BOOK REVIEW - *DIGITAL STATE*

The Story of Minnesota's Computing Industry by Dr. Thomas J. Misa - Review by Lowell A. Benson

This review is not a Readers' Digest version of *Digital State*; rather I've picked a few interesting paragraphs from each chapter intending to incentivize you to read Tom's book then write your own computer history items for our 'anthology' web site and posterity. *LABenson*

A UMN Press blurb: *"The rise of Minnesota computing after World War II—the country's first fully realized hotbed of computer technology"*.

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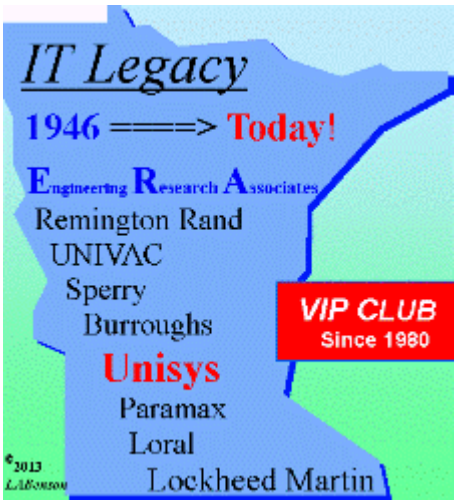
Review Prologue

The book's back cover has this statement. "Thoroughly researched and engagingly written, Thomas J. Misa's impressive book tells the story of a revolutionary group of companies and individuals who, during the middle of the twentieth century, transformed the computing industry right here in Minnesota. Digital State provides a much-needed look at the roots of Minnesota's high-tech economy." By **Margaret Anderson Kelliher**, president and CEO of Minnesota High Tech Association and former Speaker of the Minnesota House of Representatives.



Harvey Taipale, a retired 40+ year employee of Sperry → Lockheed Martin, wrote: "The IT Legacy Goal: **E**ngineering **R**esearch **A**ssociates (ERA) began a remarkable story of technological innovation and contributions to the computer industry in 1946. We aim to relate this 67+ year story as many of us have lived parts of it—most history book entries have limited defense industry info among the commercial development stories."

Dr. Misa's book tells parts of this IT Legacy as he covers the breadth of the Minnesota computer history. He used data from 23 archives and manuscripts, 55 oral histories, 185 published works, and many, many hours in creating the preface, introduction and eight focused chapters of this book. 28 pages of notes, listed chapter by chapter, cite who said what or who wrote what as there are so many, many stories within Minnesota's technology history. Tom goes outside the ERA lineage listed in the VIP Club's legacy icon in that he covers the genesis of Minnesota's computer industry including history aspects of Control Data, Honeywell, IBM-Rochester, 3M, et al'. He includes a 10-page appendix listing of employment levels of industry companies over 40 years in the state. He cites our club web site in a few places and lauds the Mike Svendsen' writings about the UNIVAC influence on the semiconductor industry. The books most appropriate dedication is:

> "To the memory of Erwin Tomash (1921-2012), a native son of Minnesota, one of the pioneers with the Engineering Research Associates, a notable computer industry leader, and the guiding spirit behind the Charles Baggage Institute."

Digital State Preface

"I first considered this story in 2006 when I came to the University of Minnesota as the as director of the Charles Babbage Institute, a leading research and archiving center that helped create the professional field of computing history since its founding in 1978 in Palo Alto, California."[1]

"I resolved to plunge headlong into this captivating tale. At CBI during the academic year 2007-8 we organized a yearlong series of public lectures on the theme of Minnesota's hidden history in computing." "As the notes for this book make clear, I have extensively drawn on the Control Data corporate records, the papers of William Norris, a number of individual collections from Univac and Control Data employees, the flagship CBI collection on the Honeywell v. Sperry Rand lawsuit, the Mark McCahill papers and the Marvin Stein papers as well as additional documentation on the singular Minnesota Educational Computing consortium."[2]

