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Twenty Years Ago: Birth of the Supercomputing Institute

(In recognition of the Supercomputing Institute's 20th anniversary, the following article was prepared by Professors Thomas W. Jones, Department of Astronomy, and David A. Yuen, Department of Geology and Geophysics, both Fellows of the Supercomputing Institute and long-time Institute researchers. Photographs are courtesy of Tom Jacobson and Scott Bertilson.)

The Minnesota Supercomputing Institute for Digital Simulation and Advanced Scientific Computation (or MSI, as it is generally known) recently celebrated its twentieth birthday. MSI was born and put into full operation during 1984–86. It came into being through the timely and unique convergence during the early 1980s of a series of national, state, and University initiatives to strengthen supercomputer manufacturing industries in the state of Minnesota and to improve high-performance computer access and computational science and engineering at American universities. Especially given the tremendous contributions that MSI has made and continues to make to the University of Minnesota's international competitiveness, we thought it timely to recap some of the events that led to MSI's being created, as well as some of the early Institute history. The legacy of MSI and its computational infrastructure is rich. For brevity we concentrate here only on its formative years, leaving the more complete story for another contribution.

The world of high-performance computing was very different in the early 1980s. Much of what we take for granted today, including such basics as networking, "the Internet," and data visualization, was either brand-new or unknown still. In addition, we feel it is important for us all to remember the central role that Minnesota and the MSI have played in the ever more important field of high-performance computing. In fact, Minnesota, especially by way of the creative genius of Seymour Cray, an alumnus of the University, was the birthplace of supercomputing and was for many years the principal center for the design and manufacture of supercomputers. Control Data Corporation, born here in Minnesota in 1957 and Cray Research, Inc., formed here in 1972, both introduced high-impact sequences of the world's fastest vectorized computers, while pioneering such innovative computer technologies as LSI chips and RISC, vector and parallel architecture strategies. As this pioneering effort grew, leaders of the local computer industry, most notably John Rollwagen, CEO at Cray, and Bill Norris at CDC, strongly urged the University of Minnesota to develop a high profile on the frontiers of academic computing and computer engineering. This message was articulated especially effectively through an industrial advisory council set up by Institute of Technology Dean Roger Staehle when he arrived here in 1979.

The University took a bold step in this direction in 1981, becoming the first American university to purchase a class VI supercomputer (a 100 megaflop Cray 1). In order to help

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Figure 1. MSC computer room with prototype and production Cray 2s and a Cyber 205.

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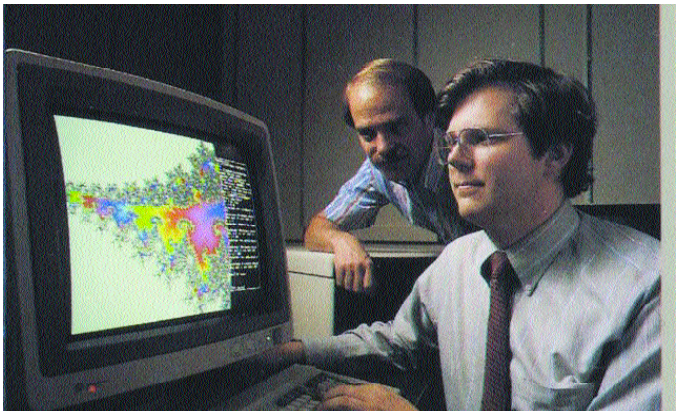

Figure 2. Thomas Jacobson (right) and Paul Woodward with early Cray 2 application: Mandelbrot set explorer via remote shell from SGI Iris.

manage the considerable expense of acquiring and operating the Cray 1, while limiting direct costs to academic computer users, the University decided also to sell supercomputing resources to outside, non-academic users. To maintain its tax-exempt status while selling computer resources on the open market, in 1982 the University created a for-profit company, the Minnesota Supercomputing Center, Inc. (originally known as Research Equipment, Inc., or REI). Ownership of MSCI was shared with the University of Minnesota Foundation, which was actually the majority owner. Into 1985 supercomputing facilities continued to be operated by University employees at its Academic Computing Center in Lauderdale, just off Highway 280. Both the original Cray 1 and its successor, a single-processor Cray 2, were initially installed at that site. By early 1986 MSCI was operated as an independent company, and supercomputer hardware ownership was transferred to MSCI. The company's board of directors came from the University of Minnesota Foundation and from the University administration. Its CEO was John Sell, previously a University Academic Computing Center employee. Coincidentally, the City of Minneapolis and its Mayor Don Fraser, together with the State of Minnesota and Governor Rudy Perpich, were trying to revitalize the old milling district between downtown and the University West Bank Campus. This led to a so-called "High Tech Corridor" initiative along Washington Avenue. As a contribution to this effort and as an effort to help encourage financial support for supercomputing from the state legislature, MSCI and its supercomputers moved into a remodeled soft drink warehouse at 1200 Washington Avenue South in the fall of 1986.

During this same period a broader serious national concern was developing around the realization that the US was not maintaining a competitive edge in high performance computing, generally. In 1982 the Department of Defense and the National Science Foundation sponsored a blue ribbon panel to examine this problem, chaired by Peter Lax of the Courant Institute. The resulting Lax Report of 1984 stressed the need for a more coordinated and aggressive national academic computing effort, noting in particular that researchers at American universities did not have adequate access to high-performance computers. In response to the Lax Report, the NSF created an Office for Advanced Scientific Computing and subsequently issued a call for proposals to create several national academic supercomputing centers.

