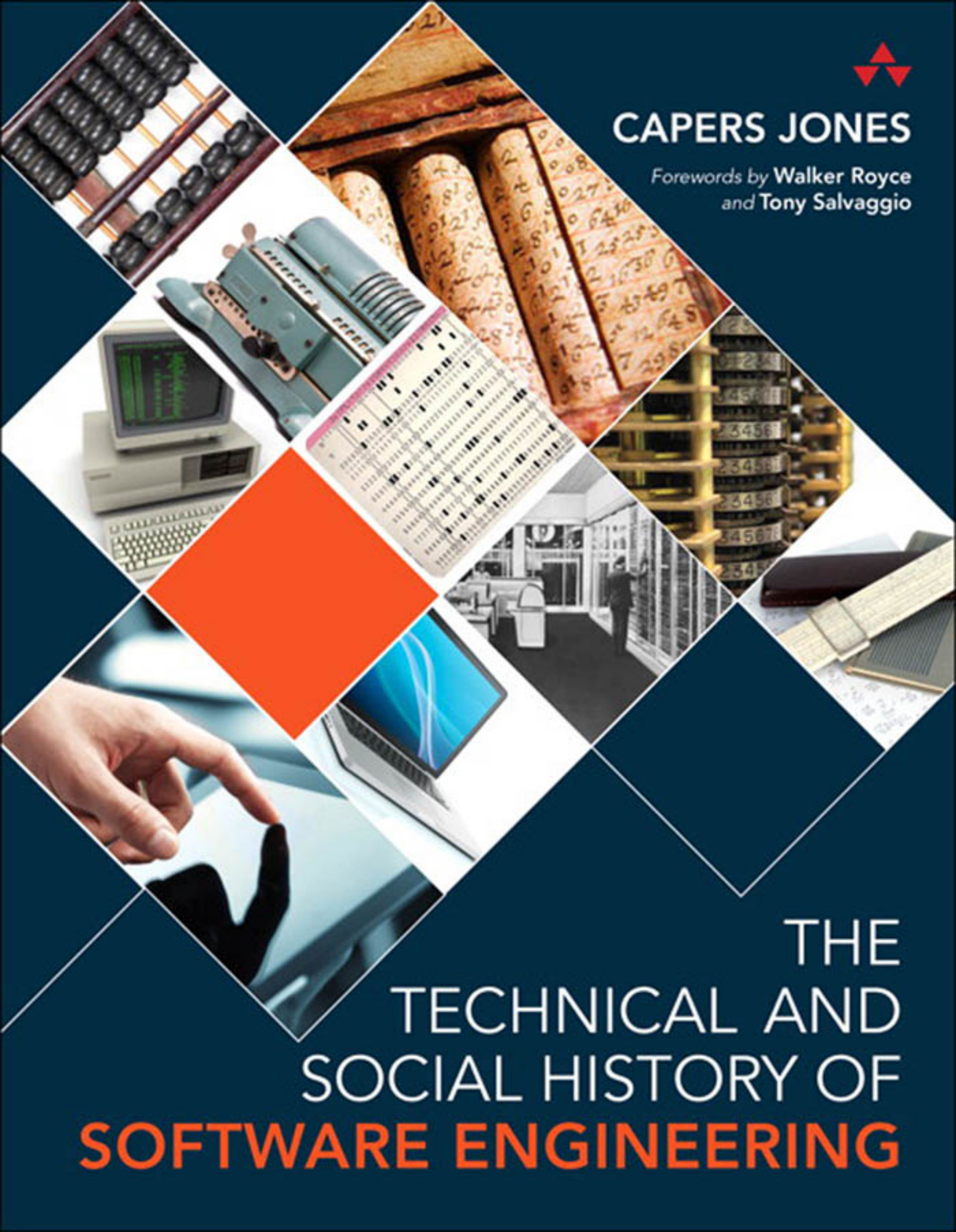

CAPERS JONES

Forewords by **Walker Royce** *and* **Tony Salvaggio**

THE TECHNICAL AND SOCIAL HISTORY OF SOFTWARE ENGINEERING

The Technical and Social History of Software Engineering

- GE
- Honeywell
- National Cash Register (NCR)
- RCA
- UNIVAC

During this decade, the computer and software business was exploding in size and capabilities. In later decades, the business climate would change and most of the smaller computer companies would be acquired, withdraw from computers, or go out of business, as will be discussed in later chapters. The competition between IBM and these companies is interesting in its own right but only of peripheral interest to the history of software engineering.

Other computer companies not included in the "seven dwarf" list were somewhat specialized and included the following:

- Amdahl
- Apollo
- Cray
- Data General
- DEC
- Ferranti
- Fujitsu
- Groupe Bull
- Hitachi
- Mitsubishi
- Nixdorf
- Olivetti
- Scientific Data Systems (SDS)
- Sun
- Wang
- Xerox

Not all of these appeared in the 1960s, but it is clearer to list them all in one place rather than scattering them through several chapters.

