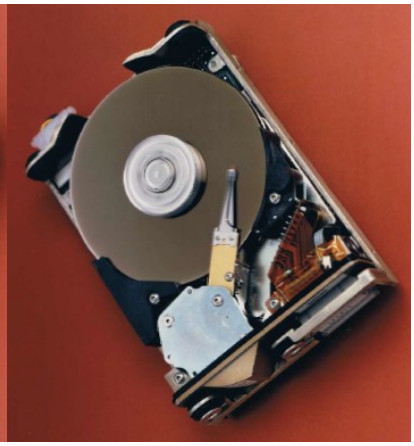
Conner CP340 Family

1987	**Conner CP340 Family**
	Leading early supplier of 3.5-inch HDDs

Finis Conner

Circuit side of CP340 disk drive



Inside view of CP340 disk drive

Significance:
Finis Conner foresaw the trend toward smaller computers and was adept at leveraging relationships. Conner Peripherals established a successful business model using a novel drive design and a unique relationship with a customer-investor which established a growth pattern unmatched in its day. The reliance on total microprocessor control of the drive allowed it to perform better than its contemporaries, and facilitated an unmatched proliferation of drive models. The drive was capable of testing itself, simplifying production and lowering overall product cost.

- Conner became the largest producer of the 3.5-inch hard disk form factor, which remains the principal size used in personal computers over 25 years later. Adoption was simplified by using the Sony 3.5-inch flexible disk form factor already built into millions of personal computers.

- First mass market supplier of the IDE small drive interface, which became the industry standard and was dominant for over 20 years. (See Research Note on Compaq/Conner CP341 IDE/ATA Drive for Compaq Computer's and Conner's involvement in the design and commercialization of this interface).

- Early user of embedded servo track positioning for mainstream desktop drives, allowing closer track spacing and greater capacity.

- Introduced microprocessor controlled drive functionality into mass produced drives, enabling the drive to adapt to its own component variations. The drive replaced hardware with software, lowering cost and providing additional design flexibility.

- Introduced self-testing to commodity drives, allowing the disk drive to analyze and correct defects, or identify itself as "faulty" requiring further technical support. Other companies relied on expensive independent test stands, adding cost and extending manufacturing time.

- Employed a strategy of "sell then build" which guaranteed success by forming an investment relationship with primary customer Compaq. This relationship allowed Conner Peripherals became the fastest growing company at that time in history.

Discussion:

Finis Conner was a co-founder of both Shugart Associates, a flexible disk drive innovator, and Seagate, which became the largest provider of 5.25-inch disk drives. As vice chairman of Seagate, Connor announced plans for a 3.5-inch Seagate disk drive at a trade show in early 1984, but three of Seagate's senior management subsequently

shelved this plan, deciding to concentrate on existing 5.25-inch diameter models. Key disk drive market metrics included storage capacity per drive and cost per megabyte, which favored larger diameter disks with greater recording area. Conner subsequently left Seagate in September of 1984, with $15 million in hand, some of which was spent on a disk drive startup in Southern California, founded as Conner Peripherals in 1985. That development effort produced no new products, and the project was abandoned after less than 1 year. (See 1985 Electronic News article).

The 3.5-inch form factor hard disk drive had been introduced in 1983 by Rodime, a small company in Glenrothes, Scotland (see CHM Rodime article), which was not a commercial success. Rodime and subsequent 3.5-inch drives generally emulated the 3.5-inch flexible disk drive form factor introduced by Sony in 1981. The Sony "Micro Floppy" was adopted by most desktop computers, providing a replacement opportunity for hard disk drive makers whose products could fit into the same space. Other early 3.5-inch producers included MiniScribe, in Longmont Colorado, which Terry Johnson co-founded in 1980. Johnson said IBM, already a major customer for their 5.25-inch product, was a potential customer for MiniScribe's planned 3.5 inch drive (see CHM oral history of Terry Johnson) but MiniScribe could not execute on their plans, and " IBM went away". Terry subsequently sold the company and retired. MiniScribe eventually went bankrupt shortly after a 1989 inventory scandal, and the assets were purchased by Maxtor in 1990.

What became the Conner Peripherals 3.5-inch disk drive was created by John Squires and Terry Johnson, who had worked together at MiniScribe. They joined forces in 1985 to form a new company, CoData, which began in Johnson's Colorado guesthouse. Higher performance features, such as a closed loop dedicated disk servo system, could provide greater capacity favored by the market, but had been deemed too expensive for commodity products. Prior to the Conner CP340 family the 3.5-inch HDD form factor was not a dominant product even though it offered technical advantages of reduced packaging volume, lower power consumption, and was mechanically more robust.

Terry Johnson John Squires

Johnson described Squires' new product as, "a disk drive like one I had never seen before and I'm not sure the industry had ever seen anything like this before" (see links below to CHM oral interviews of Terry Johnson and John Squires) It was totally microprocessor-centered, compared to mechanically controlled drives. The servo system utilized pre-recorded "embedded servo" tracks on the disk itself which allowed the track density to be increased beyond the capability of conventional low cost drives (e.g. those using mechanical stepper motors) and thereby first achieved in the 3.5-inch form factor the capacity point required for broad market success, then 40 MB. While not the first to use this type of servo technology (see DEC RL01), Conner was first in this form factor.

In January 1986, wanting to strengthen the management structure, Johnson and Squires approached Finis Conner about joining their team. Conner, having just left Computer Memories Inc., liked what he saw but it was apparent to both Squires and Johnson that he "had to have his name on the door." In a rather astute gesture, Johnson agreed to step aside and in Feb 1986 Codetta merged into Finis Conner's shell company, Conner Peripherals. Conner did get his name on the door, and when Conner Peripherals went public, Johnson owned 7.1% of the company (see 1998 Prospectus).