[1] Digital State preface, page IX
[2] Digital State preface page X

"Another unique CBI resource is the remarkable set of oral histories, both published and unpublished, that shed light on innumerable episodes as well as contribute color and perspective to these pages."[3]

Introduction: Minnesota Goes High-Tech

"Minnesota's computer industry transformed the state's economy and identity in the years following the Second World War. Part of the reason this story has never been told is that Minnesota's computing companies, while world famous in their own way, were never in the business of selling computers directly to individual consumers." "Indeed, for three decades or more they built their most highly regarded computers for the military and intelligence agencies, frequently behind the closed door of top-secret classified contracts. … By 1983 the state, despite its legacy of Scandinavian reserve, proclaimed itself as the Supercomputer Capital of the World."[4]

"ERA also served as a fertile training ground for a distinctive group of far-seeing business entrepreneurs, technically minded scientists, and talented electrical engineers who went on to build several generations of computers for the Univac company as well as create over time perhaps as many as fifty start-up companies."[5]

"ERA, at that time struggling for financial stability, took up a contract with IBM to develop magnetic technology, which resulted in the transfer to IBM of "two massive patents" that provided crucial intellectual property and technical insight in the newly emerging field. … While ERA sold dozens of its high-end computers with magnetic drum storage, IBM sold a phenomenal two thousand units of the modestly priced model 650 from 1954 to 1962."[6]

1. Philadelphia Story: Wartime Origins of Minnesota Computing

"In its early years, Minnesota's computer industry was improbably but decisively yoked to the Philadelphia story. … The Philadelphia-based effort to build the ENIAC machine during the war—and commercialize the invention after the war—was one origin for the American computer industry. And, not least, the pioneering Philadelphia computer company and the pioneering St. Paul computer company were joined together when business machine giant Remington Rand bought them both and fitfully merged them, as chapters 2 and 3 will recount. Fallout from the resulting Philadelphia—St. Paul fracas triggered the formation of Control Data, as discussed in chapter 4. And the Philadelphia story returned to a Minnesota courtroom in the landmark Honeywell v. Sperry Rand lawsuit treated in chapter 5."[7]

[3] Digital State preface, page XI
[4] Digital State page 1
[5] Digital State page 3
[6] Digital State page 13
[7] Digital State page 17

"Engstrom circulated a secret seven-point plan in February 1945 that contained the seed that became St Paul's ERA. … Ongoing top level cryptography work at NCML, Bell Laboratories, and Eastman Kodak would be folded into the company, to be headed by four prominent CSAW and NCML staffers—including Engstrom himself. … If one or two of these big companies had really cozied up [to government contracting], there never really would have been a need for ERA."[8]

"And just in case anyone was uncertain about the navy's imprint—with a navy-affiliated cryptography group and the Naval Computing Machinery Laboratory transferred from Dayton, Ohio, in summer of 1946—the St. Paul factory was leased from the navy and officially designated as a Naval Reserve base so that the navy might post guards there to keep watch over the goings-on."[9]

2. St. Paul Start-up: Engineering Research Associates Builds a Pioneering Company

"Before long, ERA hired fully 40 percent of the University of Minnesota's electrical engineering class of 1943, including Frank Mullaney and Erwin Tomash, and a smaller but notable fraction of the postwar graduating classes, including Seymour Cray, Jay Kershaw, and Jim Thornton."[10]

"The report to ONR, overseen by ERA's Vice president for research, Charles B. Tompkins, and commercially published by McGraw-Hill in 1950 as *High-Speed Computing Devices*, eventually became the hardware "bible" for early computing in much the same manner as Wilkes, Wheeler, and Gill's *The Preparation of Programs for an Electronic Digital Computer* (1951) became the software bible. … had chapters on the basic circuit elements of computing, such as counters and arithmetic elements, "functional approaches" to machine design, and an extensive review of mechanical calculators, punch-card systems, analog computers and other large-scale computing efforts."[11]

