
CHASSE

ANNUAL REPORT 1987 OF CAP GEMINI SOGETI

CONTENTS

CAP GEMINI SOGETI

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LETTER FROM THE EXECUTIVE CHAIRMAN

Reporting 1987 revenue of slightly more than $700 million, CAP GEMINI SOGETI now holds the following market share:

- **1% of the worldwide DP services market,** estimated (according to the table on page 31) at $74 billion,
- **2.5% of the "professional services" segment of that market,** estimated at $29 billion.

For the past several years, this "professional services" market has shown an annual growth rate of 20%, and most observers agree that this level will be maintained for the next ten years. This means that even if CAP GEMINI SOGETI were merely to keep up with that pace, its revenue would be $2 billion in 1992, and more than $4 billion four years later.

■■■ CAP GEMINI SOGETI's ambition, however, is to maintain an annual growth rate comparable to the average it has achieved for the past decade (nearly 30% annually, two-thirds through internal growth and one-third through acquisitions). Should it succeed, the Group's 1996 revenue would reach nearly $8 billion, with a workforce of about 50,000 people.* Even so, **CAP GEMINI SOGETI's market share would still account for only 2%** of the worldwide 1996 DP services market and 5% of the "professional services" market!

As it happens, CAP GEMINI SOGETI does have the resources to grow at such a pace, and without sacrificing either its independence or its integrity, without plunging into risky diversification, without engaging in hostile takeovers and without compromising the quality of its services... quite the contrary, in fact, the Group invests heavily to improve quality. Therefore, should CAP GEMINI SOGETI–using the argument that last October's stock market "crash" has played havoc with so many of its apparently well-founded forecasts–echo the columnists and the economists and surrender now to the voices of gloom and caution?

■■■ If I decline to join either one side or the other, it is first because I believe the evidence will show that the chilly pessimism in fashion today is as unreasonable as the blind optimism of earlier years. And second, because CAP GEMINI SOGETI not only conducts its business in a sector that is rapidly expanding, but it is also living through **an adventure that has only just begun.**

The "Overview of Information Technology," to which this Annual Report devotes more than 40 pages will come as a surprise to some readers. It demonstrates that this already-prestigeous industry is still in its "Bronze Age." Far from slowing down or running out of steam, as one might legitimately anticipate, the technological evolution is going to continue and gain momentum. It will carry in its wake a large number of new applications, along with an equally large number of new users hoping to take advantage of these new technologies, and whose needs will be increasingly varied and complex. It is an evolution that will demand of DP service companies the kind of ongoing, expanding technical expertise that the best of them are already able to acquire, master and distribute. All in all, it is a market in which quantity and quality must develop hand in hand at a sustained pace.

In the short term, however, isn't it possible that the "crisis of confidence" caused by the stock market

** These figures are a little staggering. No more so, however, than those announced in our 1982 Annual Report ("revenue of nearly FF 5 billion and net income greater than FF 300 million in 1989," a goal that will be reached* ***one year ahead of schedule).***

crash will lead some companies to defer–if not eliminate–some of their investments? Such an outcome is not altogether impossible, although recent surveys of business leaders do not point in this direction. In any case, when a decision-maker talks about reducing or postponing certain investments, it isn't likely that his axe will fall first on those often-intangible investments calculated to enhance a company's know-how or competitiveness. Rather, his attitude would appear to be "Before buying any new equipment, let's get the most out of what we already have."

■■■ As the reader will discover in the following pages, the broadest current trends in data processing increasingly reflect user needs and concerns; what these users want most from their DP systems is help in improving the productivity and competitiveness of the business they manage.
We are living through a time of growing economic rivalry, when profits are much less the result of successful financial transactions as they are of **a company's refocusing on its basic activity.** To slacken effort in this direction, to reject investments aimed at gaining or sustaining a competitive edge could be suicidal.
Perhaps the wild wind that has just swept through the financial markets will have a healthy effect after all, by making people aware that economic stability is built on many factors, including strict management controls and greater competitiveness in the activities which constitute companies' specific "fields of excellence." An effective data processing tool is a prerequisite for meeting these objectives, and everyone is well aware that we have barely begun to exploit the existing potential for profit. I think this may explain the lack of impact (or the very subdued impact) that earlier crises have had on the DP services industry, especially on those companies dealing in "professional services."
During such times they are the preferred partners of businesses that are well-run and determined to stay that way, therefore placing heavy demands on their DP systems.
But **exactly how do you recognize a "well-run" business?** First of all, by its results, of course, although results are not always proof positive of performance. Achieving success under ideal circumstances is not that much of a feat. On the other hand, showing only moderate results in a difficult market requires very strong qualities, if not downright genius.

■■■ A banker I know recently offered a more original definition of a well-run business. According to him, two outstanding features set such a company apart:

- It is a company whose management rarely blames its problems on **outside** forces (that is, it doesn't waste its time complaining about the obstacles laid in its path by government, unions, banks, foreign competition, suppliers, customers and inclement weather).
- It is a company, on the contrary, that tackles its problems decisively and doesn't hesitate to call upon **outside** skills and support to resolve those problems which do not derive strictly from its basic line of business.

At a time when the most important challenge may be to avoid treating present-day problems with the same attitudes and the same approaches as in the past, I find this a most relevant and refreshing definition.

Grenoble, February 15, 1988
Serge KAMPF

OVERVIEW OF INFORMATION TECHNOLOGY

The goal of this Annual Report is to provide a **panoramic survey** of data processing by describing the main aspects of this field–its technology, its industry, its significance as a factor in social and economic change–within the covers of a single document. The reader will be able to fit those aspects already familiar to him into an overall perspective. He will see the confirmation of something that he probably already knows: so promising are the current developments in data processing that its history has only just begun.

Data processing is first and foremost a technology. Rather, its hardware is derived from the combination of a group of distinct technologies, the most dynamic of which is components technology. But someone had to invent a neologism–"software"–to designate that invisible construct, made up of programs, without which the machine is totally unusable. Thus was born a software technology, and the many services that have been required to implement and maintain that entity called a "DP system."

The combination of these many technologies is a unique one. There is no doubt in anyone's mind that the computer, although the product of multiple technologies, has its own fully contoured identity. Its construction and use have generated a set of activities which make up the DP industry, since–as we shall see further on–software and services now account for a greater market share than hardware itself.

With the passing years, the DP industry has successfully provided users with increasingly effective and inexpensive solutions. As a result, it has experienced spectacular growth, to the point that it now employs several million people in the Western World alone. Activities that were virtually unknown twenty years ago are now being carried on by companies with an international scope: these activities include DP services...and these companies include CAP GEMINI SOGETI.

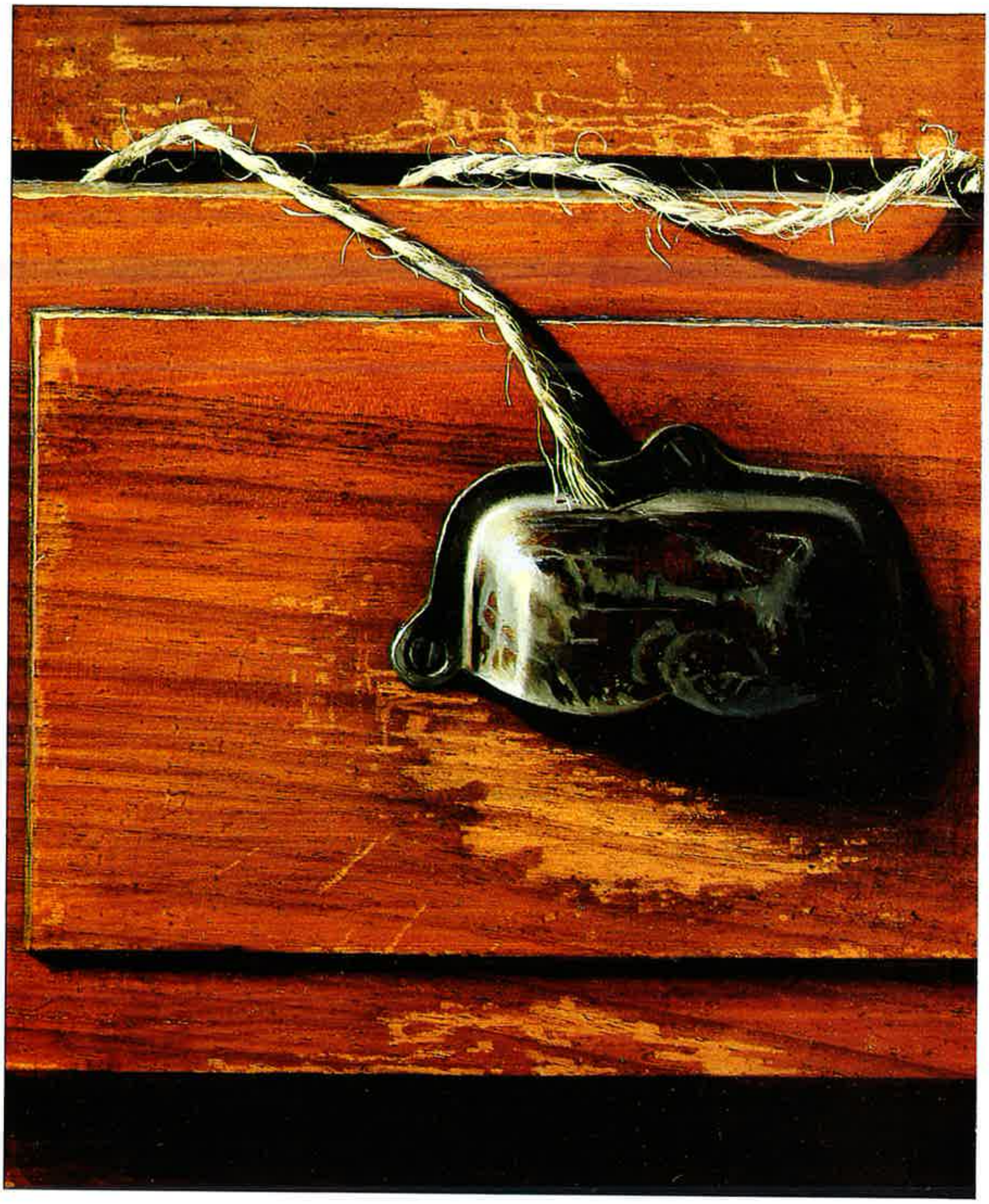
Still, we cannot say that the DP industry has attained its present size because it met a specific need. There is no question that rapid technological progress led to the development of new applications, which became at once physically possible and economically profitable. But demand would never have taken off at such a clip had the ground not already been prepared. This new tool offered the possibility of satisfying a number of basic needs such as reduction of fatigue, speed of product delivery, corporate competitiveness, risk management, service quality and aid to decision-making.

A number of factors play equally-important roles in the success of DP systems use: selection of applications, selection of technical solutions (inseparable from the first-mentioned), resource management, preparation for use and user training. For decision-makers–corporate managers and, generally speaking, all executives concerned–data processing is a source of opportunity... and of management headaches. Their role is not an easy one: they must make fundamental choices on behalf of their organizations, in an advanced-technology field where they lack special expertise. As good managers, they take care to obtain the support of knowledgeable professionals, both in-house and on assignment from large service firms.

This **overview of information technology** is divided into four parts:

- Part 1, devoted to **hardware technology**, summarizes current research and gives information for the evaluation of possible developmental paths.
- Part 2 describes the **software and service technologies**, also in the throes of development.
- Part 3 is a description of the various segments of **the DP industry**, showing their structure and possible courses of evolution.
- Part 4 deals with data processing as a **factor for change,** analyzing its major areas of impact on the corporation, the economy and society.

THE HARDWARE TECHNOLOGIES



Data processing as we know it today might not even exist at all had not Bell Laboratories researchers discovered the transistor back in 1947. Thanks to this device's very low power consumption (one millionth of that of the triode tube, invented in 1906), the possibility of manufacturing machines containing large numbers of components became real as of 1948. Forty years later, we can now fit several million transistors onto a single semiconductor chip.
Integration has developed in such a manner that, since 1960, the number of components per integrated circuit has practically doubled from year to year. The consequences of this development are hardly surprising: circuit performance has improved, processing speeds have risen, cost per memory unit has fallen and increasingly powerful and reliable machines are being placed on the market.

■■■ What peaks will this ascent allow us to reach? How are other techniques involved in DP systems going to develop? We shall successively review the answers for:

- components
- central processing units
- peripheral equipment
- telecommunications.

COMPONENTS

There are limits on the growth of integrated-circuit power, as experienced over the past thirty years. Some are dictated by the laws of nature. For example, the energy levels of semiconductor electrons fluctuate randomly. They necessitate a minimum level for the signal being processed by the transistor, below which there would be confusion with natural fluctuations or "noise." Other practical limits are related to materials, imposed by chip size or geometry, or set by the resolution of optical lithographic equipment used in integrated-circuit fabrication.

■■■ It is currently possible to produce small series of fingernail-sized chips onto which two million transistors have been squeezed. The transistors themselves occupy only about one-third of this area, however: the remainder is used for connections. Since 1960, simultaneous advances have been made in the areas of decreased transistor size, increased useful chip area and improved transistor-on-chip packaging (the diagram on the page opposite shows the past and foreseeable future development of the number of components per chip).
Three major research paths are currently being followed. The goal of the first is to achieve chips containing one billion transistors (or 60 megabytes of memory); the other two are striving for higher performance levels through a complete change in chip technology.

First path: More of the same.
According to some specialists, billion-component chips will make their appearance shortly after the year 2000. Achievement of these levels of integration will require transistors with a new structure, currently under laboratory investigation. Also required will be large (1.5 in^2) chips of pure silicon or some other material. Further needed will be lithographic equipment required for etching microscopic transistors (the smallest of which are currently one micrometer wide). Widths of 0.1 micrometer–one thousandth of the thickness of a human hair–will probably be achieved using X-ray lithography. With regard to transistor materials, the hopes placed in gallium arsenide are beginning to fade. Although faster than silicon, and less sensitive to radiation and temperature extremes, it is also more expensive and, above all, does not lend itself to the same degree of integration. Surprisingly, however, the industrial use of superconductors is now entering the realm of possibility: two scientists at IBM's Zurich laboratory, working on oxides produced at the University of Caen in France, have managed to raise the superconducting temperature of these materials, leading to the possibility of fabricating wires which conduct electricity without any heat rise. Over 100 research teams–with strong representation by IBM and AT&T–are currently working on this subject in the U.S. Significant research budgets have been allocated for this field in both Europe and Japan: its promise is unquestioned.
Looking further beyond, there are still important reserves of power in the application of microelectronic technologies (multidimensional transistors, Josephson effect in superconductors, etc.). Tomorrow's "gigascale integration" will be only one stage on a road whose end is not in sight.

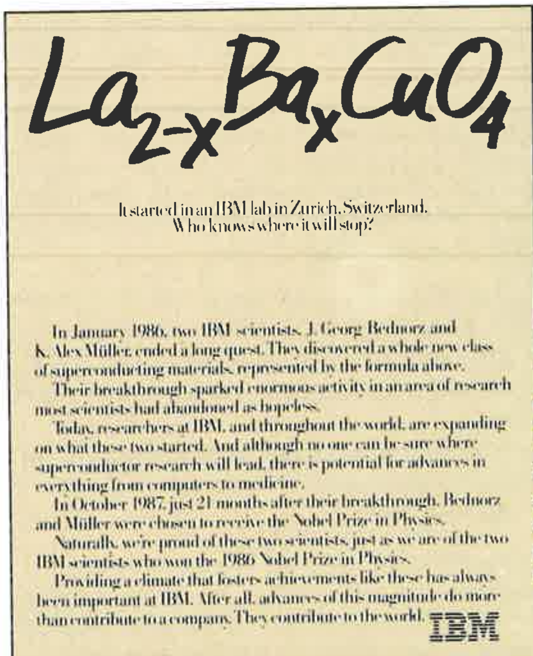
Second path: Replacement of electricity by light.
Thanks to lasers and fiber optics, optical applications have been substantially developed in the areas of telecommunications and recording (as witness the success of the compact disk). Nonetheless, use of these techniques in computers has been a subject of controversy among scientists. It is probable that light rays will be used increasingly for transmission at all levels of the DP system: between central units (fiber-optic local area networks already exist), between a machine's various modules (an optical "bus" has been developed in Japan), between printed circuits (AT&T uses optoelectronic connections between circuits in its 5-ESS digital telephone switch) and even between individual components.
On the other hand, there is still no such thing as a photon transistor: AT&T researchers produced an optical diode over a decade ago, but no one has yet managed to create a photonic triode. IBM gave up its research after several years of effort, and some company spokesmen have openly expressed their skepticism on the subject. Still, research is continuing in all of the industrialized nations, its prime goal being to increase computer speed. The stakes are high, as it would be possible to improve performance by a factor of 1,000: by creating components and circuits having time constants under one trillionth of a second; and by equipping systems with optical devices capable of acquiring and instantly processing large volumes of information.

