

Software Dependability and More at CSTB

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The National Academies

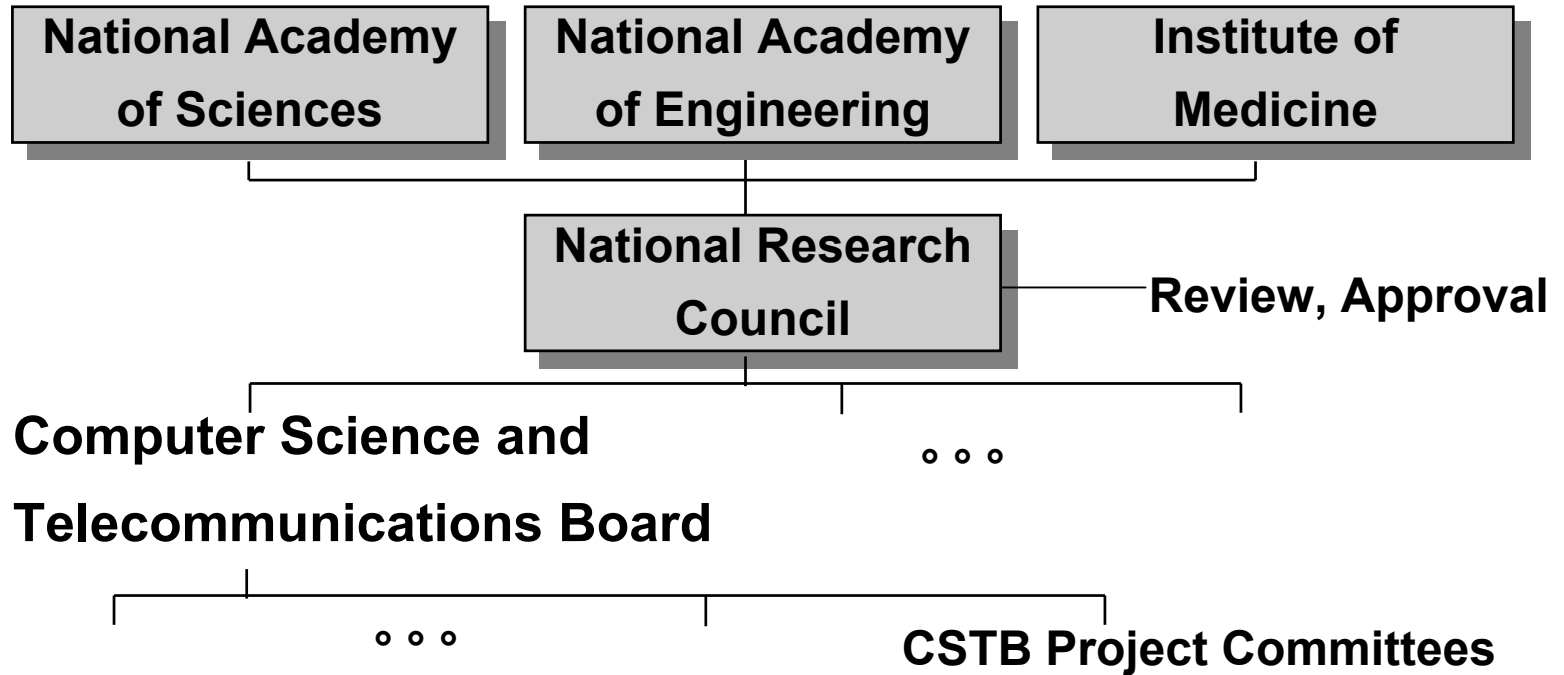
Today's Topics

- **CSTB – Who, What, How**
- Certifiably Dependable Software Project
 - Workshop Report
 - Committee Consensus Report
- Recently Completed Activities
 - Reflections on Computer Science
 - RFID Technologies
 - Future of Supercomputing
- Ongoing Projects
 - Spectrum Policy
 - E-Voting
 - Biometrics
- Potential Future Projects
 - 21st-Century Computing

