COMPUTING RESEARCH NEWS

The News Journal of the Computing Research Association

May 1992 *Vol. 4/No. 3*

News Analysis

HPCC battle focusing on money, NREN

By Fred W. Weingarten
CRA Staff

Last year was a watershed for the computing research community. The administration announced a special budget initiative on High-Performance Computing and Communications (HPCC), and the president signed the High-Performance Computing and Communications Act of 1992, which Sen. Al Gore (D-TN) had pushed for years. In an era when setting priorities has become a catch phrase in science and technology policy, these two events clearly are a statement by politicians that information systems are high on any such priority list.

The computing research community, however, has not had much time to enjoy the warm glow of that endorsement. All that last year's victory bought was admission to this year's fight. And this battle is shaping up to be far more complex and contentious. This latest battle has developed on at least two fronts—appropriations and National Research and Education Network (NREN) policy.

Money wars

A battle over appropriations was expected. Budget requests and authorization legislation simply were a hunting license—permission to seek appropriations of money. The fight will be a hard one. Appropriations face three particular pressures this year:

• Politicians think the electorate is in a particularly grumpy and impatient mood this election year. The resulting panic creates pressures toward tax cuts and other short-term remedies and away from longer term investment.

• Both the administration and Congress have an eye on shifting R&D spending from defense to civilian agencies, as reflected in the fiscal 1993 budget request. But this measure is running into the firewall erected between defense and civilian budgets in the 1990 budget agreement. If defense R&D budgets decrease, those savings simply are used to protect other defense expenditures. If civilian sector R&D spending increases, those increases mean other popular domestic programs were cut.

• As the costs for such projects as the supercollider and the space station escalate, it is becoming harder to maintain the fiction that science and technology spending is not, in some way, "zero sum." Last year, National Science Foundation (NSF) appropriations became directly mixed up with

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NSF report highlights evolving research needs

By W. Richards Adrion

A National Science Foundation (NSF) report has made several recommendations to improve the infrastructure and funding for computing research.

The report describes discussions and recommendations from a one-day workshop on the infrastructure and human resource needs for computing research. The workshop was sponsored by NSF, chaired by Andries van Dam of Brown University and organized by the Computing Research Association.

The report from the workshop includes several recommendations:

• maintaining the NSF Computer and Information Science and Engineering (CISE) Institutional Infrastructure programs at a funding level of $20 million;

• creating an $8 million a year program for matching infrastructure grants to support group projects in experimental research;

• increasing the size of the CISE instrumentation program for specialized equipment and facilities for shared and collaborative projects to $3 million a year and adjusting grant amounts to allow the purchase of sophisticated systems, such as massively parallel machines;

• encouraging the CISE Directorate to work closely with the NSF Education and Human Resources office to ensure continued funding for educational infrastructure and human resource programs;

• expanding the opportunities for postdoctoral research; and

• ensuring greater representation of disadvantaged minorities and women in computing and computing research.

Several earlier reports outlined the difficulties rapid growth and inadequate funds had caused for the computing research discipline (the Snowbird report [2] and the Feldman report [1]). The charge of the workshop was to:

• examine the current state and needs for infrastructure in the areas of research supported in NSF's CISE Directorate;

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Inside CRN

Canada to spend more than $1 billion on university-based research and training

By Douglas Powell

The Canadian government has announced funding of more than $1 billion (Canadian) for university-based research over the next four years, following a 4% increase to the university granting councils announced in February's budget. This is not bad in a country with an annual inflation rate running at 1.7% and where deficit reduction forms the basis of an industrial strategy.

The additional funds, which were announced in March, represent a 4% annual increase for each of the next four years, or an additional $321.5 million for university research and training over the period 1992–93 to 1995–96.

The money comes from a five-year, $1.5 billion allocation to all science-based institutions announced in last year's budget. When coupled with funds to maintain the councils' existing budgets, portions of which were set to expire, the total value of the commitment is $1.2 billion over four years.

The allotment of such a large portion of the $1.5 billion to the granting councils—the Natural Sciences and Engineering Research Council (NSERC), the Social Sciences and Humanities Research Council (SSHRC) and the Medical Research Council (MRC)—is a major Cabinet victory for Minister of Science William Winegard, a former university president who always has maintained that the councils were his top priority within the science portfolio.

> ***"The university granting councils should be dancing a jig."***
>
> *—Canadian science official*

"The importance of providing the councils with secure funding and a stable planning environment cannot be over-stated," Winegard said. "This new funding will give the councils the flexibility to plan their activities and enhance their support of university research and training."

According to a statement issued by NSERC, the new money "is a positive sign for the councils and for research." Others in Ottawa were less restrained. "The university granting councils should be dancing a jig," one government science official said.

NSERC announced that this year's 4% increase will be used to increase graduate student stipends, boost the number of industrial research fellows, create a new industry partnership program and expand the research grants program—the bread and butter of many Canadian researchers—primarily to fund new applicants.

Mireille Brochu, secretary general for the Natural Sciences and Engineering Research Council, Canada's primary

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Opinions and Letters

Is CS built on a foundation of sand?

BY William A. Wulf

I am especially fond of an analogy attributed to the late Bob Noyce. At Intel Corp.'s 1987 annual meeting, he pointed out that 30 years earlier a Cadillac limousine had cost $6,000. If cars had made the same progress as computers, he said, that limo now would cost $3.

Noyce did not say it, but that $3 limo would cruise at 2 million miles per hour and get 1 million miles per gallon. Not bad.

Friends say I should not use this analogy—it is too incredible. But I like it. It suggests why it is so hard to predict the future impact of information processing. We have thousands of years of experience with the impact of transportation. A scant two orders of magnitude separates the stone age from our jet age global economy. Yet, with all that experience, stop and try to imagine the impact if transportation were essentially instantaneous and free. I bet you cannot.

And you cannot imagine the future impact of information processing either. But I suspect, like me, you think it will be profound. After all, physical tools such as transportation devices merely amplify our physical prowess. Information processing amplifies our intellectual prowess, and that goes more to the heart of what makes us human.

My guess is that the direct visible impact will be dwarfed by the indirect affect on the infrastructure of science and technology. It is not just what we can do with computers, but what we can use them to learn and understand. That is the real leverage of information processing.

By the way, this "I do not know what it will be, but it will be profound" characterization is not something executives, research funders or policy-makers like to hear. It sounds too much like "trust me," "send money" and "I will make everything wonderful."

The unprecedented rate of progress puts tremendous pressure on our field's research community and process. That pressure is both good and bad. On the positive side, it injects a degree of realism into the research enterprise. On the negative side, it tends to leave incomplete foundations. The rush to explain and exploit the newest hot technology often is easier and more exciting, and quite possibly more fundable, than laying foundations.

By foundations, I do not mean theory exclusively. Foundations are the underlying support and the basis on which things stand, and they may be conceptual, organizational, methodological or theoretical.

