processors. CIM has close connections with **computer-aided design** (CAD). The advantages of CIM are numerous: tasks that are dangerous, monotonous, or require extreme precision can be left to computerized systems. The result is an improvement in work flow and product quality, leading to an economic advantage for a firm.

CIM allows the entire manufacturing process to be entered, tracked, and controlled by computers. It draws together all aspects of manufacturing: blueprint drafting, cost assessment, inventory management, distribution, material purchasing and transport, quality control, and billing. Ideally, a customer should be able to order a car, for example, and the CIM system would track the order, coordinate production, and order delivery. The result is a more flexible manufacturing environment in which production can be customized for the end user.

CAD and **computer-aided manufacturing** (CAM) systems were introduced in the 1970s, allowing product design or the manufacture of certain machine parts to be guided by computers. This led to an increase in productivity and lowered costs, but the need for specialized CAD and CAM systems for different production areas soon became evident. The largest drawback of early systems was that each step of production had no direct connection with the rest of the process. This meant that data resulting from one stage of manufacture had to be reentered manually into a different phase.

The architecture of a modern CIM system includes the computing and networking hardware, the application and database software, and finally, the automated machinery. Assuring that all this equipment can work together is the largest single problem facing CIM, since all of the company's management facilities and machines must be integrated into the system. In the 1980s and 1990s there were efforts by the largest consumers of computerized production facilities to introduce some communication standards, so that equipment from different manufacturers would work together. The automobile industry, where automation is pervasive, was one of the early proponents of standardization. Several organizations, such as the National Institute of Standards and Technology (NIST) and SEMATECH (a consortium of electronic and computer firms), have also proposed a CIM application framework to foster floor shop integration.

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—*Jenna L. Brinning*

Computer Professionals for Social Responsibility

Computer Professionals for Social Responsibility (CPSR) is a U.S. grass-roots organization devoted to the analysis and discussion of the social, military, and economic impact of the use of computer technology. It is a think tank of critical minds incorporated in 1983 as a national organization under the laws of California. The first national chairperson was Severo Ornstein.

CPSR traces its roots to the discussions about the perils of nuclear war; a debate group on this topic started at **Xerox Palo Alto Research Center** (PARC) in 1981. Later, the group grew to encompass other computer scientists and programmers in the region. The common concern was warning the public about uncritical use of computer technology in crucial applications or by the military. In 1982, the group adopted its current name and its first important campaign was against the Strategic Defense Initiative (SDI) launched by President Ronald Reagan (1911–). Eventually, SDI was canceled, but CPSR's membership and national exposure were greatly enhanced during the controversy.

Over the years, CPSR has broadened its scope, and some of its successful initiatives have been the Privacy and Civil Liberties Project and the Computer in the Workplace Project, the latter run by people interested in *participatory design*, that is, in ways of empowering users so that they can influence the design of the computers used in offices and industry.

In the early 1990s, CPSR participated in the debate about the **Internet** and the National Information Infrastructure (NII). CPSR wants to make sure that all segments of the population are taken into account, so that no one is disenfranchised in terms of access to technology.

CPSR is organized in local chapters and in working groups: Cyber Rights, Civil Liberties, Internet Governance, Education, Ethics, Computers and the Law, and others. Working groups consist of people who discuss a certain topic (usually by e-mail), then produce reports and policy recommendations. CPSR has a total membership of about 2000 persons, 84 percent of whom are under 35 years old and two-thirds of whom are male. Most members are computer professionals who belong to other societies, such as the **Association for Computing Machinery** (ACM) and the **Institute of Electrical and Electronics Engineers** (IEEE).

Similar organizations to CPSR exist in other countries, such as IFIP in Germany (*Informatiker für Frieden und Verantwortung*—Computer Scientists for Peace and Responsibility). Like CPSR, IFIP is composed of regional chapters and working groups and holds a national meeting every year to discuss political issues related to computer technology.

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—*Raúl Rojas*

Computer Science

Although it would be tempting to call computer science (CS) the science of building computers and making them work, there are actually several possible definitions. *Computing science* would be a better name, since it stresses that this is the science that studies computation in all its possible manifestations, the algorithms thereof, and its possible applications. In other languages CS has a more informative name: Informatik (in German), Informática (in Spanish), and Informatique (in French), stressing the fact that it is the science of automatic information processing.

Computer science became a discipline only after the advent of computers. The first professional organization in the field was the **Association for Computing Machinery** (ACM), founded in 1947, only two years after the official presentation of the **ENIAC**. The first programmers and computer scientists came from the fields of mathematics, physics, and other branches of the natural sciences. Although the first CS departments were not started officially until the 1960s, some universities, including Harvard and Princeton, started offering programming courses very early. Especially the Harvard Computation Laboratory, directed by **Howard Aiken** (1900–73), could be considered as the precursor of later CS programs in the United States.

It has been said that the term *computer science* was coined by George Forsythe from Stanford University in the 1960s. The first CS department was established at Purdue University in 1962, and the first person to receive a Ph.D. in CS was Richard Wexelblatt at the University of Pennsylvania in 1965. Over many years, the CS departments at the Massachusetts Institute of Technology, Stanford, Carnegie Mellon University, and the University of California–Berkeley, have consistently been ranked as the best in the United States.

Some authors consider CS to be a type of applied branch of mathematics, others consider it a branch of engineering. Although the discussion might seem trivial, it actually goes to the heart of the matter. In the former case, CS is considered to be a science of abstract computable structures; computer scientists abstract a representation in terms of data structures from a practical problem and develop algorithms to solve the problem. In the latter case, CS as engineering, the emphasis is on the practical approach to the solution of computational problems.

There are four major subdivisions of CS and several subdisciplines in each group. CS is divided into theoretical, technical, practical, and applied CS. Theoretical CS deals with all theoretical aspects related to computational devices. *Computability theory*, for example, examines different hierarchies of machines and its relative computational power. A universal device, such as the **Turing machine** is able to perform any computation that could be performed by a human being provided with paper and pencil (and much patience). But