MicroStrain, Inc.

Steven W. Arms, President
Williston, Vermont
www.microstrain.com

2008 VT EPSCoR Annual Conference
Grant Writing Workshop,
Davis Center, UVM, 7th June 2008

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MicroStrain's Smart Sensors

Displacement

DVRT®

Robotic systems

Orientation

Micro-AHRS

Unmanned systems

Wireless

G-Link®

Machine monitoring

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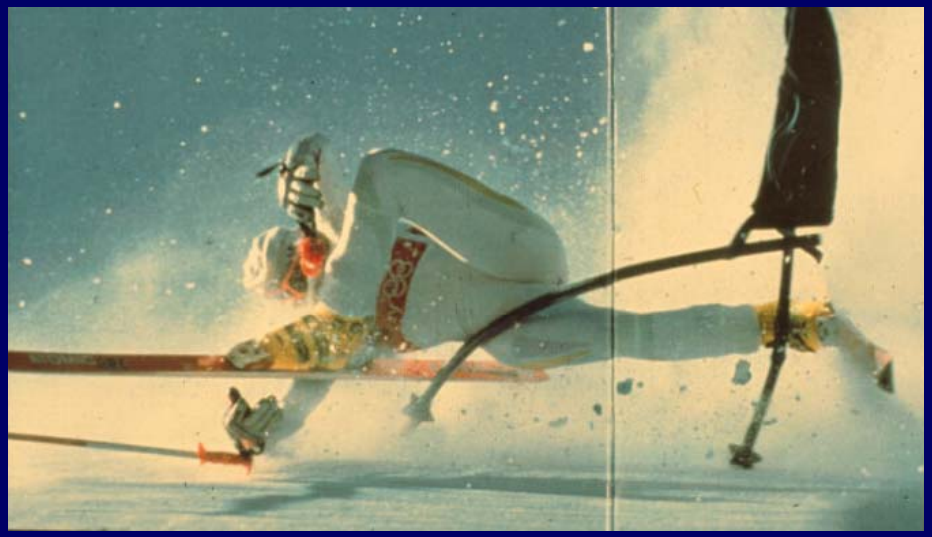
MicroStrain: where we began