To make my point without offending others, I will pick my examples of incomplete foundations from areas where I must plead mea culpa. I gave up on formal specifications and program verification. I gave up on providing cost-effective security. I gave up on the phase ordering problem in compilers. In each case the problem still is important. In each case the problem proved to be hard, and there was an easier problem at hand. In each case the lack of a solution so far has been masked by advancing technology. Reflect on your own specialty, and I think you will generate a similar list.

I am not into self-flagellation. Nor do I think that all research must pan out. If we do not fail once in a while, we probably are not reaching far enough. But I am concerned that the research community must exercise the discipline to invest in building foundations.

Researchers must invest their time, and funders must invest resources. Institutions must reward that investment. American business often is faulted for being shortsighted. It is, but before we throw stones we should stop and ponder how often we have turned away from the hard problems.

I do not think we are in a foundational crisis. Why does everything have to be a crisis before we do something about it? Nothing terrible is going to happen if we do not solve the foundations problem. We do not even need a federal foundations initiative.

I feel distinctly uncomfortable when discussing society's legitimate concerns for security and privacy, for example. Except for a relatively small community concerned with military security, researchers and funders have gone on to other problems. The systems we use every day are pitifully insecure, and even if we started today, most likely there is nothing we could do about it for a decade.

I do not even want to talk about the reliability of life-critical systems.

The hard question for both researchers and funders is whether plugging away at an old problem will pay off. Is program specification and verification a failed idea, or will the combination of plugging away and advancing technology make it practical—or even lead to a breakthrough? Is it worth solving the phase ordering problem to get another few percent optimization, or might that lead to deep insights into the nature of language translators?

Every field must make choices. When is a subject mature? Is a problem tractable with today's knowledge? When is it time to revisit a previously unsolved problem? How many resources should be applied to old problem A versus new problem B?

The danger in our field is that these questions might not get asked. Program directors in the funding agencies necessarily play a critical role in all this. They must listen carefully to their communities for a general sense of direction. And they must exercise the courage to fund both speculative and mature foundational work that may be out of favor. Good program directors do not just take a vote among reviewers. It is a tough job.

It also is a job we should plan on doing sometime in our research careers. It is expected as part of the dues for doing research in most fields. It is what helps to prevent stagnation and blind spots.

But program directors are human, and funding agencies are given more credit for tera-whatevers than for foundations. In most disciplines all this balances out because the foundations are needed in order to move on. That has not been the case in ours; an order of magnitude or two masks a lot of

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Letters to the Editor

Students should take compiler, OS classes

Dear Editor:
In his opinion piece on computer science education [March *CRN*, Page 2], David Patterson said, "I question why many computer science students are required to take courses in compilers and operating systems when the goal is…learning to write your own compiler or operating system."

How does he expect students to learn to write their own compiler or operating system without taking basic instruction in the above? His statement appears to be contradictory.

I also disagree with his statement that "one clear opportunity is a book that combines computer organization and design with assembly language programming." Anyone attempting to write a text like that will run into some very strong competition, from texts by Hayes, Hamacher and others.

I agree with the principle expressed in his statement, but I disagree with the idea that we need yet another text like that. The texts I mentioned and many others do combine computer organization with assembly language programming.

Daniel Tabak
Professor of ECE
George Mason University

Computer scientists need more clout

Dear Editor:
An article in the March 4 *Chronicle of Higher Education* [Page 1] said that biological scientists are increasing their clout in Washington, while the clout of physicists wanes. Computer science is mentioned in passing as another discipline that is increasing its influence in Washington.

But why don't computer scientists have even more clout? Why haven't computer scientists been appointed to major science policy positions? (Erich Bloch, the former director of the National Science Foundation, is an exception.)

Computer scientists should be influencing policy at least as much as the physicists or biologists. This appears to be a topic the Computing Research Association should give some thought to.

Anthony Ralston
Professor, department of computer science
University of Buffalo,
State University of New York

Opinions and Letters

Computers and democracy: friends or foes?

By Fred W. Weingarten
CRA Staff

Last summer I spent a week in Aspen as a participant in a group that explored how information technology contributes to democracy. The group was composed of experts from a variety of backgrounds: social scientists, lawyers, telephone company executives, government officials and even a venture capitalist. We did not descend from the mountains with any firm answers, but I did come away with several ideas of interest to the computing research community.

The group used a broad definition of information technology — telecommunications, mass media and computer systems. It is growing more difficult to tell one from another. Each technology is intruding on the other's turf, and systems and services now available integrate technologies from all three classes.

Technology is changing the way citizens learn about issues and influence government decisions. The group agreed citizen access to information and the ability to use it is necessary but does not ensure an effectively run democracy. Many factors shape society and determine citizens' ability to govern themselves wisely, but a well-informed public is crucial.

Several participants said the electronic media have had a profoundly negative impact on politics. In the United States, campaigns and elections largely have been reduced to tiresome, superficial and dirty affairs that are creating an apathetic electorate.

Many observers blame the electronic media for a near paralysis of decision-making in important, but controversial, areas. One issue raised was why communications technology seems to have helped pave the way for a great democratic revolution in eastern Europe and Latin America, while at the same time stifling democracy in the United States.

However, other experts believe technology provides powerful tools for pulling together common interest groups, raising funds and prompting political action. This phenomenon has been criticized as promoting special interest or single-issue politics, and, to be sure, it has done so. But in the process, technology also has empowered a variety of groups promoting causes ranging from anti-abortion legislation to environmental protection to greater funding for computing research.

Even this trend has some negative implications.

- It is easier to rouse opinion against an issue. The energy of political debate seems to center on opposing rather than promoting.
- Not all groups are effective at making themselves heard. Groups may be limited by their finances, access to technology or ability to use technology effectively.
- Some issues are too complex to be reduced to simple and loud negative battles between interest groups.
- Because it is hard to energize public interest concerns, groups with narrow, self-serving goals find a powerful tool for advancing their cause with little opposition.

Another view of information technology and democracy is that the technology contains much unrealized promise. This view is based on the belief that democracy is best served if its citizens are well informed about government policies and the politicians who make those policies. Of course, many politicians and those directing their campaigns want voters to be predictable and manipulatable. However, supporters of this view also suggest that information technology should be the principal tool for creating such an informed electorate.

It appears information technology does not give the public the kind of information it needs to be informed. A study showed that in the last presidential election, the average uninterrupted statement by a candidate on the evening news was 9.8 seconds. That hardly is conducive to stimulating informed public debate.

Just as students learn to critically evaluate and think about what they read, they must learn to evaluate electronic communications.

Information technology is potentially effective, but currently ineffectual. Although it could strengthen our democracy, technology is not being used with integrity. Changing this requires teaching people how to use information, providing them with analytical tools and ensuring that they have access to information they need.

Whenever we identify a new social problem, we turn first to education for a solution. But our educational system is busy trying to solve the problems it already has been given. Yet education is critical if we are to improve the democratic process.

Democracy is based on a literate, educated populace, and a principal job of education is to create literate people. Schools need to teach how to use information tools available for computers and communications technologies.