3. Corporate Computing: Univac Creates a High-Tech Minnesota Industry

"With the Sperry Rand merger in 1955, Bill Norris was assigned the unenviable task of wrestling the competing units of the Univac computing division into some form of cooperation. … A corporate plan to entirely separate engineering from manufacturing, circulating in early 1957 "was just goddamn ignorance on the part of the top management of Sperry Rand," he thought. Norris also opposed a misbegotten attempt to impose a wage cut on the St. Paul workforce by bribing local union officials. After giving it the good fight, Norris decided to cash out and try again at the start-up

[8] Digital State page 39
[9] Digital State page 43
[10] Digital State page 47 {Editor's note, Jay Kershaw was my boss' boss for awhile in 1962. LAB}
[11] Digital State page 53

game. … Norris joined Control Data Corporation that summer and presided over its swift ascent into the top ranks of computing (see chapter 4)."[12]

"The ERA-Univac 1103 was the test case for manufacturing in St. Paul. Originally, Rem Rand's executives could not have dreamed that ERA had a second commercial machine ready for the market besides the original Atlas-derived 1101. Atlas II was top secret, after all, an so was the existence of the 1103 resulting from it. Engineers from St. Paul sprang the surprise at the Norwalk, Connecticut, laboratory, where "we had some large flip charts, black on yellow paper . . . [with] side-by-side comparisons . . . of the IBM 701 versus the proposed ERA 1103. There was a heavy bullet showing which column was superior on each of those items. That was very impressive. … With the Connecticut corporate go-ahead secured, setting up manufacturing facilities for the 1103 was an entirely new and challenging undertaking."[13]

"Although we think of technology and engineering as a "man's world," especially in the 1950s, women played a large and visible role at ERA-Univac. A news article relayed the possible unsettling news that "Feminine Invasion of Assembly Shops Successful." The unionized assembly force had been "an all-male stronghold" until the middle of 1951 when expansion in ERA's assembly volume—soon augmented by the booming antenna coupler business—ran into a serious labor shortage that made it difficult to hire additional male workers. In June that year the International Association of Machinists signed a new contract dividing its workforce into two segments, opening up a second grade of electrical assembler where women flooded in at lower rates of pay."[14]

"The Naval Tactical Data System, or NTS, was the most significant military system that St. Paul's Univac division ever built, but is was far from the largest military computer project in the late 1950s."[15]

"Cray tried to leave the Univac-NTDS effort in September 1957, shortly after Control Data was organized (see chapter 4), but his actual departure for Control Data was delayed for some months."[16]

"It is worthy recalling that software for any sort of networked real-time system such as SAGE or NTDS had never been conceived or built before. Computation at the time was mostly in a "batch" mode where financial computations, data sorting and manipulations or scientific calculations were completed in sequential order. … While timely coordination of incoming radar signals from enemy bombers for SAGE was a significant challenge, with NTDS there was the additional complication that the radar installations themselves were on moving warships. … NTDS featured three levels of

[12] Digital State page 73
[13] Digital State page 75
[14] Digital State page 77
[15] Digital State page 79
[16] Digital State page 85

compilers including a "high-level language [CS-1] which allows programs to be written by means of powerful operators totally divorced from machine code."[17]

4. Innovation Machine: Control Data's Supercomputers, Services, and Social Vision

"A new phase of the Cold War was at hand. Immediately the U.S. Department of Defense created it Advanced Research Projects Agency with a mission of conducting farseeing military research, and soon the country's aeronautics agency was transformed into a full-blown National Aeronautics and Space Administration. While NASA directly funded the space race and created a huge market for computing and controls, ARPA literally created the field of computer science with computer science with cutting-edge projects in computer time-sharing, graphics, and artificial intelligence, as well as computer networking that eventually became the Internet."[18]

"It is insightful to conceptualize Control Data's creation as a product of the "push" of corporate politics at Sperry Rand with the 'pull" of supportive business and financial environment in the Twin cities, with Bill Norris at the center of both. What became Control Data took protean form early in 1957, when two ERA veterans, Willis K. Bill" D rake and Arnold "Bud" Ryden, met for lunch in New York and talked over the worrisome situation."[19]