In addition to digital mainframe computers, there were also a number of specialized analog-digital hybrid computers mainly used for engineering and scientific problems. These are not as well known as pure digital computers. Two examples of hybrids were the HYCOMP desktop analog/digital hybrid from 1961 and the larger HYDAC 2400 analog/digital computer from 1963. Others included the Beckman hybrid from 1960 and the EAI 680 scientific hybrid used in engineering.

Pure analog computers remained in widespread military service as bombsights, torpedo guidance computers, and missile-navigation systems. Analog computers would dominate military weapons for more than another decade. The use of digital computers on the Apollo spaceships would soon pave the way for digital computers to take over from analogs on aircraft and missiles.

Portable computers and notebook computers will be discussed in later chapters. However, although commercial notebook computers did not exist in this decade, Alan Kay created an early concept of a notebook computer called *Dynabook* in 1968. His idea was to provide schoolchildren with portable learning devices.

An article published by Kay in 1972 showed a device that looked remarkably like a cross between a modern tablet computer and a notebook. This was a visionary idea that would later grow into powerful concepts at the Xerox Palo Alto Research Center (PARC) in California where Kay worked. Xerox PARC will come up again in the next decade due to the impact that Xerox technologies had on Steve Jobs and Apple Computer.

The need for computers as business tools was clearly shown by what happened to Wall Street. Between 1965 and 1968, shares of stock traded on Wall Street increased from about 5,000,000 to 12,000,000, which stressed back office clerical work to the breaking point. Clerical staffing increased rapidly.

One of the reasons for the increase in stock sales was a reduction in the percentage of a stock's price that needed to be paid to acquire it. The rates were reduced from 100% of the stock's value down to 70%, which naturally led to increased sales volumes.

But in 1969 and 1970, stock trading declined abruptly, cutting into brokerage revenues and causing layoffs and financial distress among brokerage houses. About 100 Wall Street firms went out of business or merged, which was a shrinkage of about 17%. For Wall Street companies, this was the worst crisis since the Great Depression.

Many of the Wall Street companies that failed did so in part because they had lost control of their back office financial records due to huge clerical workloads. About 90% of the operating costs of Wall Street firms in this decade were tied up in clerical work. Clearly, Wall Street was ready for a move into computerization, which would occur in the 1970s.

Litigation Changes the Computer World Forever

The 1960s witnessed several major lawsuits that would change the nature of computing and software in unanticipated ways. The first of these major lawsuits were two patent violation cases filed by Sperry-Rand against Honeywell and a countersuit filed by Honeywell against Sperry-Rand. Both suits were filed on the same day, May 26, 1967. Honeywell filed a few minutes before Sperry-Rand, which later turned out to be important.

Honeywell charged Sperry-Rand with being a monopoly and asked that the patent on the ENIAC, owned by Sperry-Rand, be invalidated. The impact of the ENIAC patent was that Sperry-Rand was claiming ownership of the main features of all digital computers and therefore charging license fees. This patent was a clear bottleneck to the expansion of the computer industry.

This lawsuit and several predecessor lawsuits were the longest trials in American history and accumulated thousands of pages of data and information about computer technology and the history of digital computing. In total, more than 150 witnesses were involved.

Not only was this case important for the computer and software industries, but it happened to be the first major lawsuit where computerized legal files were used.

The fact that Honeywell filed first led the case to be tried in Minneapolis rather than in Washington, D.C. At the time, Honeywell was the largest employer in Minnesota, so the outcome of the case was important locally.

The case was not decided until the 1970s, so it will be discussed again in the next chapter. The importance to the industry and to this book is that the eventual decision invalidated the ENIAC patent. This had the effect of putting most of the technology used to build digital computers into the public domain. This, in turn, led to a significant expansion in computers and companies building computers.

Another momentous event for the software industry occurred in 1969, when IBM unbundled software as a result of an antitrust suit. Prior to 1969, IBM computers came with the software bundled and not priced separately. Bundling

or providing software for free was a barrier to entry, and unbundling led to the creation of today's vast software market.

The IBM antitrust lawsuit was filed at the end of the decade on January 17, 1969, by the Department of Justice. It would not be decided until the 1980s, but by then unbundling was long established. (The case was eventually withdrawn by William Baxter in January 1982. Baxter was the Assistant Attorney General in charge of antitrust.)

There were some noncomputer pure software companies during this decade, and they concentrated on applications packages that were not closely tied to any specific computer brand or model. One of the most successful and longest-running software companies was Cincom, which was founded in 1968 by Thomas Nies, Tom Richley, and Claude Bogardus. All three founders had worked for IBM prior to founding Cincom. (The unusual name of the company is based in part on the fact that it was started in Cincinnati, Ohio.)