- First arthroscopic implantation of strain gauge in live human ACL

- Collaboration with Drs. R. Johnson & B. Beynnon, et al. 1986



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Ligament Strain Measurement

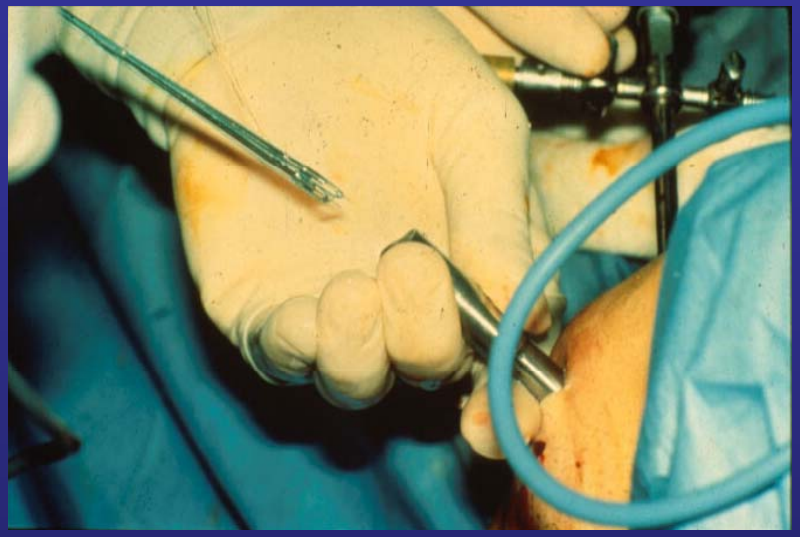
Arthroscopic implantation

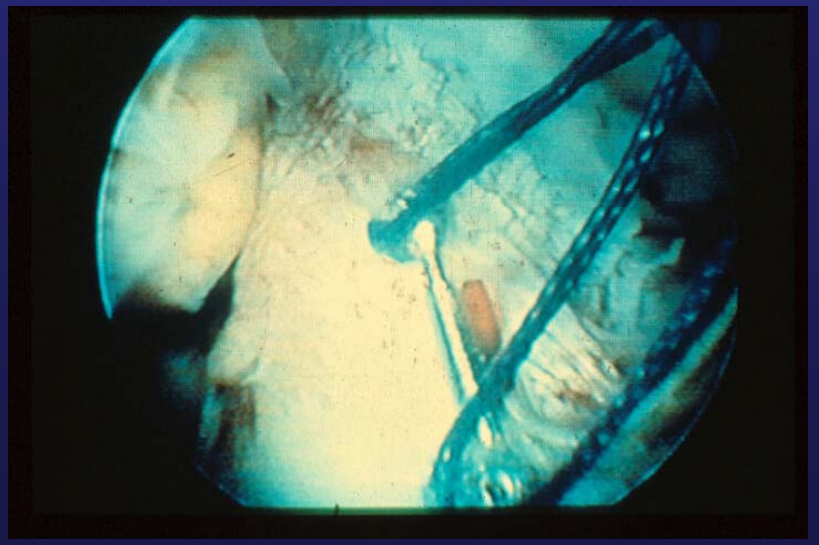
Suture-less attachment

Beynnon et al. J Bone Joint Surg 1992

Beynnon et al. Amer J Sports Med 1996

Fleming et al. Amer J Sports Med 2000





THE UNIVERSITY *of* VERMONT

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Sensing the Future

Wireless sensors, in the billions, will become deeply embedded within structures & machines.

Sensed information will be automatically compressed & forwarded for condition based maintenance.

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Market Size?

Wireless sensor market will reach $4.6 Billion by 2011, up from $500 Million in 2007*

MicroStrain's Partners:

- Navy: NAVAIR/NAVSEA
- Bell Helicopter
- Sikorsky
- Caterpillar

*ON World report, "WSN for Smart Industries", Nov 2007
www.assetmgmtnews.com "Industrial Sector Embraces Wireless Sensors" Jan 2008

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The Economist

April 28th – May 4th
2007

Problem:

Who will replace billions of dead batteries?

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Solution:

- Harvest & store energy from strain, vibration, light, and motion
- Use power management to balance the energy “checkbook”
- Use embedded processors to compress data, compute fatigue life

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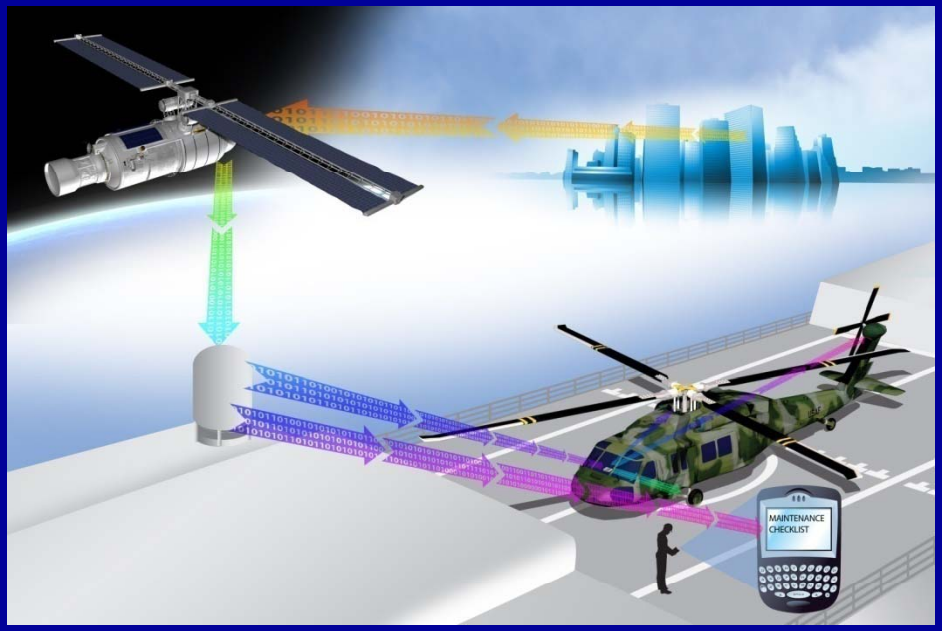
Aircraft Applications

