



HAMPTON ROADS  
**TECHNOLOGY COUNCIL**



# The Technology Workforce of Tomorrow

**TASC Luncheon**  
**April 15, 2009**



# What is the HRTC?



- The Hampton Roads Technology Council is a technical membership society dedicated to serving its members through
  - Networking, Education and Advocacy
  - Driving Entrepreneurial Culture
  - International Technology and Research Portal

**As a technology advocate, we see a huge challenge ahead of our industry**



# The Challenge We Face



- The nation is expected to face a severe shortfall of professionals in the areas of science, technology, engineering and mathematics (STEM).
  - A large fraction of such workers will be eligible to retire soon.
  - The pipeline of (US) students is falling short of the anticipated need.
  - This problem threatens US prosperity, which over the last 50 years has been driven by technological advances. It is expected to affect the Aerospace and Defense industry – and thus, companies like ours.



# STEM Components & Innovation Defined



- **Science** – the *study* of the physical world and its manifestations, especially through systematic observation and experiments.
- **Technology** – the application of scientific and engineering knowledge to achieve a *practical result*.
- **Engineering** – the creation or development of new devices and objects that are of *importance or value* to humans and society.
- **Mathematics** – a branch of pure science or philosophy (logic) that in its *applied* state can be used to help make quantitative analysis and predictions for science, technology, and engineering.

**Innovation** – Creation of new *value*

Slide from Jim Batterson  
Preparing VA's Students...  
June 2008



# Example: Humans to the Moon and Safely Home

## Carried out by:

Engineers & many other  
professions & skills

Engineers, Technicians  
& Scientists

Scientists  
& Engineers

Mathematicians

*Need for National Response to  
Sputnik/Cold War/Missile Gap*

Innovation

Humans to the Moon  
and Safely Return

Technology

Rockets, Protective  
Clothing, Computers

Science

Newton's Laws of Motion/Gravitation, Chemistry

Mathematics

Algebra, Geometry, Trigonometry,  
Calculus



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# The Challenge We Face



- A large number of activities and initiatives examine and/or address this problem. Examples:
  - *Rising Above the Gathering Storm, 2007* (National Academies)
  - America COMPETES Act (federal funding to support R&D, STEM education, innovation infrastructure)
  - 2007 NDIA Division, “National Security Science and Technology Workforce”
  - National Math + Science Initiative (public-private partnership)
  - National Academies study on “Capitalizing on the Diversity of the Science and Engineering Workforce in Industry”
  - Aerospace Industries Association initiatives... and so on

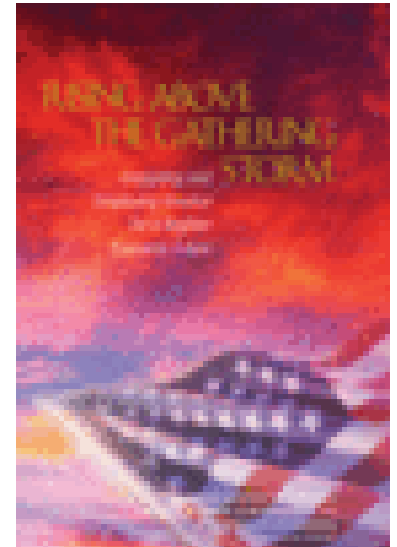


# Rising Above the Gathering Storm...

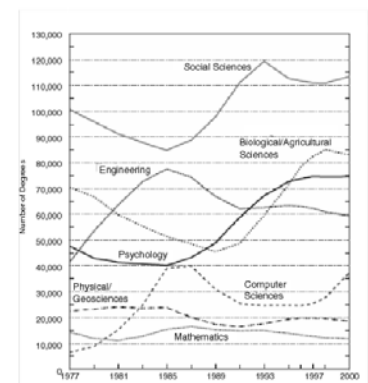


- **Four Goals:**

- **10,000 TEACHERS, 10 MILLION MINDS, AND K–12 SCIENCE AND MATHEMATICS EDUCATION**
- **SOWING THE SEEDS THROUGH SCIENCE AND ENGINEERING RESEARCH**
- **BEST AND BRIGHTEST IN SCIENCE AND ENGINEERING HIGHER EDUCATION**
- **INCENTIVES FOR INNOVATION**



