Industry Perspective:

The Challenge of Transitioning Innovative Technology

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Agenda:

- Situation
- People
- Difficulties
- Successes
- Actions

What's happening to our products?

- Complexity is following Moore's law
- Transformational system requirements are daunting
- Customers' expectations increasing and expanding

Innovative Modernization is 4-D

- New customer
- New developer
- New process
- New product

Innovative Technology:

- **Promises major long term improvements in performance, cost, quality, and/or totally new capabilities**
  - Largely unproven
  - Faces competition/adversaries
  - Lacks advocates, especially with customer
  - Forces change
  - Adds risk for industry, developer and user

People Create Innovation

- Aging workforce – experience lost
- HS Math/Science scores poor
- Engineering enrollments down
- System Engineering only On-job
- Growing Demand for Engineers

Where are tomorrow's innovators?

philg@mit.edu

Why is Transitioning So Difficult?

- Uneducated decisionmakers
- New customers
- Acceptable legacy systems
- Monies needed
- Unknown unknowns
- Doctrine/Force Structure threatened
- Community of Practice damaged

Warfighter is Critical

- Operational Insights
- Value/impact of potential capability
- When/how much new capability is needed
- But he ---
  - Doesn't understand the technology/potential
  - Might be wrong customer
  - Can't articulate key knowledge to developer

"If I'd asked my customers what they wanted – they would have asked for a faster horse" Henry Ford

Industry Reluctant To Lead Transition

- **Prefers incremental modernization**
- Hesitates to provide leadership and resources
- Doubts credibility of innovators

Success – Nano Testimony

- **Don't say "innovative" – avoid frontal assault**
- **Engage suppliers in modernization strategy**
- Worst vice is overselling!!! Credibility is Key!!

Interview, Dr. Tom Cellucci, Pres/COO, Zyvex Corp.

Nanomaterials Hit the Field

Success: DOD Nanomaterial

- **Multifunctional Nano-Structures**
  - **Ultra Light Weight**
  - **Strength, rigidity**
  - **Producibility**
  - **Mission Adaptability**

Extended Wing LOCAAS

Courtesy of Dr. Les Kramer, LMMFC

Success – JSF Lift Fan

- Lean team ‘87: USMC, DARPA and Lockheed
- USMC stayed in-charge
- DARPA support before IRAD $
- PM designed/advocated “lift fan”
- Competitor influenced final “lift fan” decision
- AF code convinced engine teams
- AF added strong staff/tech support

Interview, Dr.P. Bevilaqua, NAE
Skunk-PM, Invented Lift Fan

FIRST: STO-SSDash-VL

Courtesy of LMAero

Action: Materiel Developer

- Engage the internal R&D community
- Strengthen focus on new ideas
- Refresh labs/RDECs to ensure in-house capabilities in SE and across new domains

Reference: Mike Marshall, "From Science to Seapower"

Action: DOD AT&L

- Fund designated innovative technologies
- Add strong system engineering discipline
- Hire/support new S&Es
- Engage Industry/DOE/DHS/NSF

Action: Warfighter

- Include industry in Combat Developments
- Train cadre to examine capability options
- Use concept of “pilot” operations in field to evaluate new hardware
- Be willing to revise Doctrine, TOEs, TTPs

Action: Industry (1)

- Develop accountability
- Allocate resources
- Shield innovative technologies
- Develop credibility with customer
- Convince BOD/shareholders

Action: Industry (2)

- Establish Skunkworks
- Develop Mod-Sim-Test
- Tie above to Warfighter/Developer
- Explore the potential of new tech
- Educate system engineers, et al
- Allow failure

Summary/Conclusion

Transition is hard but essential for DOD success

Technical and engineering skills are vital

A team is required –

Industry/Warfighter/Developer

"I must work longer and harder each day to weave a world in which I can live."

Callahan, *Adrift – 76 Days Lost at Sea*

ANY QUESTIONS ?

BACKUP

People Make Products Work

- John Roebling designed the Brooklyn Bridge, alone
- Frank Crowe drove the construction of Hoover Dam alone
- Ed Heinemann knew the Grumman A-4 better than anyone else
- Kelly Johnson knew every Lockheed airplane better than anyone else

Where are system engineers today?