MicroStrain's NAVY PhI, II, & III SBIRs: Helicopter Structural Health Monitoring System

(patents issued & pending)



Patents pending

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Pitch Link w/ Energy Harvesting, Sensing, Data Storage, & Wireless Communications

MicroStrain, Inc. patents pending

RF antenna

Circuit board module, microprocessor, and electrochemical battery

Piezoresistive strain gauge

Electrical insulation, EMI shielding, & protective covering (shown transparent for illustration purposes)

Piezoelectric energy harvesting elements

Sikorsky H-60 Blackhawk

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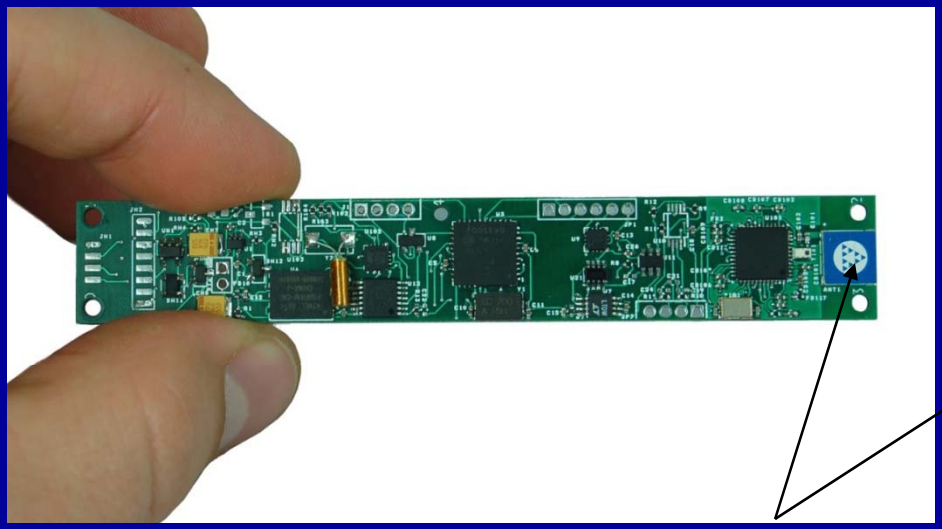
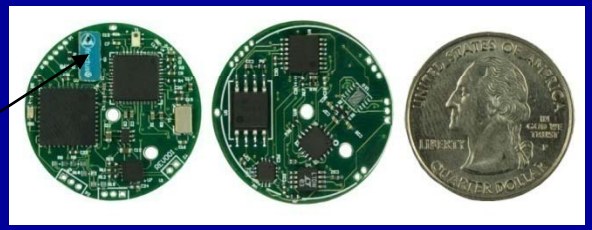
Wireless Pitch Link Strain & Load Sensing Nodes





Fractal antenna

Patents Pending

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Bell M412 Flight Test

- MicroStrain piggy-backed on Bell's planned flight tests
- Wired (slip rings) data could be collected simultaneously w/ wireless data

Patents pending

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Flight Test Results

- Energy harvesting wireless component (pitch link) installed on Bell M412 Feb 2007 (first time ever flown)

- Passed
  - in-flight EMI evaluations
  - rotor track & balance verification
  - wireless data collection during scripted flight with no indication of data loss.

