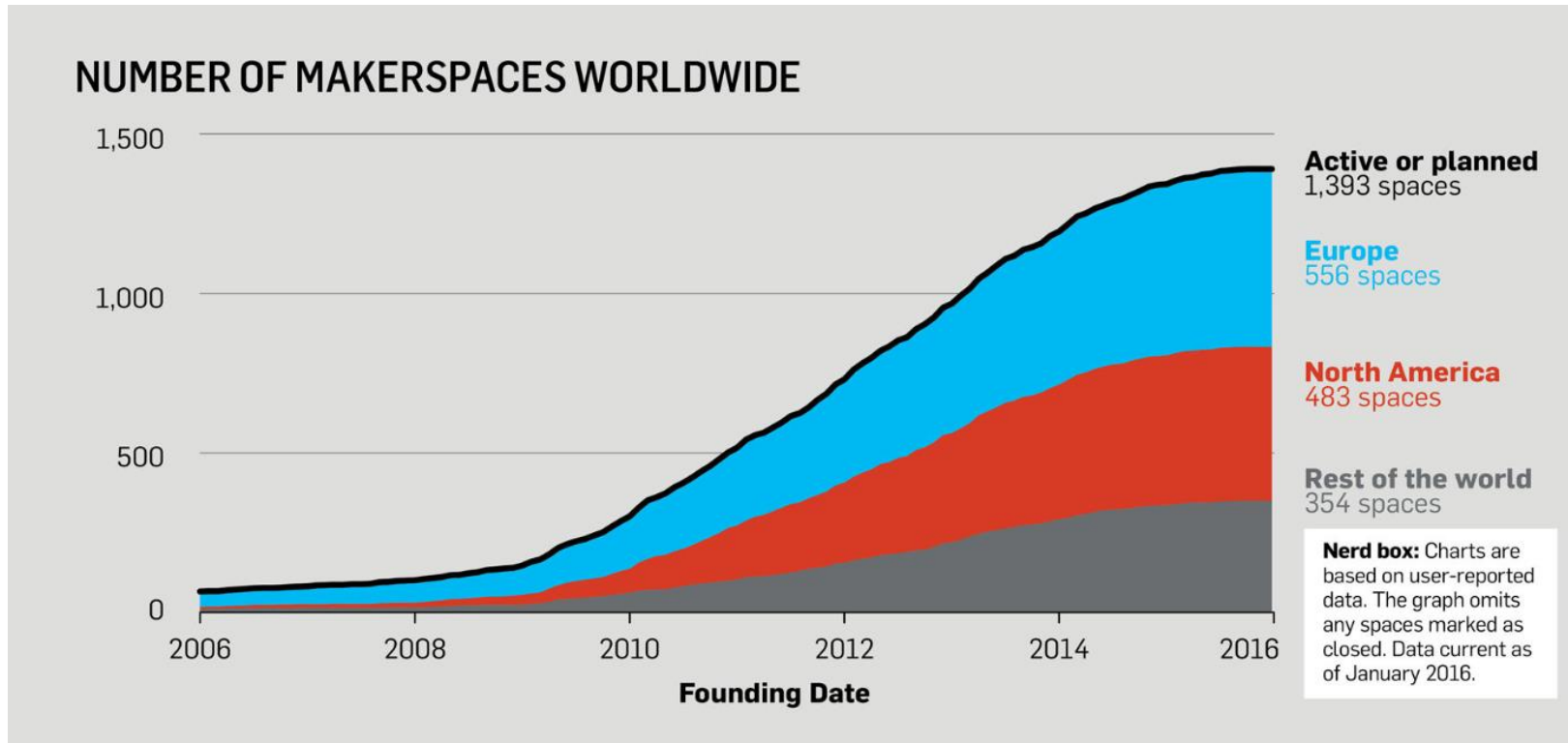