Third path: Imitation of the brain.
The brain is a machine whose billions of components–neurons–operate simultaneously, but

slowly: the neuron's cycle is on the order of several milliseconds. Still, the brain is so efficient that it has led to the idea of creating a biological computer. This machine would operate along the same principles as the brain: each neuron, connected to thousands of neural terminals, reacts to chemical impulses transmitted to its signal-sensing membrane. All of the neurons function simultaneously, with input information acquired by a quasi-tactile physical process. A first generation of "biosensors"–enzyme-sensitive components–has been developed in the laboratory.

If there were such a thing as a machine built of biological components stimulated by amino acid compounds, it would–like the brain–be capable of operating by association. For example, it would be able to recognize a tree, just as a child does, whereas electronic computers are practically incapable of such a feat.

It would obviously be very risky to offer prognoses on the viability of such projects, especially since the initial goal of research is not really to copy the human brain: instead, its aim is to supplement existing computer types with devices enabling them to handle complex applications such as image recognition and processing.

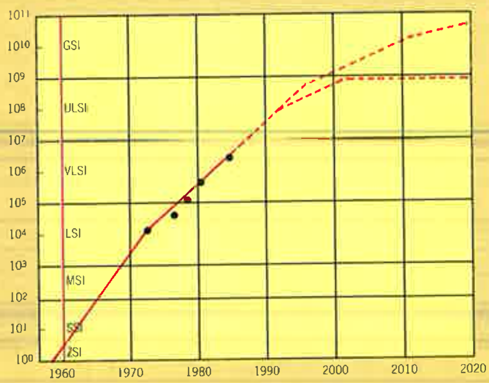


The IBM advertising copy (left) refers to the discovery of a superconductor which is likely to find industrial use. One of its many possible advantages will be to increase the density of transistor packaging on chips, thanks to the virtual elimination of heating in conductors and connections made of this material.

COMPONENTS PER CHIP AND INTEGRATION LEVELS

Number of components per chip doubled annually in the 1960's. In about 1972 designers ran out of unused space on the chip for additional components, and the rate fell somewhat. Nevertheless, according to the more optimistic projection, gigascale integration (GSI)–a one-billion-component chip–will be achieved by the year 2000. (The projections differ in assumptions about limits imposed by chip-fabrication processes.)

*From **Scientific American,** October 1987.*



CENTRAL UNITS

Improved component performance levels translate very directly into increased processing-unit power and central memory capacity. From an economic standpoint, this means that–for constant power and capacity–hardware is cheaper, takes up less space and produces less heat. The microcomputer is a striking example of this, springing to life the moment its price had fallen to the level of the individual user's budget.

■■■ But there is yet another path forward. This involves modifying computer architectures so that they operate in parallel. Parallel-processor performance levels allow them to handle problems involving large volumes of rapidly-changing information. This is the situation with all problems of image processing and dynamic pattern recognition: problems which must be solved, for example, in robot design or target acquisition and tracking. This is also the situation with technical and scientific problems in the area of fluid mechanics, as in wind-tunnel simulation.

■■■ One form of parallel processing can be attained within a single central processing unit. There are three possible ways of doing this:

- Organization of memory into a number of separately-accessible units or "banks," permitting multiple and simultaneous retrievals of data.
- "Pipelines": arithmetic units capable of performing a single operation on multiple data elements simultaneously. Pipelines are primarily used for vector computation (see inset, opposite).
- VLIW (Very Long Instruction Word) computers, which simultaneously handle multiple program instructions consolidated into long words.

■■■ Yet another degree of parallelism is more promising. This involves the simultaneous execution of multiple operations by multiple processing units located in a single computer, called a **parallel computer.** From a theoretical standpoint, the processing power of a parallel computer with 100 arithmetic units, each having the processing power of 100, should reach 10,000, but this maximum is never attained in practice. Gene Amdahl has formulated a law defining the efficiency of such machines: low up to 50% of parallelism (i.e., 50% of its processors operating simultaneously); average between 50% and 80%; and very high from 80% upward.
If the concept is simple, its implementation is much less so. The first problem arises with memory. It is hard to conceive of a large number of processing units sharing a single memory: there would be too many connections and, in the case of a single "bus" connection, there would be excessive risk of bottlenecks. Therefore the idea of "distributed memory." Each processing unit is provided with a local memory, the combination of the two forming a "node." But internodal relations pose a second problem. Total interconnection, which would directly connect each memory unit with each processing unit, would lead to a prohibitive number of connections. Among the solutions attempted, the most popular appears to be the hypercube, which owes its name to the fact that nodes are connected as if they were located at the vertices of a multidimensional cube (see inset, opposite).

■■■ The notion of parallelism has led to widely differing machine designs, depending on the application in mind and the contemporaneous state of the art. Parallel machines are sometimes distinguished on the basis of their "grain size," i.e., the power of their processing units. To simplify, we might say that there are "coarse-grain" computers (relatively few but powerful processing units, generally with shared memory) and "fine-grain" computers (numerous nodes operating with distributed memory). A few examples of existing machines will illustrate this distinction:

- In its most usual configuration, the Cray X-MP consists of four parallel-connected supercomputers.
- The IBM 3090-600 is made up of six processors, each containing a scalar (and, as required, a vector) processor.
- The "Connection Machine" contains 65,536 processors, each composed of a microprocessor and a small memory unit.

These are extreme examples. The first two are very coarse-grain computers with relatively low capability for parallelism. The third, on the other hand, is obviously a very fine-grain parallel computer.
The implementation of parallel machines, regardless of type, raises a third problem: software. In point of fact, processing should be divided into tasks which are sufficiently independent to allow simultaneous operation by as many processors as possible. Without this, parallelism would be senseless...and expensive! This requires a fresh approach; the subject will be tackled further on in the section devoted to software.

■■■ Whether related to components or to architecture, the developments described above will sooner or later have significant impact on mass-marketed hardware. On the one hand, machine power will continue to increase, at constant price. On the other, the hardware range will expand

The Connection Machine photo Stephen Grohe
Image Processing photo Karl Sims
in "Un ordinateur parallèle : la Connection Machine" by Daniel Hillis.

WHAT'S A HYPERCUBE?

This futuristic-looking, 5-foot high black cube is nothing other than the Connection Machine, designed at the Massachusetts Institute of Technology and built by Thinking Machines Corp. This computer is made up of 65,536 processors arranged in groups of 16 at each of the 4,096 vertices of a 12-dimensional cube (hence the name "hypercube").

The Connection Machine can simultaneously process 65,536 data elements, with a theoretical maximum speed of 10,000 MIPS, i.e., 10 billion instructions per second! It is primarily intended for expert systems and, more specifically, for the operation of knowledge bases. It is also well-suited for computations in flow analysis, image processing and document retrieval in text data bases.

More than 100 hypercubes of various models have been built, most of them in the United States.

An n-dimensional cube has 2^n vertices, and the same number of processors or groups of processors. Each processor executes its own program on its own data. Processors communicate with one another by passing messages. Depending on the disposition of links between the processors, a hypercube can be operated under a very wide range of topologies: mesh, star, tree, ring. There is an ideal topology for each application type. For example, a two-dimensional mesh is perfect for the study of temperature distribution on a metallic surface. The surface is divided into as many cells as there are processors. With each iteration of the computation, each processor transmits its intermediate results to the adjacent processors. The two-dimensional mesh is also well-suited for image processing. The tree topology, in turn, is appropriate for text retrieval in document bases.

SCALAR PROCESSORS AND VECTOR PROCESSORS

Frequently, each of the data items in a table has to be subjected to the same mathematical operation. In a conventional or "scalar" computer, these items are processed one after the other. In a "vector" processor, they are processed simultaneously. The terms "scalar" and "vector" have been adopted from the synonymous mathematical concepts (a table of numbers may be likened to a vector, each number being the measurement or scalar of one of the vector's components).

A vector processor has much higher performance levels than a scalar processor: the theoretical gain might reach or surpass 100. In practice, this gain becomes important insofar as the application being processed makes use of "vectorizable" processing. This is the case for the majority of technical applications. In non-technical fields such as code deciphering or text retrieval from non-structured document bases, certain associative operations are also vectorizable.

Supercomputers such as Cray or Fujitsu machines are equipped with both vector and scalar processors. Nominal performances for these machines are on the order of 1 gigaflop (one billion floating-point operations per second).

significantly at both the top and the bottom of the line:

- Supercomputers are primarily used for scientific and technical purposes. Their power is measured in number of floating-point operations per second, or "flops." The fastest machines have a nominal speed of one gigaflop, or one billion operations per second, but their actual mean performance for a set of jobs is on the order of 100 megaflops (or 10% of nominal power). Main factors affecting mean performance include workload, degree of vectorization and the manner in which applications are programmed. Foreseeable increases will be the result of developments in components and parallel processing. We can reasonably look forward to a multiplication of current performance levels by 100 within five years.

- At the bottom of the line, personal computers are diversifying through specialization as workstations of all kinds: shop floor, laboratory, technical calculation, software engineering, image synthesis, word processing based on voice recognition, etc.

The processing power of small computers is also growing uninterruptedly: IBM's new PS/2 Model 80 is just as fast as that company's big 370/168 general purpose computer, which cost several million dollars in 1975! As with mainframes before them, microcomputers are gradually taking advantage of all the resources available to increase their power: their central processors are getting faster, their internal memory is expanding, their basic software is enabling them to process multiple tasks simultaneously, and so on.

PERIPHERAL EQUIPMENT

"Peripherals" supply the processing units with information, store data and computing results, and transcribe them onto selected media. As machines are ever speedier in their processing, peripherals must themselves become more efficient in terms of both speed and storage capacity. Each in its own technological sphere, peripherals are showing spectacular development, only a brief glimpse of which can be given here.

Three levels of information storage

▪ The **central memories** on the first level–the one closest to the processing units–are made up of component memory chips. Subject to frequent demand, these memories are the smallest, the most rapidly accessible and the most expensive. Their capacities currently range from 500,000 bytes for a PC to hundreds of millions of bytes ("megabytes") for a supercomputer. Central memories will continue to profit fully from the spectacular advances in component technology. As of the beginning of the '90s, run-of-the-mill PCs will have 10 megabytes of central memory. These resources will satisfy the ravenous appetites of the user-friendly interfaces that users are so eagerly awaiting: voice input, natural-language commands, etc. In the same time frame, and for the same reasons (as well as due to the trend toward increased parallelism), large systems will routinely have central memories measured in the tens of billions of bytes.

▪ At the **intermediate memory** level, the most commonly encountered magnetic disk drives in small machines are "Winchester" or "hard" disk units. In 1980, a 5-1/4" hard disk unit had a capacity of 5 million bytes. This figure is expected to reach 5 billion bytes during the 1990s!
Information is recorded in very narrow tracks (less than a thousandth of an inch in width). The microscopic read heads skate on an air cushion a few millionths of an inch thick! Already spectacular performance levels will be still further improved by advances in all parameters. Even more minute heads will permit an increased number of tracks and more disks per case. The thickness of the disks' metal oxide layer will be reduced through the use of new materials, resulting in increased recording density. New coding techniques, storage of binary characters layered through the thickness of the disk, and increased disk rotation speed will also augment capacity, access speed and output. At this level, it is unlikely that optical disks will rapidly replace magnetic disks, as the former are not easily erasable or rewritable. In contrast, magneto-optical technology seems quite promising (a laser writes and reads information to and from a "magneto-optical" material which becomes magnetized when heated by the light beam).

▪ On the third level–that of **mass memory**, primarily used for archival storage–magnetic tape and micrographic media (e.g., microfiche) are generally employed. Optical disks, worldwide production of which is still low (in the tens of thousands annually), will doubtless gradually replace tape and film: a single 14" optical disk holds as much information as 50 large tape reels!

■■■ It is estimated that 95% of U.S. corporate information is still stored on paper in metal file cabinets (with the remainder on magnetic media [2%] and micrographic media). These figures give some idea of the potential market for disk units... and illustrate just how far office automation is still lagging behind!

Input/output units

Most data is today entered into computers by means of encoded documents (such as bank checks), devices such as light pencils used at point-of-sale terminals, or via keyboard-display terminals.
The big changes slated for the future will primarily affect software, due to the fact that "dumb" terminals will be replaced by personal computers. With the latter, data can be monitored and manipulated as it is entered. Moreover, PCs have the memory and processing power required for "user-friendliness." Naturally, these potential advantages must be implemented through appropriate software.

■■■ Voice control of DP systems is a long-standing dream. It involves the problem of voice recognition. The machine which will one day type a letter in direct response to a spoken text has already been named: the "talkwriter." But progress in voice recognition will depend on improved language analysis and the development of complex programs (see our observations on "natural language processing" in the software section of this report).

Pattern recognition by a computer is required for reading any document not written in characters coded or selected from a restricted set. It is all the more necessary if the machine is to ingest and recognize images. In order to understand the meaning of a sound or a picture, the recorded information must be compared–as in a cerebral process–with the contents of a "dictionary" of words or objects. Fine-grain parallel computers can be used for pattern recognition, as they can allocate a microprocessor to each segment delineated by a very fine breakdown of the image under analysis. The theoretical contribution of parallel architectures is easy to envision (see the inset on the hypercube, page 11), but the software problem to be solved remains complex, if only because the actual patterns to be recognized only approximately resemble their models.

With regard to information output, progress is evident in two main fields:

- **Laser printers** have captured the market. At the top of the line, these printers reach speeds of 200 pages per minute. A printer of this type can produce a document a yard thick in one hour. At the low end, personal computers are being linked to laser printers capable of turning out up to 8 pages per minute.

- **Display screens** today have a resolution close to 1 million pixels (or "picture elements," i.e., dots of light produced by a cathode ray tube). Image quality is particularly important in applications such as computer-aided design, computer animation and computer simulation. The visual appearance of images will be truly realistic only when their sharpness matches the acuity of the human eye: to reach this point, the best screen resolution obtained under laboratory conditions will have to be doubled. Improvement of resolution and refinement of the color palettes of present-day displays will provide improved comfort for users.

The speech synthesizer is another peripheral for information output. Little used (perhaps **too** much used in some passenger cars!), although easy to implement. And we should mention the mechanical interfaces which are being extensively developed, primarily in the area of robot technology.

Researchers are working on man-machine dialogue in a configuration making simultaneous use of vision (three dimensional, if possible), touch and speech. Achievement of this ambitious goal, which goes beyond today's framework of data processing and robot technology, will encourage the implementation of the most sophisticated tools imaginable.

TELECOMMUNICATIONS

Data processing and telecommunications are exchanging ideas and techniques to one another's advantage. On the one hand, networks–which result from the application of signal processing techniques–are being used to connect distant computers. On the other, high-speed components and software techniques are turning telephone switches into true computers, improving and expanding the services offered to telephone subscribers.

■■■ The progress of telecommunications is being fueled by two basic technologies: digitizing of networks (begun in 1970) and fiber-optic transmission, implementation of which began in 1980.

▪ In a digitized network, signals are coded in binary form. Sounds are sampled and coded just like data intended for computer processing. They may be stored in electronic memories and manipulated using logic operations within electronic components. Having amply demonstrated their worth in all stages of telecommunications, digital techniques are destined to become the rule.

When digitized, a coded signal is readable (or may be regenerated) without error or background noise, even if it has been attenuated. Digitizing also permits multiplexing–whereby a number of conversations are carried simultaneously over a single cable–as well as switching. The catchword is "digital revolution," and the accuracy of this expression is substantiated by the switch developed by France's National Telecommunications Research Center for the experimental PRELUDE network. This machine's switching matrix, consisting of only three printed circuit boards, has the same capacity as a 60,000-channel telephone switch, or over 3 billion connection points!

▪ Information travels through optical fibers in the form of laser-generated light pulses. Optical links can convey a much larger volume of information than their metallic counterparts. The most recent copper-wire transatlantic cable, commissioned in 1983, can carry 4,200 simultaneous conversations. The first fiber-optic transatlantic cable, to go operational in 1988, will offer a capacity equivalent to 40,000 simultaneous conversations! After decades of barely perceptible progress, then, the shift to fiber optics is a significant technical advance. In the United States, one-third of the loops between central offices and subscriber premises are no longer made of copper. And virtually all new long-distance transmission lines are using fiber-optic cable.