Patents pending

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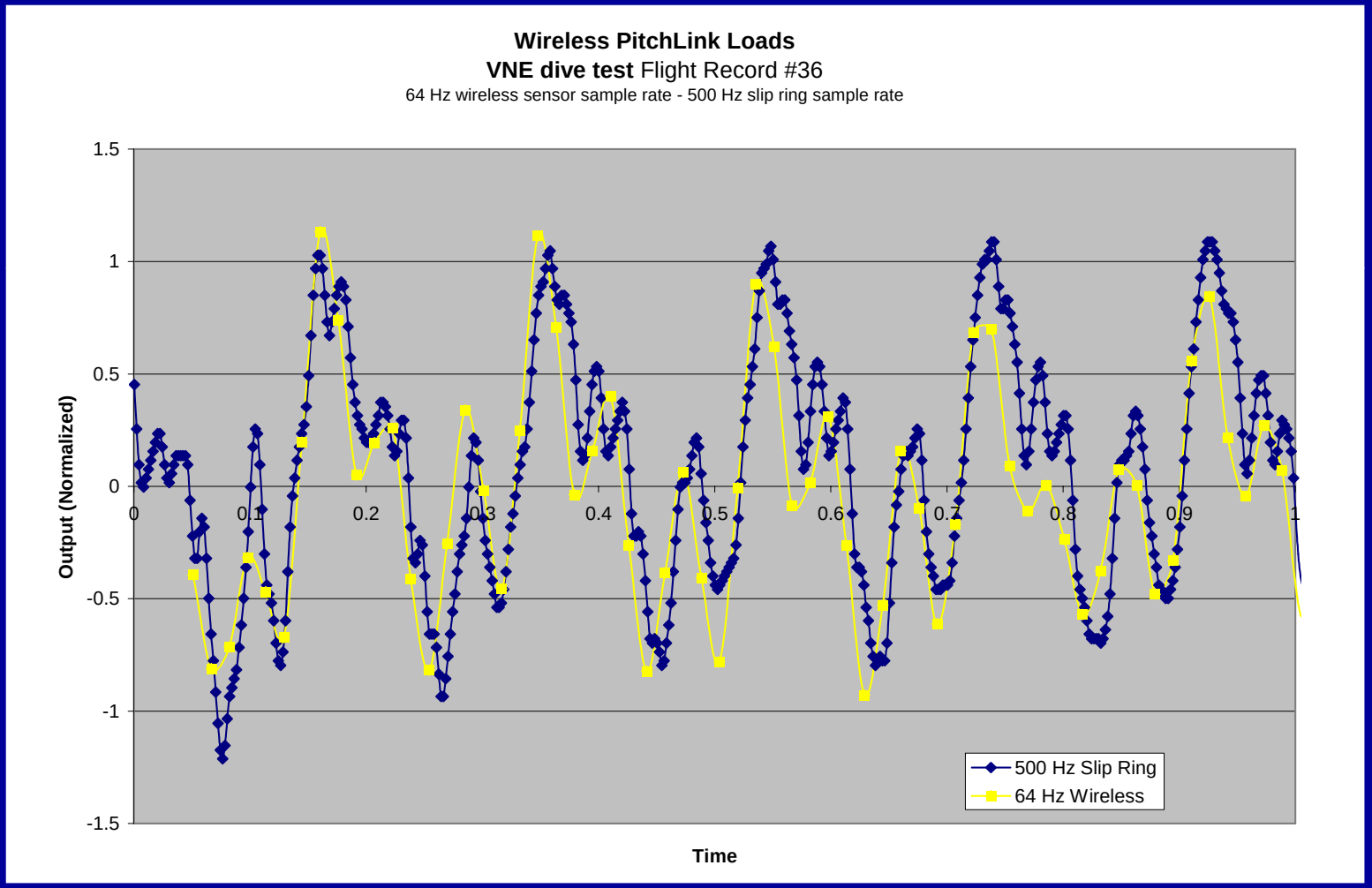
Bell M412 Wired vs. Wireless Pitch Link Flight Test Data