This does not discount the continued importance of reading and writing. They will remain vital elements of literacy. But literacy also encompasses skills to use electronic media and computers, to access electronic databases and to communicate electronically. Just as students learn to critically evaluate and think about what they read, they must learn to evaluate electronic communications.

Giving people new sources of information about critical issues will not do any good unless people can filter and analyze this information and improve their understanding of the issue. Many people and organizations are willing to provide that function, but we need to think twice before we delegate it.

In a democratic society, those filters need to be close to the individual, even though we will continue to turn to institutions, such as clubs, associations, churches and newspapers, for help.

We face that challenge now in building the National Research and Education Network. Hardware connections and facilities are not enough. We must understand how researchers will use these resources, then develop software and services to help them cope with an information environment much more complex than print alone. In the same way, new information sources for the public must be easy to use.

Policies also govern access to the information itself. Intellectual property law needs to be adapted to an electronic environment. Rules for accessing government information must be adapted to electronic media. In some sense, we have to reinvent the public library and other institutions serving as universal information sources.

The issues and the policy debates about information technology are complex. Even if we succeed in improving education, information and tools, there is no guarantee citizens will contribute more effectively to democracy. But if we do not even try, we will have no one to blame but ourselves.

CRA may sponsor technical workshop

The Computing Research Association may have some modest funding to sponsor a two-day technical workshop in conjunction with the annual meeting of the Association of Departments of Computer Science and Engineering at Minority Institutions (ADMI). The meeting is Aug. 15–18 in New Orleans, and the workshop is planned for Aug. 17–18.

On the first day, speakers will survey the state of the art in two selected areas of research and education in computer science and engineering. Two presentations on the content and techniques for teaching upper division elective courses in these topics are planned for the second day.

We expect to have funding for travel expenses and a modest stipend. Individuals interested in making presentations at this workshop should write to Fred W. Weingarten, Computing Research Association, 1625 Massachusetts Ave. NW, Suite 110, Washington, DC 20036-2212. Or send E-mail to weingarten@cs.umd.edu.

July board meeting at Snowbird

The CRA board of directors will held its next meeting during the Snowbird Conference '92. The board meeting tentatively will be from 1PM–5PM July 12 and from 6:30PM–9:30PM July 14. The final schedule, place and agenda will be posted at Snowbird.

Except for items and times specifically indicated as closed on the final agenda, and to the extent the capacity of the facilities allows, board meetings are open to observers. Observers will be charged the cost of the meal if they attend the Tuesday dinner meeting. Observers must contact the executive director, Fred W. Weingarten, at least 24 hours ahead of time if they wish to attend the board meeting.

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Policy

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Space Station Freedom funds. Because these "big science" projects are politically popular, they are formidable competition for "small science." The pressures are developing even within NSF.

In the Mathematics and Physical Sciences Directorate, more than 50% of its proposed $103 million (17%) increase is earmarked for support of major research facilities, while funding for pure mathematics remained flat. Science policy leaders in Congress are calling for priority-setting, although they are less than clear about how that is to take place. However, in the House appropriations hearing, some attention was paid to the $32 million request by NSF for ongoing construction of the gravitational wave observatory (LIGO) and its impact on individual project support in physics and math.

Victims of rhetoric

More surprising than the appropriations battle is the controversy developing over NREN. NSF is finding itself a victim of its own success, in a sense, and NREN advocates are becoming victims of their own rhetoric.

The term NREN, to the extent it can be defined, encompasses far more than anything NSF, or any government agency, has responsibility for. NREN refers to a future vision of an interconnected web of data communication networks and information services that will serve the as-yet undetermined needs of an as-yet undetermined community of education and research users through an as-yet undetermined administrative and support structure.

That is not to say that individuals do not have their own clear answers to each of these unknowns. Those individual answers simply do not fit together to form a consensus. Neither the HPCC Act nor the administration's HPCC plan has resolved any of these uncertainties, although the act did direct the administration to produce by next year a more detailed plan with some answers to specific questions.

Because of this lack of strategic guidance, NSF has had to do quite a bit of ad-hoc policy-making, and now it is paying the price. Agency officials, busy with the day-to-day problems of upgrading and maintaining network services, have been accused of not paying enough attention to long-term planning.

Rep. Rick Boucher (D–VA), chair of the House Science, Space and Technology Subcommittee on Science, wants more emphasis on the long term. A March 16 hearing originally was scheduled in response to claims by a communications company that NSF engaged in favoritism and unfair dealing in its operating policies and in its procurement plans for upgrading NREN. At the hearing, Boucher made it clear his main interest was not in a detailed rehashing of grievances, but in holding a series of hearings that would take a thoughtful and long-term look at NSF's policies and strategic plans for the network.

Because of a lack of strategic guidance, NSF has had to do quite a bit of ad-hoc policy-making, and now the agency is paying the price.

NSF faces several NREN problems.

Management: NSFnet, which serves as the core of the so-called interim NREN, is a high-capacity backbone network that connects major nodes around the United States. The nodes primarily are regional and state networks and supercomputer centers. NSFnet usage is growing at a rate of 11% a month. The agency, in response to this escalating demand, has been pressured to bring higher speeds on line at a faster rate than planned. But users have little tolerance for delays or glitches that might occur in a transition to a higher speed.

The initial service contract is about to end. NSF faces the enormous administrative challenge of rebidding for backbone services in a commercial market that is much more aware now of the large future potential markets of this technology for global communication.

In developing NREN as a fully interconnected, shared resource, NSF is trying to coordinate a multiagency effort in which neither it nor any other agency has real lead authority to make anything happen or to force cooperation. Many other agencies, such as the Energy Department and NASA, have networks to serve science and engineering. Those networks are thought to be a

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Policy

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part of the NREN concept. However, they also serve specific agency missions. Some agencies, rightly or wrongly, seem hesitant about throwing their lot fully in with the NREN concept.

NSF also must wrestle with the problem that NREN is the first infrastructure designed to serve all of science. Federal science budgets still are directed principally by field and problem. Even capital investments in instruments and facilities generally are intended to serve a specific field or solve a particular problem. As is the tradition in the politics of infrastructure, everybody wants to use it, but no one wants to be taxed to pay for it. NSF will have a long-term struggle, especially after the bloom is off the HPCC rose, to keep funding levels adequate to meet demand. The agency may need to explore other ways to pay for the network.

Constituency: As use of the network has grown, so have the demands. In the beginning, the backbone was supposed to serve national supercomputer center users. Not long after, the backbone was to serve NSF and the entire federally funded scientific research community. That group soon was joined by industrial researchers, educators, librarians and commercial providers of information services. All of these users saw NREN as a critical tool for their work or as a critical mode for offering their services.

Not all of the constituencies are technically sophisticated, nor can they all be equally precise in describing their need for network services. But they all share the view that an electronic information infrastructure intended to serve the research and education community must somehow include them. Furthermore, at key points in the debate in Congress and the administration, these users played key roles in supporting the whole HPCC concept.