HOW IS AMERICA DOING NOW IN SCIENCE AND TECHNOLOGY? 101





# Answering the Call (example)...



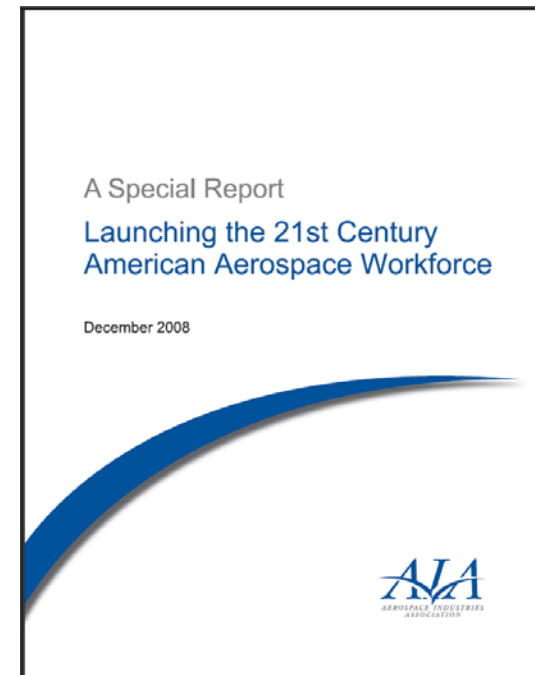
## Sept 2008, “Industry Response to Workforce Challenge”