Optical transmission throughput could still be increased by a factor of 1,000...at the cost of a decade of laboratory research, followed by another twenty years of industrialization and marketing efforts. It will be necessary for lasers to produce purer light, i.e., light of a single frequency, where this frequency can also be tuned and modulated. It will also be necessary to manufacture fibers of such quality that they cause virtually no attenuation of transmitted signals. As we have already noted, however, there is no such thing as an optical transistor, and optical techniques are therefore limited to signal transmission.

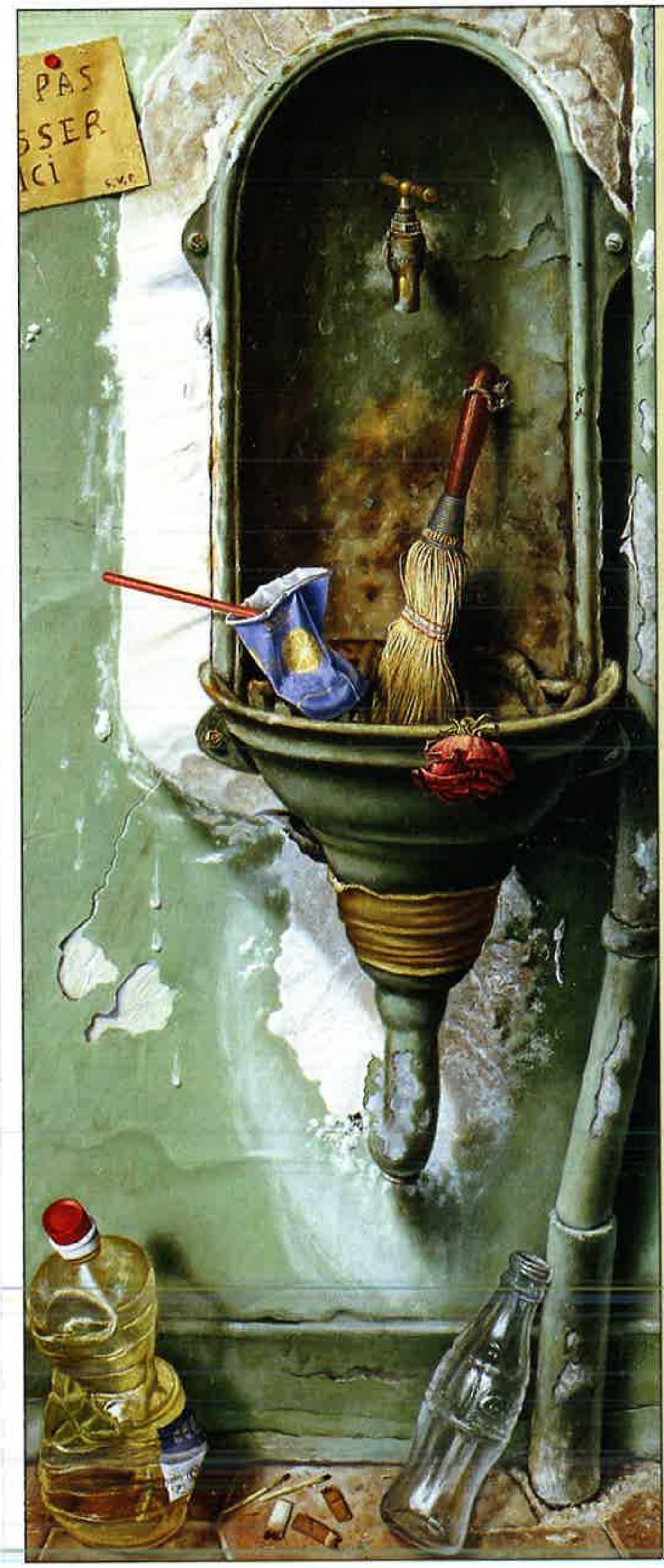
■■■ Present-day technological potential is generously adequate for meeting the needs of **telephone subscribers**. Users are already enjoying extensive services which, in the 1990s, might include picturephone and programmable high-definition TV. These services require very high transmission rates (for picturephone, 1,000 times the transmission rate of an ordinary telephone line), but these are well within the reach of the technologies described above.

■■■ Demand on the part of **DP resource users** currently accounts for less than 10% of telecommunications industry sales. But these users want to access increasingly voluminous and increasingly scattered sources of information. The number of online terminals and microcomputers will soon reach 50 million worldwide. Demand, expressed in terms of transmission volume, is growing exponentially.

At present, industrial microcomputers or workstations located in the same geographic area are communicating by means of local area networks and are sharing resources by applying the communications procedures developed for this network type. In turn, long-distance data communications are routed via the public switched telephone network, special leased lines, or networks designed especially for data transmission (see the inset on packet-switching networks opposite).

■■■ With the digitizing of communications and the virtually unlimited capacity of fiber-optic transmission, we can state that there is no major technological obstacle standing in the way of satisfying any communications requirement imaginable today. Thus the West German Bundespost is planning to place a broadband fiber-optic network in service as of 1992, forming an overlay on the existing telephone network. Nonetheless, the investments to be financed and the tasks to be completed–particularly in software development–are enormous. Here are the main reasons why:

a. Diversity of user requirements (especially among DP specialists) is so great that the network will have to harmonize a veritable Tower of Babel. It will be necessary to establish dialogue between equipment



PACKET SWITCHING NETWORKS

The first communications between computers were routed over the conventional phone network. But this network is not very well suited to the task.

In fact, the various computer types and their connected terminals need to transmit information organized in a variety of formats at very different rates. The delay required for setting up a call, for example, is unacceptable for data transmissions which are sometimes very brief and staccato in rhythm.

DP experts have therefore devised another approach, in which messages and data are routed in much the same manner as parcel post, whence the name "packet-switching network."

In this type of network, information is segmented into fixed-length sequences. Each of these sequences, called a "packet," is given a label containing the instructions required for correct routing.

The grouping and routing of packets toward their destinations are performed by dedicated computers called "switching nodes," to which the network users are connected. Nodes are interconnected by telecommunications lines, the whole forming a mesh network. At any moment, a line connecting two nodes will be carrying packets having differing origins and destinations.

The American ARPANET network was the pioneer of packet switching, but the world's largest network today is France's TRANSPAC, set up by SESA. It has over 50,000 subscriber connections and routes over 1.3 trillion characters every month. Many corporations and national telecommunications authorities have also adopted SESA's packet-swiching technology in Europe, the Americas, Australia, New Zealand and even China, with the TAIPAC network in Taiwan and the CHINAPAC network in the People's Republic of China.

having very distinct "personalities." Their information structures, their networking behaviors are incompatible. A certain degree of standardization, together with a very large number of software interfaces, will provide the practical solution to this problem.

b. This heterogeneousness is going to become more pronounced because the hardware inventory shows a tendency toward diversification and because the arrival of new users makes for an increasingly complex demand structure. Networks will have to deal with an increasing plurality of transmission rates and signal types in order to carry sound, image and data simultaneously.

c. Multiservice networks will become necessary (see below for a description of Integrated Service Digital Networks), just as it will be necessary for corporations to make their local networks communicate with one another and with their computer centers.

For the installation of such infrastructures, it will be necessary to turn to the most sophisticated software technologies and to specialists in management of complex projects, primarily DP service companies.

To these qualitative requirements is added the quantitative growth in demand. Who is investing what? At what rates? With what priorities? Government telecom administrations, private carriers, manufacturers and users are all investing. This is the advantage of current moves toward deregulation. Not haphazardly, however, for that risks technical paralysis. We now know that there are limits on deregulation.

THE INTEGRATED SERVICES DIGITAL NETWORK

ISDN (Integrated Services Digital Network) is a communication network capable of carrying voice, data, text and images simultaneously.

ISDN supports high-speed links, such as those between computers and telephone switches. For end users, however, ISDN is essentially the possibility of plugging a range of "terminals" into what looks like a standard telephone wall jack. These "terminals" might be anything from a telephone to a high-speed facsimile machine which copies a page in five seconds, a personal computer or any other device supporting a transmission rate of 64,000 bits per second (about 5,000 characters per second). These terminals may be used simultaneously or in combination. ISDN thus allows multimedia applications, such as CAP GEMINI SOGETI's "photographic audio-videotex," which adds digitized photographs and sound commentary to conventional videotex page displays.

By transmitting control signals independently of voice and data, ISDN also permits identification of calling parties, announcement of waiting calls and terminal selection directly upon arrival, all further improvements over the plain old dial-up telephone network.

Installation of ISDN presupposes the complete digitization of equipment used for both switching and transmission: public switches, trunk lines, local loops, subscriber switches and subscriber terminals. The digitizing process is well advanced in most industrialized nations, and ISDN trials are already taking place.

In the U.S., Mountain Bell has installed ISDN for several state government agencies in Arizona, while Illinois Bell is providing ISDN services at the headquarters buildings of McDonald's, the fast food chain. In France, ISDN is already getting off the ground, with Brittany and the Paris region to be served as of the beginning of 1989. And manufacturers of network switches, computer interfaces, voice data terminals and PC add-on boards all seem ready to meet a fresh surge of demand.

Finally, we take our hats off to the British, French, West German and Italian telecommunications authorities, which have said they will offer an interconnected ISDN as of 1990. In contrast to the present situation for both leased lines and packet-switching networks, border-crossing between these countries under ISDN will not result in truncated services, heavily increased cost or bundles of red tape. It will finally be possible to define the telecommunications policies of Europe's professional users on a transnational scale. This fact alone should ensure ISDN's success on the "Old Continent."

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This is an imposing technological balance. Shortly after the year 2000, chips will contain nearly one billion transistors and will have memory capacities of sixty megabytes. For small computers, disk units will hold several billion bytes, with each square inch of disk surface capable of storing 125,000 text pages. Parallel supercomputers will handle tens of billions of operations per second. Microcomputers will be as powerful as the most powerful mainframe on the market today. Machines will write text to match spoken input. And, of course, that won't be the end of the story; far from it!

An impressive evolution surely; yet it will not take place more rapidly or more slowly than the changes we have been experiencing over the past thirty years. A few examples will give an idea of the somewhat random nature and unpredictable timing of the new technologies. While 32 bits microcomputers (32 bits being the length of the data work processed in each computer cycle) were announced over three years ago, they still accounted for only 5% of 1987 deliveries. The "smart card" was invented in 1976 (see inset, below); twelve years later, its use is still largely confined to a handful of experiments. The "mouse," invented shortly before 1970, did not appear on the market until 1981. The introduction cycle for innovative products is a relatively long one, giving manufacturers and users time to evaluate their advantages and to prepare for their integration into existing resources.

GETTING A NEW TECHNOLOGY OFF THE GROUND: THE "SMART" CARD

A "smart" card is made by inserting an electronic microcircuit in a plastic "sandwich" the size and shape of a credit card. The microcircuit includes a microprocessor and a read-only memory holding about 1,000 characters. The processing and storage capabilities offered by the smart card suggest a great many applications in which it may be used as a counterfeit-proof identity document, as a portable personal file which can be instantaneously queried and updated, or as a combination of the two. The first prototype was unveiled by its inventor, Roland Moreno, a French engineer, back in 1976. The industrial prototype of the single-chip card currently in use was produced in 1981. Since 1982, a number of experimental trials, followed by full-scale testing, have been carried out (with encouragement and backing from the French manufacturer, Bull) in Europe, the U.S. and Japan. Today, the smart card is finding significant use for payments in such diverse countries as Norway, New Zealand and France, where over 15 million cards have been produced, primarily for France Telecom and for the VISA network.

In another vein, control of accesses to DP networks is a major problem which can be solved by the smart card. In cooperation with the Banque Nationale de Paris (BNP), CAP SOGETI TERTIAIRE has designed a Generalized Security Processor (GSP). The GSP consists of software and an add-on board inserted into a PC, which is then connected to the various nodes of the networks to be protected. Each network user has a smart card identifying the bearer and indicating his or her access authorization levels. The security system, consisting of smart cards and GSP, ensures user authentication as well as the integrity and confidentiality of transmitted information. The security architecture, based on the GSP, is especially adapted to the requirements of heterogeneous and multiple-access-point networks.

These examples show that smart card technology has already developed some significant markets while awaiting possible widespread use in the credit and payment card fields.

SOFTWARE AND SERVICE TECHNOLOGIES

There is no sign that the pace of technological innovation is going to slow down for the next fifteen years at least, and increasingly powerful hardware resources will continue to flood the market. This means that software and service professionals will continue to carry out their mission of making these electronic resources assist in the solution of every sort of problem. These men and women analyze problems, structure data, design and configure systems, code and test programs, and maintain DP applications throughout their operational lifetimes. Their know-how advancing in step with innovation, these professionals take the increased processing power available each year and make it usable.

■■■ Software bridges the gap between hardware, which evolves under the influence of technological progress, and applications, which evolve with the environment that they serve. Software and service technologies are thus doubly obliged to adapt continually to the course of events. After having summarized the current state of these technologies, we shall attempt to examine the changes in architecture and the increasing scope of the applications confronting software and services.

TODAY'S TOOLING: BASIC SOFTWARE AND SOFTWARE ENGINEERING

Operating systems and utilities–sorting routines, for example–are unique to individual machine types. Usable for all applications, they are generally furnished by the computer manufacturers. They are accompanied by still other programs, less general in nature, such as languages and database management systems, to make up part of a machine's "basic software." All together, they make it possible to optimize the use of computer resources and reduce the effort required for applications development. The tools of "software engineering" (this is the name given to the art of program development) supplement the ensemble of aids to development and operation available to DP professionals.

■■■ The immense majority of existing programs are written in languages invented 20 to 30 years ago. FORTRAN dates from 1957 (see inset, opposite), COBOL was born in 1960, BASIC in 1964, LISP (an artificial intelligence language) in 1959! The same is true for operating systems. UNIX is nearly twenty years old, and relational databases date from 1970.

■■■ It was with the close of the 1930s that the American mathematician Johann von Neumann began to define the general architecture of computers, and this in turn has given birth to a number of successive generations of machines over a period of more than forty years. Yet one has the impression that only a dozen years were needed to invent all the software currently in use! In actual fact, the advance of software has been slow and steady. Not being dependent on a dominant technology, software does not progress by sudden innovation. It is continuously improved upon. Languages themselves are gradually modified in order to take advantage of new hardware functions.

■■■ The only real innovation of recent times has been the ADA language, rights to which are

owned by the U.S. Department of Defense. ADA was developed in 1980 by a Frenchman, Jean Ichbiah, to facilitate the implementation of large military systems. The first ADA compilers were produced in 1984. ADA's major contribution is its "programmatic environment," software engineering methods and tools which are still highly specialized. Early users are satisfied so far, but it must be stated that no very large, full-scale system has yet been developed under ADA.

Software engineering methods and tools, more numerous every day, are provided to assist in the implementation of all phases of applications development. If an appropriate method is employed, the design phase is carried out with greater strictness, the application matches the user's requirements more closely, and coding and maintenance tasks will be made substantially easier. Software engineering tools include data dictionaries, code generators, fourth-generation languages, etc. Some large users have set up their own "software engineering workshops," automating their methods and installing their tools in a system fully dedicated to development, accessible from dedicated workstations.

While substantial, advances in software have not been spectacular... nor can they be. "Software development is hard because there are so few exploitable design regularities": this statement by David L. Parnas, a professor of computer science at Queens University, Kingston, Ontario (cf. **Computer Design**, January 1, 1987) clearly summarizes the basic reason why implementation of applications is a job for professsionals. Tools are useful, but know-how is decisive!

FORTRAN'S 30TH BIRTHDAY

1953: *John Backus, an engineer at IBM's research and programming laboratory, advances the concept of FORTRAN for the 704 computer. The first FORTRAN compiler is available the next year.*

1957: *Release of FORTRAN 1 for the IBM 704. The first FORTRAN program is run for the Westinghouse Nuclear Power Laboratory in Pittsburgh.*

1960: *Various versions of FORTRAN released by other manufacturers (CDC, Honeywell, etc.).*

1961: *McCracken publishes the **FORTRAN Programming Guide** (over 300,000 copies sold). IBM releases FORTRAN IV for its Series 4 7090 computer.*

1962 : *The American Standards Association (later known as ANSI) sets up a committee to develop a FORTRAN standard.*

1964: ***Datamation** compiles a census of 43 FORTRAN compilers.*

1982: *FORTRAN's 25th birthday celebrated at the National Computer Conference Pioneer Day in Houston.*

1987: *Microsoft introduces its FORTRAN 77 for IBM PC-compatible microcomputers.*

1988: *FORTRAN 8 could become the new international standard.*

Today FORTRAN is in the prime of life: nearly 90% of all technical and scientific applications are written in this language.