Introducing CSTB

- Unbiased advisers to the government and the nation on critical issues concerning IT and its place in society
- Pioneered Internet tech/policy analysis
- Excel at objective treatment of complex, controversial topics that mix technical and non-technical aspects
- Diverse portfolio of 80+ reports since 1987
 - 15+ trustworthiness (security, privacy)
 - 20+ on economic and social impacts of IT
 - 20+ on applications of IT (e.g., health, government)
 - 20+ on (tele-)communications and Internet
 - 10+ on law
 - 20+ R&D and tech trends

The National Academies



How We Operate

- Balanced group(s) of national experts
 - The Board plus its committees for projects
 - Cross-sector, cross-discipline
 - Professional staff complement
- Engage the best minds
 - Senior/authoritative—not shrinking violets
 - Cross-section of communities or views
 - Consensus development
- Study projects or special meetings
 - ~2 years vs. < 1 year, amount of deliberation
 - Neutral meeting ground

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Certiably Dependable Software Systems

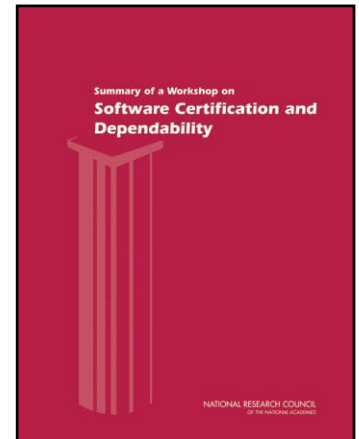
- Genesis in discussions with HCSS at NCO
- Committee empanelled late 2003
- Workshop spring 2004
- Reviewed workshop report fall 2004
- Several standard committee meetings
- Now in drafting phase for final report
- Sponsors: NSF, NSA, ONR, FAA; other agencies providing input
- **Charge: Assess current practices for developing and evaluating mission-critical software, with an emphasis on dependability objectives**

Dependable Committee

- **Daniel Jackson**, MIT, chair
- **Joshua Bloch**, Google
- **Michael DeWalt**, Certification Systems
- **Reed Gardner**, University of Utah
- **Peter Lee**, CMU
- **Steven Lipner**, Microsoft
- **Charles Perrow**, Yale University
- **Jon Pincus**, Microsoft Research
- **John Rushby**, SRI
- **Lui Sha**, UIUC
- **Martyn Thomas**, Eng. And Phys. Sciences Research Council
- **Scott Wallsten**, AEI/Brookings
- **David Woods**, Ohio State University

Workshop Panels

- Strengths and Limitations of Process
- Looking Forward: New Challenges, New Opportunities
- Certification and Regulation: Experience to Date
- Organizational Context, Incentives, Safety Culture, and Management
- Cost-Effectiveness of Software Engineering Techniques
- Case Study: Electronic Voting



Highlights from Workshop Panels

(note: not findings of committee)

Strengths, Limits of Process

- Process not sufficient, but important
- Appropriate metrics needed; secondary artifacts may need to be used as surrogates
- Proper allocation of resources can improve dependability and cost-effectiveness

Highlights from Workshop Panels

(note: not findings of committee)

New Opportunities

- Desktop systems becoming increasingly important task-critical for users
- Programming language tools (type checkers, static analyzers, model checkers, etc.) can help
- Systems integration very challenging; new tools and strategies needed

Highlights from Workshop Panels

(note: not findings of committee)

Certification Experience

- Certification may provide collateral benefits
- Lifecycle changes in systems may cause certification value to decay over time
- Market forces can create incentives to release flawed software
- Validation is harder than verification

Highlights from Workshop Panels

(note: not findings of committee)

Organizational Context

- Certification may not apply to future contexts of a system
- When a system demonstrates sustained reliability, dependence may increase to more than was originally anticipated
- Accountability, reporting, and communication are important and need to be planned and managed carefully

Highlights from Workshop Panels

(note: not findings of committee)

Cost-Effectiveness of SE Techniques

- Seemingly opposed approaches (XP, CbC) do share some substantive overlaps
- Defining terms (e.g., “dependability”) is important
- Process, people, tools—all matter

Highlights from Workshop Panels

(note: not findings of committee)

Case Study (E-Voting)

- Structural flaws in voting infrastructure go beyond absence of voter-verifiable paper trails
- Lack of risk analysis, lack of openness pose challenges
- Current process does not seem to have resulted in secure or dependable voting systems

Forthcoming Final Report (Teaser)

- Committee currently drafting final report
- Issues likely to be addressed
 - Certification – Roles, Effects
 - Dependability -- Ranges, Expectations
 - Actions – Recommendations, Exhortations
- Final report – Aiming for late 2005
 - Jackson briefing at next year's workshop?