- Self-directed action plan, signed out by member CEO’s

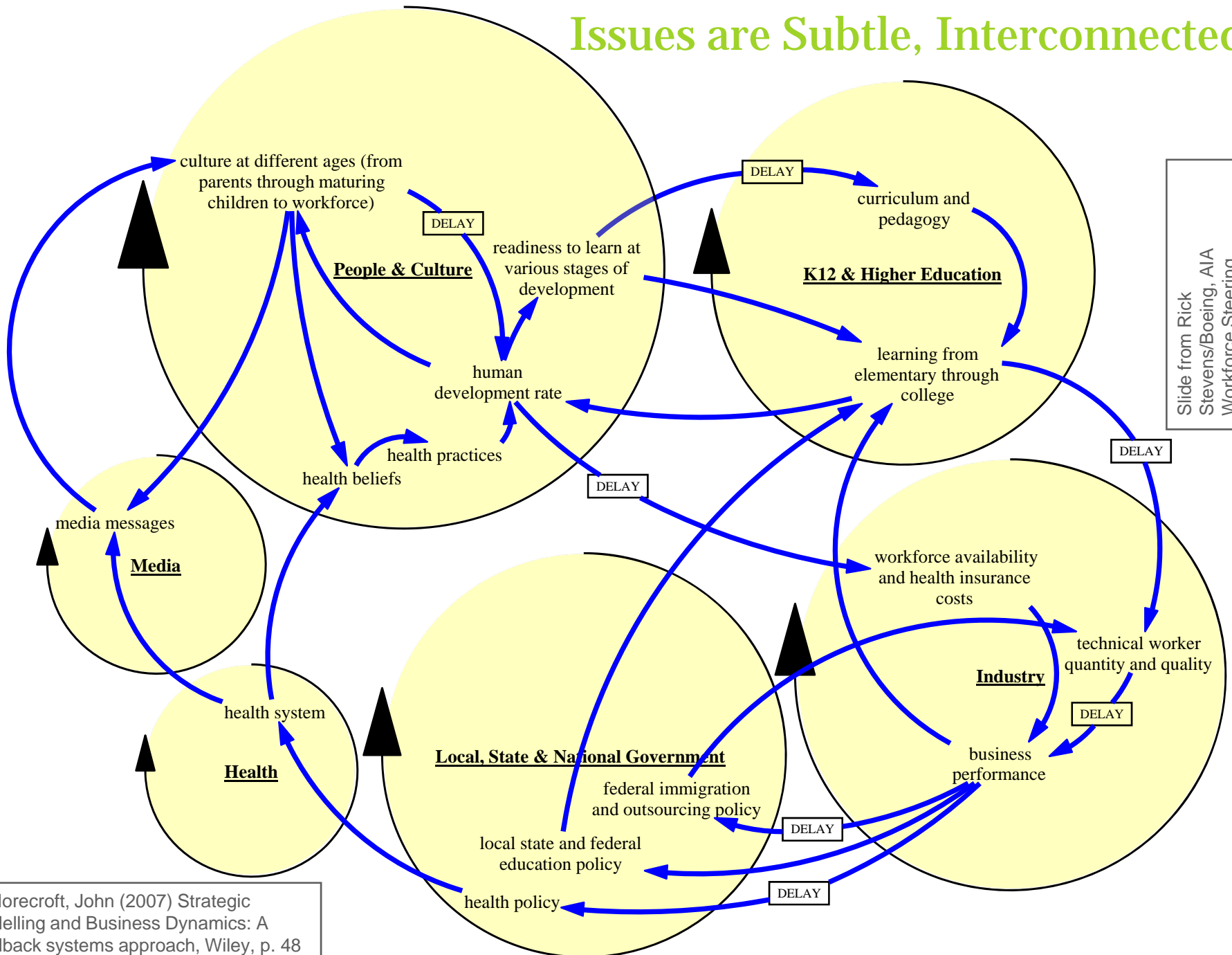


## Dec 2008, “A Special Report”

- Targeted at prompting government action
- Also includes list of industry activities



# Issues are Subtle, Interconnected



Slide from Rick Stevens/Boeing, AIA Workforce Steering Committee Kickoff, Mar 2009

1. Morecroft, John (2007) Strategic Modelling and Business Dynamics: A feedback systems approach, Wiley, p. 48



# STEM in the Commonwealth



- In the summer of 2007, under the Virginia Secretary of Education, panels of practicing scientists & engineers conducted a gap-analysis of Virginia's physics & chemistry Standards of Learning (SOL) and engineering program to help inform the State Board of Education's 2010 science SOL review.



# Preparing Students for the 21<sup>st</sup> Century STEM



- Panels of broadly selected practicing engineers and scientists met in facilitated two-day workshops
- Addressed the question of what science a competent Virginia citizen needs to know for the 21<sup>st</sup> Century
- Called for major changes to current content philosophy in chemistry & physics (current content is mid-20th C.)
  - 20% laboratory integrated and assessed
  - Contemporary & emerging applications must be taught & integrated
  - Organic chemistry must be reinstated
  - Move to a core/elective approach
  - DOE support open-source wiki for timely development of content
- Engineering design process *learned* by all students and pre-engineering high school program *available* to all students in VA (Engineering is NOT currently institutionalized throughout K-12 in the Commonwealth).



## Summary of Study Findings



- While Virginia's SOL are clearly written and panels did not find another state whose SOL could be simply imitated - -
  - VA science (physics & chemistry) content are severely dated (early 1960's)
  - VA physics content is too broad causing shallow coverage
  - Engineering is neither required of nor generally available to all of Virginia's children
  - Virginia does not take advantage of 21st Century technology such as open source software (wiki) to develop timely curriculum content

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# A Chronology of “Nanotechnology”



**First Use of Term Japan (1974)**

**Scanning Tunneling Microscope (1982)**

**Carbon nanotubes/fullerenes (1986)**

**Atomic Force Microscope (1987)**

**Science Magazine Special Issue (29Nov 1991)**

**Should be read by  
HS science teachers**

**Scientific American Magazine (1996)**

**Nobel Prize to R. Smalley et al (1996)**

**Should be read by  
lay citizens**

**National Nanotechnology Initiative – U.S. (2001)**

**60% science teachers aware of nano;  
33% familiar with nano;  
18% understand; 7% teach nano (2003 KY survey)**

**Congress figures it out**

**VA Science SOL review – no nano (2003)**

**Nanotechnology Day at  
VA General Assembly (2007)**

**Panel of experts recommends  
inclusion in VA chemistry SOL (2007)**

**VA Board of Education  
SOL Review? (2010)**

Slide from Jim Batterson  
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# STEM Pipeline: Opportunities for Action



## Scope of Impact:

## Examples of Support:

Nation-wide

Support national organizations (teaching standards boards, professional organizations, SWE/NSBE/SHPE/etc, Girl Scouts/4-H/etc). Support curriculum development. Sponsor national ad campaigns. Create national-release videos and documentaries. Develop and host on-line games. Sponsor national-level challenges, “finals” of competitions.