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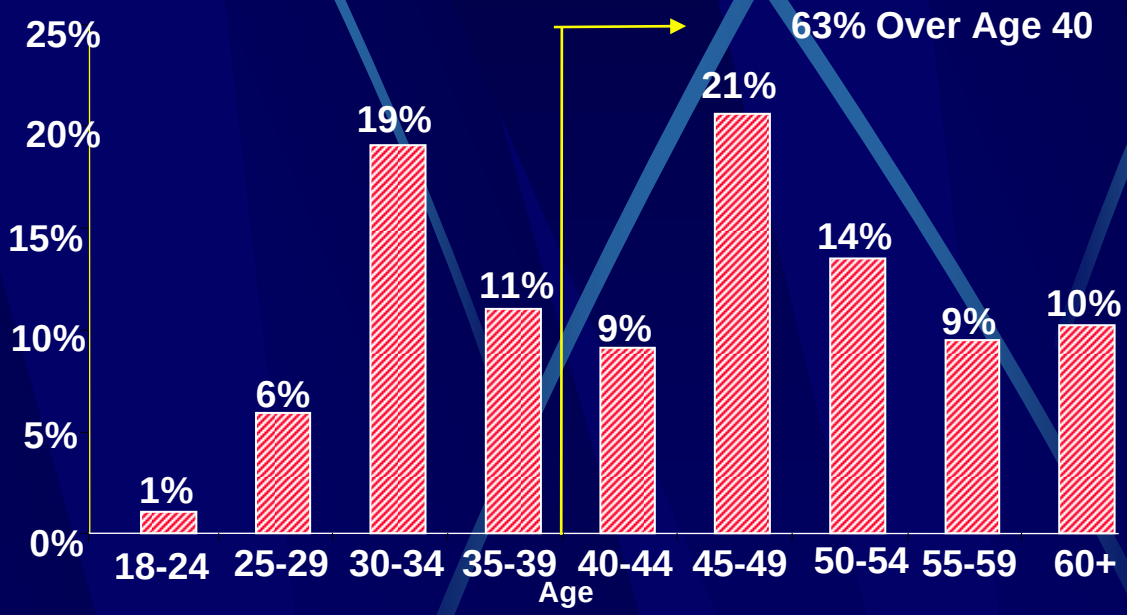
Aerospace Workforce Aging

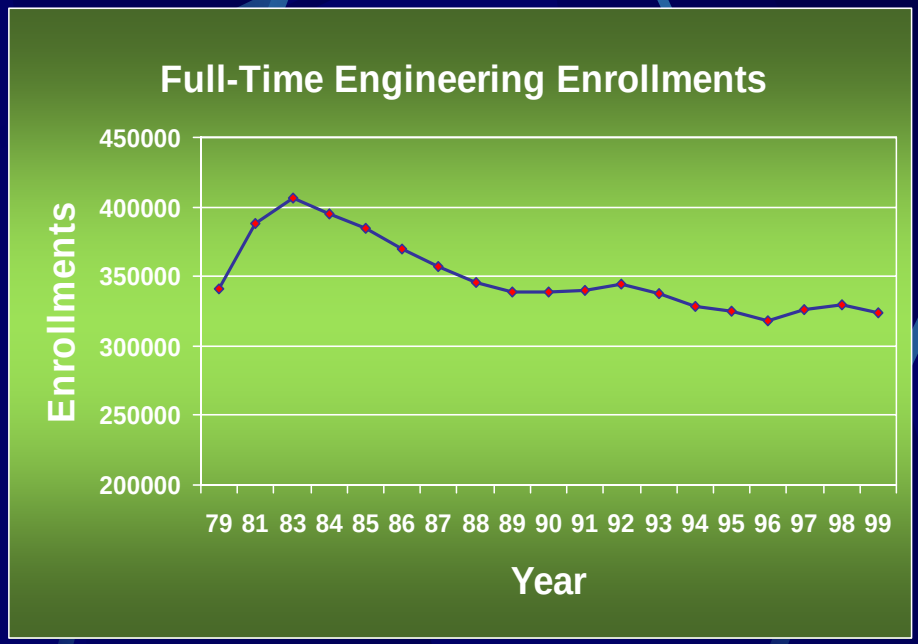
Industry Age Distribution



Source: BAH Study

Industry losing many experienced SE's annually

Engineering Enrollment Down ...