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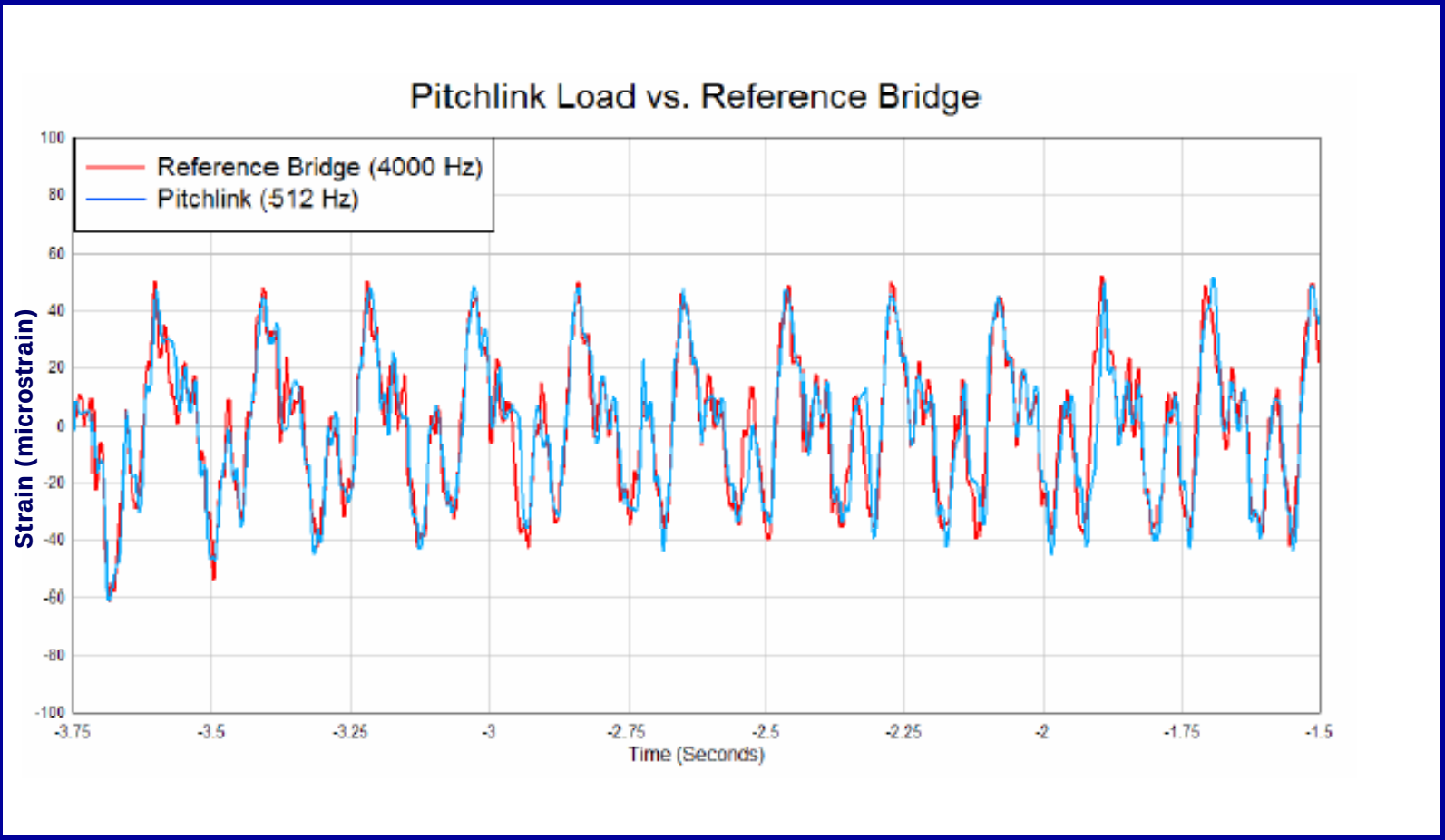
MicroStrain, Inc. High Sample Rate Bench Test:
hard-wired reference bridge vs. wireless pitch link

(two separate & distinct strain gauge bridges bonded to a single steel plate in 4-pt bending)



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MicroStrain's (S.W. Arms) SBIR approach:

"Consider only those SBIR topics that fit our core strengths & our product development strategies"

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Arms' SBIR approach (con't):

Pick one (maybe two) PhI SBIRs to focus on within each solicitation period.

Study the topic, call TPOC during allowed time period.

Write only a few proposals per year to sharpen focus

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Arms' SBIR approach (con't): Start w/ specific aims

Ask associates to help by "fleshing out" one or two of the specific aims w/ figures & descriptions

The PI typically authors the SBIR abstract & introduction w/ problem statement

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Arms' SBIR approach (con't):

Leave time for the details

budgets
references
resources & environment
commercialization report
page limitations
extra day for editing

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After the grant is submitted

Don’t wait to get product and/or service revenues flowing

If it’s funded, great!

If it’s not funded, it may still warrant working hard on it

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Commercialization

SBIR should fit long term product development strategy

Keys to converting SBIRs into commercial products

Leverage Phase II results to prove efficacy in applications with market potential

Include field trials in Phase II effort in collaboration with objective professionals or early adopters/future customers

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MicroStrain has leveraged EPSCoR Phase O's into significant Federal R&D:

8 Ph0's:
~ $60K.

11 Ph1's, 5 Ph2's, 3 Ph3's:
~ $8.2M

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But we’re not a “grant mill” !

