The Control Data Corporation's Supercomputer Systems

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The Need for Speed

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Chapter One

Control Data Corporation

Source: Worthy 1987

Control Data Corporation (CDC) was founded in late summer of 1957 to develop high performance computing machines for the scientific and engineering environments. Several engineers, including William C. Norris and Howard Engstrom, left Sperry Rand Corporation to found CDC in Minneapolis, Minnesota. The new company was financed by the sale of 600,000 shares of stock at $1 per share. Control Data was the first computer company to be publicly financed in the United States (Worthy 1987).

The new company occupied an old warehouse. Over the next several months, other engineers from Sperry Rand joined CDC. Norris and his team worked in an area where "floor space was divided by temporary chipboard partitions". Years later, these partitions still stood and remained unpainted as the company continued to grow (Worthy 1987).

By the late 1950s, IBM had gained control of the computing marketplace. Other competitors, such as General Electric, RCA, and Bendix, tried and failed to compete with IBM, and eventually withdrew from the market. Norris, realizing the futility of competing with IBM, recognized a niche existed in which IBM was not providing systems – the high-performance scientific computing arena. Norris and his team determined "to design and build the most power computers the world had ever seen" to fill that niche.

Through the early 1960s, CDC made several acquisitions that brought in needed technologies and skilled personnel. In the 1960s, many computer systems were leased rather than purchased outright – following a model pioneered by IBM, which guaranteed a continuous inflow of capital. To support such a model, debt was incurred to finance the leasing operation, but this had an effect on the balance sheet and investor perception of the company's financial stability.

One of these acquisitions was Commercial Credit Corporation (CCC) of Baltimore, Maryland in 1968. CCC retained its corporate autonomy (due to financial regulations), but provided CDC with a source of capital for financing computer leasing.

CDC decided to manufacture its own peripherals as it realized that a large portion of the cost of data processing systems was allocated to peripheral equipment. CDC's computer systems required high-performance mass storage systems with significant capacity to match the speed of its computers. Such devices were not available from other companies, so CDC had to design and build its own. Its success allowed it to become a source in the Original Equipment Manufacturer (OEM) market for companies that did not have the capability to build their own peripherals.

CDC also realized that software was becoming a major expense to many organizations. Norris realized that many small to medium companies would buy a computer system if it came with software that could already do what they needed in the way of applications. CDC began developing software applications that ran on its computers that addressed the needs of many corporations. It also modified software applications from companies that it had acquired.

CDC also realized that many corporations could use high-performance computing, but only in less amounts than an entire machine would provide. Their computer systems were too expensive to purchase for many firms that could use some of that computing power. Norris decided that "he wanted to sell a little piece of a big computer at a time". As a result of an anti-competition suit against IBM, CDC gained control of the Service Bureau Corporation (SBC) in settlement (Worthy 1987).

SBC enhanced CDC's ability to offer a suite of services and systems to its customer base. SBC more than doubled CDC's service business both in quantity and breadth of offerings by adding business data processing services to complement its engineering and scientific applications services. Most importantly, it brough a highly qualified and talented management and staff.

By 1969, CDC's timesharing service, which was offered to small and medium companies, was large enough to spin off into its own division, called CYBERNET. With SBC's personnel and expertise, CDC was a prime competitor in the time-sharing arena.

Norris had always been interested in seeing how computers could aid in education. Norris, learning of interesting work at the University of Illinois, offered to install a high-speed CDC computer for the group working on PLATO. PLATO evolved from the late 1960s into a powerful system to support instruction by computer until it became a commercial offering.

As Norris planned to retire in the mid-1980s, he appointed Robert Price as President and Norbert Berg as Deputy Chairman of the Board. The three of them formed a Corporate Executive Office with Price and Berg running the company and Norris offering advice and assistance as needed. By the mid-

1980s, pressure from competitors and the minicomputer vendors whose prices significantly undercut the large, powerful CDC machines. CDC exited the OEM disk drive market, and lowered its prices in other areas. The reduction in profit margins meant less support for research and engineering for new systems.

Competition from Cray Research at the high end of supercomputing, and IBM and DEC in the middle ground, along with financial and management constraints imposed by the SEC and its lending banks, presented CDC management with significant problems. CDC had to slow or severely reduce some of its products and manufacturing facilities, which further eroded its financial viability. Among the losses were Commercial credit, remote data processing, the ETA division, and its training and education programs.

The result was a slimmed down company that focused on computing and systems integration services. In 1992, it changed its name to Ceridian Corporation and spun off computer operations into Control Data Systems, Inc. CDSI focused on systems integration services. By the mid-90s, the mainframe supercomputer manufacturer had ceased to exist although the name Control Data was used by CDSI.

William C. Norris (1911 – 2006)
William C. Norris, the founder of Control Data Corporation, was born in Nebraska in 1911. By high school, he had become interested in physics and electrical engineering. He graduated from the University of Nebraska in 1932 with a degree in electrical engineering. Upon the death of his father, he returned home to run the family farm. At age 30, he joined the U.S. Naval Reserve where he was assigned to a unit whose responsibility was to intercept, analyze, and decode German and Japanese radio transmissions to try to locate enemy submarines. In 1946, he received funding from a group of investors to found Engineering Research Associates in St. Paul, MN. ERA was purchased by Remington Rand in 1951. In 1955, after Sperry Corporation bought Remington Rand, Norris became General Manager and Vice President of Sperry Rand, a consolidation of four computer divisions. Lacking support from Sperry executive management, he formed Control Data Corporation in 1957 where he became President. CDC developed a niche in high performance computer systems for scientific and engineering applications. Between 1960 and 1979, CDC acquired over 80 small companies that greatly

expanded its technical expertise and market. In 1986, Norris retired from CDC after anointing his successors. In 1986 he received the National Medal of Technology for advances in microelectronics and computer technology.