Source: National Science Foundation – Science and Engineering Indicators 2000

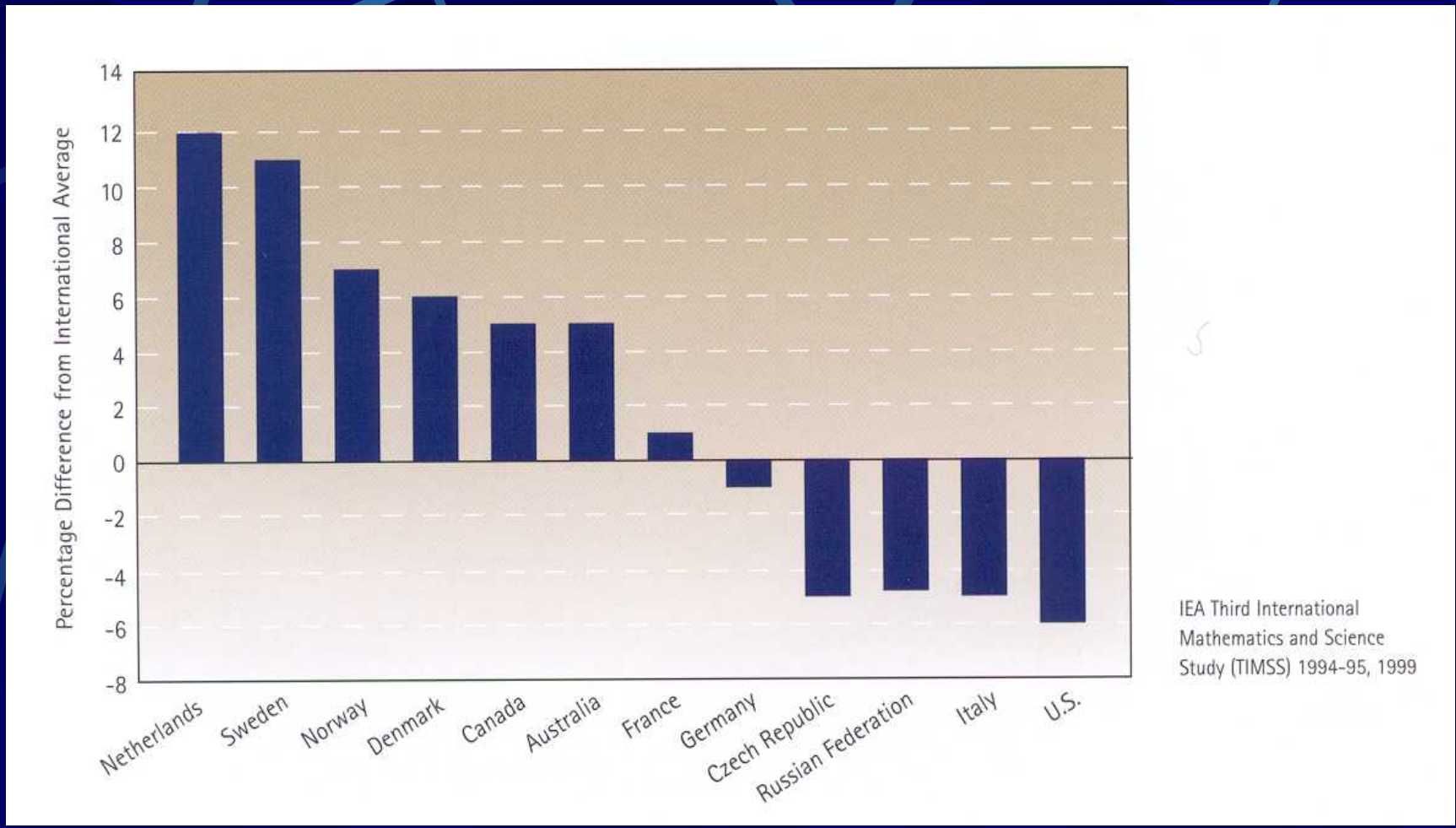
Engineering Graduates Selected Disciplines

Discipline*	1991	2000
Aerospace	4,072	2,175
Electrical	29,024	21,424
Mechanical	19,443	17,241
Computer	8,259	15,351
Total	60,798	53,189

Source: Engineering Workforce Commission

*System Engineering Discipline not available in most universities

U.S. 12th Graders Underperform in Math and Science



Source: The Second National Innovation Summit 2001, Council on Competitiveness

… While Demand Growing

U. S. Engineering Job Growth- Selected Disciplines 1998-2008

Discipline*	1998	2008	% Change
Aerospace	53,000	58,000	9.4
Electrical	357,000	450,000	26.0
Mechanical	220,000	256,000	16.4
Computer	5,626,000	11,144,000	98.0
Total	6,056,000	11,908,000	96.6

Source: U. S Bureau of Labor Statistics

*System Engineers needed for most DOD applications