This success is bound up with the very concept behind FORTRAN (an abbreviation of "formula translation"), which was a language designed to provide engineers with a simple instrument close to mathematical language. This is one of the main reasons for its ease of learning and the speed with which it enables programs to be written and debugged. These advantages are enhanced by the fact that FORTRAN can run on many machines and is endowed with an extensive applications library.

On the other hand, it would appear that, when compared with languages such as PASCAL or C, FORTRAN will require a number of improvements if it is to become a modern language permitting more functional–i.e., more machine-independent–programming. Current proceedings by ISO (International Standards Organization) Working Group No. 5 and ANSI (American National Standards Institute) Subcommittee X3J3 are aimed precisely at the development of FORTRAN 8, which should become the new and unique world standard.

NEW PROBLEMS, NEW APPROACHES

The simultaneous use of a large number of processors collected within a single "parallel" machine raises a serious software problem. Indeed, how do you break down a problem into a multitude of tasks to be executed in mutual independence? How do you coordinate and synchronize all of these tasks? How do you judiciously distribute sets of instructions, data and results? Current languages lack the necessary vocabulary and syntax. They let you write "do A, then B, then C," but not "do A, B and C at the same time." The new parallel architecture needs new programming languages. This also raises the more general problem of the structure and nature of what might be called "parallel programming."

This is presently the subject of research along various channels, both industrial and academic. "Parallelizing" software would allow programs written for conventional machines to be processed with the greatest degree of parallelism possible. Parallel languages would include a messaging function to link the different tasks. "Systolic" programming would be created for machines into which data are injected at regular intervals. Work is also under way on symmetric languages.

■■■ Work related to artificial intelligence is also advancing along a number of paths. One reason behind recent developments in this field is the availability of high computing speeds. In fact, each of the main artificial intelligence application areas is an insatiable consumer of computer power:

a. Expert systems simulate the thinking of specialists in a given field. Experts' knowledge is recorded in a machine in the form of a collection of facts, rules and declarations. The computer, asked to make a diagnosis, applies rules of inference. By exploring all possible relationships between the observed facts and the data held in the "knowledge base," these rules actually make it possible to judge the truth of a proposition on the basis of other propositions. As might be expected, the practical effectiveness of such systems depends primarily on the amount of knowledge memorized. This quantity must be increased if one desires answers which are professionally usable, in turn leading to an exponential increase in processing requirements.

■■■ The chief areas in which expert systems have begun to be applied are financial modeling, diagnosis (medical, mechanical) and systems configuration. After having overcome the obstacle of computing speed, advances have yet to be made in the area of knowledge acquisition, in order to expand the field of application of this problem-solving technique.

b. Natural language processing collides with the computer's extreme backwardness when it comes to understanding a text. To do so, the machine must perform a very fine analysis not only of the text itself, but of its context as well. It seems obvious that the more precisely this context is specified, the less chance there will be of a mistaken interpretation. And this precision will be gained through increased computer power consumption, computing speed and memory capacity. The stakes are enormous, as success will mean the ability to give a computer commands in everyday language and–as a secondary benefit–to perform translations automatically.

■■■ At present, it is possible to query certain databases in natural language. This has been made possible by the availability of powerful and inexpensive hardware, particularly microcomputers. As databases become more complex and more widely distributed, however, their structures and inquiry procedures will grow increasingly unfamiliar to users: natural language access interfaces will become necessary. There is also a desire to make expert systems more user-friendly by creating natural language user interfaces.

There may be limits to the computer's power of comprehension, given the implicit, unstated content of any text or discourse. The existence of more sophisticated and more powerful resources will enable researchers to discover these limits (if they exist) and to approach as near to them as possible.

c. In principle, **artificial vision** confronts present-day machines with insurmountable problems. Still, there are industrial applications (see inset opposite) for situations in which the objects to be viewed are simple (a dial indicator needle, an empty or occupied storage slot, an intact or broken filament, etc.). This diminishes the problem of interpreting what is viewed. At the current level of scientific knowledge, however, a machine must function analogously to the eye and the brain if it is truly to "see." Every human eye contains one hundred million light-sensitive cells; each cell, acting on a tiny segment of the field of vision, continuously registers information on contrast, variations in luminosity/brightness, contour, orientation, etc. The information sent to the brain via the optic nerve is compared with memorized images and, when required, the identification of the viewed object becomes conscious. This model makes it easy to imagine the contribution of fine-grain parallelism and the need for a large number of computations for each image.

It must be acknowledged, however, that an exact definition of "artificial intelligence" remains to be agreed upon...just as with natural intelligence, for that matter! In the November 1983 issue of **Computerworld**, Prof. Marvin Minsky, a pioneer of artificial intelligence (he participated in the 1956 Dartmouth conference at which the name was hatched), summarized the situation in the following definitions:

- "A.I. is the science of making machines do things that would require intelligence if done by men..."
- "It seems to me that intelligence is just the things that people do that they can't explain so it's not a thing. It's a way to solve problems."

The only truly obvious conclusion to be drawn from all of this is that the more one wishes to use machines intelligently, the more consumption of human brainpower is going to be needed.

THE INDUSTRIAL APPLICATIONS OF COMPUTER VISION

Check the correct insertion of 2,000 component leads into circuit boards in 25 seconds, guide a loading robot, calibrate a scale in just a few seconds, inspect 10,000 pharmaceutical ampules per hour, make an angular measurement accurate to one-tenth of a degree on a circuit breaker in 300 milliseconds, check the quality of a clutch assembly: this selection of applications designed, implemented and installed by ITMI is only a hint of the potential applications of computer vision.

This technique, which aims to simulate the functions of the human eye, is assisted by powerful software to perceive, identify and interpret scenes observed by cameras. It is applicable to every industry: automotive, electronics, pharmaceuticals, food, aerospace, and so on.

Its applications–virtually always in the area of quality control, the key to industrial competitiveness in today's world–are quite numerous: compliance inspection, robot and machine guidance, identification and sorting of objects, etc.

By making decisive new contributions to computer vision (real-time processing, operation in ambient light, software application generators, interpretation assisted by expert systems, and others) and by mastering the integration of this technique into the production tool, CAP GEMINI SOGETI, through its subsidiary ITMI, is providing manufacturers with the resources they need to achieve excellence.

THE EXPANSION OF SERVICE TECHNOLOGIES

Sophisticated as they may be, DP tools are usable only if mastered by the service technologies. The know-how of software developers–a major component of these technologies–must include the adoption of new hardware as soon as it makes its appearance. It must also be able to encompass problems which are new in type and broader in scope. We have chosen three topics to illustrate these propositions:

a. **Value-added networks** are going to proliferate. Besides the simple function of data transport, they offer access to information and the ability to perform transactions. Service activities have developed in order to take part in the design, implementation and operation of these systems. Techniques for network architecture, data structuring, rate charging, network management, connection, etc., have been developed.

b. The human complexity of **systems development tasks** is growing more pronounced. Large projects (see inset this page on the U.S. air traffic control system) are carried out by large, scattered and multidisciplinary teams, working for partner firms of differing nationalities (and sometimes differing languages). The end product results from the assembly of thousands of elementary operations, most of them taking "concrete" form as software programs. System quality depends on the quality of each program, of course, but also on the effectiveness of overall organization. And this organization is achieved only if it is possible to motivate each professional, encourage his or her creativity, ensure data integrity, enforce compliance with major technical decisions and see to it that shared resources are properly used. For very many projects, this complex goal is achieved by turning to service companies whose fund of know-how in this domain, carefully and patiently assembled, is an invaluable technological asset.

c. The need for an **environment of databases integrated at the highest level** is being felt because information is now recognized as an important part of corporate assets. For example: a customer order is an item of information which should be just as easily accessible by technical applications (for scheduling, start-up and shop-floor inventory management) as it is by sales applications for marketing management or billing purposes. This information might also prove necessary for the implementation of a strategic application, e.g., the definition of a new policy for subcontracting or for alliance with a supplier. The establishment of universally-accessible distributed databases implies the creation of data models and, in the long run, corporation models.

The actual complexity of such an approach is further burdened by the weight of existing structures and procedures, which more often than not make it necessary to proceed from the bottom upward. To solve this very difficult–and increasingly frequent–problem, service companies have had to invent database engineering and corporate modeling technologies enabling them to assist their client organizations effectively.

THE REBUILDING OF A COLOSSUS: THE U.S. AIR TRAFFIC CONTROL SYSTEM

15,000 airports, 400,000 miles of air traffic lanes, 43 million takeoffs and landings and 48 million flight hours annually: that is the scope of air traffic in the U.S. The system which enables the 14,000 air traffic controllers to manage smooth, prompt and safe traffic flow has been finely tuned and has a wealth of features. Nonetheless, the constant increase in traffic (accelerated by the effects of deregulation) is leading to system saturation and with it an increase in the number of safety-threatening incidents.

The FAA (Federal Aviation Administration) has decided to develop a new system whose characteristics are typical of the large infrastructures to be built between now and the end of the century. The system's software alone will cost several billion dollars. Its lifetime is estimated at 30 years. It will be extremely complex, due to the number of technical features and interfaces between the different subsystems.

Other remarkable characteristics include:

- *Availability: uninterrupted throughout the lifetime of the system. No possibility of service interruption, even partial.*
- *Reliability: set at 99.9995%, meaning no more than 3 seconds down time annually, no more than 30 seconds of emergency mode annually (essential functions only, traffic slowed), no more than 2 minutes of reduced capacity mode annually (essential functions only, but traffic normal). Full service is to be provided during the remaining time.*
- *Man-machine interface: this is a priority concern, and a new methodology will ensure that this concern remains in the forefront from the definition phase to system commissioning.*
- *Adaptability: air traffic, aircraft and data processing will all change during the system's lifetime. The system must therefore be capable of evolving to meet new demands as well as to exploit new technologies.*

These features are all to be found, to a greater or lesser degree, in all of the large civil aviation projects under construction or in the planning stage. The CAP GEMINI SOGETI Group has participated–and is continuing to participate–in a large number of these systems. Its subsidiary SESA, for example, is working on the overhaul of the French air traffic control system, after having implemented a message-swiching network–consisting of thirty systems spread over five continents–for the ICAO (International Civil Aviation Organization).

Just as with hardware technologies, the software and service technologies are the object of an unprecedented effort, in the form of major research projects, by the industrialized nations. The inset on page 27 describes the most important of these projects, at the same time illustrating the friendly competition taking shape between the United States, Western Europe and Japan.

It is interesting to note that these programs show a strong cooperative strain: universities and businesses, often in competition with one another, are

working together on each project. Costs are being co-financed, i.e., governments and private participants are splitting the tab. And all Europe is united within the ESPRIT, RACE and EUREKA programs.

The results of these efforts will not take the form of finished products, but instead research reports, prototypes, methodological rules, and so on. Upon conclusion of each program, participating corporations will be free to develop their own products.

This approach gives current projects a credibility which will rebound to the future advantage of both the DP industry and users. It offers proof–if proof were needed–that private enterprise and public authorities of the world's leading nations are attaching considerable strategic and economic value to software and to the future technologies of data processing.

THE BIGGEST RESEARCH AND DEVELOPMENT PROGRAMS

Both the "Fifth Generation" project announced by Japan at the end of 1981, and the creation of ICOT (Institute for Computer Technology) in that country were aimed at bringing about the marriage between artificial intelligence techniques and the architectures of parallel processors. If the public relations aims of this project have been largely achieved, its technical results are subject to debate and its initial budget commitments have been brought into question. Still, this Japanese effort has undoubtedly provoked a lively reaction in Europe and the United States, as may be seen from the table showing large programs currently under way.

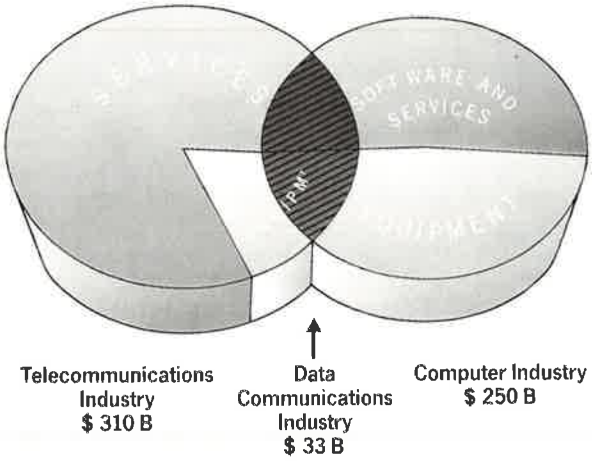
CAP GEMINI SOGETI is an active participant in the ESPRIT, RACE and EUREKA programs. In the case of EUREKA, CAP GEMINI SOGETI is engaged in five projects: one on industrial risk management by expert systems (FORMENTOR), another on information systems security (OASIS), and a third dealing with three-dimensional image synthesis (CERISE). The most notable, however (3,500 man-years over a ten-year period), are the EUREKA SOFTWARE FACTORY (ESF) and EUROPEAN ADVANCED SOFTWARE TECHNOLOGY, combining the efforts of twelve major European partners to design an advanced architecture enabling the development of, and standardized communications between, all software engineering tools.

Project	Budget/ Duration	Research areas
5th generation (Japan)	$500 million over 10 years	Parallel architecture, knowledge techniques, artificial intelligence
ALVEY (Great-Britain)	$500 million over 5 years	VLSI circuits, software engineering. Knowledge bases, man-machine interfaces
ESPRIT I (Europe)	$1.5 billion over 4 years	LSI microelectronic, information processing technology, software engineering
ESPRIT II (Europe)	$4 billion over 5 years	
RACE (Europe)	$750 million over 5 years	Advanced telecom technologies (ISDN, mobile communications)
EUREKA (Europe)	$5 billion over 10 years	Advanced technologies: data processing, biotechnology, new materials, etc.
MCC (USA)	$250 million over 4 years	VLSI circuits, software engineering, parallel architecture, databases, artificial intelligence, human factors
STRATEGIC COMPUTING (USA)	$1 billion over 10 years	Microelectronics, advanced architectures, "intelligent machines" combining knowledge bases, visual and speech recognition, natural language

INFORMATION TECHNOLOGY: AN INDUS

TRY

The "information technology" industry includes both the telecommunications and data processing industries. In this document, we have elected to present and analyze the DP industry only. While fruitful technological exchanges have been taking place between the two domains, as we have already noted, it remains a fact that there will be very little overlap between the DP and telecom industries until the year 2000. Data communications still represents only 13% of DP industry volume; and the plain old telephone, with its adjuncts, still accounts for a large majority of jobs and about 90% of revenues for the telecommunications industry as a whole.



As shown on this chart, the information technology industry consists of two largely separate industries.

THE DP INDUSTRY: GOODS AND SERVICES

A spectacular turnabout has taken place in the data processing industry, with software and services now accounting for substantially greater revenues than hardware: 46% vs. 41%. And this reversal is going to become more pronounced. So the announcements of corporate results and the trend analyses that thrive in the media must be interpreted with care: since they usually refer to hardware alone, they are not representative of the overall DP industry or, by the same token, other non-hardware segments of this industry.

■■■ As for the DP industry proper, it provides goods and services to all of the players in the economy: businesses, government agencies, consumers. This industry's production has been divided into four major fields in order to draw up the table opposite:

- DP hardware (computers, peripherals and terminals), in turn broken down into four categories of machine size.
- Maintenance services and basic software directly related to hardware and generally supplied by hardware manufacturers.
- DP services: processing, program products for specific applications, software services.
- Data communications, divided between hardware (such as modems) and data transmission services.

