

# *Engineering Matters<sup>®</sup>, Inc.*

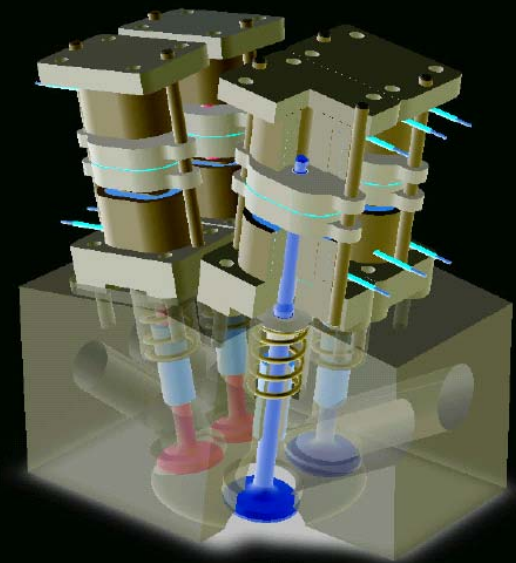
Engineering Matters, Inc.

375 Elliot Street

Newton, MA 02460

[www.engineeringmatters.com](http://www.engineeringmatters.com)

19 May 2006



# *Company/Team*

- Incorporated May 1998 by 3 MIT Ph.D.'s
- Woman-Owned Sub-S Corp.
- 4 employees + several technical and business consultants
- Marketing responsibilities:
  - Lauren Cope (pursuing licensees)
  - Nigel Harvey (pursuing venture capitalists)
- Utilize Board of Directors, Business Advisors

# *Company—Product—Advantages*



- Company Electromechanical Focus
  - Specialty actuators and motors, power electronics, robotics, electromagnetic signature control and analysis
- Internal Combustion Engine Valve Actuator
  - Independent electronically-controlled electromagnetic valve actuator
- EVA Advantages
  - 15% improved engine efficiency
  - 20% reduced emissions
  - 33% greater low speed torque

# *EVA Technologies*

- **Engineering Matters**
  - Moving-iron actuator (stationary PM and coil)
  - Variable valve **timing** and **lift** as a function of engine speed and load
  - Controlled forces (significant push & pull forces throughout stroke)
  - Non-resonant action
  - Low valve landing speed
  - Low power (12V system)
- **Competition**
  - **Valeo, FEV**  
Electromagnetic resonant
    - Holding force-only
    - Fixed lift
    - High NVH
  - **BMW, Honda**  
Electromechanical
    - Limited variability
    - Complex, Expensive
    - Reliability issues

# *Electromagnetic Valve Actuator Comparison*

<u>Engineering Matters' EM Valve</u>	<u>Solenoid with Spring/Mass</u>
Commanded acceleration	Commanded holding
Controlled forces (push & pull)	Holding force only
Force throughout stroke	Force only at ends of stroke
Variable stroke	Fixed stroke
Instant "ON"	Slow build-up req'd at start-up

# *Value Proposition*

- Adoption costs of \$450 per vehicle for 15% improved gas mileage, 20% reduced emissions, and 33% improved low speed torque.
- Consumer examples:
  - EVA (for non-hybrid vehicle)
    - 12,000 miles per year → \$300/yr fuel savings
    - Payback in 1.5 years.
  - Compare today's Hybrid vehicle proposition:
    - \$4000 cost for 33% increase in fuel economy
    - Payback in 6 years.

# *EVA Business Model*

- Sell or License EVA Intellectual Property to Tier One or automotive OEMs
  - e.g., Pollak, Magna
  - e.g., Ford, Mitsubishi
- Sell Engineering services for customer integration
- Presently negotiating licensing agreement to a large company for another EMI technology.
- Have P.O. in hand with that company for technology integration engineering services.

# *Market Opportunity*



- Valve annual sales: 400 million domestically, 700 million worldwide
- Valve sales growth: +6.5%/yr.
- Most OEMs are investing in variable valve actuation
- Market, regulatory, and strategic forces are accelerating growth.

# *Finance & Revenue Model*

- Funding required: ~\$1M
- Additional monies: Debt, License fee, Equity (Angel, Tier 1, OEM, VC), Phase IIB funding
- Commercialization: To be performed by Tier One supplier or OEMs
- First Revenues: ~2Q07

## *Additional Information*



- Published technical paper SAE 2006-01-0044.
- Paper also selected to be published in SAE Transactions.
- Member MIT Enterprise Forum
- Two U.S. patents, 4 patents pending, 2 soon to be filed.

# *Back-up*



# *Internal Combustion Engine Valve Actuator*

- Camless actuators replace cam drive train (cams, rocker arms, cam shaft, timing belt, etc.) (mfg Savings)
- Intake valves:
  - Gains of 15-20% in fuel efficiency and low speed torque possible by control of intake valves (consumer Savings)
  - Low valve lift capability can replace throttle mechanism (mfg Savings)
- Exhaust valves:
  - Exhaust valve control can eliminate Exhaust Gas Recirculation (EGR) mechanism (mfg Savings)

# *Electromagnetic Variable Valve Actuation*

- Commanded-holding
  - Holding forces-only
  - Resonant Spring-Mass action
  - Variable timing-only
  - Fixed stroke
  - Slow build-up required at start-up
- Commanded acceleration
  - Controlled forces (push & pull throughout stroke)
  - Non-resonant action
  - Variable timing
  - Variable stroke; significant force throughout stroke

# *Engineering Matters<sup>®</sup>*

## *Business Strategy*



- Maintain expertise in electromechanical innovation
- Leverage Government research opportunities (SBIR, etc.) to develop commercial products & technologies for manufacturing or licensing
  - 5 patents issued
  - 10 patents pending
- Target engineering services leading to hardware development
  - Technical product development for clients is approximately 50% of our work

# *Engineering Matters<sup>®</sup>*

## *In-house Expertise*



- Electromagnetics
  - Motors & Actuators
  - Sensors
  - 2D, 3D Simulation
- Electrical design
  - Power electronics
  - Analog and digital design
  - Simulation
- Mechanical design
  - 3D CAD
  - Prototyping
  - Design for Manufacturing
- Firmware design
- Control Design
- Systems integration