See Also:
William Norris: Computer Pioneer, Maverick Social Activist; Jones Telecommunications and Multimedia Encyclopedia, 1999
Worthy, James C. "William C. Norris: Portrait of a Maverick" Ballinger Publishing Company, Cambridge, Massachusetts, 1987

1.1 CDC Systems Overview

Norris, Engstrom and others had become disillusioned with the company support they were getting for the development of computer equipment and decided to start their own business. Norris and colleagues set up shop in the old Minneapolis Star and Tribune Company warehouse. Initially, Control Data started out as a subcontractor for components used by the big computer companies. Norris's goal was to build the most powerful computers the world had ever seen.

The true history of CDC perhaps begins with the hiring of Seymour Cray in 1958. He developed a modular circuit configuration that could be used in high-speed digital computers. Using Cray's work, in the late 1950s Control Data Corporation produced the world's most powerful computer, the CDC 1604, at that time. At the same time, Cray sketched out the designed for a small computer (e.g., a minicomputer) – the CDC 160 – with a 12-bit word size that could serve as a personal computer or a front-end to the CDC 1604. The CDC 160 influenced the design of the PPs for the CDC 6600.

In June 1958, Control Data got its first order for the new computer from the U.S. Navy Bureau of Ships. The computer was delivered in January of 1960. When CDC announced the 6600, IBM immediately countered, announcing the development of its own supercomputer. The CDC 6600 was billed as a 'supercomputer', defined as a machine that with its relative power, in any given time period, possessed certain performance and architectural capabilities that made their creation unique within the general framework of computer systems (Lincoln 1982).

Orders for the CDC 6600 stalled, waiting to see what IBM was going to come out with. But IBM's machine only existed on paper, and when this became apparent after a year, CDC filed an antitrust suit against IBM. The same month the suit was filed, CDC released its next supercomputer, the

7600, basically daring IBM to try anything. IBM did nothing this time and the 7600 was one of the most successful computers ever built. Five years later, Control Data won the lawsuit against IBM.

When Cray left CDC in 1972, CDC invested over $300,000 in his new company, Cray Research, Inc. CDC further developed the STAR computer system and delivered it commercially as the Cyber 203. A following model, the Cyber 205, was successful. Another group of engineers left CDC with management approval to set up ETA to develop a new generation of supercomputers. Eventually, CDC reeled ETA back in when it felt its prodigy was encroaching too much on the parent's market.

The development of microprocessors, the emergence of superminicomputers and minisupercomputers, threatened CDC's long held niche. Competitors included Digital Equipment, IBM, and Cray Research. CDC started losing money; William Norris stepped down in 1986 as Chairman. But, in an attempt to recover, CDC sold Commercial Credit, its remote data processing bureau, its training and educational services division, and closed its ETA division.

By 1990, it spun off its computer division to a company called Computer Data Systems, Inc. and changed its name to Ceridian, which emerged as a provider of computing and systems integration services. Both still exist, but the mainframe computer manufacturer, a world leader in supercomputing for almost 40 years, is no longer there. Ceridian was eventually bought out and its new owners appear to be committed to eCommerce and Human Resources solutions.

In 2007, CDC published an overview of its first (and last) 50 years (CDC 2007k).

We will not discuss the Omega 480, which was similar to the IBM 370 Series in instruction set and architecture. This machine was not very successful for CDC before it collapsed. We also will not discuss the CDC 924, an early CDC computer system of which only a few were manufactured and, apparently did not much influence the rest of the CDC computing systems.

CHAPTER TWO

CDC 6600

INTRODUCTION

Source: Rosen 1969, Thornton 1980b

CDC wanted to compete with IBM in the scientific marketplace. IBM had the 7094 and CDC had the 1604 – both not quite supercomputers, but the fastest machines in their market space at the time. CDC did not want to build a machine based on a current architecture with faster components because it realized (e.g., Seymour Cray realized) that led to limited performance improvements since the architecture might hobble some engineering enhancements if compatibility was required. Further, CDC had realized that no more speed could be delivered by the existing transistors, so brute force computing was not possible.

Seymour Cray led the engineering team that was to develop the new machine which became the CDC 6600. He had pressed for an entirely new architecture which could wrest the last bit of performance out of the machine given the appropriate components. CDC had been developing new circuitry that extended the capabilities of the components used in the CDC 1604.

James Thornton had been to a UCLA Seminar on existing high-performance machines. Nearly all machines "had exploited some level of parallel operation" (Thornton 1980b). It was recognized that a large percent of computing time was spent traversing the wiring between logic gates. This was estimated to be 25 to 30 percent of the time in critical paths (Thornton 1980b). One specification for the new machine was one million instructions per second (1 MIPS).

About this time, silicon transistors from Fairchild Semiconductor became available. Their improved operating characteristics made denser packaging feasible and led to shorter critical-path wire lengths, which allowed circuit boards to be placed back-to-back with all components mounted internally. New packaging solved several cooling problems that had arisen with the denser circuits. Resistors extended from board to board