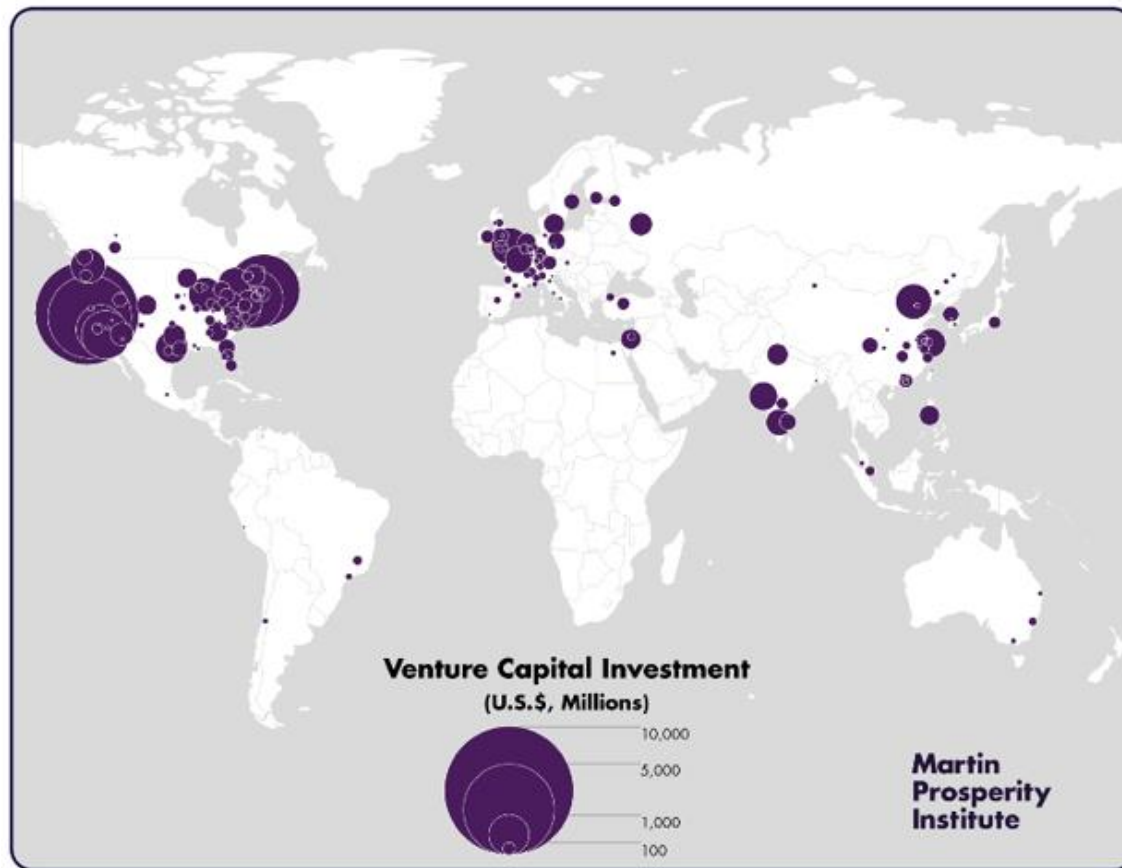