In those days, IBM provided operating systems and systems software and compilers, but client companies were expected to write their own applications. Having clients write their own software applications explains the huge increase in software personnel during this decade.

The Cincom vision was to commercialize common kinds of software applications that were widely used and needed. One of these areas of common need was the database. The Cincom TOTAL database package entered the market in 1970 and was a pioneer in commercial DBMS. Cincom was and is a successful software company that has outlived many of its competitors.

Computers and Software in Space

On July 20, 1969, the Apollo 11 spacecraft landed Neil Armstrong and Buzz Aldrin on the moon. This was one of the greatest scientific achievements in human history.

The Apollo spacecrafts pioneered the use of digital computers and software for the space program. The physical computer used on the Apollo program was among the first to combine integrated circuits and low-power transistors. It was named the Apollo Guidance Computer (AGC).

The AGC utilized a special kind of read-only memory (ROM) called a *core rope*. A magnetized strand passed through hollow cores. Up to 64 separate wires could pass through a core, and each carried software information. The advantage of core ropes was high-density storage—about 18 times more data than conventional magnetic cores could hold.

These core ropes were actually woven by female seamstresses. This gave rise to a slang term for the memory of "LOL," or "little old lady."

Although the Apollo team included many famous engineers and scientists, Charles Stuart Draper was one of the Apollo computing pioneers. The famous MIT lab in Cambridge, Massachusetts, is named for him.

IBM was also a participant in the Apollo program, and the famous IMS database was first created for the Apollo program, but it was also marketed commercially.

The Apollo software was programmed using both an assembly language and an interpreted language. A special real-time, multitasking operating system was developed for the Apollo program. While the Apollo computer was slow and limited compared to today's computers, it was a great step for computing, just as landing on the moon was a great step for mankind.

Alarmingly, during the descent to the moon, a number of error conditions and error messages appeared, indicating computer or software problems. Apparently, too many tasks were executing concurrently and exceeding the system capacity.

Fortunately, the software had priority scheduling algorithms and it was possible to eliminate low-priority tasks so that the actual guidance of the descent operated perfectly. One of the Apollo guidance controllers, Steve Bales, received a Presidential Medal of Freedom award in recognition of his successfully ensuring the Apollo landing.

The Apollo computer and software systems were important precursors to "fly-by-wire" systems that would become the norm on future aircraft and the space shuttle. The near disaster during the Apollo 11 descent, and the even greater problems with later Apollo missions, emphasize the fact that onboard software for aircraft and space vehicles needed to approach zero-defect quality levels.

Computer and Software Growth in the 1960s

As the decade neared its end, computer programming was evolving toward software engineering, with improved standards and better quality control.

I went to work for IBM at their lab in Boulder, Colorado. During a 12-year tenure, I was fortunate to meet a number of IBM colleagues who would contribute important insights to the software engineering field.

Among my technical colleagues were Dr. Harlan Mills of "clean room" and "chief programmer" fame; Dr. Ted Codd of relational database fame; Dr. Ken Iverson, the inventor of APL; Dr. Charles Turk, the codeveloper of IBM's first software cost-estimating tool; and Dr. Gerald Weinberg, the author of *The Psychology of Computer Programming*.

Among my management and executive colleagues were Jim Frame, who managed the IBM Santa Teresa Lab; Ted Climis, the head of the Systems Development Division; Dr. Fred Brooks, who was in charge of the OS/360 and later wrote *The Mythical Man-Month*; and T. J. Watson, Jr. Watson personally sponsored an initiative to improve the quality of IBM software, and he was the executive who sponsored the S/360 line.

By the late 1960s, computers were also starting to have an impact on sports. In 1968, a golf pro named Jim Healy built the first computerized tool for calculating golf handicaps. Later, this kind of software would become the industry standard for amateur and professional golfers.

The original tool was a one-off build using a custom microcomputer. Later, in the 1980s, the software migrated to personal computers starting with Radio Shack Model II and then moving to Apple and IBM personal computers.

The decade also witnessed the development of the UNIX operating system by AT&T Bell Labs in 1969. The same year, the Department of Defense Advanced Research Projects Agency (DARPA) introduced ARPANET, which was the forerunner of today's internet.

There were cowboy development, low-level languages such as assembly and later macro-assembly languages, and then mid-level languages such as COBOL and FORTRAN.

Small applications were the norm at the start of the decade, but size increased by the end of the decade. Toward the end of the decade, several newer languages such as ALGOL, LISP, COBOL, and FORTRAN started to be increasingly used.

Table 5.2 shows approximate numbers of U.S. software applications for the 1960s. The number of applications was starting to expand across all kinds of software applications. Software was no longer restricted to scientific and military endeavors but indeed was moving into every aspect of human life.

All of the major business categories have software applications, and even games and artistic activities are starting to use software. This would accelerate in later decades.