





DRAFT



DRAFT

DRAFT

DRAFT

evaluation, (b) prototype tool hardening, and (c) new tool development. This evaluation board would be composed of researchers, vendors, users, and center staff.

The group noted that the mission of the proposed center naturally complements both the Parallel Tools (PTOOLS) consortium and the National HPCC Software Exchange (NHSE). The PTOOLS group works to

DRAFT

## Summary

The need for "better" software performance analysis and debugging tools (where better means easier to use, more efficient, better integrated, and more informative) for high-performance parallel systems is a well documented and widely recognized need. The Strategic Implementation Plan [1] of the Committee on Information and Communications of the National Science and Technology Council has noted that "Raising the productivity of the software industry through simplifying toolkits can yield significant dividends in the international marketplace and enable more rapid introduction of hardware advances into affordable production systems." Raising the productivity of applications developers through appropriate, easy-to-use software performance and debugging tools creates a larger market for these affordable production systems. Providing a place where these tools can be effectively tested, evaluated and improved can ensure success in the entire high-performance parallel computing industry.

## References

1. Committee on Information and Communications, National Science and Technology Council, "Strategic Implementation Plan: American in the Age of Information," March 1995
2. Koelbel, C., Loveman, D., Schreiber, R., Steele, G, and Zosel, M.,

DRAFT

## Appendix A Workshop Agenda

Tuesday, October 15, 1996

4:00 p.m. Registration  
6:30 p.m. Reception

Wednesday, October 16, 1996

7:30 a.m. Registration  
8:45 a.m. Keynote, Ken Kennedy, Rice University "Technology Transfer Paths for HPCC Software Tools"  
9:45 a.m. Dan Reed, University of Illinois, "Software Tools: Sin and Redemption"  
10:30 a.m. Break  
11:00 a.m. Dennis Gannon, Indiana University, "Does Our Model of Parallel Program Performance and Programming Tool Design Scale to Metacomputing?"  
11:45 a.m. Christopher Kerr, IBM, "Use of Software Tools for Application Development"  
12:30 p.m. Lunch  
2:00 p.m. Working Group Sessions  
3:30 p.m. Break  
4:00 p.m. Working Group Sessions  
6:00 p.m. Conclusions of Working Group Sessions  
7:00 p.m. Dinner  
8:30 p.m. Dessert/Poster Session

Thursday, October 17, 1996

8:30 a.m. Ian Foster, Argonne National Laboratory, "Tools for Network-Based Supercomputing: Lessons from the I-WAY Experiment"  
9:15 a.m. Andrew Grimshaw, University of Virginia, "Supporting Diversity and Performance in Wide-Area Metasystems"  
10:00 a.m. Break  
10:30 a.m. Working Group Sessions  
12:30 p.m. Lunch  
2:00 p.m. Evgenia Smirni, University of Illinois, "Parallel I/O: Problems and Solutions"  
2:45 p.m. Barton P. Miller, University of Wisconsin, "An Overview of the State of Parallel Debugging"  
3:30 p.m. Break  
4:30 p.m. Working Group Sessions  
6:30 p.m. Conclusions of Working Group Sessions  
7:00 p.m. Clambake

Friday, October 18, 1996

8:30 a.m. Working Group Sessions  
10:00 a.m. Break  
10:30 a.m. Working Group Reports  
12:30 p.m. End of Workshop





## DRAFT

- How can data mapping and motion issues be correlated effectively with observed (or measured) program performance?

While definitive answers are not offered for most of these, they helped direct the group's discussion. Additionally, the group referenced issues identified by Dan Reed in his talk, "Software Tools: Sin and Redemption," including: emerging opportunities/problems, multiple programming model support, hardware/software support, source code mapping, adaptivity, supporting multiple languages, and the Center for Testing and Evaluation (HPSST Task Force).

Finally, the group refined some of the aforementioned issues and brought forth a few additional ones of interest, as follows:

- In the context of opportunities/problems in metacomputing environments, time-shared, interactive environments, and adaptive, dynamic environments, what are new roles for performance tools? For example, will Quality of Service replace FLOPS as a baseline metric?

