

It's A Digital, Digital, Digital, Digital World!*

by R.M. Roberts, 2003

Analog to digital

Analog (from analogy): a physical model of physical system. Analog models generally require that a new model (analogy) be constructed for each new system being emulated. John von Neumann defines analog this way: “In an analog machine each number is represented by a suitable physical quantity, whose values, measured in some pre-assigned unit, is equal to the number in question.” (*The Computer and the Brain*. Yale University Press, 1958). Integral to the idea of analog is the concept of *continuous* values.

Digital: Physical procedures are reduced to mathematical algorithms. This allows the procedure to be manipulated as a mathematical process rather than a physical process. In digital machines, each number is represented by a symbol rather than a physical property. An essential element of the digital concept is *discrete* values.

The development of digital machines allows us to move from machines that can do only one job to machines that can do multiple tasks: a “universal machine.” A *computer is a digitally-based universal machine. It receives input data and manipulates that data by applying mathematical algorithms that emulate physical procedures and outputs the results in some meaningful manner.*

Our world is impacted by the development of digital machines.

- The speed of technological change increases geometrically (the “pace of change”). That is, the time lag (“information float”) between new scientific discoveries and the mass application of those discoveries continually decreases.
—See David Thornburg, *2020 Visions*
- Another important by-product of digital computing technology is “mass customization.” The large-scale manufacturing of customized products facilitated by “agile manufacturing” and networked computers.
 - “mass customization” coined by Alvin and Heidi Toffler in *The Third Wave*.
 - “agile manufacturing” coined by Brian Maskell in *The Agile Manufacturer: Computer Systems and World Class Manufacturing*.
- We are rapidly moving toward what has been termed “ubiquitous technology:”
 - Early computer era (“The Mainframe Era”)—One computer, many persons
 - The modern era (“The PC Era”)—One person, one computer
 - The future (“Ubiquitous computing”)—One person, many computers
[Concept from Mark Weiser of Xerox PARC]
- One goal of business and education is to make our technology “transparent.” “The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.” —Mark Weiser, head of the Xerox PARC Computer Science Laboratory

*With apologies to Stanley Kramer and the cast of “It’s A Mad, Mad, Mad, Mad, World!” (MGM/UA 1963).