NSF's problem will be to serve these varied constituencies as well as possible, without trying to be all things to all people and watering down its vital contribution to leading-edge basic research. NSF also needs to define and order the boundaries of service in a clear and enforceable way, lest the potential user community become so broad and diffuse that NSF becomes vulnerable to the accusation, already made, that it is essentially running, or subsidizing, a common carrier communications service in open competition with the private sector.

Leading the way

In the last few years, in the separate arena of information policy, some technologists and industry leaders have been promoting the concept of a national universal broadband communication system. Views differ on the details of this system, such as how fast and how universal the system would be, what it would carry and who would provide the service. Despite these differences, there is a widespread belief that society will need such an infrastructure in a few years.

That belief was tapped in arguments for the HPCC, and much of the broad political support for the bill and initiative stems from the promise that NREN will, in some way, help accomplish that vision.

NSF has been surprised to learn that in less than a decade, its networking mission has shifted, at least in the eyes of some, from providing chemists and astronomers access to Cray 2 supercomputers all the way to helping build the nation's communication infrastructure. The phone and cable companies have been equally surprised, because they always thought that was their task.

NREN may help that vision along in tangible ways. It can serve as a testbed and prototype for hardware and software. As the constituency expands, more can be learned about the types of user services needed. NREN will be an arena in which debates on information policy—in areas such as privacy, intellectual property and access to government data—will be played out. Depending on the pricing structure, economists could learn more about costs, demand and the elasticities of the information market.

The challenge for NSF will be to see that at least some of these benefits are realized without having NREN become too embroiled in telecommunication policy, or become perceived as directly competing with the private sector—a perception that, in the current political climate, could be fatal.

CRA's job

CRA will continue to participate in the NREN debate. We are users of the network, both for research and education, and we have a direct stake in how these issues are resolved. We also have technical expertise within our community. After all, a high-speed data communications network is, from one perspective, highly distributed computational device. We have been there from the start, from the creation of DARPAnet to NSFnet. Some in our community, such as Mike Dertouzos, have been in the vanguard of calling publicly for building the new information infrastructure.

Through workshops, meetings and debates in *CRN,* we need to influence these policies as they evolve. All of the interested government agencies and Congress need and want advice, and we need to make our voices heard.

Canadian news roundup

By Douglas Powell

Just prior to the 1992–93 budget announcement, Minister of Science William Winegard unveiled a five-year, $27 million (Canadian) microelectronics sector campaign. The Industry, Science and Technology Canada (ISTC) ministry will provide up to $12 million, and an additional $15 million could be levered from industry.

"Canada has the ability to boost its competitiveness in a number of areas of microelectronics if we continue to build upon our innovative strengths," Winegard said.

The campaign calls for the creation of the Strategic Microelectronics Consortium (SMC), a non-profit, industry-led organization to advance Canada's microelectronics products and explore market opportunities.

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Although the Canadian information technology industry grew by 4.9% in 1991, a critical shortage of skilled software professionals is possible.

Market researcher International Data Corp. Canada Ltd. (IDC) has pegged the Canadian information technology sector—which includes computer and communications hardware, and packaged software and services—at $16.2 billion (Canadian) in 1991. The strongest growth sector remains packages software and services, and that is exactly where a new report from Employment and Immigration Canada[1] predicts a human resources shortfall.

The problem is two-fold: a declining number of computer science graduates and a lack of upgrading for those already in the workforce.

According to the report, Canadian universities, the traditional source for entry-level software workers, are producing fewer computing science graduates. A negative image of software workers among high school students has been identified as one factor contributing to the reduced numbers of people entering the software field.

Furthermore, the two-thirds of Canada's 150,000 software workers employed as in-house workers within the management information systems (MIS) departments of Canadian industry and government, increasingly are plateauing in mid-career due to a critical obsolescence of skills. The study also identified a profound lack of training or retraining.

"A general lack of recognition of the contribution of software to all aspects of Canadian life and competitiveness is evident in the dearth of software-related government policy or direction," the report said. "Worse, although lip service is given to the importance of information technology to Canada's future, among policymakers we find no evident recognition of the key to the effective use of technology: the human resources which make all computers work."

IDC expects stable growth of the Canadian IT industry until 1995, when the industry could reach the $20 billion level.

[1]Software and National Competitiveness, December 1991, Employment and Immigration Canada.

❑ ❑ ❑

The province of Ontario has formed a communications advisory committee as part of the province's long-awaited industrial strategy. The communications industry in Ontario, which includes Northern Telecom, employs 90,000 people, generates revenues of more than $9 billion (Canadian) annually and spends more than $600 million each year on R&D.

"The vision we have for Ontario is that of a world leader in the development and application of telecommunications," said Ontario's Minister of Culture and Communications, Karen Haslam.

The committee is expected to file its report by the end of June.

❑ ❑ ❑

Gilles Brassard, a specialist in cryptography at the University of Montreal, is one of four winners of the 1992 E.W.R. Steacie Memorial Fellowships, Canada's most prestigious academic award for mid-career scientists.

Brassard is acclaimed internationally for his work in zero-knowledge protocols and for developing, with Charles Bennett of IBM Research, the field of quantum cryptography.

Brassard and his colleagues began developing approaches to quantum cryptography in 1979 when, at the age of 24, he returned to his native University of Montreal as a faculty member. Brassard's approach involves the fundamental principles of quantum physics, in particular Heisenberg's uncertainty principle, to create a system for transmitting unconditionally secure information.

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• consider potential opportunities for refocusing part of the support provided by the infrastructure programs, with participation by appropriate disciplinary programs in both the evaluation and funding aspects of the projects and in new directions, such as project-oriented group grants and shared facilities projects; and

• recommend actions to best meet the needs of the field.

Computing research as a discipline and the number of academic departments grew slowly until the 1970s when substantial growth in new programs, new demands for doctoral-level scientists and undergraduate enrollments pushed the discipline into a crisis as reported in [2]. Since the time of that report, government, industry and universities have worked to improve the computing research environment at universities in order to retain faculty and graduate students. An essential ingredient in the improvement of the discipline over the last 10 years has been the extra attention paid by NSF and others to building a research infrastructure.

Continued on page 9

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university granting agency, said, "We are really pleased. In a very difficult budget like this one, we feel we've done quite well." The NSERC budget will increase from $483.6 million to $500.8 million in 1992–93.

NSERC also boosted the number of post-graduate scholarships and fellowships for 1992 in the engineering and computer science disciplines. The result is an additional 37 post-graduate scholarships and three postdoctoral fellowships.

In other budget news, the government allocated $230 million over the next five years to improve the administration of R&D tax credits, a system recognized as one of the most generous in the world on paper, but which has proven difficult to carry out.

Several groups, including the Canadian Advanced Technology Association and the Information Technology Association of Canada, have lobbied extensively for changes in the tax system.

Douglas Powell is with the Information Technology Research Center at the University of Waterloo.