Back at the University of Minnesota, in late 1983 an ad hoc group of faculty, led by mathematics professor George Sell, were aware of the likelihood of a national academic supercomputing initiative and began to prepare for a Minnesota bid. Physics professor Tom Walsh agreed to lead that effort. The resulting plan involved creation of an academic institute for high-performance computing distinct from MSCI. In support, the University, as part of its initiative to secure legislative supercomputing funding, agreed to create several new faculty positions to recruit leaders in supercomputer-based research. The Minnesota Supercomputer Institute was thus born. The newly recruited faculty would be identified as Fellows of the MSI. An international and interdisciplinary faculty search was carried out in late 1984 through the Institute of Technology, then headed by Dean Ettore Infante. The original MSI Fellows hired through that search were Jan Almlöf (Chemistry), Paul Woodward (Astronomy), David Yuen (Geophysics) and John Zabolitzky (Physics). Aneesur Rahman (Physics) was also recruited a little later, but, unfortunately, he succumbed to cancer shortly after his arrival at the University of Minnesota. Peter Patton, who had been director of the University Academic Computing Center, became the first MSI director, and Tom Walsh became the MSI scientific director. In an effort to broaden the role of the MSI within the University, the Office of Academic Affairs also took over its responsibility from IT.

In the meantime the University did submit its NSF bid to become one of

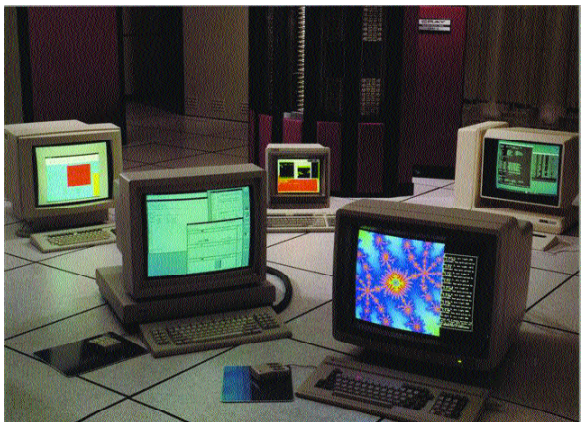

Figure 3. Early demo of Cray 2 networked via TCP/IP with diverse clients.

four national supercomputing centers. The proposal, with Tom Walsh as Principal Investigator, was very forward thinking and thus risky. It was centered on the brand-new Cray 2 supercomputer, which was the first supercomputer to utilize a flavor of the UNIX operating system and to incorporate both vector and parallel architectural features. The planned University Cray 2, with four processors, also had 8 GB of memory, which was enormous for its day. While the University did obtain what amounted to bridge funding from the NSF, it was not selected to be one of the national supercomputing centers. From that point on the MSI has been operated through state funds, although its presence here has facilitated very substantial outside funding to the University. In the early MSI years the legislature included a "state special" appropriation to purchase computing time from MSCI.

As it was starting MSI was a real "seat of the pants" operation that required lots of individual initiative. Among the many challenges was developing networking connections between the supercomputers and the main campus. Networking technology was in its infancy then, and such modern standards as the TCP/IP protocol were largely unknown entities. Tom Jacobson and Scott Bertilson from MSCI, along with Tom Walsh and his designated network administrator, Randy Smith, set out to demonstrate TCP/IP viability for academic computing. Very early tests included setting up a 56 kbps connection between Lauderdale and the University of Wisconsin in Madison through the ARPANET using a VAX computer as the local hub. The idea of implementing a TCP/IP network on the campus for researcher access, while central to effective use of the Cray 2, was resisted by a skeptical University community more familiar with an already archaic remote entry punch card computer access. It was important to demonstrate the newer technologies even though they were not yet authorized nor funded. This led to such unauthorized tasks as installing optical fiber cables on campus inside various subterranean steam tunnels under cover of darkness. The fibers actually had to be installed more than once, since it turned out that the coatings of the original fibers could not withstand the steam tunnels' extreme temperatures. In the end these initiatives won the day and the University became an early participant in what became the modern computer communications paradigm. In 1985 and 1986 MSI hosted its first summer schools in supercomputing on the east bank campus.

Figure 4. Stuart Levy doing network testing.

Before the new supercomputing facilities on Washington Avenue were available, the MSI was administered out of a series of temporary offices. Initially Tom Walsh and his administrative assistant, Angie Vail, occupied two tiny offices in the Shepherd Labs on the East Bank campus. Angie recalls arriving for her first day on the job to find a phone on the floor, but nothing else in either office. As the operations came together and Peter Patton came on board as the new director, another staff person, Ann Johns, was hired. The MSI staff transferred into another temporary, larger, but very isolated location in the Business and Technology Center across from the Metrodome on the West Bank. In September 1986, MSI, along with MSCI, moved into its new, permanent facility on Washington Avenue, where it remained until 2002. Once in the new building, MSCI installed the Cray 1 and both Cray 2 supercomputers, as well as a Cyber 205 from CDC, making it one of the premier supercomputing centers in the world.

Figure 5. Radical idea of UNIX as a supercomputer OS.

A few months after the move, Peter Patton left the University to take a corporate position in Austin, Texas. Tom Walsh resigned his scientific director position in November 1986. By that time, according to MSI records, already over 250 University faculty researchers were utilizing MSI supercomputers. The MSI was temporarily managed by an executive committee of MSI Fellows, but shortly thereafter, the two director positions were merged, and Don Truhlar from the Department of Chemistry was appointed to be the director. He remained in that position for almost 18 years, guiding the MSI through a major revolution in the nature and scope of high-performance computing.

Acknowledgements: We are very grateful to many colleagues who helped us reconstruct the events of this story. We especially thank Scott Bertilson, Tom Jacobson, Mitch Luskin, Rama Murthy, Skip Scriven, George Sell, Angie Vail, and Tom Walsh for their recollections.