

Seagate ST-506

First 5.25-inch form factor HDD

Why it's important By reducing the size of a HDD to fit within a PC case, the HDD industry was able to facilitate the explosive growth of the PC industry. By making available an HDD in the same physical size as the 5.25-inch floppy drive introduced by Shugart Associates in 1976, Shugart Technology's ST-506 made it possible for personal computer manufacturers to easily offer upgrades in storage capacity and access time.

Discussion

Finis Conner as a sales executive at Shugart Associates was familiar with the success of 8-inch HDDs able to fit into the same space as 8-inch FDDs and operate with a similar controller (Shugart Associates SA1000). Conner left Shugart Associates in early 1979, and after a brief interval at International Memories, Inc, he and Al Shugart decided to start a company to produce an HDD which would fit into the same space as the 5.25-inch floppy drive used by the emerging desktop personal computer industry.

By December 1979, Shugart and Conner had recruited Syed Iftikar, Doug Mahon and Tom Mitchell as co-founders to complete the founding team. With their extensive industry contacts, they established a development team which was able to complete a 5.25-inch HDD in time to be shown at the National Computer Conference in May 1980, with actual production of 1,200 drives by the end of 1980.

The company was deliberately named Shugart Technology in the expectation of free publicity from a lawsuit from Xerox Corporation, the parent of Shugart Associates with the rights to use the Shugart name. Surprisingly, Xerox didn't sue and after the ST506 was delivered to customers, the name was changed to Seagate Technology to avoid legal action; nonetheless, Xerox then sued (the suit was settled). Seagate was coined by Al from the letters SGT in his name by combining the words sea gate (he couldn't find one word with the three letters in order).

The initial business plan called for shipping 50 units in Q4, 1980, with a floppy replacement rate of 10% each subsequent year. But when Iftikar had completed the mechanical design in January, 1980, and ordered hard tooled components three months ahead of schedule, a new business plan was generated in February, 1980 that specified shipping 1,200 drives in calendar 1980. The actual number of drives shipped was 1,205. Tom, Syed and Doug tested and shipped the last 5 drives to exceed the plan for good measure at midnight on the last day of December. The founders thought that if 30% of PCs could have a hard drive, then their wildest dreams would have been realized. Today, almost all PCs have a hard drive.

The company's initial facility was a loft built over a warehouse in Scotts Valley near Carbonero Trailer Park and Leo's Liquors. Leo's Liquors became the landmark for providing directions to the company's facility. The loft was built in two weeks by a

contractor--one of the early “venture” investor in Seagate--as a part of his contribution.

Shugart and Conner looked high and low for startup funding, visiting venture firms in Silicon Valley, corporations like 3M, HP & Exxon Enterprises and casino owners in Las Vegas but came back empty handed. No one was interested in a team with no experience running a business and with the threat of a new technology called bubble memories pioneered by Texas Instruments. 3M, however, cut out six 5.25-inch diameter disks from their production 14-inch diameter oxide disks to play with. Iftikar used these disks to test airflow and start/stop times using a Pabst fan motor that Bernhard Schuh, the sales VP of Pabst provided. Mitchell and Conner were very good at convincing suppliers about the great market potential for the Seagate drive.

Norm Dion, the CEO of Dysan, agreed to be the initial disk supplier and to provide initial venture funding of \$500,000. He insisted that the 5 founders sign a promissory note for \$100,000 to pay Dysan back for providing the initial funding. The disk supply agreement was sealed with a handshake and wasn't documented until later rounds of venture funding.

The five founders invested an additional total of \$130,000. With \$630,000 in the bank, the team started developing the prototype drives for the National Computer Conference (NCC) in May 1980. At NCC, Conner started showing the product to potential licensees like Memorex, Shugart Associates, 3M, Texas Instruments, Compaq and Honeywell Bull of France, to name a few. TI and Honeywell Bull decided to purchase the license to manufacture and market the ST506 for \$5 million each. This became the source of major funding for Seagate. It was very important for Seagate to have multiple sources for its ST-506 to promote an industry standard. During its second year of operations, and a few months before its public offering, Seagate was able to raise \$1 million from a venture capital firm.

The initial price was \$1,500 for a 5 MB formatted drive or \$300/Mbyte. John Roach of Radio Shack, one of Seagate's earliest customers told Al that, "... get that down to \$100/Mbyte and I'll buy all you can ever make." Today HDDs are less than 1 hundredth of a cent per MB.

In order to convince TI that Seagate was indeed a viable company and not just a loft over a warehouse, Connor had a local developer make an artist's sketch of a new building and had it displayed prominently in the only conference room in the loft. Tom Mitchell paid a tractor driver \$100 to drive his tractor up and down the adjacent field creating a lot of noise and dust at the time TI was visiting. When TI saw the tractor they assumed that the construction of production facilities had begun. With the \$10 million of license money, Seagate was able to lease a newly constructed building that the artist had sketched for the dog and pony show.

The founders were very hands-on and enthusiastically visited suppliers and customers to pick up components and deliver products to expedite the company's fast growth in its first year of operation. The Seagate team designed the first 5.25-inch hard drive, the first

Winchester arm and E-Block, the first mini air filter, the first brushless DC motor, the first mini stepper motor to run on 12 volts, the first 5.25-inch oxide disk with a 20 Angstrom layer of disk lubrication, the first start/stop tester to measure stiction and the first particle counters to measure levels of contamination. All this was done in 5 months. Seagate's clean room became the showcase to many OEMs who signed up as its customers. Details of the drive are shown in a 1981 product brochure.

The success of the ST-506 provided a stimulus for numerous other disk drive manufacturers to initiate 5.25-inch HDD programs, and by 1983 there were 32 manufacturers producing 5.25-inch HDDs, with a worldwide production total exceeding one million drives. The 5.25-inch HDD form factor remained dominant with desktop personal computers until 3.5-inch HDDs became widely available in the second half of the 1980s. Seagate's success in establishing a major marketing campaign and in obtaining licensing agreements with major firms such as Texas Instruments and Cii-Honeywell Bull created a high level of stature in the industry for the Seagate drive and its interface.

For the first several years of production, most manufacturers of 5.25-inch HDDs used the same interface as the ST-506, which became the dominant standard until embedded controllers were introduced in the late-1980s, see Conner CP340A. In the early 1980s, HDD capacities were mostly specified in unformatted capacities, and the ST-506 was specified at 6.38 MB, although today we generally think of its capacity in formatted terms, at 5 MB.

Seagate went public in September 1981, thus making the founders well known in an industry that grew by leaps and bounds and making Seagate the dominant supplier of hard disk drives.

Additional anecdotes: While the IBM PC architecture would ultimately dominate, DEC was first major customer for the ST-506 for its Rainbow PC (which used both 8086 and Z80 CPUs). Shugart and Connor were invited to show the ST-506 prototype at DEC's annual engineering management conference at Stratton, VT, probably the biggest exposure they had yet. In traditional Silicon Valley fashion, their first purchase order was negotiated over cocktails and written on a cocktail napkin. Conner saved it. After he left Seagate, as CEO of Conner he had it framed and displayed, but inside a closet door in his office.

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