DRAFT

DRAFT

optimization, will continue to be used; however, new tuning techniques are essential. The objective of tuning

DRAFT

robust tools for multiple platforms; greater availability of tools; availability of canonical benchmarks for tool testing and evaluation; and education. Several alternative strategies instead of setting up a center were cited:

-



DRAFT

-

## DRAFT

- Coherent, stable team of primary partners
  - \* Technical staff with corporate memory
  - \* Team available to initiate new ventures without startup delay
- Executive Management
  - \* Reallocation of funds to respond to unanticipated opportunities
  - \* Continuing assessment of progress and directions by key participants
- Coordination among partners to ensure interoperability
- More responsive to smaller tools
- \* Experts available to quickly assess ideas

Advantages of the CNRI Model include:

- Open structure
  - \* Evolving set of participants
  - \* Easier to terminate projects and initiate new projects
- Mini-consortia can be formed to ensure involving all segments of HPC community interested in a specific tool
- Flexibility
  - \* Choice of projects and their arrangements
  - \* Subcontracts including intellectual property
- Close interactions with agency program managers
  - \* Selection of projects consistent with agency programs

These distinctions are, of course, not totally exclusive; moreover, both models would support

- organizing workshops and forums to determine user requirements, interfaces among tools, and system interfaces, and
- providing basic technical services, e.g., generate test suites.

In both models, each project team should include

- Application developers (academia, Centers, laboratories),
- Tool developers (academia, laboratories, ISVs, vendors), and
- Software engineers (laboratories, ISVs, vendors);

moreover, the project team should include representatives of the developers of the prototype to be enhanced.

Question 4: Envision the management structure of this organization. How large a staff? What skills must





DRAFT

## Report of Working Group 3:

## DRAFT

platforms. In this context, "vendor" refers to a computer manufacturer or independent software vendor.<sup>5</sup> If a Center is proposed to help solve the software tool inadequacy, then seeking vendors' acceptance and use of the Center is critical. Not surprisingly, vendors have a diversity of positions and concerns regarding what a Center might contribute and what type of vendor involvement would be most beneficial and desired. This section highlights the Working Group's discussion of vendors' perspective on software tools for HPC, evaluation vs. hardening options for a Center charter, and the potential roles vendors could play. Conclusions arising from these discussions make it



DRAFT

researchers would further efforts to make the tools usable by the user community. In contrast, members of the user community might propose desirable tools that currently do not exist at all. Vendors could propose testing and evaluation of their prototype tools or tool "kernels." They could also propose to contribute non-proprietary tools

## DRAFT

associated with implementing software tool proposals. Researchers will be able to evaluate the difficulty associated with enhancing or developing a tool. Vendors will be able to identify tools that would be useful to their user base or applicable to upcoming architectures. Users will be able to identify tools that would be adopted by the user community. Center staff will be able assess the cost of processing (be it test, evaluation, enhancement, development, or other support). Board members should serve on a staggered, rotating basis. This approach would

## DRAFT

- ¥ Interoperability -- a tool should support sufficiently general application and user interfaces so as to integrate well and interoperate with a variety of commercially available development environments and hardware.

Center activities are meant to realize state-of-the-art hardened tools and make them available to the user community. To attain this goal in a timely manner, Center activities associated with any one tool must be limited to a reasonable number of person-hours. The plan for handling each tool must be clearly delineated and meet the following selection criteria.

- ¥ Well-defined Activities -- the activities associated with the processing of a tool (be it test and evaluation, enhancement or development) must be clearly defined and attainable. Thus, it is of utmost importance that the enhancement or development of a tool not require any research activities.
- ¥ User Involvement -- periodic test and evaluation during the development of a tool by the user community is imperative.
- ¥ Measurable Milestones -- attainable milestones, as well as related test and evaluation procedures, must be defined. (Such test and evaluation procedures may trigger the tool's exit from the Center's work flow, if milestones are not met.)

The Center makes a resource commitment to any tool that it accepts. This investment is made in expectation of returns on the investment accrued by later users of the tool. Hence, the type and level of resource requirement for the tool project within the Center should be considered as part of the selection criteria. Resource requirement for the

the Center makes a resource commitment to any tool that it accepts. This investment is made in expectation of

returns on the investment accrued by later users of the tool. Hence, the type and level of resource requirement for the

tool project within the Center should be considered as part of the selection criteria. Resource requirement for the



DRAFT

## Report of Working Group 4: Intellectual Property Issues

## DRAFT

extremely helpful to the whole concept of the Center if the HPCC agencies could come to agreement on the basic IP issues involved in jointly sponsored ventures (see Recommendations).