■■■ There is nothing scholarly about this breakdown. It is intended to isolate differing service types as clearly as possible and to aid in explaining current developments. The table contains an estimate of the world market, together with a three-year growth projection. Obviously, this information does not lay claim to extreme precision, but it is very thorough and has been compiled from many sources generally regarded as reliable. Note also that figures are expressed in U.S. dollars, a currency which remains the generally-accepted standard despite its fluctuations on the world's exchanges. Analysis of this information enables us to draw some interesting conclusions:

a. With a sales volume on the order of 250 billion dollars and a worldwide workforce in excess of three million people, the DP industry is already one of the world's largest; according to some projections, only agriculture will surpass it in volume of activity by the end of the century.

b. Basic software, maintenance and DP services today account for 46% of all DP activity, in contrast to 41% for hardware and 13% for data communications. The traditional activity of **manufacturers** (hardware + basic software and services) accounts for 58% of the total; but hardware production is no longer showing a very high growth rate (estimated at 9% in value for the next three years) and manufacturers, striving to maintain their own growth, are concentrating their technical and marketing efforts on the basic software and maintenance markets, with an estimated yearly growth rate of 20%.

c. The DP industry today appears to consist of ten more or less homogeneous and uniformly-dimensioned segments. It is thus impossible to say that central systems or microcomputers, for example, are more representative of DP activity than maintenance or software services. On the other hand, the growth rates shown in the table make it obvious that software services are going to form the industry's main sector of activity within 5 years. This comes as no surprise, and reflects the fact that expenditures on new applications are growing at least as fast as installed computing power. And computing power is growing much more rapidly than the increase in value of deliveries would lead us to believe, since technological progress has led to a continuing decrease in hardware cost.

d. The market structure of the two most important segments today (central systems and local systems) is concentrated in the hands of a few manufacturers, whereas that of the other areas is highly fragmented. The manufacturers, led by IBM, obviously dominate the five segments embracing hardware and directly-related products and services. It is quite logical that their salespeople sign clients up for hardware maintenance services and basic software in a single operation. Customers also rightly view these two items as essential to smooth hardware operation, and they generally prefer that they be provided by the manufacturers themselves.
A significant note: except when they also manufacture computers, manufacturers of peripherals are not shown in the table: in point of fact, these manufacturers sell the bulk of their production to computer manufacturers, and not to end users. It must be noted, however, that peripherals account for 35% to 40% of total hardware value.

e. Tens of thousands of companies are sharing the DP service field, and no single one of them holds over 3% or 4% of the market for its own segment of activity. This extreme fragmentation is probably the result of the "local" origins of these companies, as well as the relatively small amount of start-up capital required. Still, a few international leaders–including CAP GEMINI SOGETI–are beginning to emerge.

THE WORLD DP MARKET (a)

	1987 market $ billion (b)	Share of total DP market	Growth rate 1987-1990 (c)	Main actors (market share > 2% Name underlined: > 10%)	Products and services offered
I. DP HARDWARE (1)	105	41%	**9%**	(CONCENTRATED MARKET)	Computers, peripherals, terminals
• CENTRAL SYSTEMS LARGE SYSTEMS	37	14%	**6%**	IBM, FUJITSU, NEC, UNISYS, also BULL-HIS, HITACHI	Supercomputers, central computers with basic configuration price > $ 700,000 — Peripheral equipment such as: printers and disk drives
• DEPARTMENTAL SYSTEMS, MID-RANGE AND MINI-COMPUTERS	26	10%	**10%**	IBM, DEC, HP, also BULL-HIS, DATA GENERAL, FUJITSU, NCR, NEC, PRIME, SIEMENS, TANDEM, UNISYS, WANG	Central computers with basic configuration price < $ 700,000 Superminis, minicomputers
• LOCAL SYSTEMS WORKSTATIONS, MICROCOMPUTERS, TERMINALS	42	16%	**12%**	IBM, APPLE also COMPAQ, DEC, HP, NCR, NEC, NIXDORF, OLIVETTI, TANDY, WANG, ZENITH	Workstations, stand-alone and connected microcomputers, dumb terminals
II. HARDWARE-RELATED SERVICES AND SOFTWARE	44	17%	**20%**	(CONCENTRATED MARKET)	Products and services for basic computer operations
• MAINTENANCE	25	10%	**17%**	SAME AS DP HARDWARE, CENTRAL AND DEPARTMENTAL SYSTEMS (1)	Failure detection, local and remote trouble-shooting and repair, preventive maintenance
• BASIC SOFTWARE PRODUCTS	19	7%	**24%**	IBM, UNISYS, DEC COMPUTER ASSOCIATES MICROSOFT (2)	Operating systems, database management systems, telecom monitors, scheduling and management systems, languages, data dictionaries, utilities, software engineering tools
III. DP SERVICES	74	29%	**16%**	(HIGHLY FRAGMENTED MARKET)	Products and services for data processing use
• PROCESSING SERVICES	31	12%	**11%**	ADP, EDS, REUTERS, DUN & BRADSTREET	Data entry, service bureau, processing services, data bank servers, network services
• APPLICATION PROGRAM PRODUCTS	14	5%	**18%**	IBM, LOTUS	Horizontal packages (payroll, accounting, inventory management, word processing, spreadsheets, etc.), vertical packages (portfolio management, hospital management, computer-aided design, etc.)
• PROFESSIONAL SOFTWARE SERVICES	29	11%	**20%**	IBM, CAP GEMINI SOGETI, ARTHUR ANDERSEN, COMPUTER SCIENCES CORP., TRW, EDS	Consulting, organization and operation of DP resources, software development, systems integration (excl. hardware) customizing of program products, training, conversions
IV. DATA COMMUNICATIONS	33	13%	**11%**	(FRAGMENTED MARKET)	Equipment and services directly related to data communications
• EQUIPMENT	15	6%	**12%**	IBM, AT&T, DEC, also MOTOROLA, RACAL, ALCATEL NV, NORTHERN TELECOM, SIEMENS	Data transmission and switching equipment: telecom control units, modems, concentrators, multiplexers, packet-switching and local area networks
• SERVICES	18	7%	**10%**	NTT, AT&T, DEUTSCHE BUNDESPOST, BRITISH TELECOM, FRANCE TELECOM, GTE, the 7 AMERICAN REGIONAL COMPANIES, BELL CANADA	Provision of dedicated equipment and data transmission services on all network types (3)
TOTAL	256	100%	**13%**		

(a) CAP GEMINI SOGETI estimates based on compilation of numerous outside sources, including ALEX BROWN, DATAMATION, EIC, IDC, INPUT, GARTNER, GOLDMAN SACHS, PAC, QUANTUM, SHEARSON LEHMAN, TELECOMS MAGAZINE.
This is the worldwide market of suppliers of products and services related to data processing. Total DP expenditures for business and government agencies would be obtained by adding the cost of MIS development and operations staff, miscellaneous expenses (supplies, rent, utilities, etc.), cost of middlemen (financing, distribution) and transactions between subsidiaries and parent firms, which are not taken into account in this table.
Please note that the structure of the table (worldwide market and breakdown by activity) minimizes (or even overlooks) the activity of large companies holding strong positions in certain countries and selling a wide range of products and services. In particular, this is the case with large European manufacturers such as BULL, ICL, SIEMENS, PHILIPS, OLIVETTI and NIXDORF.

(b) Duplicate accruals have been eliminated (e.g., the hardware component of integrated systems is included under Section I, "DP Hardware" but not in Section III, "DP Services"). Figures accurate to 10%.

(c) Average annual growth rates in current currency. Figures assume that the exchange rates will remain at their level of 12-31-1987 and include an estimated average inflation rate of 3%.

(1) Leaders in third-party maintenance, such as TRW and Sorbus (Atlantic Bell), have market shares lower than 2%.

(2) Computer Associates leads independent suppliers with a market share on the order of 3.5% followed by Microsoft with 2.4%. Other independent suppliers each hold market shares lower than 2%.

(3) This activity accounts for an average 7% of Communication Carriers' revenue.

f. The data communications equipment and service field–indispensable to DP users–accounts for 13% of the total market. All telecommunication carriers (including the European PTTs) and equipment manufacturers have thus become–if marginally–members of the DP industry.

g. The original core of the DP industry, the manufacturing of central systems, shows the lowest projected growth rate (6%, i.e., only 3 points above inflation). There are several possible explanations for this: large surplus of unused processing power, increased power at constant cost, increasing decentralization of certain applications which are better served with smaller machines. Naturally, the companies in this sector have been affected since 1985 by their falling growth rate. The alleged "DP crisis" trumpeted by the media, however, is simply a slowdown in the most visible DP activity...an activity which represents only 14% of the total DP industry! In contrast, software-related sectors are showing a very strong and very stable growth–on the order of 20% annually–whether in the form of products (basic software, application software) or software services (consulting, design, custom implementation, training, etc.).

Before making a more detailed examination of the evolution of two major DP business categories–manufacturers and service firms–we should also recall that, applying average 1986 exchange rates, the geographical distribution of the value of purchased goods and services is: U.S., 40%; Europe, 32%; Japan, 16%; other countries, 12%. This confirms the fact that the non-Communist industrialized nations consume virtually all DP products and services and that data processing is not yet playing a priority role in the developing countries. It should also be noted that the proportions held by the U.S. and Europe are now quite similar, even further approaching one another in 1987 (if only for reasons of exchange rates).

HARDWARE MANUFACTURERS

Twenty years ago, the leaders of the pack were caricatured as "IBM and the Seven Dwarfs." Following the withdrawal of two of the "dwarfs," IBM's competitors on the central-computer market came to be called "The Bunch" (Burroughs, UNIVAC, NCR, Control Data, Honeywell). Today, the first two of these have merged to form UNISYS, while Honeywell Information Systems is virtually controlled by Bull, its former subsidiary! Between 1978 and 1985, however, The Bunch had already lost ground; its revenues had fallen from 54% to 41% of IBM's, evidence that the central systems segment is stabilizing.

■■■ If IBM still holds a substantially dominant position in central systems (and therefore in directly-related software and services as well), the same is not true for other segments of the DP industry. In departmental systems, DEC is running neck-and-neck with IBM. And Big Blue holds only 15% of the local systems market. For the overall industry, a simple comparison of total revenue ($256 billion) with IBM revenue ($54 billion) shows that this company holds about 20% of the market. Is it necessary to point out that, only 20 years ago, IBM held 60% of the mainframe computer market? But that was an era when there were no microcomputers, when minicomputers had only just made their debut and when service companies were taking their first steps. In any case, it is certainly possible to speak of the "demonopolization" of data processing!
The recent fluctuations in IBM's results have stimulated a highly logical response on the part of company management: reduction of overhead, beefing up of the sales force, increased investment in high-growth sectors which can be directly exploited by the IBM distribution network (basic software, supercomputers, workstations, packaged application software). The future SUMMIT product line, to be unveiled–according to the Gartner Group–in 1990, will doubtless embody all of these new orientations. Announced at the end of 1987, IBM's agreement with Steve S. Chen–a guru of parallel architecture who had just left Cray–lies well within the framework of these trends.

■■■ In a number of European countries, IBM is confronting "home-grown" challengers whose activity is far from purely domestic in scope: Bull in France, ICL in the U.K., Siemens in Germany, Philips in the Netherlands and Olivetti in Italy.
It might also be noted that, in the long run, all manufacturers have aligned their behavior to that of minicomputer and microcomputer manufacturers: reliance on networks of small-machine retailers, numerous technical alliances, sale–rather than lease–of hardware. IBM's rental revenue, which amounted to 60% of gross in 1971, had fallen to 7% fifteen years later! Still, we are witnessing the birth of a new "rental base" of basic software which is quickly taking on significant proportions.

■■■ It is not possible to draw general conclusions from the situation of mainframe computer manufacturers. The leaders of the minicomputer and microcomputer sectors, for example, do not have to face the same problems, as their market is experiencing stronger growth.
A more detailed examination of the "local systems" sector–indicating overall growth of approximately 12% annually–shows certain booming segments. This sector, which includes "dumb" terminals, now being replaced by microcomputers (France's Minitel terminal being an exception which does not negate the general trend), also embraces personal computers, which are continuing their sustained pace of market penetration. It also includes workstations, whose market, while still small ($1.5 billion in 1986), is showing rapid growth in the areas of industrial (CAD) and scientific applications, the main suppliers being Hewlett-Packard, Sun and Apollo.

■■■ A part of the "mainframe" market sector, the supercomputer is showing energetic growth. According to **Business Communications**, the supercomputer market will go from $1.1 billion in 1986, to $7.1 billion in 1991, for an annual growth rate of 45%! Cray currently holds 60% of the market, with Fujitsu, Control Data and IBM straggling far behind. Activity is equally dynamic in the area of peripherals. Thanks to rapid technological development, 5-1/4" hard disks are gradually going to replace other types currently used in minicomputers. The hard disk market, with a current volume of $12 billion, is growing rapidly (15% to 20% annually), and independent companies such as Seagate, Storage Technology, Micropolis and Miniscribe are making their presence known alongside the big manufacturers.

DP SERVICE AND CONSULTING FIRMS

In its July 1987 issue, the U.S. publication **Business Week**, quoting Robert F. Berland, an executive who directs many software activities at IBM, ventured the opinion that "The computer business is going to turn into a software and services industry." Facts and forecasts alike seem to indicate that software and services are going to win a dominant share of the overall DP activity. This is clearly indicated by the table on page 31. Although these two fields cover activities that are often highly disparate, there are deep and lasting reasons behind their strong overall growth. In point of fact, demand for software and services is a function of:

- the installed DP base: existing applications must adapt to changes in the environment (organization, activity, legislation, etc.) and constantly generate a strong demand for services;
- the continuing growth of computing power, primarily due to technological advances: lowered costs make new hardware applications economically viable, in turn creating new software and service needs;
- the degree of complexity of tasks to be carried out to implement an application. Systems are becoming more complex, if only because they increasingly involve hardware of highly diverse origins and–in a manner which will become virtually systematic–telecommunications industry products. At the same time, consumers want increasingly "user-friendly" products. And it is no secret that the simpler it is to use a system or a product, the more complex its design and implementation;
- the professional capabilities and worth of service firms, providing customers with the confidence to subcontract and giving meaning to the adage "to each his own job."

■■■ These factors are more or less immediately applicable to various services, the situation of suppliers varying greatly depending on sector of activity:

Hardware maintenance remains the bailiwick of manufacturers, but certain companies specializing in "third-party maintenance" have managed to provide high-quality service to users of highly disparate systems.

The "heaviest" and most machine-dependent **basic software**–operating systems–is developed at great expense by manufacturers during the design phase of each machine. It is therefore supplied exclusively by the vendor (with a notable exception in the case of the PC and PS/2 machines, for which IBM turned to Microsoft, a company specializing in software for microcomputers).

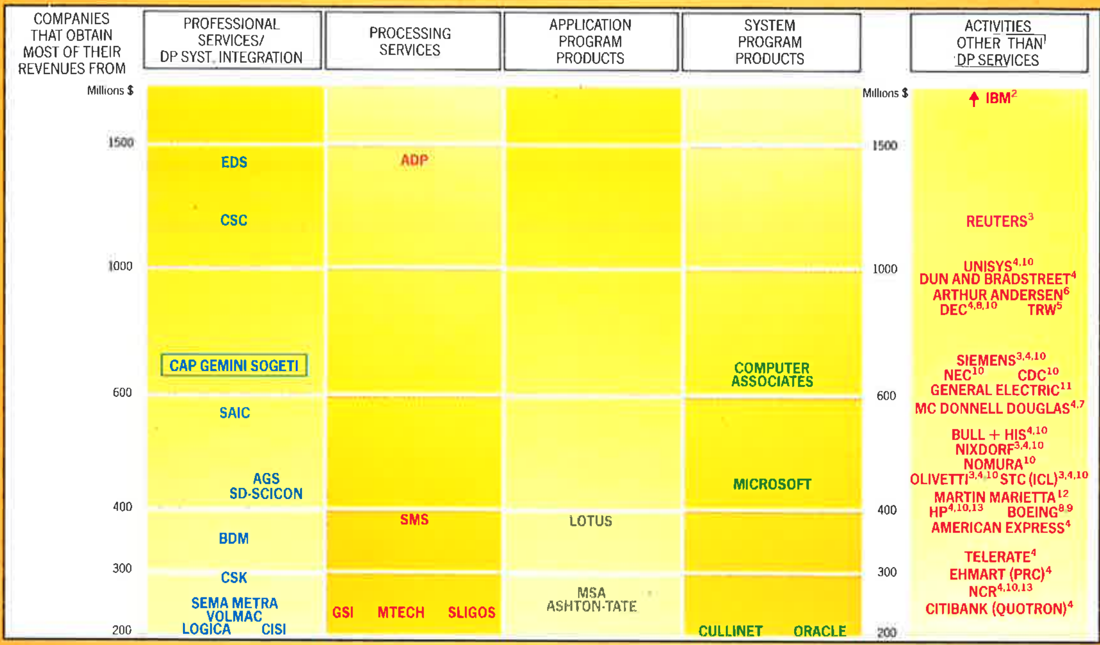
Other basic software items are also primarily supplied by the manufacturers, but users of widely-distributed hardware can often obtain advantageous alternatives from independent suppliers. The largest of these companies is Computer Associates which, owing to the recent acquisition of its competitor UCCEL, is now showing revenue almost equal to 10% of IBM's in this field.