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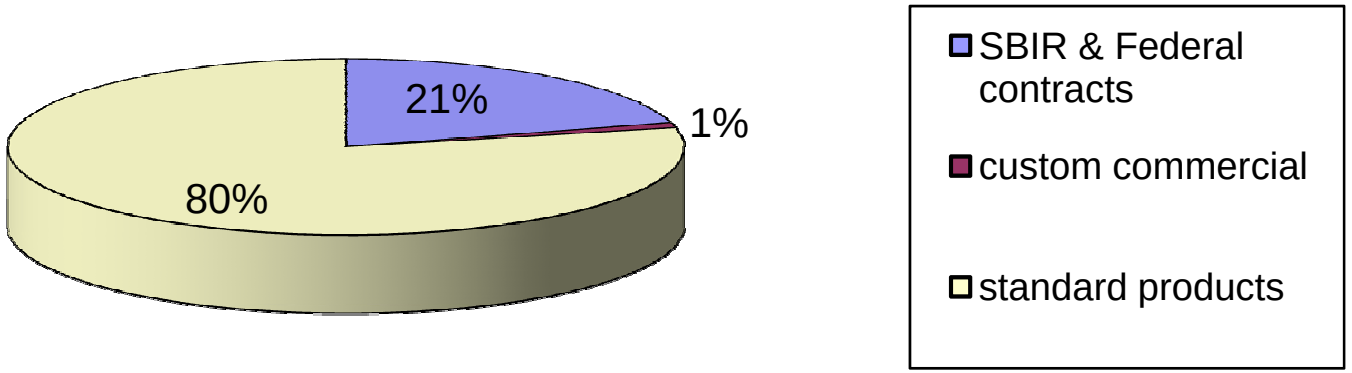
Turning ideas into products

MicroStrain, Inc.
2007 Revenue Distribution
(SBIR & Federal contracts ~21%



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About MicroStrain, Inc.

- 35 employees
- 80% revenue from product sales
- products developed w/ SBIR funds
- growing at 35%/year
- zero debt
- no outside investment to date

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MicroStrain's Future

- Energy harvesting wireless sensors
- Integrated cellular & satellite communications
- MIL-STD qualifications
- Open architecture sensing systems

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Acknowledgements:

VERMONT EPSCoR
NAVY SBIR
NSF SBIR
DHHS SBIR

Thank You!

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Know your firm's strengths & weaknesses

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Outsource production that requires high capital expense & that yields relatively low profit margins.

