1971: A Year In the Life of Computing Technology and Applications

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The 1970s were a seminal decade in the history of both computing machinery and the applications humanity was finding for its increasingly intelligent machines. The proliferation of cheaper computing power and the rise of a formal software industry both would prove influential to computing. The year 1971 would spark the growth of the personal computer, the precursors of the Internet, and give birth to the "processor on a chip" microprocessor, the 8" floppy drive and the word processor[i].

Events relevant to the history of computing during the year 1971 can best be segregated into two categories: The technologies and products themselves and the uses corporations and institutions found for these products. The general purpose computing technology that began to arise during 1971 would allow the "DP" or data processing companies that had sprung up during the 1960s to re-brand themselves and their products for more widespread use. This de-isolation of the computing industry would allow for the birth of the PC and the death of the specialist that had until that time dominated the application of computing technology. Most importantly, the individual user would began to see the applications and benefits computing technology could hold for their lives, a development that would take another decade to realize but began in 1971 with the creation of a product known as the Intel 4004.

The Intel 4004, which went into production between October 1970 and January 1971[ii], was originally designed as a processor for small calculators for an electronic firm known as Busicom. Busicom had made arrangements for Intel to produce the chip; however the engineers working on the project were quick to realize the general-purpose applications that the 4004, and its accompanying chipset could provide. The processor's inventors were three Intel engineers: Ted Hoff, Federico Faggin and Stan Mazor[iii]. In

November of 1971, they lobbied Intel to change their agreement with Busicom to allow Intel to market the chip independent of the other manufacturer. In what would become a watershed move for Intel, the chipmaker was able to modify the exclusive manufacturing agreement with the calculator manufacturer to allow them to market the chip for broader purposes. Without this leap of insight on the part of Hoff and the other inventors, Intel may have stuck to their core business of RAM manufacturing and wound up a bit player in the high technology industry, rather then the industry giant it has become. As Hoff's biography demonstrates, changing the corporate mindset at Intel was easier said then done. Intel had trouble seeing the reasons they should dilute their focus based on the whim of a few junior engineers:

> Hoff, Faggin, and Mazor immediately pitched ideas for new chip uses to Intel. But Intel initially thought the chips were only good for calculators, and besides, Busicom owned the rights to it. The developers finally convinced Intel that the 4000 series could be used in other applications and Intel renegotiated a non-exclusivity agreement with Busicom. In November 1971, Intel began marketing the 4000 series (then known as the MCS-4) to the public. The original 4004 chip had as much computing power as the first electronic computer, ENIAC (1946), which filled an entire room.[iv]

The 4004 would become the progenitor for the entire series of Intel processors, and the Ted Hoff's idea of a "processor on a chip" would be secure for decades to come. The 4004 gave birth to several processors, culminating in Intel x86 microarchitecture, a computing platform that today runs a large portion of the worlds' desktop personal computers. For the microprocessor, 1971 would turnout to be a defining year.

Advanced in data storage, and specifically the invention at IBM of the "diskette" or "floppy disk" as its commonly know also contribute to the changing perception of computers, increasing their versatility and reliability. The story of the floppy disk begins with IBM. In 1967 the company realized that a better way to load the main control

program onto their system 370 minicomputers was needed. Since the entire program's was stored in volatile memory, a power interruption would force a time consuming reload of the control program from tape. A method of storing data in a non-volatile, instantly accessible fashion was deemed necessary, and IBM's storage division began work on what would eventually become the floppy disk. In 1971, IBM presented its 8-inch floppy disk, which it called a "memory disk."[v] The technologies behind the disk seem quite simple, but were revolutionary at the time, and would help to push computing closer towards the idea of instantly accessible, non-volatile storage, a concept that would later be embodied by the smaller floppy disks and finally the hard drive. A rapidly spinning, metal-oxide coated piece of plastic formed into the shape of a disc was spun at high velocities beneath a read head. The head could sense the subtle magnetic variations contained with in the oxide surface of the disk, and interpret those variations as data. The inventor of the disk was an IBM storage group engineer David Noble[vi]. Besides inventing the device its self, Noble ingeniously came up with the idea to enclose the disk in a cloth sleeve that prevented contaminates from causing errors in the head's read and write operations. Al Shugart, Noble's supervisor at IBM, speaks of the crucial notion of the plastic sleeve:

> It was a read-only, 8-inch plastic disk coated with iron oxide, weighing just under 2 oz. and capable of storing about 80K bytes. A crucial point in its design was the creation of the protective enclosure. "We had this floppy disk running, but it wasn't in an envelope [plastic jacket]," Shugart says. "The contamination just killed you. Error rates were too high." So the jacket was lined with a non-woven fabric that continuously wiped the surface of the disk as it rotated to keep it clean. "That made the thing go," Shugart says. After passing extensive tests, the floppy was incorporated into the System 370 in 1971; it was also used to load microcode into the controller for IBM's Merlin 3330 disk pack.[vii]

The crude, early device of 1971 would go on to become the basis for IBM's Winchester hard drive design and the 5 and one-quarter and 3 and one-half inch disks that

were quite prevalent in the world of computing until recently. Another spinning disc coated with material on which it's data is stored has replaced it – the CD-ROM.

While Intel was creating the first general purpose microprocessor and IBM was creating what would become the standard for computer storage, Apple pioneers Steve Wozniak and Bill Fernandez were busy working on what they thought of as a hobby – the legendary "Cream Soda Computer."[viii] Named after the amount of soda the two drank while designing and building the machine, the computer was technically unremarkable, but is historic in the sense that it was the first venture between two of the three individuals who would go on to found a computer company that would introduce ease of use as a concept to the personal computer market. Wozniak would eventually become one of the Engineers working on the Apple I, the first foray by Apple into the personal computing market.

The simple computer the two built consisted of no microprocessor, but did contain two 4-bit logic units, and a series of lights and switches that were used to accept inputs and convey outputs. Wozniak even designed a few simple pieces of software to run on the machine, performing simple arithmetic and other operations. When Fernandez's mother heard about the machine the two had built, she called a local reporter to come to their garage and do a story about the machine[ix]. When the two attempted to demonstrate their computer to the reporter, a fault power supply caused some of the circuits to short out, and smoke poured from the burning electronics. The reporter decided that a story about the two budding young engineers was perhaps not such a wise idea, and the two would go undiscovered for several more years until their work at Apple. Wozniak expressed his dismay; "We didn't get our story in the papers. We didn't get our

pictures taken. We didn't become heroes."[x]

Another leap forward in the general application of computing technologies came in the form of the world's first word processor, the Wang 1200. Although word processing would not catch on until 1979 and the introduction of the PC based WordStar package, Wang released the 1200 as a dedicated, computer based word processing system when no other corporation viewed the computer as a platform to complete such a task.

One of the most relevant new technologies to see the light for the first time in 1971 was the early forerunner of the Internet, "DARPANET." This network, sponsored by the U.S. government's Defense Advanced Research Projects Agency, would provide the technical legwork, such as the introduction of core protocols and global addressing schemes, to allow the Internet we know today to flourish. 1971's relevance to "DARPANET" and the Internet is that it was the first year that a sufficient level of functionality was present on the network in order to allow applications to be developed for it. In 1971, the Network Computing Protocol, or NCP was fully operational amongst all of the network nodes. Because this level of service had been achieved, the researchers, who until then had concentrated on finding a way to get the network to function technically, could begin developing applications to run across the network. Internet protocol pioneers Vint Cerf and Bob Kahn agreed that since this long awaited network software phase was now complete, development could commence on applications.