The group attempted to identify precedents, among recent efforts in the software development community, for how the Center's IP problems might be addressed. The National High-Performance Computing Software Exchange (NHSE) sidesteps basic ownership issues by not distributing software, but rather providing pointers to the original software owners; it essentially functions as a clearinghouse. It was the consensus of the group that this model did not make sense for the Center,

## DRAFT

In all, five likely models were identified. Each is described below, together with our conclusions about the ramifications for IP.

### "Consumers' Union" Model

As discussed by the group, this model would constitute an independent review board to test and evaluate software tools. Like the Consumers' Union, reviews would be made publicly available in order to help users determine a priori whether or not a software tool was likely to be of help to them.

Two precedents all, noted. First, NHSE had originally stated that objective reviews would form an important part



DRAFT

2. The procedures and policies established by the Center should make it possible to exploit multiple outlets for



DRAFT

In furnishing software to the Center, the author is ceding direct control over its future, with the expectation that it

## DRAFT

- When are the decisions made and by what process?
- At what point does something become a "new tool"? How long does original ownership last?
- To what extent is the T&E Center responsible for claims concerning a tool? Liable for errors in judgment or shortcomings in the T& procedures?

DRAFT

# Report of Working Group 5: Technical Infrastructure for a National Software Tools Center

Workshop on Software Tools for HPC Systems  
October 16-18, 1996

## Working Group Members

Rod Oldehoeft	DOE
Dan Reed	Illinois
Thomas Sterling (Chair)	Caltech
John Toole	NCO
Bob Voigt	NSF

## Introduction

This working group addressed the technical infrastructure issues associated with the formation of a national Software Tools Center. Several working assumptions underlie the observations and recommendations of this report:

-

## DRAFT

Activities at the proposed Center will be driven by several inputs:

- A major driver will be the early proof-of-concept codes from experimental projects in software tools research. These may come from any cooperating research organization including universities, national laboratories, other not-for-profit research institutes, and even computer vendors. However, no source may impose proprietary

## DRAFT

functionality and interface as well as a fully operational tool. Users of reference implementations of tools from the Center can expect them to be of high enough quality to be used on a production basis and can install them among their main software tools. Once a tool has reached the level of reference implementation, additional changes to functionality will be rare and will be reflected by controlled version numbers; this to retain uniformity of different vendor implementations and manage user expectations.

### 4. Conventions and Standards

DRAFT

## DRAFT

be stringent and depend on a high probability of success. A key component to that will be the participation of the vendor community in its evaluation and endorsement of the end product. One or more vendors A key corequired, a priori, to show strong A keingness to consider internal advanced development and product distribution if the project is to countertaken by the Center. This A keymean that the contribution to comade by releasing the reference implementation is clear and compekeing. Such evidence A keycome from use by parts of the community of earlier advanced prototypes of the research code previously developed and released by the Center. Additional issues of ownership and reference version controeymust also coresolved before project initiation.

Standards and Conventions are of a different nature than the other Center product types. These are frameworks or conceptual infrastructure that enabl0.0oftware tools communities and their products to work together and to provide a necessary level of stability to the end user community. Selection of efforts to establish such standards or conventions A key coderived from perceived need both A thin the Center and by the community. They A keyemerge,

DRAFT

### Center Resources

The focus of the work of the Center is the development, enhancement, and testing of innovative software tools for

DRAFT

management will be provided by the Center Director, who will be primarily responsible for coordinating with the Center Advisory/Steering Committee, establishing direction and procedures, and maintaining relations with

DRAFT

Lauren Smith

# Report of Working Group 6: Technical Issues -- Debugging

Mike Gittings

## Workshop on Software Tools for HPC Systems

Erica Dorenkamp

October 16-18, 1996

Juan Meza

### Working Group Members

~~CONFIDENTIAL~~ (LANL)Tj 5.5000 Td (J)Tj 10 0 0 10 147.86002 535.99985 Tm (o)Tj 10 0 0 10 152.84018

Jeffrey Brown

LANL

Karla Callahan

Intel

Suresh Damodaran-Kamal

Hewlett-Packard  
Thinking Machines

LANL.0050 Tc ( )Tj 10 0 0 10 144 591 Tm -0.0090 Tc (LANL)Tj 7.7000 Td

SNL

NSA

Rich Title

Hewlett-Packard

DRAFT

DRAFT