"FIGURE 4.2. McGill Building at 501 Park Avenue in Minneapolis (shown here circa 1962) was Control Data's first headquarters. The original "Control Data Corporation "sign to the left of the entrance door is now at CBI."[20]

"In November, possibly even before Cray came on board, Control Data bought up Cedar Engineering, a sizable local machine shop that made motors, servos, and actuators for the aircraft industry. Cedar Engineering, located in the near-west suburb of St. Louis Park, named for the nearby Minneapolis and St. Louis Railway, was itself a five-year-old spin-off from Minneapolis-Honeywell (chapter 5) that added manufacturing and engineering prowess to the metro area's expanding industrial district."[21]

5. First Computer: Honeywell, Partnerships, and the Politics of Patents

"Throughout these years, Honeywell's national profile in military technology expanded impressively. It became such a prominent symbol of the military-industrial complex—a concept coined by Malcolm Moos, speechwriter for President Eisenhower and later president of the University of

[17] Digital State page 89
[18] Digital State page 99
[19] Digital State page 101
[20] Digital State page 103
[21] Digital State page 105

Minnesota—that it caught the eye of antiwar protesters in the Twin Cities, who organized the Honeywell Project (1968-90), an unusually long-running protest movement."[22]

"Sweatt, along with his two sons as junior partners, recognized the vital importance of sales and marketing, and he prompted stove manufacturers to adopt designs that might easily be refitted with his patented temperature-control system."[23]

"The battle to claim the title of "first computer" has been intensely contested ever since the U.S. Army lent its publicity muscle to the ENIAC effort in 1946. … It seems incomprehensible that the legal questions surrounding the invention of computing in the 1940s were not settled until 1973, nearly three decades after the fact."[24]

"The year 1956 was a pivotal one, with antitrust consent decrees issued against IBM as well as Bell. IBM had filed one of the eleven interferences against the ENIAC patent, and IBM and Sperry Rand subsequently filed separate patent infringement suits against each other. In August 1956 the two companies settled their differences with a complex agreement, exchanging patent licenses between them and proposing that IBM pay Sperry Rand ENIAC-based royalties of ten million dollars over an eight-year period."[25]

"Judge Earl Larson's final decision, like nearly everything else about *Honeywell v. Sperry Rand*, defies easy description. Larson was a Minnesota native, University of Minnesota alumnus, and trial attorney who had been named by President John F. Kennedy to the U.S. District Circuit for Minnesota. "Patent cases are difficult for judges," he later wrote, noting that he had tried to engage an outside expert in electrical engineering and law (a former University of Minnesota law professor), but when the expert declined the assignment, "I had to do it on my own." Handing down his decision on October 19, 1973, seven months after sitting through nearly two years of court proceedings, Larson set down his findings in a complex 248 page document. … Larson nonetheless ruled that Eckert and Mauchly were the sole inventors of the ENIAC, setting aside the hopes and claims of half a dozen potential co-inventors and, it may be suggested, creating animosities that persist until today. One of the individuals so slighted by Larson was Arthur Burks. A Minnesota native, born in Duluth, Arthur Burks (according to the court's findings) "made major contributions to the design of the accumulator and multiplier of ENIAC and signed at least 77 drawings" while at the Moore School, then joined John von Neumann's computer project at the Institute for Advance Study in Princeton before spending his career as a computer-science faculty member at the University of Michigan."[26]

[22] Digital State page 135
[23] Digital State page 139
[24] Digital State page 149
[25] Digital State page 152
[26] Digital State page 155

6. Big Blue: Manufacturing and Innovation at IBM Rochester

"IBM was the first computer company to consciously choose Minnesota as a base of operations. The state's other computing ventures had arrived somewhat by happen-stance or grown organically as start-ups or spin-offs. Back in 1946, the location of the Engineering Research Associates was largely a matter of luck, when the navy intelligence officers in Washington, D.C., and Dayton, Ohio, recruited John Parker and his empty glider factory in St. Paul to the cause. … Beginning in 1956, IBM connected Minnesota to the largest computer company in the world. … It also created a development laboratory that assisted with the design, engineering, and development of an array of products and was itself awarded 2,700 patents over three decades adding an additional 440 patents in 2009 and 500 in 2010."[27]