> Computers were added quickly to the ARPANET during the following years, and work proceeded on completing a functionally complete Host-to-Host protocol and other network software. In December 1970 the Network Working Group (NWG) working under S. Crocker finished the initial ARPANET Host-to-Host protocol, called the Network Control Protocol (NCP). As the ARPANET sites completed implementing NCP during the period 1971-1972, the network users finally could begin to develop applications.[xi]

Although 1971 was a year when few historically significant developments for the Internet took place, critical work on the protocol suites and network applications was being completed. The Internet had yet to grow from this primitive scattering of nodes at various universities and military organizations to anything tangible, but during this year the development of the consumer-friendly and commercially viable network we now see today was rapidly taking place.

Technologies like those described earlier have been instrumental in changing what was once the monolithic, costly, and difficult façade of computing into what we see on our desktops, laptops and cellular telephones everyday. Although movement in core technologies is always important, of more consequence is how society in general, driven by the computing industry uses these technologies. 1971 was not only a year when computing moved forward, it was a year when the imaginations and vision of those in computing were quickly finding new ways to use these wonderful technologies.

Sports and electronic data processing (EDP) were being brought together for a variety of applications. EDP systems were being utilized for statistical tabulations and analysis, information retrieval, real-time modeling, and other purposes. Sports teams around the nation were enhancing the viewer's entertainment experience with graphical interpretations of game data, analysis of player performance and scoring, and simply providing as much information to the viewer as possible. EDP was used to create massive, animated banners to display scores and related statistics to fans at sporting events, and the fan's response was very positive. Datamation, in a 1971 piece about sports and EDP, outlined several areas where computers could be, and were, being applied in the sporting world.

> 1. *Entertainment*. Athletics are fun; people enjoy participating in and watching sports, which means computer people can easily enjoy applications in this area. 2.*More Information*. Computers can make the sport more interesting since it provides more information to everyone involved. *3. Improved Performance*. Computers can improve the athletic performance and quality by providing more information in less time than with other methods. It should be made quite clear at the start that computers or their output are not going to take the place of people in any sport. Rather, computers simply provide a way to organize and analyze the available information so that it can be put to the best possible advantage of the athletes.[xii]

It seems very telling that the author is quick to warn the readers that computers will not "take the place" of any athletes in sports. This exemplifies the sentiment of the time that computers were at risk of removing humans from certain aspects of life. Some 30 years later this is still not the case, but in the intervening decades computers have found a far-reaching role for themselves in sports. Sporting events are produced, displayed, scored and analyzed all with the help of computing technology. Computers have allowed sports to mature into the mass-market product they have become. Weather or not this is a positive outcome will have to be left to historians.

Optical character recognition, or OCR, is of course the system by which computers, utilizing some sort of optical interface, can recognize printed words from a page of text and convert them into "machine readable" format. In 1971, OCR was a technology that had been available for almost 15 years, however during that time period the rudimentary optical scanning and pattern recognition hardware and software that was available made the technology unreliable and expensive. 1971 was a year when corporations saw human input costs increasing, while at the same time the price of OCR equipment was dropping. This lead to the widespread deployment of OCR systems, systems that would take the place of many human data entry specialists. Far from being a negative side effect, this increased adoption of computing technology for general-purpose

applications would help the industry spread and flourish. The year saw OCR equipment, which had been in the $750,000-1 million range; drop to between $50,000 and $100,000 per install. With costs dropping, organizations quickly found applications for OCR. Datamation, in 1971, described the rapid spread of OCR to the corporate world

> As prices have declined, the number of applications for OCR systems have been expanded. In the past, the chief concern of most users was the replacement of card (keypunch) systems where return documents were processed. This philosophy spurred the development of credit card charge slip, utility billing and subscription fulfillment systems. Despite this, there is little realization, even among data processing people, that the large gasoline and financial credit card systems would simply not be possible without reliable, highs peed, OCR charge slip readers, and by far the largest volume of credit card processing is done in an environment of multiple machine installation…"[xiii]

Saying that such systems would "simply not be possible" without effective OCR highlights just how important this technology was (and is) to business. OCR is a powerful enabler when it comes to transferring the written world of humans to the digital world of machines. Although reduced in significance somewhat by purely digital transaction systems, OCR still allows the credit card and bill processing industries to exist in a cost-effective form.