Research News

Technology development: a partnership that makes sense

BY Kyle Y. Rone, Robert B. MacDonald and A. Glen Houston

All too often, government, industry and academia find themselves developing technology on a basis of perceived needs, rather than specific needs. While this approach has its place, it can be wasteful in applied research. This problem is compounded when groups in several different organizations are involved.

Historically, it has proven difficult to bring these distinctly different organizational cultures together to achieve the benefits of collaboration. However, evidence shows there are advantages to cooperative efforts among professionals from academe, government and industry. One example of effective collaboration is the Land-Grant U.S. Agricultural System. This structure, comprised of government, academe and the agribusiness community, is credited with being the most efficient and productive agricultural system ever created.

Driven by need, organizations in Clear Lake, TX, formally initiated an effort in 1986 to bring the different groups together to develop a long-term, research- and professional-level education program in computing and information systems.

The problem

During the past 40 years, tremendous advancements have been made in materials research, development and the engineering of hardware components and systems for computing and information systems. But the capability to engineer instruction sets, commonly referred to as software systems, has not kept pace with hardware development.

Moreover, the education programs required to produce software engineers only now are being discussed seriously. The computing field also lacks adequate education programs that can teach software practitioners about improved software engineering methodologies.

To make timely and effective use of cutting-edge concepts, methods and technologies, industry needs to understand and support the concepts and methods of academe. This should be in concert with informed requests by government agencies. The problem is determining how to recognize a specific need and focusing resources from several institutions on fulfilling the need, without compromising the independence of the institutions.

A specific approach

In 1986 the University of Houston-Clear Lake (UHCL) formed the Research Institute for Computing and Information Systems (RICIS) as part of a cooperative program with the NASA Johnson Space Center (JSC). The two organizations jointly define and manage an integrated program of supporting research- and professional-level computing education. Since its inception, RICIS has been responsible for more than $27 million of research. The institute organizes and manages a gateway to research organizations in universities and industry. RICIS also conducts a significant portion of research and education activities with UHCL faculty and staff.

RICIS attempts to serve as a clearinghouse of research ideas, new methodologies and concepts and software technologies that are, or should be, of interest to NASA. The institute makes the research selection process easier, coordinates the selected efforts as they are conducted and disseminates the results.

RICIS uses the gateway mechanism to determine if existing research results can be applied to critical NASA projects. Examples include research conducted by the Microelectronics and Computer Technology Corp. (MCC) consortium and the Software Engineering Institute at Carnegie Mellon University. The institute helps make transferring technology and knowledge into NASA easier.

The RICIS program is building on the strengths of government, academe and private industry to take advantage of computing and information systems know-how and technology for the benefit of all participating organizations. Goals of the program include

- creating an environment to foster on-going, working-level, people interactions,
- removing the mystique and building mutual understanding and trust among participating university, NASA and industry staff and professionals,
- identifying and incorporating incentives to encourage this outreach,
- building mechanisms to better affect knowledge and technology transfer and infusion between universities and government, and
- avoiding using universities as substitutes for industrial partners.

RICIS has adopted the proven government–university "Land Grant" model as the foundation for its program. NASA has adopted the "Cooperative Agreement" as the contract instrument to implement this program. Both NASA and UHCL/RICIS are concerned about the process and the content of this collaborative effort.

The world has produced a considerable amount of research results, knowledge and technology that needs to be better understood, appreciated and exploited. Considerable effort is needed to gain the benefits of applications research.

Rounding out the picture

RICIS provides a necessary mechanism to work with the government to plan and oversee needed research- and professional-level education. The missing element is the

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Research News

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view of industry, such as from government contractors who ultimately have the responsibility of inserting technology into NASA's programs. While NASA and UHCL always have envisioned industry as a third element of the RICIS program, the initial emphasis was placed on developing the university–government link. RICIS now is in a position to encourage industry to be a significant partner in the program.

After extensive talks between RICIS and various aerospace organizations, UHCL and IBM recently entered into a new partnership agreement. This is viewed as the first step in creating an industrial affiliate component of the RICIS program that ultimately will involve several industrial organizations in the Clear Lake–Houston area. The agreement covers five areas of cooperation:

• IBM, as the first industrial affiliate, will help UHCL define how industry can help carry out the RICIS role. The initial thrust is to serve in an advisory capacity on a planning board structured for this purpose. Other industrial affiliates will be invited to serve in a similar capacity.

• IBM will assist UHCL/RICIS in providing a series of credit and noncredit project management classes for the RICIS community.

• UHCL/RICIS and IBM will conduct cooperative research in group and organizational analysis. Initially, this will concentrate on interviewing techniques in support of information engineering, knowledge engineering and management consulting.

• UHCL/RICIS and IBM will investigate other areas of joint interest for possible collaborative work, such as the Space Station Data Management System, image processing and engineering of reusable software components.

• IBM will assist UHCL/RICIS in bringing other industrial affiliates into a collaborative program.

This thrust adds a new dimension to the model already established. The final step is a formal interface between IBM and NASA. Such an interface already exists in the form of contracts that govern the work IBM does for NASA.

These contractual relationships can be used to recommend and accept technology insertion based on prototyping done in support of research accomplished through the RICIS/NASA relationship.

The RICIS industrial affiliate program will provide the missing link between the existing NASA–IBM contract relationship and the NASA–UHCL cooperative relationship. This provides closure for all the relationships required to generate and evaluate research for the NASA community.

In general, the industrial contracting community needs to function in the academe, government and industry triad in the role being prototyped with IBM. One could replace IBM with industry contractors and this model works well as a cooperative model for NASA, UHCL and industry. This specific situation could be expanded to serve as a general model of cooperation among any government agency, or major customer, and its university and industrial counterparts.

NASA

The initial stimulus for the joint NASA–UHCL cooperative program was JSC's recognition of a need for a forward-looking, longer-term engineering research and continuing education program in the rapidly evolving fields of computer and information sciences and engineering. JSC, as a major space engineering center and a major developer and user of computing and information systems, has a clear need to stay at the forefront of the concepts, methods and technologies rapidly emerging from these fields.

In 1984, JSC's Mission Support Directorate began an effort to develop and plan for the initiation of such a supporting research and continuing education program. That program included provisions for UHCL to create RICIS—an "institute without walls."

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Universities, for competitive reasons, raised salaries to levels near industrial laboratory salaries and began providing and upgrading research laboratory facilities. Industry provided a large amount of equipment through gifts and substantial discounts. The government, through NSF's Coordinated Experimental Research program, NSFnet and cooperative Defense Advanced Research Projects Agency programs, improved experimental research facilities at several universities. By 1985, the environment for carrying out computing research in many universities had improved dramatically, relative to 1980.

Crisis isn't over

Although the crisis caused by rapid growth in demand for computing research solutions and the lack of sufficient human resources appears to be easing, the discipline still is in a precarious position. The depth of most departments is modest at best, and outside the top 20, departments typically are strong only in a few subspecialties. In 1980, there was a significant gap in research capability between the top three departments of computer science and the rest. This gap, although smaller, still exists.