The **processing services** segment has been undergoing profound change over the past ten years. Time-sharing services have virtually lost their *raison d'être* since corporations have set up their own networks. Likewise, service bureaus have been unable to hang on to customers who have equipped themselves with microcomputers. On the other hand, companies in this domain have been able to develop true expertise in certain areas of application, or to invent new services (access to technical or financial data banks, access to videotex servers, value-added services). These firms have continued to grow, as witness the results for the leaders in this field, the American company ADP, INTEC in Japan, or GSI in France, DATEV in Germany, and so on. Two special cases deserve mention:

- "Facilities management": this is the complete takeover and management of all of a company's data processing activity (including its DP personnel) by a service firm. This formula has enjoyed its greatest success among U.S. health insurance funds, but has shown little development outside of the United States.
- For some time now, companies such as Reuters have been providing services which were not considered "DP services" because the production technique did not involve data processing. Now that these companies have completely computerized their operations, they have virtually become DP service firms! At the same time, they are diversifying their services, taking advantage of the power and flexibility that their computers provide.

Companies offering **application program products** for microcomputers have sprung up like mushrooms in all of the industrialized nations. "Spreadsheets" have made the fortune of Lotus Development Corporation, the largest of these companies. It is quite logical that small companies with only limited DP budgets look for inexpensive, ready-made application packages. Small-user applications aside, however, program products are not the best approach for handling applications unless they are very universal in nature (as is the case with many technical computations) or involve highly regimented or routine procedures (as with general accounting applications). There are more complex packages on the market, but the cost of adapting them to the purchaser's requirements is often much greater than that of the program itself.

On the whole, the application program product market has always enjoyed steady growth, which even exceeded 30% when the demand for personal computers literally exploded. Still, the variety of needs and approaches is such that there can be no universally-applicable solutions. Users often have the choice between a "packaged" solution, a "made-to-industrial-measure" solution and a true "tailor-made" solution. In any case, despite the efforts of certain vendors to sell their products outside of their country of origin, programs and markets are still primarily national. Suppliers are



The above table was prepared utilizing our good faith efforts in estimating the revenue levels in DP services, excluding hardware sales, rental and maintenance revenues. The information was obtained from the sources mentioned in the following footnotes and that we believe to be reliable. However, we do not guarantee the accuracy or completeness of these estimates. Indeed, we wish to stress that the selection and positioning on the chart of the companies that achieve the best part of their revenues from activities other than DP services are based on very rough estimates.

1. *The companies themselves, supported by studies conducted by Alex Brown, Robert Flemings Securities, Goldman Sachs, Shearson Lehman Hutton and Smith Barney.*
2. *IBM announced 1987 revenues of $6,836 M for program-products and $2,238 M for the Federal Systems Division (Systems Integration). We estimate that the better part of the program-product revenues corresponds to system and utility software products, and that approximately 30% of the Federal Systems Division's revenues corresponds to Professional Services, as opposed to Hardware or Software Products.*
3. *Robert Flemings Securities*
4. *Input*
5. *TRW indicates that its activity in Federal and Commercial Information Systems represents at least 25% of its total revenues, which in 1987 amounted to $6,821 M. However, such activity includes a high proportion of internal and/or hardware-based revenues.*
6. *Arthur Andersen*
7. *McDonnel Douglas announced 1987 revenues of $1,247 M for its Information Systems activity. However, such activity includes a significant proportion of internal and/or hardware-based revenues.*
8. *Shearson Lehman Hutton*
9. *Boeing announced 1986 revenues of $616 M for its Computing and Electronics activity.*
10. Datamation
11. *General Electric*
12. *Martin Marietta announced 1987 revenues of $939 M for its Information Systems activity. However, such activity includes a high proportion of internal and/or hardware-based revenues.*

found in all countries, then, but the largest (MSA, McCormack and Dodge, etc.) are all American, simply because the United States has the largest market for application program products.

■■■ The range of services offered by **professional software services companies** is a very broad one. In the realm of consulting, they are increasingly called upon to formulate recommendations on the strategic aspects of data processing, on top of the technical advice and DP master plans they have always provided. Their software development activity extends to the integration of large systems; their consulting and operations assistance activity extends to infocenter and network management. The largest of these companies combine complete mastery of service technology with an in-depth understanding of the sectors of business in which they work. They have shown an annual growth rate exceeding 20% for the past twenty years, enabling some of them to attain a significant size. Along with ADP (the leader in processing) and EDS (a General Motors subsidiary specializing in facilities management and generally viewed as the world's largest DP service firm), the largest service companies are, in fact, software services firms. Included among them are CSC (Computer Sciences Corporation), and CAP GEMINI SOGETI. Arthur Andersen (one of the "Big Eight" accounting firms) is also a large provider of software services. The above table gives a ranking of DP service firms by major sector of activity.

DATA PROCESSING AND TELECOMMUNICATIONS

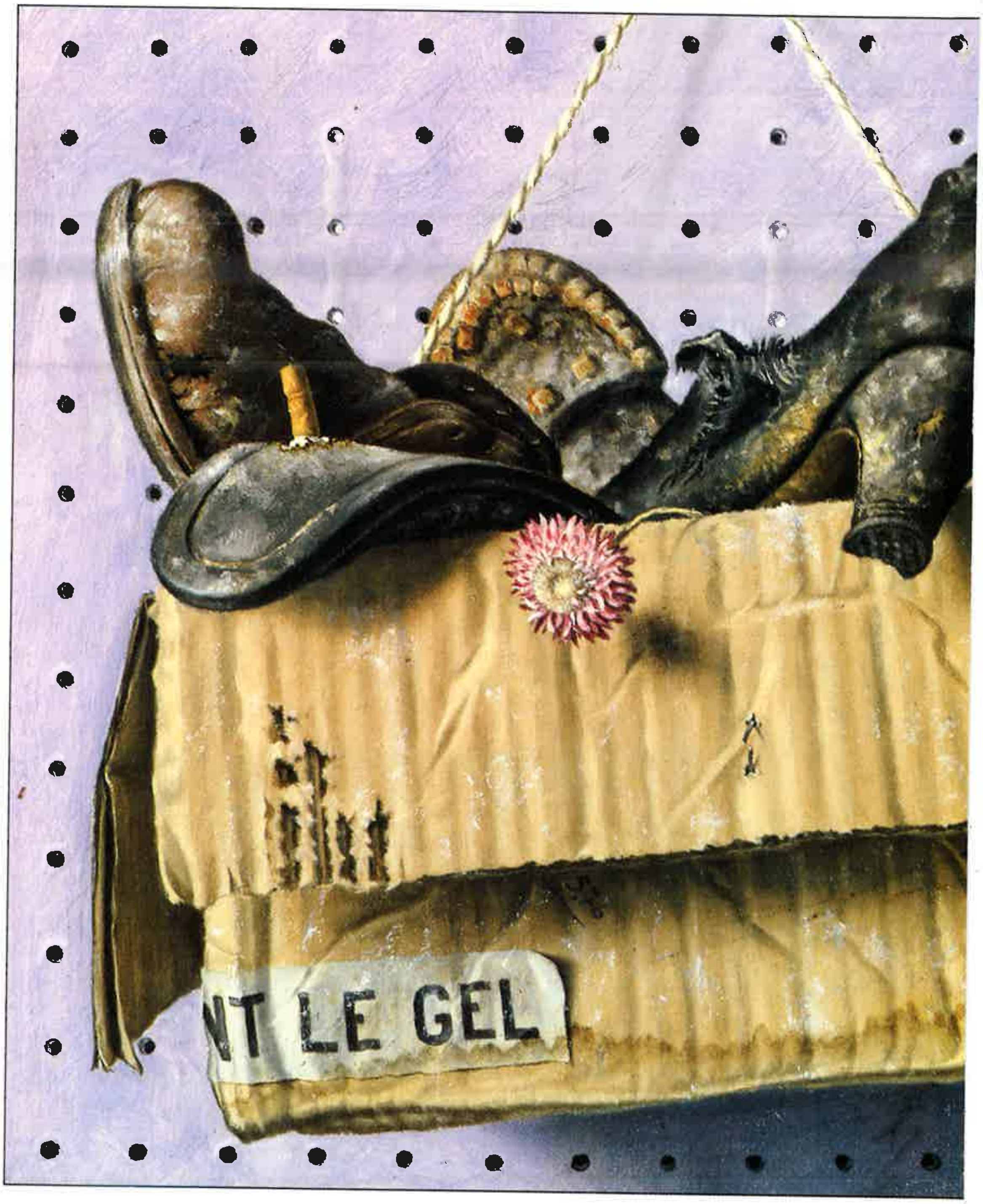
It is not possible to conclude this section on the DP industry without returning–this time with a forward look–to the idea of convergence between the DP and telecommunications industries. Their dovetailing is obvious from the technological standpoint, and researchers in companies as different as AT&T and IBM are today working on the same subjects, while each of these two companies is deriving roughly the same revenue ($2 billion, not an overwhelming sum for these giants) from the other's area of specialization.

■■■ In a medium-range view, it would appear that there will be increasing interaction between these two sectors, particularly from the following three points of view:

- Personal computers, equipped with laser printers and scanners capable of reading printed text, will be able to replace facsimile equipment, as they have already replaced dedicated word processors.
- When they become available, integrated services digital networks (ISDNs) will necessitate a re-examination of the specifications (and in some cases the very *raison d'être*) of modems, local area networks and private telephone switches.
- Value-added networks will embody the integration of techniques, including those of DP services and telecommunication operations.

■■■ If only very gradually, then, DP hardware manufacturers will be led to expand into the telecommunications sector, and vice versa. One thing is sure, however. Service companies, already major participants in large DP projects within the telecommunications sector, will find it to be one of their major sources of future growth.

INFORMATION TECHNOLOGY: A FACTOR FOR CHAN



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Just as electricity might be termed the symbol of the first third of the 20th Century and the atom the symbol of the second, so it is possible that information technology will come to be the emblem for the last third. Perhaps it will be held responsible for great achievements and dire catastrophes, as though it were somehow capable of generating inexorable chains of events. In actual fact, the computer does only what it is told to do, and the reader knows very well that data processing is not the only factor influencing the transformations in store for human activity. The more one speaks in generalities, the harder it is to distinguish the effects of information technology from those of other influences. It is certain, however, that the computer's sway will be comparable to that exercised during past centuries by the printing press or the steam engine. The question even arises as to whether all the techniques of information (the latest-born, data processing, being only one of them, along with telecommunications, education, etc.) are not going to hasten the end of the industrial era.

EFFECTS ON PROFESSIONAL ACTIVITY

The most massive impact of data processing has been the creation of a broad range of new professions. Over six million people are employed by users, hardware manufacturers and service firms. They are engaged in a spectrum of occupations: logicians, ergonomists, project managers, analysts, programmers, system engineers, network controllers, job schedulers, DP auditors, data analysts and so on. On the other hand, there are many human jobs which are only just starting to be affected by the computer, particularly in agriculture, small retail commerce, leisure and recreation, construction and public works. Moreover, many people work in areas where data processing has not yet penetrated, merely because it takes time for change to spread or because DP encounters resistance. This is particularly the case with clerical functions, where office automation, launched some time ago, is advancing very slowly.

■■■ Many occupations are profoundly affected by completely new working tools: bank tellers, accountants, secretaries, airline pilots, engineers with "computer-assisted (CAD) design" workstations (75,000 workstations now in use worldwide), production inspectors, etc.
In the United States, 35% of white-collar workers performed their jobs at computerized workstations in 1986. This trend will be amplified by the introduction of powerful personal computers and–according to Spectrum–the above percentage will reach 87% in 1995. What changes in skill levels will this development lead to? Some functions will lose a measure of autonomy; generally speaking, however, occupations will be enriched.

■■■ Developments in data processing might well be a source of satisfaction to people who want to learn and who are capable of performing more complex tasks. On the other hand, it is doubtful that computerization will open up enough job opportunities for those who prefer simpler working lives.

■■■ In view of these changes, the educational system should certainly modify its curriculum and stop offering training in today's vocations to young people who will be performing tomorrow's jobs. Education must teach **the art of learning** to people who will have to keep on acquiring the new skills imposed by technological progress throughout their professional lives.

EFFECTS ON BUSINESS

All businesses–very small companies excepted–now have and use computers. The impact of data processing on these businesses is often substantial, all the more so if their activity has a strong informational content (as with banks) or if the value of information is high despite low data volume (as with oil refineries, optimized by linear programming).

■■■ In the case of production, for example, each stage is significantly modified by data processing, as this simplified table shows:

Stage	Sample application
Input logistics	Automated warehousing
Plant	Flexible workshops
Output logistics	Automated order processing
Marketing	Telemarketing/Distributor management
After-sales service	Remote diagnosis

In a broader view, it may be stated that data processing changes the way in which companies operate. It affects the process of product creation (see the inset below on supercomputer-aided design). It profoundly modifies the product (or service) itself. It simplifies manufacturing processes. It establishes ties of interdependence between activities. It electronically connects a company with its customers and its suppliers, creating privileged or even exclusive relationships, and so on.

■■■ The strategic nature of information technology is becoming more pronounced. Well-known examples of this include airline reservations (see the inset, page 42). The search for strategic applications–now a function of the Information System Manager–necessitates close and continuing dialogue between members of corporate management.
On the other hand, information technology is neutral from the organizational standpoint, and managers can turn it into an instrument of centralization or decentralization.

■■■ Can we pass judgment on corporate DP budgets, estimated to average 2% of revenue? Is this level of expense justified by results? Accountants do

SUPERCOMPUTER-ASSISTED DESIGN

Traditionally, the design process is largely based upon experimentation, and thus on empirical trial-and-error manipulation of prototypes. In contrast, digital methods aim to understand and explain phenomena and to arrive at optimized solutions on the basis of the systematic scanning of parameters. Digital methods offer the prospect of new technical solutions, of replacing expensive, difficult or dangerous experimentation, and of reducing the duration of the overall design process. Final experimentation is reduced to a checking function, but it is still a necessity in order to confront reasoning and calculating methods with reality.

The applications of digital simulation are limited only by computing power. Moreover, the productivity of an engineering staff is directly linked to a DP system's response time. If engineers are not to be kept waiting for "test" results, the total execution time for an application must not exceed 12 hours (or overnight). This includes the time required to output the mass of test results in a mode accessible to the user–still or animated images–which might amount to one-half of allocated machine time.
Fresh applications can be tackled at each stage in this race for computing power. For example, the automaker Peugeot Citroën has acquired a Cray XMP14, currently used exclusively for five strategic CAD applications. One application is targeted at optimizing engine combustion chambers, a subject in which the conventional approach bogs down in the extreme difficulty of obtaining intermediate measurements. A second application deals with the acoustic comfort of passenger compartments, a complex problem due to the many paths taken by sound waves and to the phenomenon of resonance, which requires an increasingly fine mesh as frequencies under examination rise. The third application, based on a dense mesh (with at least 8,000 nodes), deals with safety and simulates an auto crash against a wall: 3 hours of machine time are used to simulate the first 80 milliseconds of the crash. The fourth application is a model with fifteen degrees of freedom for simulating a vehicle's behavior under the effect of stresses encountered in highway travel. The fifth and last application simulates the process of deep-drawing sheetmetal.

Still other domains are going to benefit from the contribution of high processing power or are still awaiting significant developments, not only in hardware, but in digital computing methods as well. Such is the case with the "digital wind tunnel," which requires meshes on the order of 100 million nodes.

not yet calculate "return on information" as they do "return on investment," but this is sure to happen soon, particularly in organizations which are highly information-dependent: banking, insurance, telecommunications, mail-order distribution, air transportation are all industries whose total DP budget might one day reach 5% of revenue. In this case, it will be necessary to tally end-user expenses, cost of outside networks and expenses incurred by automation of production in addition to the central DP budget.

Businesses will also be led to allocate more resources to data processing because it is undoubtedly a factor for competitiveness. They will want to know what to do and how to do it, and they will need an improved instrument for monitoring investment profitability.

COMPUTERIZED FLIGHT RESERVATION SYSTEMS

In the mid'70s, when United and American Airlines launched their two computerized flight reservation systems, named "Apollo" and "Sabre," respectively, these companies not only had to acquire a true technological expertise, but they had to have faith in their strategic vision as well. At the time, few people guessed the technological lead and the competitive advantage that these systems were going to bring to the new, competitive environment, which included falling air fares, complex ticket pricing systems, the emergence of a new clientele, the possibility of a substantial increase in air traffic, etc.