A union between computers and engineering that would at first seem experimental, but go on to encompass the entire industry, was also tentatively defined in 1971. Engineering professionals began to see computers as a technology that could both streamline and increase the safety and efficiency of their work. Outside the native realm of electrical engineering, one of the first "traditional" disciplines of engineering, architecture, began to realize the value computing and EDP could build for their industry. The Boston Computing Conference of 1964 was the first ever gathering of architects looking for computing technology that would suit their needs. The needs of architects are broad, and range from arithmetic calculations to materials analysis and computing stress

loads on their structures. Because of this general need, hardware and software manufactures were slow to develop applications specifically designed for the architectural community. Additional reasons were described in Datamation in September of 1971.

> Hardware manufactures and general software companies have been slow to develop programs for the architectural industry. There are two reasons for this apparent lack of interest: 1. The market size of the architectural industry is limited relative to other industries such as aerospace, etc. and 2. computer specialists typically have a lack of understanding regarding computer potential within the architectural industry.[xiv]

Because of this disconnect between the architects and the computer specialists, architectural applications were slow to emerge. However, a few applications were turned out for some of the most common architectural applications. “Space planning,” the allocating of area within a building such as an office or home was something that became available to architects in 1971. A program known as MATRAN was developed for this task, and enjoyed some success amongst the architectural community. Additionally, programs for urban planning were developed at the Laboratory for Computer Graphics and Spatial Analysis at Harvard. This was the only organization formally churning out software for the architectural community at the time. Because of the graphics-intensive nature of architecture, the technologies of the day were simply not mature enough to be of a great use to architects. The early acceptance and need for such programs demonstrate that in 1971, architecture was an industry filled with opportunities and applications for computing technology.

Large organizations exhibit a high degree of complexity in their processes for resource allocation, HR management, payroll, and other logistic efforts. This confluence of batch processing needs makes them an obvious target for computing technology’s

streamlining abilities. Although universities used computing to scientific or academic ends, 1971 was one of the first years when enterprise resource planning and organizations communications software would proliferate on the academic front. Dartmouth College began using a time-sharing system, known as the DTSS in 1971 to solve logistical shores, but also to provide executive support and decision support information. An analysis of their system in 1971, Datamation looks at the situation of the college's president.

> John G. Kemeny, computer genius, Ivy League College Professor, mathematician, philosopher and football nut sat down at the teletypewriter console in his office. Dartmouth College was in the last stages of its capital fund drive. The trustees were coming the next week. Kemeny needed to some projections: How well was the drive going? What would Dartmouth's financial position be in five years?
>
> Kemeny punched away at the teletypewriter, and, moments later he had the answers to his questions. "I don't know how an American executive can get by without a computer," Kemeny told a recent visitor in describing how he uses the Dartmouth Time-Sharing System.[xv]

Organizations were beginning to realize the efficiency and decision support gains technology could offer them. Dartmouth is notable in so far as was one of the first academic organizations, not corporations, to use technology for a non-academic goal.

When it comes to the advancement of computing technology, 1971 is rather unspectacular. No wonderful breakthroughs or Earth shattering new technologies. Perhaps more important then any of that, 1971 was a year when much of the technological legwork that makes computing possible was completed. Things that society wanted from computers were becoming viable products, and organizations for the first time were becoming proactive in identifying market needs and trying to role out software products to meet those needs. With the delivery of the Intel 4004, the Wang 1200, parts of what would become the Internet, and the growing general application of technology to most facets of a modern business's operations, 1971 should be considered an important year to all computer scientists.

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