"IBM's decision to create a new manufacturing facility made sense only in the context of the vibrant and expanding punch-card industry. IBM examined eighty Mid-western cities before naming Madison, Wisconsin, and Rochester, Minnesota, as finalists. … Except for the activities of the Mayo medical family in the 1880s, "Rochester would have undoubtedly developed into a pleasant little trade and railroad center for the farmers whose rich claims surrounded it," according to the 1938 *WPA Guide to Minnesota*."[28]

"Although it had defined the personal computer in 1981, IBM had little experience in selling cheap commodities directly to consumers and the stellar profits from personal computers flowed first to Compaq and Dell and ultimately to Intel and Microsoft. … Personal computers first ate into the market for minicomputers, felling the once-predominant DEC, which was acquired by Compaq in 1998 in a merger that created the number-two computer supplier behind IBM."[29]

7. Industrial Dynamics: Minnesota Embraces the Information Economy

"Minnesota companies were at the forefront of the computer industry for two or three decades, but it was a commanding position that proved impossible to sustain. Looking back, it is rather remarkable that Minnesota computing thrived across three distinct generations of technology—vacuum tubes, transistors, and integrated circuits—as well as wrenching changes as computing matured from its founding in government-subsidized niches and entered into the mainstream. These changes required engineers, designers, and managers as well as production workers and maintenance people to master new skill sets several times in one working career."[30]

"FIGURE 7.1. Repairing vacuum-tube computer in 1953. This computer was built by Burroughs, which later merged with Sperry to form the Unisys company in 1986."[31]

[27] Digital State page 163
[28] Digital State page 169
[29] Digital State page 180
[30] Digital State page 189
[31] Digital State page 190

8. High-Technology Innovation: Medical Devices and Beyond

"Other Minnesota divisions of global enterprises include the high-tech anchor firms. The case of IBM Rochester (examined in chapter 6) suggests both advantages and liabilities of being a division of a global corporation. While Rochester benefited from IBM's immense resources as well as handsomely contributed its design, engineering, and manufacturing skills to IBM over many years, IBM's corporate emphasis on "computer services" in recent decades has meant that Rochester has had to scramble to maintain its relevance. Control Data, during the 1960s became a global company with significant activity in Europe, Asia, and Australia. Univac, too, successfully sold its computing systems worldwide, including its lucrative air-traffic-control systems to European and Asian countries. … A number of homegrown Minnesota companies have themselves become global enterprises, such as the medical-device anchor Medtronic. Oakdale-based Imation, the well-known magnetic and optical media manufacturer, was spun off from 3M in 1996 and today has offices, laboratories, and factories in thirty-five countries around the world."[32]

Author(s)

Dr. Thomas J. Misa

Dr. Misa holds the Engineering Research Associates Land-Grant Chair in History of Technology, as such is the Director of the Charles Babbage Institute at the University of Minnesota. His previous computer history books include *Leonardo to the Internet: Technology and Culture from the Renaissance to the Present* and *Gender Codes: Why Women Are Leaving Computing.* Tom is shown here with the portrait of CBI founders, Erwin and Adelle Tomash and an ERA drum collage.[33]

Lowell A. Benson – U of MN BEE, 1966

Mr. Benson has been the IT Legacy Committee Co-chair since its 2005 inception by the local Lockheed Martin Company systems engineering organization and the VIP Club Board of Directors. Since April '07 Lowell has edited or created a relevant 'Article for the Month' for the web site. Each article tells bits or pieces of our Information Technology pioneering. http://vipclubmn.org/documents.html has links to all of them.

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[32] Digital State page 223
[33] Misa CBI snapshot by LABenson; drum collage donated by Don Weidenbach, centered with the drums.