In addition, while the number of departments capable of leading-edge research in a reasonable number of subspecialties has increased substantially, this number is still small when compared with the number of first-rank departments in other disciplines.

As the infrastructure provided to the discipline ages, research goals continue to increase demands on existing infrastructure support for infrastructure is as vital now as when the discipline was in crisis. Obsolescence of experimental research equipment and facilities is a major concern in many disciplines, but computing research is so closely tied to rapidly evolving technology that the problem of obsolescence is particularly severe.

Although the crisis appears to be easing, the discipline still is in a precarious position.

Ambitious research programs identified by the High-Performance Computing and Communication initiative require a substantial investment at certain sites in such specialized facilities as highly parallel computers, integrated circuit design and fabrication and complete, integrated hardware and software system design and production.

In addition to the HPCC initiative, computing researchers have been called on to attack computing problems in areas that traditionally have not been addressed in computer science, such as manufacturing, communications, health care, transportation and education. These will require specialized facilities not now in place in universities, as well as significant cooperation with other disciplines and with industry. Continual replacement and enhancement of the computing research infrastructure, including nontraditional facilities, is essential to ensuring that progress continues.

Most academic and much industrial computing research is carried out by a single investigator with one or two research assistants. Units with one or more senior researchers and several postdoctoral or junior researchers and more than two graduate students are much less common. Major research projects that could address significant problem domains require a critical mass and a much larger and more diverse group of researchers if they are to be successful.

The shortage of federal funding for groups of this size often precludes such areas of research from being pursued. The government must make a firm commitment to a balanced portfolio of funded research projects that includes single investigator, group and large-project activities.

Lacking diversity

The shortage of human resources in computing research has lessened, but diversity in the population of computing scientists still is lacking. Under representation is occurring at the doctorate level and, to a lesser degree, at the master's and bachelor's degree levels. With an entering work force that increasingly will consist of minorities and women, it is vital that means be found to encourage these groups to participate in computing research to a greater degree. The K–12 grades are extremely important in ensuring an adequate technically trained work force. A way must be found to couple research, higher education and K–12 education to maintain the pipeline of interested and educated persons.

Four-year colleges and universities have even greater needs than major universities for more infrastructure for research and education. Particularly hard hit are minority institutions, such as the historically black colleges and universities, which have been unable to build any form of computation infrastructure. This is due equally to lack of money for equipment and lack of money for personnel to support the equipment. Most graduates entering the work force will not have been educated at the top 20 Ph.D.-producing research universities. Even at the stronger four-year colleges and universities, there is a great need for additional equipment and networking infrastructure. The needs of these schools were not addressed in plans to help the experimental computer science research infrastructure.

The workshop participants were W. Richards Adrion of the University of Massachusetts at Amherst; Gregory R. Andrews of the University of Arizona; John Foster of North Carolina A&T; Edward D. Lazowska of the University of Washington; Barbara Liskov of the Massachusetts Institute of Technology; Michael J. O'Donnell of the University of Chicago; Burton J. Smith of Tera Computer Co.; Robert Sproull of Sun Microsystems Inc.; Peter Weinberger of AT&T Bell Laboratories; and Jack K. Wolf of the University of California at San Diego. Charles Brownstein, Harry Hedges and John C. Cherniavsky represented NSF.

REFERENCES

[1] Feldman, Jerome A. and William R. Sutherland, Rejuvenating Experimental Computer Science, *CACM*, September 1979, pp 497—502.

[2] Denning, Peter J., et. al., A Discipline in Crisis, *CACM*, June 1981, pp 370—374.

W. Richards Adrion is a professor of computer and information sciences at the University of Massachusetts at Amherst.

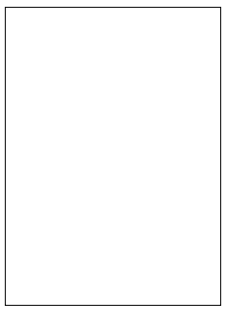
Wulf selected to head CSTB

William A. Wulf has been selected as the new chair of the National Research Council's Computer Science and Telecommunications Board (CSTB). Wulf, a professor of computer science at the University of Virginia, is succeeding Joseph Traub, a professor of computer science at Columbia University. Traub was CSTB's founding chair and served six years.

Wulf has been a member of the CRA board of directors for two years. After a distinguished research career at Carnegie Mellon University, Wulf spent two years as the assistant director of the National Science Foundation's Computer and Information Science and Engineering (CISE) Directorate. He joined the faculty of the University of Virginia in 1990. His CSTB term starts in June.

People in the News

Hopcroft nominated as NSB member



President Bush has nominated John E. Hopcroft to serve as a member of the National Science Board. Hopcroft is awaiting Senate confirmation.

Hopcroft is a Joseph C. Ford Professor of Computer Science in the computer science department of Cornell University. He has a bachelor's degree in electrical engineering from Seattle University and a master's and doctorate degree in electrical engineering from Stanford University.

Hopcroft is recognized for his pioneering work in the theoretical aspects of computing, especially in the analysis of algorithms, formal languages, automata theory and graph algorithms. He played a key role in the development of methods for theoretically analyzing the efficiency of algorithms.

National Academy elects members

The following are recently elected members of the National Academy of Engineering who are from the computing research community.

Richard Conway, professor of computer science and information systems, Cornell University. For contributions and leadership in the area of scheduling theory, simulation methodology and simulation software for manufacturing.

C. William Gear, vice president for computer science research, NEC Research Institute Inc., Princeton, NJ. For seminal work in methods and software for solving classes of differential equations and differential-algebraic equations of significance in applications.

John L. Hennessy, William R. and Inez Kerr Bell Professor of Electrical Engineering, Stanford University. For innovations in computer architecture and software techniques for reduced instruction set computers (RISC), and for quantitative evaluation methods for modern computer architectures.

Richard M. Karp, professor of electrical engineering and computer science, University of California, Berkeley. For major contributions to the theory and application of NP-completeness, constructing efficient combinatorial algorithms and applying probabilistic methods in computer science.

Richard S. Muller, professor of electrical engineering and computer sciences, University of California, Berkeley. For contributions to the technology and design of integrated electronic sensors.

Charles L. Seitz, professor of computer science, California Institute of Technology. For pioneering contributions to the design of asynchronous and concurrent computer systems.

Edward H. Sussenguth, retired fellow, IBM Corp., Cary, NC. For technological contributions and engineering leadership in the architecture of computer and communications systems.

Richard A. Tapia, Noah Harding Professor of Mathematical Sciences, Rice University. For contributions in linear and nonlinear programming, and for creative leadership in minority education in computer science.

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National Science Foundation

There are two vacancies, but John Hopcroft of Cornell University has been nominated to serve on the board.

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kludges. Consequently (here comes a sweeping over-generalization) the sociology of the discipline has tended to be broad-but-shallow research. As I said, it is not a crisis, but as the field matures it is time to introspect about such things. Maybe a little culture change would be a good thing.

