Software Design and Productivity (SDP)

NITRD Agencies: NSF, OSD and DoD Service research organizations, NIH, NASA, NIST, NOAA

SDP R&D will lead to fundamental advances in concepts, methods, techniques, and tools for software design, development, and maintenance that can address the widening gap between the needs of Federal agencies and society for usable, dependable software-based systems and the ability to produce them in a timely, predictable, and cost-effective manner. The SDP R&D agenda spans both the engineering components of software creation (e.g., development environments, component technologies, languages, tools, system software) and the business side of software management (e.g., project management, schedule estimation and prediction, testing, document management systems) across diverse domains that include sensor networks, embedded systems, autonomous software, and highly complex, interconnected systems of systems.

President's 2008 Request

Strategic Priorities Underlying This Request

Software design for the 21st century: Generate creative, scientific advances in the design of software artifacts and software-intensive systems through innovative, interdisciplinary research to provide scientific foundations for managing issues of complexity, quality, cost, and human intellectual control of software systems design and development; new approaches that impact design research and education. Priorities include:

- **Adaptation of ideas from other design fields:** Integration of design and systems engineering research streams across software engineering, computer science, engineering, and other scientific fields
- **Testing and validation methods and services:** Application of design science in the understanding, development, and evaluation of software-intensive systems
- **Interoperability:** Use of formal methods; integrated design and operation through software interoperability

Highlights of Request

Design for software-intensive systems: Increased emphasis on interdisciplinary, team projects to adapt and apply design science to the understanding, development, and evaluation of software-intensive systems – NSF

Computing processes and artifacts: Increased emphasis on cyberinfrastructure and computational science to address software engineering challenges for the "e-science" community engaged in software-intensive system development; foundations of computing processes and artifacts **(**software design and engineering methodologies; tools for software testing, analysis, software understanding, maintenance and evolution, and verification; semantics, design, and implementation of programming languages; software engineering and languages) – NSF, NASA

System information integration and informatics: Increased emphasis on the use of digital forms of information and knowledge in the state of software-intensive systems (issues of information design and integration; digital content of software system state; processes, technologies, and human involvement in creation and use of information and knowledge in software systems) – NSF

Standards validation and testing: Methods and tools for standards development and implementation, with focus on shortening the development, validation, implementation, and testing cycle) – NIST

Biomedical modeling tools: Software for advanced multiscale modeling of biological, biomedical, and behavioral systems – NSF, NIH

Planning and Coordination Supporting Request

Workshop on Interoperable Software (WINS): Explore the role of interoperability in new network-enabled applications. Today's software systems can interact over the Internet, cellular networks, and enterprise networks; such software systems are most easily designed, produced, and maintained when they can use services provided by other networked software systems – NIST, with DOE, NASA, NIH, NSF

Additional 2007 and 2008 Activities by Agency

NSF: University-based research in scalable software architectures; managing complex combinations of requirements, such as meeting real-time constraints and coordinating control in embedded, failure-prone

environments; software system interoperability, robustness, and reliability; productivity of software development; flexibility and agility in software development processes; open-source software development; end-user software development

OSD: Finish defining concept of operations and architecture for a software and system development research support facility that will provide standardized research problems to assess promising technologies, and begin implementation; university and industry research in software technologies for interoperable systems of systems; complete NA study on Advancing *Software-Intensive Systems Producibility*

NIH: Support development of innovative software and tools for modeling, simulation, bioinformatics, and imaging across the range of NIH biomedical research fields

NASA: Modeling frameworks for earth and space science; application modeling and development frameworks; software and data interoperability for Earth System Modeling Framework (with other NITRD and non-NITRD agencies)

NIST: Scientific data integration methods; software security; automated generation of test suites for integration standards; Digital Library of Mathematical Functions (with NSF); supply chain software interoperability; international testbeds for business-to-business solutions; sharable data structures for neutron research; ontological approaches to automate process of integrating supply chain systems; units mark up language; interface standards for interoperability of manufacturing control systems; product representation scheme for interoperability among computer-aided engineering systems; standards for exchange of instrument data and chemical reference data; ontological methods for representation and exchange of mathematical data