Software Design and Productivity Coordinating Group Report on Planning Workshop Held April 18-19, 2001

Frank Anger, NSF

Janos Sztipanovits, DARPA

SDP Workshop

- **Goals**
  - Bring together leading-edge researchers and practitioners
  - Encourage brainstorming and out-of-box thinking
  - Inform the research agenda
  - Raise the visibility of SDP
  - Involve Federal agencies and research community
- **Participants from**
  - 14 universities and non-profits
  - 8 commercial enterprises
  - 11 Government agencies

Panel Organization

- **Future of Software and Software Research**

  Software's rapid penetration throughout the economy challenges fundamentals underlying software research and how research is conducted.

- **New Software Development Paradigms**

  Software is increasingly the universal integrator for large-scale and possibly network-centric distributed "systems of systems." Paradigms are needed for systems that are very complex and larger than previously built systems.

- **Software for the Real World**

  There are vast numbers of embedded systems with behavior constrained by the physical world. We need principled methods for composition and integration of such constraints with conventional functional requirements and components.

- **Software for Network-Centric Distributed Systems**

  Challenges include latency hiding, partial failure, causal ordering, dynamic service partitioning, and distributed deadlock avoidance. Techniques for end-to-end quality of service frameworks, multi-level distributed resource management, and adaptive and reflexive middleware are also needed.

Expanding Challenges for Software Design

- From Unattended to Human-Centric
- From Legacy to Net-Centric
- From Desktop to Embedded and Mobile-Global
- From Stand-Alone to Complex Systems of Systems
- Long-Lived and Pervasive
- Multi-Intent and Multi-Faceted
- Accidental complexity:
  Incompatible models, languages, platforms, methods, standards

Expanding Challenges for Software Productivity

- Larger and more diverse systems
- Pervasive demand
- Increased criticality
- Global teams and interoperability
- Workforce

Representative Goal Space

- Formal, repeatable ***Software Engineering*** discipline
- Software that provides consistent experience
- Software that self configures and self repairs
- Systems of large numbers of low-cost, redundant throwaways
- Load-adaptive behavior
- New types of systems and system support

Sample Solution Space Needs

- Trade-offs among managed properties
- Move away from one-size-fits-all
- Multi-level middleware:
  Quality of Service (QoS) at all levels
- Support for multiple points of view
- Redefine the “what” of programming
  and the “who” of programmer
- New ways to conceptualize and realize systems

Sample Solution Space Needs

- **New high-productivity construction paradigms — examples:**
  - Aspect oriented
  - Intentional approaches
  - Compositional methods
  - Multi-view abstractions and environments
  - Rich modalities for capturing programmer intentions
  - Change the meaning of “program” and “programmer”
- **New workforce solutions**
  - Education and training
  - Empowering end users: Domain Specific Languages (DSLs)
  - Open software development

Next Steps

- **Create an SDP Research Agenda**

  Based on Workshop results:
  - **Assess critical levels of research available in the community**
  - **Formulate next best investments toward goals**
  - **Produce SDP Research Needs document**
- **Second workshop — being planned**

Backup information: SDP Workshop Participants

Panel 1: Future of Software and Software Research

Bill Mark (lead)	***SRI International***
Barry Boehm	**USC**
Doris Carver	**Louisiana State University**
Bonnie John	**Carnegie Mellon University**
Benjamin Pierce	**University of Pennsylvania**
Shankar Sastry	**University of California, Berkeley**
Kevin Sullivan	**University of Virginia**

Panel 2: New Software Development Paradigms

Charles Simonyi (lead)	***Microsoft***
Grady Booch	**Rational Software**
Ralph Johnson	**University of Illinois**
Gregor Kiczales	**University of British Columbia**
John Vlissides	**IBM T.J. Watson Research**

SDP Workshop Participants

Panel 3: Software for the Real World

Don Winter (lead)	***Boeing Phantom Works***
Martin Feather	**NASA/Jet Propulsion Laboratory**
Gabor Karsai	**Vanderbilt University/ISIS**
Patrick Lardieri	**Lockheed Martin Advanced Technology**
Edward Lee	**UC Berkeley**
Cleve Moler	**MathWorks, Inc.**

Panel 4: Software for Network-Centric Distributed Systems

Rick Schantz (lead)	***BBN Technologies***
Ian Foster	**Argonne National Laboratory**
Doug Lea	**State University of New York at Oswego**
Adam Porter	**University of Maryland**
Jim Waldo	**Sun Microsystems, Inc.**

Federal government participants:

DARPA DOE EPA FAA NASA NCO NIST NSF ODUSD(S&T) ONR OSTP

More Productive or More Confident?