One last point concerning Noyce's analogy. He was only talking about the advances in hardware technology. The advances in algorithms, compilers and other software technologies have been comparable. So his estimate of a $3 limo is much too high. Isn't it fun to be part of all this?

William A. Wulf is a professor in the computer science department of the University of Virginia.

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Although the total program represented by the JSC–UHCL Cooperative Agreement NCC 9-16 is based broadly on the computing and information fields, much of the attention and efforts of research and education have been directed to issues of the newly emerging field of software engineering. Many professionals at JSC strongly believe that the center needs to be at the forefront of modern software engineering methodologies and practices if it is to achieve NASA's missions and goals.

UHCL

The primary mission of a university is education. To stay abreast in educating its constituents, a university must establish and maintain a strong research component. Clear Lake is a science and engineering community with ever-increasing demands for advanced computing and information technology. With this in mind, UHCL, in the early 1980s, set out to encourage JSC and local industry to provide support, including sharing personnel and facilities, as well as contributing funds, for research and education in computing and information systems.

UHCL then established RICIS in cooperation with JSC. As pointed out previously, RICIS is positioning itself to establish stronger ties with the indus-

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The format of an ad must conform to the following: (1) the first line must contain the name of the university or organization and will be printed in bold, (2) the second line must contain the name of the department or unit and will be printed in italics and (3) the body of the ad should be in broken into paragraphs. The words in the first two lines are included in the total word count for the ad. Any headings or text requested in all uppercase will be set in bold and counted as two words.

As of July 1, the rate is $2 per word (U.S. currency). A check or money order *(please do not send cash)* must accompany the ad copy. Purchase orders are acceptable. All CRA members receive at least 200 free words per dues year.

Display ads cost $30 per column inch. The ad must be submitted in camera ready, offset (positives or negatives) or mechanical form.

Computing Research News is published five times per year in January, March, May, September and November. Professional Opportunities ads with application deadlines falling within the month of publication will not be accepted. (An ad published in the September issue must show an application deadline of Oct. 1 or later.) Advertising copy must be received at least one month before publication. (The deadline for the September issue is Aug. 1.)

James Madison University
Department of Computer Science

Applications are invited for a tenure-track position at the assistant or associate professor level in computer science. Candidates should have a doctorate in computer science or a closely related area or have significant industrial experience in software project management. Commitment to excellence in teaching is essential. Preference will be given to applicants in software engineering, particularly those with experience in large-scale computer systems applications, expert system applications or information systems applications.

Responsibilities include developing a curriculum in software engineering, teaching 18 credits per year at both the graduate and undergraduate levels and doing research. Competitive salaries will be offered to attract the best candidates.

Send a letter of application, resume and the names, addresses and telephone numbers of three references to Dr. J. Archer Harris, chair, search committee SE, Office of the Provost, College of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807. Screening of applications will begin immediately and continue until a suitable applicant is found.

James Madison University is an affirmative action, equal opportunity employer and especially encourages applications from minorities and women.

James Madison University
College of Integrated Science and Technology

The new College of Integrated Science and Technology invites applications for an associate or full professor position to begin on or about July 1. Duties will include developing a core curriculum in knowledge engineering, teaching and conducting research in expert systems applications, and designing courses in computer science and the management of technology.

Candidates should have a doctorate in science, engineering, educational technology or knowledge-based systems. Experience should include curriculum development, industrial or governmental management positions directing expert applications, university teaching, development of knowledge-based systems and management of joint university/corporate research projects. Salary and rank are commensurate with qualifications and experience.

Send a letter of application, resume and the names, addresses and telephone numbers of three references to Dr. Charles W. Reynolds, chair, search committee KE, Office of the Provost, College of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807. Screening of applications began April 24 and will continue until a suitable applicant is found.

James Madison University is an affirmative action, equal opportunity employer and especially encourages applications from minorities and women.

James Madison University
Department of Computer Science

Applications are invited for a tenure-track position at the assistant or associate professor level in computer science. Candidates should have a doctorate in computer science or a closely related area. Commitment to excellence in teaching is essential.

Preference will be given to applicants with applications experience in human/computer interfacing or visualization of information. Responsibilities include developing a curriculum in human/computer interfacing, teaching 18 credits per year at both the graduate and undergraduate levels and doing research. Competitive salaries will be offered to attract the best candidates.

Send a letter of application, resume and the names, addresses and telephone numbers of three references to Dr. John R. Fairfield, chair, search committee HCI, Office of the Provost, College of Integrated Science and Technology, James Madison University, Harrisonburg, VA 22807. Screening of applications will begin immediately and continue until a suitable applicant is found.

James Madison University is an affirmative action, equal opportunity employer and especially encourages applications from minorities and women.

The University of Chicago
Department of Computer Science

The department of computer science at the University of Chicago has junior and senior positions available. The university prefers candidates with expertise in an area of experimental computer science, such as programming languages or distributed systems, but it will consider exceptionally strong applicants from any area.

Send curriculum vita and three letters of reference to Professor Janos Simon, chair, department of computer science, University of Chicago, 1100 E. 58th St., Chicago, IL 60637. Inquiries can be directed to chair@cs.uchicago.edu.

The University of Chicago is an equal opportunity, affirmative action employer.

University of Oregon
Department of Computer and Information Science

The department of computer and information science invites applications for a senior faculty position created by a new state Centers of Excellence award. We are seeking a person who will be an active leader in the department, willing to serve one or more terms as department head and play a key role in relations to the computer industry.

Applicants should have a Ph.D. in computer science or related field and a distinguished record of teaching and research in the area of parallel processing, including parallel architectures, languages and performance modeling, or human-computer interaction, including computer graphics and scientific visualization.

Our department has 14 other faculty positions, including one other new position for which we are currently recruiting, about 20 Ph.D. students, 50 master's of science students and 150 bachelor's of science students.

We have strong research programs in parallel and distributed systems, computer graphics, user interfaces, programming languages, software engineering, artificial intelligence and theoretical computer science, and we have active interdisciplinary ties with other on-campus groups in the fields of cognitive science, neuroscience, economics, biology, physics and mathematics. We offer a modern computing environment (a MasPar MP-1100, two Sequent Symmetry multiprocessors and dozens of Sun and HP workstations) housed in a new computer science building.

Review of applications will continue until the position is filled. The position is available in September, with a target date to fill the position by January 1993.

Qualified applicants should send a curriculum vita and the names of at least three references to Professor Stephen Fickas, faculty search committee, department of computer and information science, University of Oregon, Eugene, OR, 97403-1202. Tel. 503-346-3973; E-mail: fickas@cs.uoregon.edu.

We especially encourage applications from women and minorities. The University of Oregon is an equal opportunity, affirmative action employer committed to cultural diversity.

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trial community. With the triad in place, the university will better serve the community.