Finis Conner's marketing mantra was "Sell, Design, Build", in order to ensure that a new product would be a guaranteed success. He found a willing customer at Compaq computer, which liked the prototype drive, took a 49%

stake in the company with a series of investments, and guaranteed to buy all the drives Conner could build at that time. With money, product, and a significant customer in hand, Finis Conner obtained additional investments, built foreign factories, and Conner Peripherals became the fastest growing company in American history (see 1990 Fortune magazine article). Compaq bought 90% of Conner's drive output in 1987, the first year of production. Conner sales went from $10 million in Q1-1987, to $30 million in Q2, and finished 1987 at over $113 million, then over $256 million in 1988. Conner reached $1.337 billion in sales within four years, a record growth for a startup.

Compaq Computer at that time was introducing a new intelligent interface (IDE) with a drive made for them by CDC. However, in perhaps one of the more interesting HDD management blunders, CDC declined to do a 3.5-inch version thereby creating an opportunity that Conner was quick to exploit (see The History of CAM ATA and Compaq/Conner CP341 IDE/ATA Drive). Conner offered 3.5-inch drives in the desktop and mobile markets, along with SCSI versions for the enterprise market; including narrow, fast, and wide SCSI. The SCSI models were favored by OEMs for their ability to make numerous operational adjustments (e.g. buffer management FIFO/LIFO) in order to optimize performance for particular applications. The Fast & Wide SCSI also allowed "hot swaps", an exchange of drives without need to power down the system. The SCSI standard included features that made drive more complex to design and test than IDE.

The Conner drive could also adjust itself, by measuring the actual acceleration and deceleration of the head positioner, in order to optimize the access speed (e.g. controlled acceleration and deceleration), which reduced the overall positioning time. The firmware was dubbed "Niwot Code", named after a Native American Indian tribe in Colorado. The code was used in all Colorado developed IDE/ATA products and later transported to San Jose for subsequent SCSI products. Another revolutionary change was using the processing power within the drive to test itself during manufacture. Conventional practice before this innovation was to attach each drive to an expensive and relatively slow test stand, which was a bottleneck in production and very expensive, since factories required hundreds of testers, millions of dollars invested, waiting time for tester deliveries, and significant floor space plus manpower. The Conner method utilized the drive to write multiple data patterns and read-back verify to assure correct operation. The only requirement was a power supply; usually one large supply on a rolling rack was used to test over 100 drives at one time. The only drives requiring human intervention were those that failed self-test, lighting an indicator that signaled the need for technical help and possible rework. If a drive failed after two rework cycles it was scrapped.

During the growth years, Conner Peripherals purchased Domain, a thin-film disk company in Milpitas CA, which had pioneered a low cost multiple disk sputtering system. Conner's foray into vertical integration with a more efficient disk manufacturing process provided a significant cost advantage over competitors, which relied on the merchant market for media. Other acquisitions and investments were not as positive: heads (Sunward), tribology (Visqus) and tape (Archive) did not contribute to lowering costs.

Original Conner products were focused on the mass-market opportunity, with designs in Colorado and manufacturing in Asia and Scotland. Conner established world headquarters in San Jose on Zanker Road, including acquisition of nearby land for an even larger world headquarters, but that dream was never realized and the land was later sold.

Seeing an opportunity in the enterprise market (e.g. with Sun, EMC, Intel, etc.) John Squires hired executives from IBM led by VP Mike Workman (PhD servo engineer), who in turn hired a number of co-workers from IBM in San Jose to develop SCSI products. Products developed in San Jose were focused on the high end, were exclusively SCSI, and were designed to provide the maximum capacity achievable with merchant market components. This effort was only modestly successful, with a few big-name customers (e.g. Intel) The various reorganizations during the mid 1990's hindered these efforts and led to the loss of key personnel such as Mike Workman.

When former partners and recent rivals Finis Conner and Al Shugart were seen together at Comdex Fall 1995 the tongues started wagging, and rumors were confirmed days later with the announcement on September 19 of a merger between Conner Peripherals and Seagate. After the merger, Seagate abandoned the Conner enterprise products in favor of those designed in Minneapolis (ex CDC/MPI) and Oklahoma (ex GE/Honeywell/MPI). The Conner acquisition included the highly valued media factory in Milpitas, the skilled Colorado design center for commodity desktop drives, plus additional Asian manufacturing capacity. A number of Conner-unique products were discontinued and sold off shortly after the merger, and the Conner San Jose facilities were turned over to the Seagate Scotts Valley design team to develop 2.5-inch laptop drives. The 2.5-inch drive operation in San Jose had a golden opportunity to supply disk drives to arch-rival laptop makers Toshiba and IBM (plus Acer), but technical and quality problems rendered the effort unsuccessful and the Conner Peripherals San Jose operation was closed. Small drive responsibility was successfully restarted by Seagate at the Longmont, Colorado facility, and the old Conner flagship facility in San Jose became the headquarters for SEMI, a trade association for semiconductor equipment

manufacturers.

Additional information

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1990Fortune "America's Fastest Growing Company," Fortune Magazine, August 13, 1990, p. 48+
Review article:http://www.fundinguniverse.com/company-histories/conner-peripherals-inc-company-history.html

Patents of interest

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US 4965684 "Low height disk drive", Frederick Stefansky, 23 October 1990
US 5029026 "Disk drive architecture", Frederick Stefansky, Glade Bagnell", 02 July 1991

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