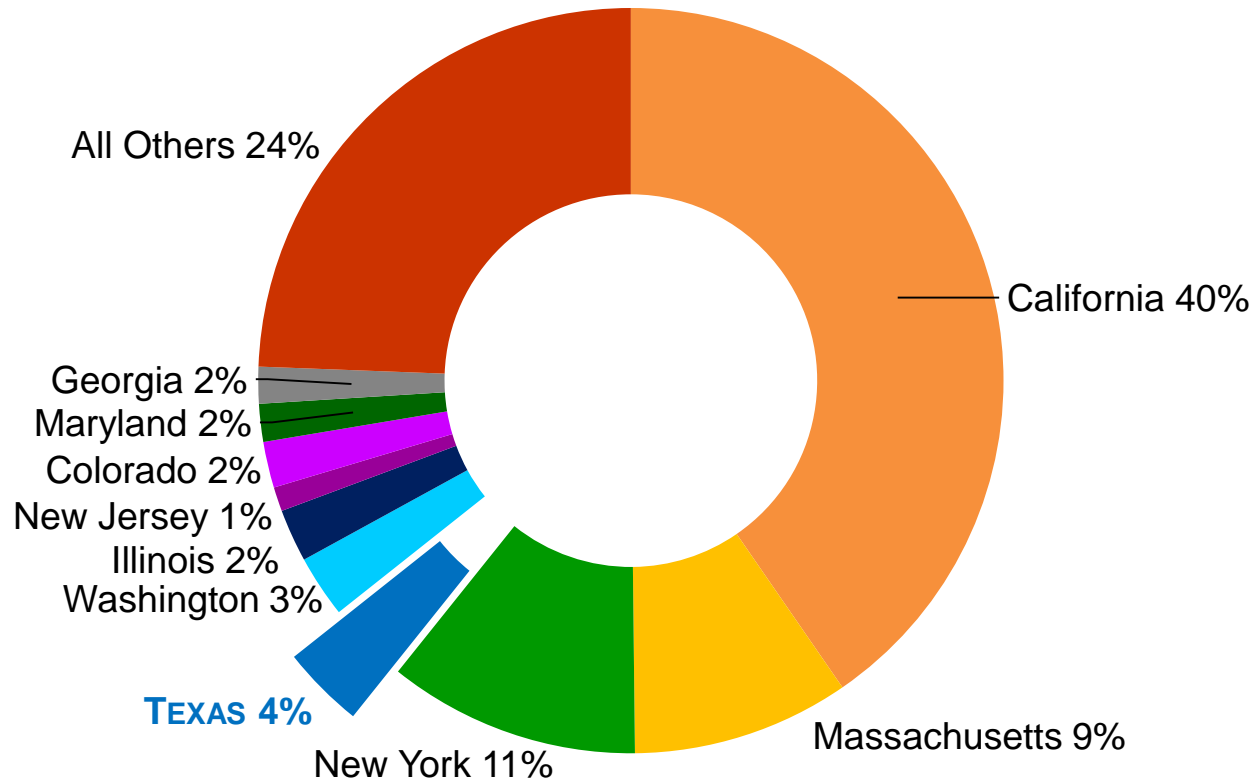
Chart by Katie Peek

Data Sources: Hackerspaces.org; U.S. Census Bureau

Venture-Capital Investment by City



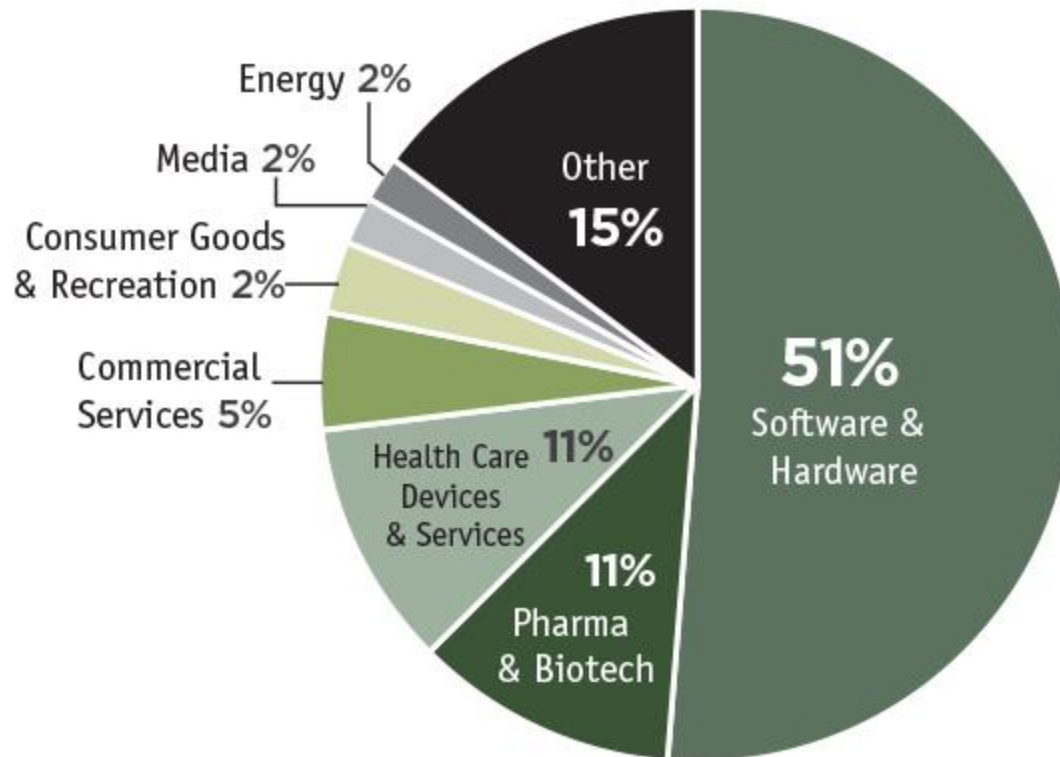
2015 Venture Funding - Geography is Important!



Source: NVCA Yearbook 2016

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Percentage of U.S. VC Investment by Sector in 2016



Source: National Venture Capital Association, "Venture Monitor," Q4 2016, p.9.

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