# *: How has and will Moore's Law impact computerized decision support?*

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Predictive “natural” laws provide some comfort in a complex, volatile and uncertain world. The "laws" simplify and make sense of otherwise complex phenomena. Gordon Moore's Law (1965) has provided that type of comfort to many technologists for almost 50 years. Moore, co-founder of Intel Corporation, made a significant observation about computing. So what is Moore's Law and how has it impacted our thinking about decision support?

In 1965, Gordon Moore wrote an article for *Electronics* magazine in a feature titled “The experts look ahead”. Moore's article was titled “Cramming more components onto integrated circuits”. He began “The future of integrated electronics is the future of electronics itself. The advantages of integration will bring about a proliferation of electronics, pushing this science into many new areas. Integrated circuits will lead to such wonders as home computers ...”

According to the Intel web site, Moore observed an exponential growth in the number of transistors per integrated circuit and predicted that the trend would continue. The popularized statement of Moore's Law is that the number of transistors in an integrated circuit doubles every 18 to 24 months. In 2005, Intel expected that Moore's Law would continue to be predictive through the end of the decade. The “mission of Intel's technology development team was to continue to break down barriers to continuing the trend observed in Moore's Law”. By 2011, the transistor count on a single chip had surpassed 2,600,000,000, i.e., 2 billion, six hundred million.

Gordon Moore helped found Fairchild Semiconductor and then Intel. His efforts and those of his colleagues made sure integrated circuit technology evolved and improved at the predicted rate of progress.

The evidence of the past 50 years supports the conclusion Moore reached in 1965. Intel and other companies made the vision or observation a reality. Intel introduced the 4004 microprocessor in 1971 with 2,250 components. The 8008 chip introduced in 1972 had 2,500. By 1974, the 8080 chip had 5,000 components. The groundbreaking 8086 microprocessor of 1978 had 29,000 components. In 1982, the 286 chip had 120,000; the 386 processor in 1985 had 275,000; by 1989 the 486 DX processor had 1,180,000 components on a small chip. Once the million barrier was broken, the number and density of components expanded rapidly. In 1993, the Pentium processor had 3,100,000 components and the Pentium II processor in 1997 had 7,500,000. In 1999, Intel introduced the Pentium III processor with 24,000,000 components. Approximately 18 months later, Intel announced the Pentium 4 processor with 42,000,000 components. On March 12, 2003>, Intel

introduced its Centrino mobile technology integrating wireless capability. Apple used a fast Samsung ARM processor in its iPhone in 2007.

The two most important Integrated Circuit product categories are the microprocessor and memory devices. These products provide the technology that enables computerized decision support. As the technology has gotten more powerful and more cost effective new applications have become feasible.

Improvements in microelectronics have stimulated and enabled the development of more sophisticated decision support technologies. The earliest Integrated Circuits provided some limited decision support capabilities for Apollo Space missions. The chips of the late 1970s made it possible to develop spreadsheets and PC-based decision support applications. Specialized chips in the early 1980s stimulated Artificial Intelligence research. The 386 and 486 DX processor made client-server applications and GDSS feasible. Improvements in memory size and speed in the early 1990s made data warehousing feasible. Putting more components on microprocessors miniaturized our computers and supported development of innovative input and output technologies. Suppliers of innovative microelectronics make innovative decision support possible.

There seems to be a 2-3 year lag in the diffusion of improvements in microelectronics into decision support applications. In 2003, the capability of the Pentium 4 for enhanced graphics and visualization was reflected more in video games than in DSS. The Centrino mobile processor innovation expanded the presence of decision support in our work and personal lives. Today, the AMD K 10 and new Xeon processors coupled with massively distributed, parallel processing can analyze massive amounts of varied data quickly and expand data-driven decision support.

Moore's Law has served as a stimulus and benchmark for developments in microelectronics and information processing. It has become a driver of innovation and progress in the semiconductor industry. Expectations matter! Decision support applications need to exploit the enhanced capabilities that result from cramming more components on integrated circuits.

There has been a mutually beneficial relationship between innovation in semiconductors and end-user decision support applications. The advance of technology lets us work to implement what we can envision to create innovative DSS and analytics. Advanced decision support will result from technology advances, opportunistic and fortuitous circumstances, and from the active imaginations and dedicated actions of innovators.

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