In the intervening years, these systems have been continuously enhanced as a result of technological change (development of heterogeneous networks, dissemination of powerful personal computers, etc.). Annual investment on the order of $100 million is required to maintain these highly-ramified systems, which process 1,500 queries per second. Apollo's central site contains seven IBM 3090s and 540 IBM 3380 disk units; Sabre, in turn, is supported by 60,000 installed terminals, which not only permit reservations with 650 airlines to be made 11 months in advance (in other words, access to over 15 million flights!), but also allow users to reserve rental cars, hotel rooms and tours...and to send flowers as well.

The evolution of these systems, which were initially constructed to meet in-house needs and which have since become paragons of the electronic marketplace, is quite interesting:

***Phase 1**: United develops a system which enables its own network (as well as independent travel agencies) to make reservations directly and to issue tickets for United flights.*

***Phase 2**: American interconnects its system with those of other carriers, offering automatic access for inquiry and reservations on all airlines from a single terminal. The system is self-serving in two ways: American's own flights are listed first (and are therefore most frequently selected); and exploitation of data recorded in the system provides American with a remarkable marketing tool which, combined with a flexible mode of operation, enables the company to adapt its pricing and scheduling to demand. In an industry with a 5% profit margin, control over the cost of reservations–nearly 2%– is of fundamental importance.*

***Phase 3**: Tired of being the pawns of outside systems which act to their disadvantage, the other airlines sue and set up their own systems. These systems become independent profit centers and, in many cases, subsidiary companies (United, TWA, Texas Air). In spite of increased competition, Sabre and Apollo still generate annual sales in excess of $300 million and a strong operating profit.*

***Phase 4**: Today, airline reservation systems have integrated new technological breakthroughs. They are abandoning their old dedicated terminals, allowing stand-alone personal computers to connect at will to Sabre, Apollo, System One (Texas Air), Pars (TWA, NW) or Data II (Delta). Decentralized applications manage costs, generate cost sheets for each passenger and provide corporate travel departments with helpful information for negotiating with suppliers.*

At the same time, European companies are joining forces to set up systems comparable to Sabre and Apollo. Amadeus, for example, is a system developed and operated collaboratively by Air France, Iberia, Lufthansa and SAS. It will ultimately be used by a number of other airline carriers, representing a total investment of $270 million for the four founding companies.

Flight reservation systems are an example of the emergence of electronic marketplaces and of a far-reaching development in our society toward an economy of competitive, perfect and global markets. Every corporation must get ready to open and interconnect its DP system to these distributed markets.

EFFECTS ON THE ECONOMY

Observations made at this level touch not only upon data processing, but all technologies of information as well. They appear to reveal significant trends pointing toward a profound change in economic behavior. We have noted four distinct points:

1) We are witnessing an **increasing dematerialization of production**, taking place under the thrust of several factors. First, consumption of all types of services (leisure, credit, security, health, transportation) is growing. Next, products are incorporating more automation and software and less raw materials (which, for instance, account for only 2% of the cost of VLSI components). Last, manufacturers are more and more accompanying their products with services. New car dealers, for example, handle the sale of used trade-ins, offer credit packages, etc. To summarize, production includes a constantly increasing service component.

2) Business's investment in "brainpower" has been showing strong growth for the past fifteen years. This investment includes software (primarily for applications development), research, marketing and training. Entered in corporate accounts as expenses, these "applications" of funds actually work as investments. In France, they currently account for over 40% of gross fixed capital formation, and the proportion of value added that they represent increased from 3.8% in 1974 to 5.4% in 1984. Software, the item showing the strongest growth, accounts for 28% of these investments (in contrast to 14% ten years earlier). These figures show that businesses, faced by the pressing need to be competitive, are to a greater and greater degree incorporating "intelligence" into their products and services.

3) The increasing value of information is leading to a certain **globalization of economic activities**, all the more so as new telecommunications capabilities are pressuring governments to deregulate. These trends are spurring businesses on to exploit their advantages on a worldwide level by setting up global data communications networks and by establishing networks of business alliances.

4) The radical drop in the costs of processing and communications **favors a market economy**. Automation of manufacturing processes makes it possible to reduce substantially the optimal size of production runs. Products have a shorter lifetime, as producers can react more rapidly to changes in specifications requested by customers. Continuing corporate adaptation to the imperatives of supply and demand is becoming crucial. Flexibility is a must, and it requires the acquisition, storage and rapid processing of large quantities of information. Subcontracting is taking on new proportions.

Shop-floor and warehouse inventories are being reduced. According to André Danzin (in an article published in **Futuribles**), "new, symbiotic relations will be established between suppliers who design products and related services, on the one hand, and customers whose requirements are continuously evolving on the other."

These trends attest to a change in industrial structure and economic behaviors. This change is not without risk, as in certain fields–the financial markets being perfect examples–"everything happens as though the information on the exchangeable object (currency, raw material, etc.) were now more important (or more valuable, in any case) than the exchange itself" (from an article by Bruno Lanvin in **Futuribles**). Looked at another way, this worldwide competitiveness might be viewed as a modern and bloodless form of combat, which would prove–again according to André Danzin–that we are entering into a civilization without war.

EFFECTS ON SOCIETY

Man has accumulated infinitely more new knowledge and information during the past fifty years than during the whole of his previous history. Measured by volume of scientific publications, human knowledge is doubling every five years! This is confirmation of the fact–obvious, in any case–that society is growing increasingly complex. But scientific knowledge is not the only thing being accumulated; administrative skills, law, art, have all become more complex. The increasing pressure to process and communicate the resulting information has found an ideal tool in data processing.

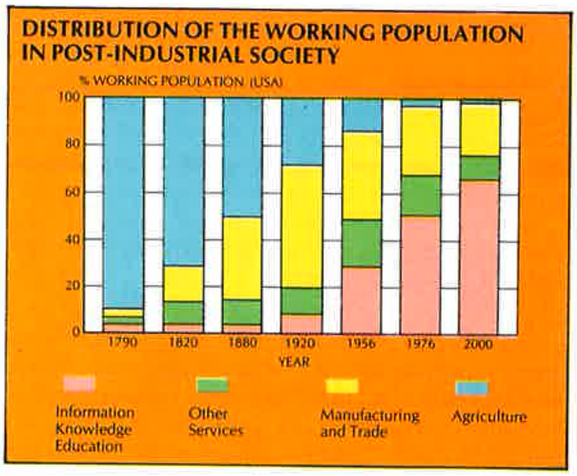
■■■ The need to communicate information was not born of the computer. The DP industry found a well-cultivated terrain, without which it probably would not have enjoyed such vigorous growth, and the technology which made the creation of computers possible was thus very welcome!

■■■ An analysis of the evolution of the working population offers additional evidence of the fact that a great movement, a profound change in society had begun before the birth of FORTRAN and COBOL. According to this analysis (discussed in an article by J. Baal-Schem in the December 1985 issue of the **IEEE Technology and Society Magazine**), over one-half of the total American workforce is made up of information workers, and this figure will be nearly two-thirds as the year 2000 approaches. "Information workers" in this context refer to people engaged in service activities which do not involve work with material objects or the performance of tasks of a physical nature. Lawyers, insurance agents and teachers all work with information; hairdressers and taxi drivers provide physical services. The graph below, compiled by MIT researchers, shows this preeminence of work with information. Above all, it shows that this trend clearly predates the rise of data processing: 10% in 1920, 30% in 1956 and 50% in 1976. The information technologies are contributing to this evolution in two ways: directly, through the millions of jobs they have created; and indirectly, through their supportive and motivating effect.

Some final observations with regard to society:

- A certain reversal in the trend toward mass production and consumption is taking place. Whereas radical standardization had been feared only 10 or 20 years ago, products are instead being increasingly adapted to the consumer's wishes, thanks to the flexibility provided by data processing. A customized order can be inserted into the manufacturing process at an appropriate moment and without significantly increasing production cost (analogously, white-collar workers are being equipped to a greater and greater extent with their own microcomputers for doing their own work at their own convenience). The proliferation of regional newspapers, specialized magazines and local radio stations is further proof of this trend toward diversity.
- Greater protection has been provided for the rights of individuals. Legislation has been adopted in Western Europe and the United States to prevent abuse of computerized information. It is a fact that, due to their enormous capacity for acquiring, manipulating and storing data, interconnected computer systems can assemble highly detailed "files" on individuals. The result is a possible threat to the right to privacy and democratic freedoms. The legislation adopted is addressing the field appropriately, even with the emergence of "networks of networks" and distributed databases. Monitoring compliance with these laws is made more expensive by the complexity of systems. But prospects are worrisome in those countries where individual liberties are not respected.

■■■ Data processing (and, in a broader view, the technologies of information) are a factor for change and development toward that post-industrial society whose initial phases are now being discovered by Western Europe, North America and Japan. We have also seen that, from the technological standpoint, this history has only just begun. We must therefore anticipate new practices and the expansion of infrastructures now being built. The framework of our lives will undergo gradual change. Business and society will continue to evolve along the lines described in the preceding pages, but in accordance with human decisions, for man still has the last word.



CONCLUSION

Vigorous and diversified, information technology has developed to the point where it is today one of the world's great industries. It has placed increasingly powerful and complex resources in users' hands, and trades tend to change along with the tools these users employ. Most businesses are changing their structures and the way they operate as information gradually becomes the chief exchange commodity and the essential component of their competitiveness. Access to information and the ability to process and disseminate it have become vital corporate functions.

This is quite an impressive distance to have traveled. The resulting pattern of change is so clearly delineated as to suggest that an "end-point" will be reached in the medium term. At that time, all repetitive functions will have been automated, all information of general interest will be accessible from anywhere on the face of the earth and all industrial products will be crammed with electronics. Not at all a realistic perspective, however, because no such "end-point" in potential applications is imaginable today.

A tool endowed with new capabilities

Far from slowing down, technological progress will continue at a sustained pace. Naturally, this progress will help us to perform the "conventional" tasks touched upon above. But it will also enable us to go much farther, as it is generating a new type of tooling, endowed with new capabilities. Here are the ones which seem most worth noting:

- **Comprehension**, of which the most elementary act is the identification of the correct meaning of a word or of an object represented by an image.
- **Learning**, which consists of the accumulation and effective use of knowledge.
- **Simulation** of complex phenomena. Scientific domains as important as biology are still unable to profit fully from the possibilities of computer simulation due to a lack of appropriate methods for description of phenomena or adequate computing power.

A fundamental expectation

"Increasing complexity is not a necessity, it is a reality." Darwin called our attention to this fact a long time ago. And as complexity increases, man wants to study its mechanisms and to master them. That is one of his basic expectations.

The application of new information technologies in order to meet this expectation is one of the great challenges of the 21st Century. As an illustration, here are some areas of application:

a) The growing complexity of the social and economic structure is a reality. It is reflected in an increase in the exchange of goods, services and information and by the globalization of certain trade routes. The use of information technologies to manage this complexity is vital. The saturation of airport traffic is only a small and isolated example of situations which can only be improved by the installation of reliable, modern systems. This new complexity will have a "biological" (or living) aspect that will leave a very strong imprint on the socio-economic fabric, and will even further necessitate the use of information processing tools with the capabilities described above.

b) Our understanding of the human brain is only very partial, particularly with regard to the functioning of the thought and memory processes. Computer simulation, implemented by parallel machines, will help advance our knowledge in this area. Conversely, research on the brain's problem-solving methods will be invaluable to the software technologies. It goes without saying that the human sciences will be the chief beneficiaries of developments that enhance our understanding of the brain.

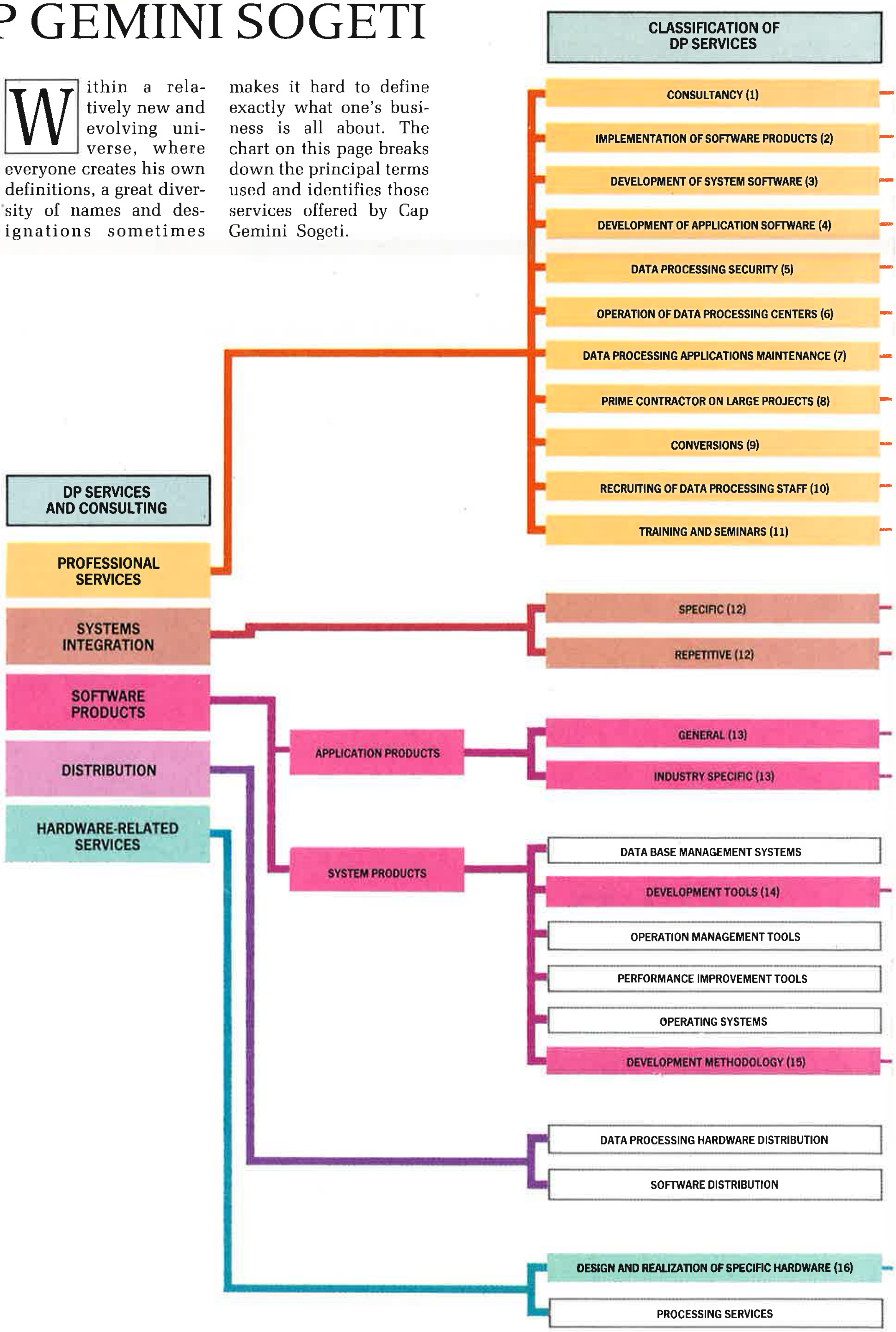
c) The method by which knowledge is acquired remains virtually unknown. Gradual discovery of the procedures by which man learns and accumulates knowledge will be facilitated by the use of the new tools of information technology. Moreover, use of these tools for educational purposes will become increasingly effective as research into the learning process is advanced. The impact of such progress far exceeds anything we can possibly imagine, as it involves the mental and occupational capabilities of practically all of mankind.

It is not the intention of this Annual Report to risk entering the realm of science fiction. The problems evoked here are real ones. It is impossible to deny that they are of fundamental importance, or that major technological efforts are being made to solve them. Once this perspective has been established, it seems all the more clear that the history of information technology has only just begun.

CAP GEMINI SOGETI : GENERAL ORGANIZATION

THE BUSINESS OF CAP GEMINI SOGETI

Within a relatively new and evolving universe, where everyone creates his own definitions, a great diversity of names and designations sometimes makes it hard to define exactly what one's business is all about. The chart on this page breaks down the principal terms used and identifies those services offered by Cap Gemini Sogeti.



SERVICES OFFERED BY CAP GEMINI SOGETI

1. To provide consulting services and/or to conduct studies prior to the development of DP systems or applications may involve the following areas: DP master plan, specifications, advising on methodology, quality-assurance, choice of equipment, software packages or new technologies, etc.

2. Cap Gemini Sogeti assists its clients in the implementation and use of products or new techniques and performs specific adaptations, modifications or developments for its clients on program products they are using or that they plan to acquire.

3. The development of system software includes specifying software functions and their interfaces with existing systems, defining portability and performance criteria, writing and debugging programs, conducting tests, editing documentation, etc.