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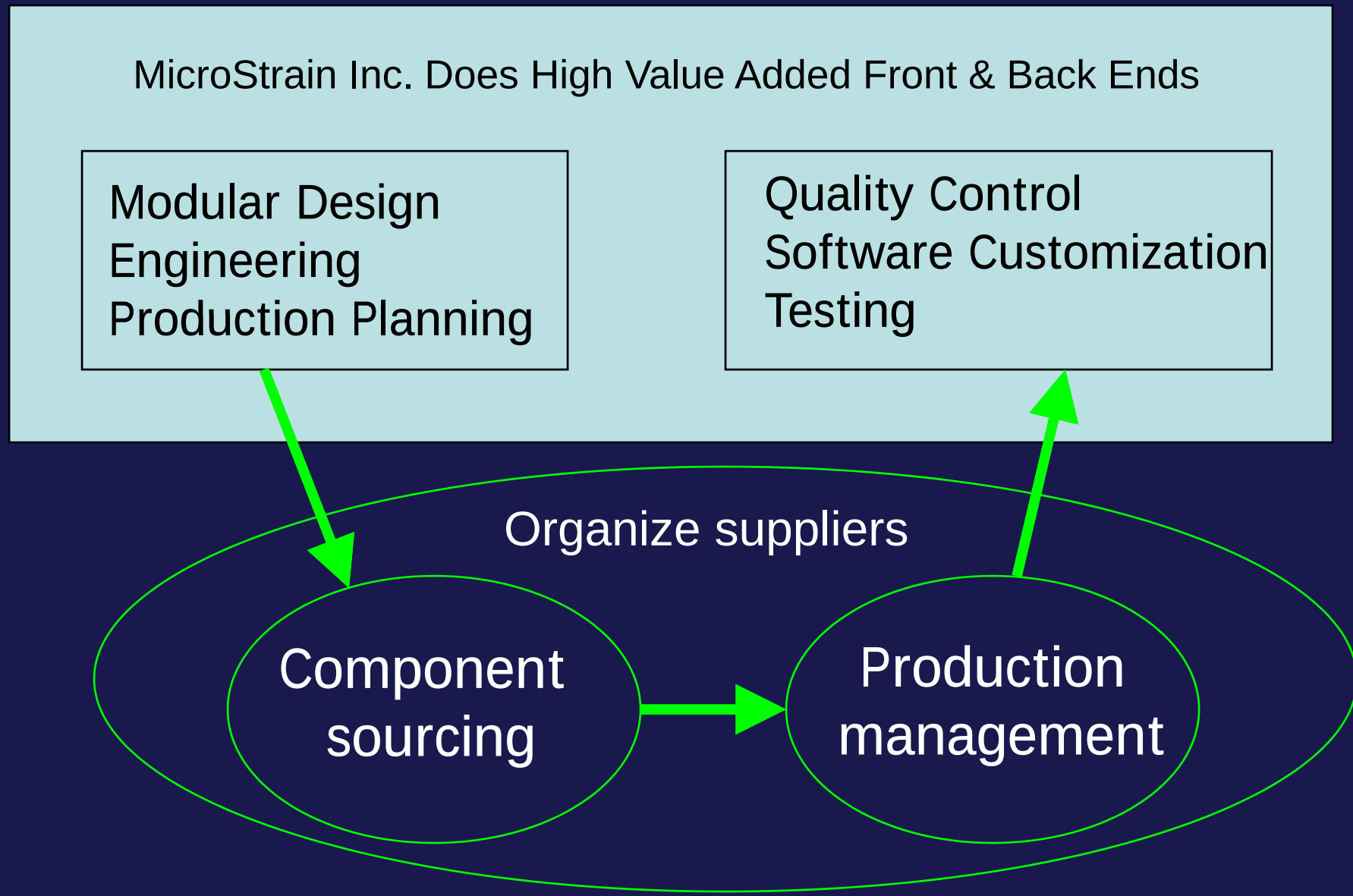
Supply Chain for Innovative Products



(adapted from Harvard Business Review, 2000)

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Leverage what you do best to strengthen those capabilities & to raise capital for innovation.

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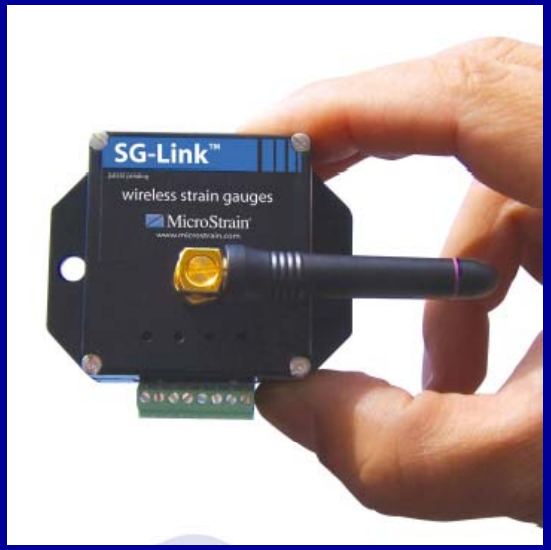
MicroStrain's technical strengths

US patents (sensing): 15 issued, 11 pending
Federal SBIR support: received over $4.4 M

- Energy harvesting
- Power management
- Sensor fusion
- Wireless sensor nets



SG-Link® 802.15.4
Wireless strain node

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MicroStrain Competitive Advantages

Features	Benefits
embedded intelligence	sense, record, & report damage & fatigue
patent pending data logging transceivers	eliminates costly wiring
patent pending energy harvesters	eliminates battery maintenance
base station GSM/SAT uplink	no human intervention required to get reports
wireless offset, calibration	fast installation & test

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