State-wide

Support state initiatives (state STEM legislation, state-level competitions, etc).

Community-wide

Sponsor local science fair. Organize local competition, e.g. one that feeds state- or national-level challenge.

School-wide

Sponsor STEM-focused Career Day. Establish or support multi-grade design challenges. Donate STEM-related equipment. Assist with curriculum insertion.

Class/team

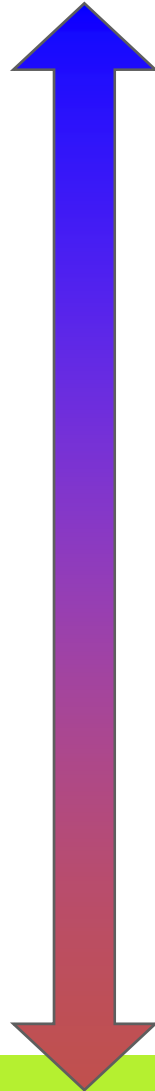
Support National Engineers Week. Send employees into classrooms (e.g. incentive volunteering). Sponsor class projects. Invite students to tour industrial facility.

Individual teacher

Support professional development programs (Space Camp, PLTW training). Bring teachers into industry for sabbaticals. Award teacher prizes.

Individual student

Award scholarships, fellowships, internships. Award individual student achievement prizes.





# Technology in Hampton Roads



**Jefferson Lab**



**NORTHROP GRUMMAN**





# Local STEM activities



- For Inspiration and Recognition of Science and Technology (FIRST)
  - FIRST Robotics Competition for high-school students
  - FIRST Tech Challenge for high-school students
  - FIRST LEGO League for 9 to 14 year-olds
  - Junior FIRST LEGO League for 6 to 9 year-olds
  - FIRST Place for ages 6 to adult
- Project Lead the Way (PLTW)
- NDIA – STEM Division
- AIA – Launch into Aerospace
- Future Cities
- Be the Game
- Tidewater Science Fair
- Individual Corporate Efforts
- ...and more...



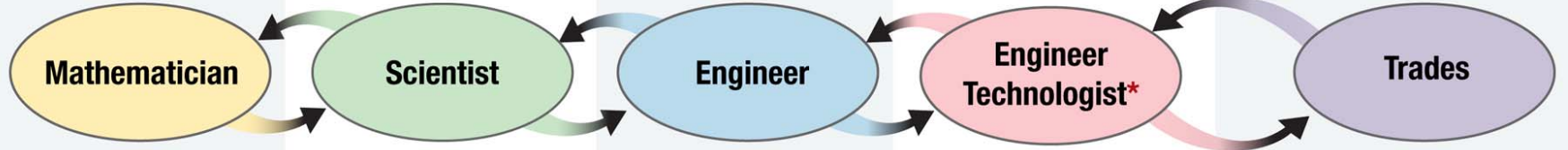
# A Call for Action



- ...but there are many more activities (100+)
- This is our challenge – Industry must lead the way
- Two tangible ways
  - Participation – Corporate and individual to help lead and coordinate
  - Resources – Sponsors



Theoretical Physics  $\longleftrightarrow$  Experimental Physics



*Discover languages to quantitatively describe existing world*

*Discover & describe existing world*

*Design & build new systems*

*Fabricate & operate new systems*

*Build or repair existing systems/components*

Algebraist  
Geometer  
Topologist  
Statistician

Physicist  
Chemist  
Biologist  
Research MD  
Astronomer  
Geologist

Aerospace  
Automotive  
Chemical  
Electronics  
Computer  
Civil  
Model & Simulation  
Research Surgeon

Wind Tunnel  
Aircraft Maintenance  
Airframe/Powerplant  
Particle Detectors  
Integrated Circuits

- Traditional
  - Welding
  - HVAC
  - Electricity
  - Plumbing
  - Electronics
  - Manufacturing (Surgeon 19<sup>th</sup> C.)
- 21st Century
  - A+ Comp Repair
  - Comp Network Admin
  - CISCO Network
  - ORACLE Internet
  - CAD
  - Model & Simulation

4-yr College (+)

4-yr College (+)

4-yr College (+)

2-yr college/OJT

HS with National Certifications

Traditional Academic

Current K-12 "Gap"

CTE