Siemens first moved into data processing with the development of the "2002" digital computer (below). Since then, IT has transformed the semiconductor industry (far right), and today it has a major impact on all of Siemens' Groups.

SOFTWARE IS THE KEY

Software is a key technology for Siemens. Back in 1954, a small team of 16 pioneering technicians began to develop what would become the world's first fully transistorized, general-purpose computer. Today, half a century later, Siemens employs more than 30,000 software specialists.

By today's standards, the budget back in 1954 was tiny. Hans Kaufmann, then head of Data Processing Research at Siemens, and his small team were given 150,000 deutsch marks a year (about $75,000) to build a digital computer.

Today, IT and software are more important to Siemens than any other core technology. There's hardly a system or device sold by the company — whether in automotive electronics, rail technology, factory automation, power plant control, medical technology or telecommunications — that doesn't feature digital circuitry and "embedded intelligence." These days, it's generally the software, and no longer just the hardware, that determines which functions and features electronic products can offer.

Of the roughly five billion euros that the company invests every year in research and development, 60 percent of the total is dedicated to software. "And software's significance in products is about to take on even larger dimensions," says Reinhold Achatz, head of Software and Engineering at Corporate Technology. Today, Siemens employs approximately 30,000 programmers and software engineers.

More than half a century ago, when the company was still picking up the pieces after the Second World War, some farsighted managers at Siemens had already recognized the potential of data processing. A resolution of March 18, 1954, records the decision by the managing board of the former Siemens & Halske AG to take the company into the then fledgling field of "information processing," as computer technology was known in those days. Four months later, the central laboratory had set up a working group for data processing, which was headed by Hans Kaufmann.

Despite scanty equipment and no relevant experience, Kaufmann's team managed to produce an initial working prototype by 1956. The Siemens "2002" digital computer was the first of its kind to completely replace temperamental, bulky tubes with reliable semiconductors.

The 2002 was the world's first production scale, fully transistorized general-purpose computer. The company's first customer was the German Research Foundation (DFG), which in 1957 placed orders for three data-processing systems for university institutes in Aachen, Berlin and Tübingen.

Soon after, Siemens' central laboratory began development of the "3003" series, the first to feature the integrated circuitry used in today's computers. The 3003 was designed not only for commercial and technical-scientific tasks; it could also be used as a process-control computer in industry. In 1966, a 3003 system was interfaced for the first time with a 3003P process-control computer at pipe manufacturer Thyssen Röhrenwerke. It was a milestone on the road toward fully automated production — a trend that would later create a sensation in the 1980s with the emergence of computer-integrated manufacturing (CIM).

In this respect, Siemens was carrying on the tradition of Konrad Zuse's ground-breaking innovation of 1941, the "Z3" relay computer. "Speaking from a historical perspective, the Z3 was the first computer — that is, a program-controlled processor — that really worked," says Kaufmann. Zuse KG, which the computer pioneer founded in Bad Hersfeld, Germany, in 1950, mainly produced specialized computers for the optical industry. Zuse's company was subsequently taken over by Siemens in the mid-1960s.

By then, there were already clear signs that data processing was on its way to becoming a tremendously dynamic and very profitable business for the company — and one that would have a major impact on other Siemens businesses, such as plant automation, medical technology, telecommunications and transportation systems. In 1960, Siemens posted sales of a mere ten million deutsch marks with data-processing systems. Twenty years later, sales at the former Data Technology Group had grown to 3.2 billion DM. Today, about 60 percent of the company's total sales of 75 billion euros depend on software in one way or another.

The importance of in-house IT innovations for the company as a whole is perhaps best illustrated by the development of a computer aided design (CAD) system for large-scale integrated circuitry that was launched on the market in the early 1980s.

This was a major leap forward for the so-called "mega-project" (see p. 94), and one that wiped out the advantage that Japanese industry had held in the development of integrated circuits. The CAD system wasn't only marketed to external customers; it also was used intensively at Siemens Data Technology and Telecommunications as well as at the business units for Automotive Electronics and Factory Automation. "Our CAD systems helped all the groups within the company to speed up development and cut costs," recalls Heinz Schwärtzel, at that time a corporate department head for computer science and software.

By the mid-1980s, Siemens launched development of what's known as a "parallel computer," in which thousands of small processors simultaneously work on one complex task. This research eventually led to development of the "Synapse" neurocomputer, which was launched on the market in 1993.

With a processing power of 5.1 billion operations per second, it was the fastest computer of its kind at that time. Synapse imitated the function of the human brain, which is made up of billions of neurons linked by an equally enormous number of synapses. Neurocomputers are used for applications involving complex processes, such as image processing or voice recognition, which cannot be encapsulated by exact formulae.

Around the same time, Corporate Research also set up a team dedicated to developing algorithms for use in artificial neural networks and their applications. This subsequently led to the establishment of a center of excellence for the development of neural and fuzzy logic applications as well as adaptive learning procedures for plant and machinery, which have since been used very successfully to optimize processes in areas such as the steel and paper industries and wastewater treatment.

These adaptive algorithms demonstrate just how useful software has become in today's society. Yet the growing complexity and volume of code is confronting computer programmers with what is perhaps an even more formidable challenge: Tomorrow's software will have to be user-friendly and free of defects — not to mention cost-efficient.

■ *Günter Heismann*

COMPANY-WIDE SOFTWARE INITIATIVE

Back at the beginning of the 1990s, Heinz Schwärtzel launched an initiative at Corporate Research with the objective of improving the quality of software and boosting the level of expertise of development engineers in this field. The Strategic Software Program comprised six points, including an improvement in customer satisfaction, an increase in productivity and the creation of a technology road map. This program, spurred on by mathematician Monika Gonauser, proved so successful that it led to the establishment of the Software Initiative of 1996 (see *Pictures of the Future*, Fall 2004, p. 46) and was eventually extended to cover all research and development activities throughout Siemens. Thanks to the direct support of former CEO Heinrich von Pierer and the vision of Klaus Wucherer, who was largely instrumental in having the program implemented on a company-wide basis, the Software Initiative is today an important part of the *top*+ program, which is designed to bring about a fundamental re-engineering of all company processes. All in all, it's another prime example of the supreme importance of software at Siemens.