The university will derive tremendous benefits as well. The exposure to complex problems will increase the expertise of the faculty and professional staff. The faculty will be able to stay at the cutting edge of research and contribute to the scientific body of knowledge. The results of the research will find its way into the classroom and enrich the educational experience. Moreover, such a relationship will provide research and educational seasoning for UHCL students.

A relationship involving UHCL with industry and NASA, and potentially other government agencies, will result in new degree programs, as the needs of the community are better understood. An example is the new master's degree program in software engineering science. RICIS was a major factor in establishing the rationale for getting the needed support to develop this program.

IBM

Research is essential if an industry is to remain viable. Topics for research are many; however, there is not enough money invested from profits to cover all the topics. By participating in RICIS, IBM can direct funds into topics based on the needs of the agency it primarily serves in the Clear Lake area. Access to research directed by RICIS also enables each industrial affiliate to avoid duplicating work already performed by others and invest in complementary work.

Working with UHCL gives IBM access to research skills that complement its own skills. It also gives IBM access to training associated with research of interest. Through RICIS, IBM provides prototyping opportunities in real projects to prove the value of technology under study at UHCL.

Because IBM is a NASA contractor, it can react sensibly to technology insertion requests in NASA request for proposals, if prior prototyping has been accomplished through the RICIS mechanism. This final contracting mechanism completes the picture of cooperative research: the need for the research, a conducive atmosphere for its completion, prototyping to show viability and a mechanism for inserting technology into programs.

RICIS has helped developed a combination of interfaces among three entities to function as a whole. This is a necessary mechanism if the institutions involved are to maintain their technical vitality. Each of the interfaces must remain independent to maintain a healthy counterbalance of the respective entities. However, each entity can, and must, understand the entire mechanism to exploit each interface to the fullest.

Only through such cooperation can the continued technical success of the NASA and Clear Lake area be assured, and the community continue to contribute to the technical accomplishments of the nation.

Kyle Y. Rone is a senior systems engineer at IBM's Federal Systems Co. Robert B. MacDonald is the manager of research for education and university programs in the technology division of the Information Systems Directorate of the Johnson Space Center. A Glen Houston is the director of the Research Institute for Computing and Information Systems.

Conference News

Snowbird Conference '92 ♦ July 12–14 ♦ Snowbird, Utah

Preliminary Agenda

Sunday, July 12

Registration
3:00PM - 7:30PM

Welcome Reception
6:00PM -7:30PM

Dinner and State of the CRA Address
7:30PM - 9:30PM
John Rice, chair of the CRA board of directors, will update attendees on CRA activities.
Fred W. Weingarten, CRA's executive director, will offer some brief insights into how science and technology policy is affecting the presidential election.

Monday, July 13

Morning

Breakfast
7:00AM – 8:30AM

Keynote Address
8:30AM – 10:00AM
The Changing Face of Industry and Academia Relations
Increasingly, policymakers at both the state and federal levels are expecting academic research and graduate education to deal with this country's economic and social needs, as well as contribute toward the development of new industrial products and services.

To meet these expectations, industry and academic researchers are being forced to forge closer relationships.

A leading senior computer industry executive and a noted academic leader will address the issues, problems and opportunities arising from these cooperative efforts.

Academic keynote speaker: Peter Likins, President of Lehigh University.
Industry keynote speaker: Wayne E. Rosing, President and director of Sun Microsystems Laboratories Inc.

Morning Break
10:00AM – 10:30AM

Panel Discussion
10:30AM – 12 NOON
How Can Universities and Academia Work Better Together?
A panel of industrial computing research managers and academic department heads will lead a discussion of industry and academic relationships prompted by the Keynote Address.

The discussion will highlight the problems and opportunities created by this closer industry and academia relationship. The panel will focus on the ways to make the relationship work.

Audience participation is key.

Session Chair: James Foley, Georgia Institute of Technology.

Afternoon

Luncheon and Address
12:00 NOON – 2:00PM
A. Nico Habermann, the assistant director of the National Science Foundation's Computer and Information Engineering Directorate, will discuss modern trends in federal science policy.

Panel Discussion
2:00PM – 3:30PM
Human Resources: Where are We Now?
• Ph.D. production in computer science and engineering is up once again this year, topping 1,000 for the first time.

Are there enough jobs for Ph.D. recipients? Should there be? Should we rethink our assumptions about what Ph.D.s in these fields do or should do? Is the education they get appropriate for the jobs they seek?

Experts will debate these issues.

• Aggregate numbers are not the only important human resource issue. Find out what is being done to increase the participation of women and minorities in computing research.

Afternoon Break
3:30PM – 4:00PM

Session
4:00PM – 5:30PM
What's New at the Computer Science and Telecommunications Board?
Juris Hartmanis, study committee chair, and Herb Lin, study director, will discuss the CSTB study on the scope and direction of computer science and engineering.

Marjory Blumenthal, CSTB's executive director, will report on the companion project on human resource issues in the field. CSTB also has been active in many other areas since the last Snowbird update.

Evening

Dinner and address
6:30PM – 8:30PM
Speaker: Sheryl Handler, President of Thinking Machines Corp.

Tuesday, July 14

Morning

Breakfast
7:00AM – 8:30AM

Session
8:30AM – 10:00AM
New Directions in Computer Science and Engineering Research (Part 1)
Computing researchers increasingly are being called on to explain their field to the outside world. But can we simply and accurately communicate computing research results to lay people?

Senior researchers from two NSF-funded Science and Technology Laboratories will discuss major new developments in their fields of computing research.

Labs highlighted in this session are:

• The Center for Research in Cognitive Science (University of Pennsylvania) and

• The Center for Discrete Mathematics and Theoretical Computer Science (Rutgers University).

Session Chair: Paul Young, University of Washington.

Morning Break
10:00AM – 10:30AM

Session
10:30AM – 12:00 NOON
New Directions in Computer Science and Engineering Research (Part 2)
Senior researchers from two NSF-funded Science and Technology Laboratories will discuss major new developments in their fields of computing research.

Labs highlighted in this session are:

• The Center for Research on Parallel Computation (Rice University) and

• The Center for Computer Graphics and Scientific Visualization (Cornell University, Brown University, the California Institute of Technology and the University of North Carolina).

Session Chair: Paul Young, University of Washington.

Afternoon

Luncheon and Address
12:00 NOON – 1:30PM
Herbert Edelsbrunner, a computer science professor at the University of Illinois, Champaign-Urbana, and a winner of the Alan T. Waterman Award, will discuss recent advances in computational geometry.

Workshops
1:30PM – 3:00PM and 3:30PM – 5:00PM
Topics to be announced

To Register:

If you would like to receive registration information, please contact CRA at 1625 Massachusetts Ave. NW, Suite 110, Washington, DC 20036-2212.
E-mail: Kimberly@cs.umd.edu.
Also, CRA expects to have a limited amount of grant money available for small undergraduate and minority institutions. If you are interested in applying, send your request to CRN by regular mail. All applications will be reviewed by a CRA committee. The grants will cover conference registration and include $600 for travel expenses.