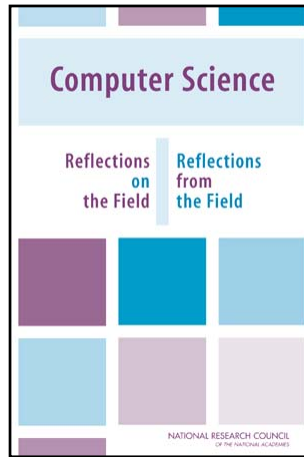
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Recently Completed

Reflections on Computer Science

- Essential Character of CS
 - Symbols and Manipulation
 - Abstractions
 - Algorithms
 - Artificial Constructs (apart from physical laws)
 - Exponential Growth
 - Computational Boundaries
 - A focus on association with human intelligence



Collection of Signed Essays

- Turing Machines
- Augmenting human performance
- Theory of algorithms
- Programming languages
- Relational data
- The Internet
- Simulation
- Non-expert use of systems

Recently Completed *RFID Technologies (Workshop)*

- Small follow-on to *Embedded, Everywhere*
- RFID – range of techs, capabilities; understanding specifics key to determining appropriateness
- RFID still in infancy; much experimental research needed
- Cultural and social questions include privacy, data collection

Recently Completed

The Future of Supercomputing

- Overall Recommendation
 - To meet the current and future needs of the United States, the **government agencies that depend on supercomputing**, together with the U.S. Congress, need to take primary responsibility for **accelerating advances in supercomputing** and **ensuring that there are multiple strong domestic suppliers** of both hardware and software.

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Ongoing Projects

Wireless Technology Prospects and Policy Options

- Workshop report released mid-2004:
*Summary of a Forum on Spectrum
Management Policy Reform*
- Committee (David Liddle, Chair) exploring
comprehensive assessment
 - Wireless technology
 - Application trends
 - Implications for spectrum management and
policy

Ongoing Projects Framework for Understanding E-Voting

- Co-chairs: Governors Thornburgh, Celeste
- Summer 2004 Workshop, ongoing meetings (next in late April)
- Aim is to develop framework
 - Tech, social, operational issues
 - Inform policymakers, election officials, public
 - What questions should be asked about voting systems?

Ongoing Projects

Whither Biometrics?

- Chair: Joe Pato
- First meeting: October, 2004
- **Public Workshop March 15-16, 2005**
(Constitution Ave. Building)
- Builds on previous authentication, identification system work
- Broad assessment
 - Current capabilities
 - Future possibilities
 - Role of government
- Workshop report in 2005; final report expected in 2006

Biometrics Workshop Panels

- Scientific and Technical Challenges for Biometric Technologies & Systems, Including System Integration, Architecture, and Contexts of Use
- Measurement, Statistics, Testing, and Evaluation
- Legislative, Policy, Human, and Cultural Factors
- Scenarios and Applications
- Information Sharing and Cooperation: Technical and Policy Aspects

Other Ongoing Projects

- Digital Archiving at NARA
- Cybersecurity Research
- Information Fusion and Data Mining
- IT for Disaster Management (FEMA)
- Privacy in the Information Age
- E-government/E-services Strategy at SSA
- Telecommunications R&D
-and more

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Potential Future Project

21st-Century Computing

- Early-stage preliminary concept paper
 - Builds on *Embedded, Reflections on CS*, Dependable project...
 - “Popular” Moore’s Law persistence
 - Processors outpacing memory; bandwidth limitations
 - Arithmetic - cheap
 - Bandwidth - comparatively expensive
 - Parallelism’s resurgence?
 - New programming models?
 - Boundaries between hw, sw too conceptually constraining?
 - What applications will need/exploit new ways of thinking?
 - Research implications

For More Information...

- <http://cstb.org>
- *CSTB Update* – Newsletter
 - Available on website and by email
 - To subscribe, email news@cstb.org
- Contact Lyn – lmillett@nas.edu