4. The development of application software entails analyzing the clients' needs, defining functional specifications, setting up the team. It involves project management, system analysis, program writing and debugging, editing the documentation, training users, installing the application and formally delivering it to the client.

5. Ensuring system security and confidentiality involves studying the devices and procedures that provide the physical protection of the facility, the security of files, control of the access to information, data encryption (SETH25 system of SESA), the restart of DP centers after accidental interruption, etc.

6. Consulting and technical assistance in computer operations cover a wide range of functions from defining the organizational procedures of a DP center to running of the computer room, including auditing operations, training, consulting and technical assistance in the implementation and use of products. These tasks may finally amount to complete responsibility for operating the DP center.

7. Maintaining DP applications refers, on the one hand, to consulting activities – help with the implementation of the necessary technical and administrative procedures – on the other, to assistance with the actual maintenance tasks themselves.

8. The Group assumes responsibility for the development of complete systems: general specifications, consulting with possible subcontractors, project management and administration, technical coordination, definition of the system architecture, software development and implementation, software and hardware integration, acceptance of the system, follow-up and maintenance, etc.

9. Converting software so that it will operate on a different system (hardware and/or operating systems) requires highly specialized tools. Cap Gemini Sogeti uses methodologies, computerized planning tools and translators.

10. The Group assists its customers in analyzing staff requirements and in selecting and recruiting appropriate candidates for the various positions within a DP department: design, development, operations, technical support, maintenance, etc.

11. Cap Gemini Sogeti provides training to both DP users and DP personnel (managers, development staff, operations staff). Several forms of training are available: seminars, inter-company or single-company classes.

12. Cap Gemini Sogeti may undertake a complete DP solution for a customer by integrating standard hardware and software, or by carrying out specific developments that include responsibility for function, performance and targeted delivery dates.

13. Cap Gemini Sogeti's range of generic or industry-specific application products allows the Group to respond to the users' needs with the most economical solutions available. Standard Application Modules (SAM) covering the major business applications, MULTITEL videotex monitors, TIGRE software product for interactive securities management, etc.

14. Development support tools feature the MULTIPRO software engineering system, DP systems computerized design tools, INFOLIB (conversion estimating and scheduling tool), along with a complete range of translators.

15. Cap Gemini Sogeti offers its clients software development methodologies that have been developed by its own subsidiaries, and assists them in implementing these products, some of which are supported by the MULTIPRO software engineering system.

16. The Group has, with SESA, proven capability in the design and development of specialized equipment, bringing together the necessary plant sites and teams noted for the quality of their production of telecommunications frontals (front-ends/interfaces), packet switching equipment, exchange and distribution busses, etc.

CAP GEMINI SOGETI: GENERAL ORGANIZATION

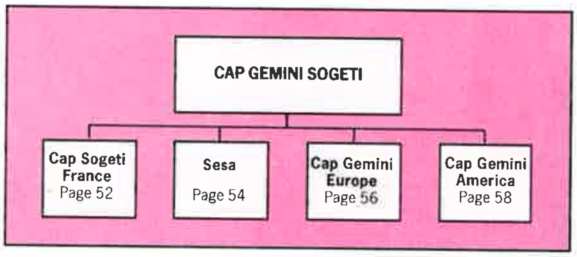
The most striking feature of CAP GEMINI SOGETI's organizational structure is its decentralization into autonomous operational units. One aspect of this decentralization naturally involves the supervision and coordination of some specific corporate activities; the other calls for a central authority that takes charge of a certain number of functions of general concern to the entire Group.

DECENTRALIZATION: MORE THAN 200 BRANCHES

The basic operational unit of the Group is the branch, which consists of an average of about 50 professionals–the largest branches sometimes reaching 100 or 150. Each branch covers a specific geographic territory or business sector, under the leadership of a Branch Manager who has total responsability for his resources and his results.

The Branch Manager is therefore able to perform the two basic functions underlying all service and consulting activities: to manage a team of consultants and to act as a full-time intermediary vis-à-vis the Branch's clients. As a result of this kind of organizational structure–which allows the Group, despite its size, to stay in close touch with its clients–CAP GEMINI SOGETI is able to maintain an excellent observation post from which it can keep watch over advances in technology as well as the concerns of its clients. This makes it possible at all times for the Group to adapt its services appropriately to market requirements.

The branches are gathered into Regions or Divisions, then into Companies, which are in turn divided into four operational groups. Each of these groups is presented in detail on the following pages.

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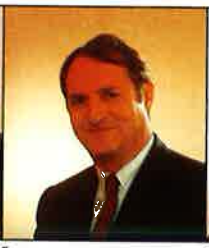
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1 Serge KAMPF
Executive Chairman

2 Philippe DREYFUS
Vice Chairman

3 Michel BERTY
Secretary General

4 Michel JALABERT
Vice President Corporate Development

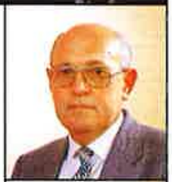
5 François MAIRE
Vice President Corporate Marketing

6 Daniel SETBON
Chief Financial Officer






7 8 9 10 11 12



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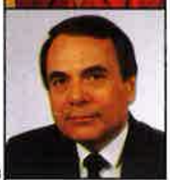

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CAP GEMINI SOGETI'S GENERAL MANAGEMENT

Decentralization–the guiding principle behind CAP GEMINI SOGETI's organizational structure–implies the existence of an informed, efficient central body in charge of a certain number of basic functions.

■■■ The main responsibility of CAP GEMINI SOGETI's General Management is to **ensure the cohesion of the entire organization:** choosing strategy and defining general Group policy, evaluating risks and allocating resources, analyzing costs and administrative management, monitoring the environment and key indicators, overseeing systems and organizational structures, keeping track of managers' career development, arbitrating and managing conflicting interests, managing and presiding over governing or coordinating bodies, promoting and defending the company's system of values, enhancing the Group's corporate image.

■■■ Other responsibilities are carried out in the following areas:

- **Corporate Development:** studying and analyzing trends in the environment, working out development scenarios, helping to define CAP GEMINI SOGETI's general strategy, developing the 5-year plan, selecting and implementing equity investments.
- **Financial Management:** defining the administrative and financial procedures, preparing the annual Group budget, managing central staff expenses, monthly consolidating, analyzing the results, setting up the Group's consolidated accounts, managing general legal and fiscal problems, determining Group financial policy, internal auditing, overseeing opportunities for, and profitability of, investments, designing and implementing financial structures necessary for growth,
- **Internal Organization:** formalizing decisions made by the Executive Committee, transmitting them to those directly concerned, monitoring their application, working out and transmitting Group operational procedures, setting up the internal DP system, supervising general services.
- **Communications:** approving topics and methods, coordinating actions defining and regulating conditions for use of the Group trademark, internal communications (managers and staff), external communications and press relations, the Annual Report.
- **International Marketing:** strategic considerations for adapting major marketing trends and overseeing their cohesion, coordinating certain multinational marketing activities, stimulating internal cooperation and exchanges among subsidiaries, assisting the operational units, developing Groupwide internal programs.

Corporate Development assures cooperation between Cap Gemini Sogeti and those companies in which it holds a minority interest, namely:
- *the BOSSARD GROUP (management consultants), which in 1987 realized total revenue of FF 510 million (Cap Gemini Sogeti interest: 49%);*
- *CISI (DP services), which in 1987 realized total revenue of FF 1200 million (Cap Gemini Sogeti interest: 36%).*

7 Jean Baptiste BLEU
Financial studies

8 Didier CASADO
Internal Data Processing

9 Jacques de COMBRET
Manager Development

10 Pascal GIRAUD
Accounting

11 Philippe HENNEQUIN
Corporate Counsel

12 Manuel JAVARY
Treasurer

13 Jacques LESCAULT
Strategic studies

14 Jean Jack LOUDES
International Marketing

15 Eric LUTAUD
Technological studies

16 Hervé MARIN
Internal Audits

17 Catherine THOMAIN
Press Relations

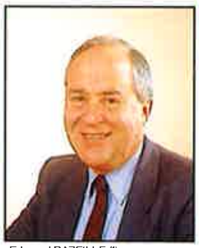
18 Jean VACHERON
General Business

CAP SOGETI FRANCE

Alain LEMAIRE (*)
President

Jean François DUBOURG (*)
General Manager

Jean-Paul FIGER (*)
Operations
Support



Edouard BAZEILLE (*)
Deputy General Manager
Personnel Management

Dominique ILLIEN (*)
Administration
and Finance Manager

José BOURBOULON (*)
General Secretary

Francis BEHR (*)
Director

CAP SOGETI FRANCE is in a strong growth cycle which, far from slowing down, is continuing at a sustained pace (with 1987 revenue 18% higher than in 1986). This increase in the growth rate has been quite obvious during the last few months: a clear indication of the trends in a business having enormous reserves. And what is this business exactly? It is one that combines all the functions (consulting, audits, analyses, software design and development, maintenance, operations, training, etc.) that go into the implementation of data processing systems.

With DP requirements being limitless and technological resources becoming more and more efficient, it isn't surprising that the growth of this entire industry, as described in the preceding pages, is showing no sign of abatement. Yet within this rapidly growing field, our DP consulting and services business is developing at an even faster rate in proportion to the growing trend to buy rather than to make (sometimes referred to as "assignment") in both private and public sector companies.

Today this assigned part represents only about 20% of the total volume, which makes it all the more important to have reserves of growth. Still, we must be ready to respond effectively to this increasingly pressing demand on the part of our clients.

Convinced of the urgency of this need, we are pursuing our efforts in the direction of steady quality improvement, not only through greater mastery of our basic techniques, but also by acquiring more knowledge and a stronger understanding of our clients' business, the stakes involved, their problems and their very real needs.

These objectives were demonstrated in 1987 by our very serious efforts in research and the attainment of new skills in several high-tech areas (artificial intelligence, networks, security, computer aided vision, etc.), by perfecting our methodological tools (software engineering system and the Expert method) and by an emphasis on our consulting and analysis operations.

These endeavors will be pursued and strengthened in 1988, thereby confirming our desire to assure our clients of a constantly-improving, high-quality professionalism. They will also pave the way to bright futures for the members of CAP SOGETI FRANCE.

Coordination and Support Functions of Cap Sogeti France

Operations Support	Jean-Paul FIGER
Networks and Special Projects	José BREVAL
Quality Support and Methods	Claude Pierre DENIAUD
Multipro and Software Eng. Support	Bruno PERRIN
Videography	Nadine MOSCA
Quality Control	Paul OLCESE
Quality	André WORONIAK
Military	Christian GALLIN
Microcenter	Claude DRAY
Strategic Data Processing Group	Alain SARRAZIN
Communications	Christine GOAVEC

(*) Members of Cap Sogeti France Management Committee

OPERATIONAL COMPANIES OF CAP SOGETI FRANCE

CAP SOGETI SYSTEMES


Alexandre HAEFFNER (*)
Chairman


Jean-Claude BUSELLI
General Manager

Christian GLEYO	AFM
François RIAS	DTSM
Françoise DOUTRIAUX	Human Resources
Christine CASU	Communications

NORTHERN REGION


Marcel de TAEVERNIER

Michel GUINARD	Lille Manufact.
Jean Marie THIBAULT	Lille Services
Michel TURPYN	Lille Adm. and Fin.
Jean-Jacques NICOLLE	Rouen
Raymond PAWLOWSKI	Senlis

EASTERN REGION


Denis SERGENT

Marc MINISINI	Nancy
Denis DEYBER	Mulhouse
Jean Pierre DRACA	Strasbourg
Eric BRIDE	Luxemburg
Bernard REGNAULT	Reims

WESTERN REGION


Bertrand de TROGOFF

Philippe de BEAUCHAMP	Manuf. West
Patrick de BOISFOSSE	Services and adm. West
Bernard GUEHENNEC	Telecommunications and services
Jean-Michel PARMENTIER	Services Center
François LEPETIT	Manuf. Center
Bertrand de TROGOFF, acting	Brest

SOUTHWEST REGION


Jean-Loup BOUDINEAU

Jean-Philippe GAUTRIAUD	Bordeaux Services
Jean-Louis BURDET	Bordeaux Manuf.
Jean-Pierre MAZIN	Pau
Jean-Loup BOUDINEAU, acting	Toulouse Aerospace
Henri LAGRASSE	Toulouse Manuf.
Jean-Michel ROY	Toulouse Services

MEDITERRANEAN REGION


Paul CHAFFARD

Charles-Henri LIMOUSIN	Marseilles Manuf.
Bruno BAIXE	Marseilles Services and Administration
Alain GIRAUD	Montpellier
Philippe BRACONNIER	Nice

RHONE ALPES REGION


Jean ROCHET

Jean Pierre REY	Lyons Manuf.
Michel BASTIAN	Lyons Services
Patric BARBEROUSSE	Grenoble Services and Administration
Raoul RUIZ	Valence Grenoble Manuf.

CAP SOGETI INDUSTRIE


Jean-Philippe GAILLARD (*)
Chairman


Gilbert ELOIRE
Deputy General Manager

Geneviève MICELI	AFM
Claude FORSANS	MSSM
Eric PIAT	DTSM

Alain WILBOIS	Mech., Electr. & Constr.Eng.
Jean-Pierre FOUSSIER	Petrol, Chemicals & Food Industries
Serge CHIARINI	Aeropace Industries
Bruno CHAPUIS	Telecommunications & DP Manufacturers
Alexandre LEVY	FACTORY AUTOMATION DIVISION
Dominique PASTOUREL	Real Time DP Systems
Thierry KOCH	Automated Process Control

ITMI

Jean-Paul FIGER
Chairman


Gérard MEZIN
General Manager

Anne Marie TORIBIO	AF
Yann GALLAIS	MSS

Pierre SINFISO	Vision
Pierre MONTCUQUET	Automation
Bruno DUFAY	Artificial Intelligence
Yannick DESCOTTE	Research

CAP SOGETI INSTRUMENTS

Franois BEHR (*)
Chairman


Jean Loup PERRIN
Deputy General Manager

Martine BIGE	AFM

AFM	Administration and Finance Manager
AM	Administration Manager
MSS	Marketing and Sales Support
MSSM	Marketing and Sales Support Manager
DTSM	Development and Technical Support Manager
TSSM	Technical Staff Support Manager

(*) Members of Cap Sogeti France Management Committee

CAP SOGETI LOGICIEL


Henri STURTZ (*)
Chairman


Jacques TIXERANT
Deputy General Manager

Yann GROLIMUND	AFM
Gérard FIRROLONI	MSSM
Christian RENARD	DTSM

François PHULPIN	Government Agencies
Michel ROUZAUD	Public Corporations
Jean Marie BARRE	Military
Jean François LEFEBVRE	Information Technology 1
Philippe MACE	Information Technology 2

CAP SOGETI EXPLOITATION

Jean-François DUBOURG
Chairman


Georges COHEN
General Manager

Pierre DALMAZ	AFM
Jacques AUGER	MSSM
François NEANT	DTSM
Jean Marc BY	TSSM

FINANCE AND ADMINISTRATION DIVISION	Dominique DUFLO
Dominique DUFLO, acting	Finance
Claude CHIABRANDO	Administrations
Dominique DUFLO, acting	Banking
INSURANCE AND SERVICES DIVISION	Gérard JAMAIS
Gérard JAMAIS, acting	Insurance
René CHAUVIN	Services
Jean Pierre LE SECH'	Pension Funds
INDUSTRIAL DIVISION	Jean Pierre POUTEAU
Jean Pierre POUTEAU, acting	Aeronautics
Christian TOURNIER	Electronics
Michel CADOUX	Petrol, Const. Eng.
Claude BUGEY	Switzerland

CAP SOGETI INNOVATION

Jean-Paul FIGER
Chairman


Roland VARENNE
Deputy General Manager

Anne Marie TORIBIO	AF

Maurice SCHLUMBERGER	Grenoble Research Center
Paul DECITRE	Paris Research Center

CAP SOGETI TERTIAIRE


Jean Marc SCHAUVLIEGE (*)
Chairman


Jean BISSELICHES
General Manager


Christian CHEVALLIER
Deputy General Manager

Frédéric PLACES	AFM
Francis DROUIN	DTSM

Bernard SARRAZIN	Banking 1
Bernard LEUBA	Banking 2
Pierre BONVARLET	Insurance
Gérard PAYEN	Services

CAP SOGETI FORMATION


Jacques BERTHELOT (*)
Chairman


Cornel SIMIU
Deputy General Manager

Guy EREL	AFM

Cornel SIMIU, acting	Institute
Alain LE BRETON	Professional training
Jacques BERTHELOT, acting	User's training
Franck O'MEARA	Management and communications
Jean SAINT-HUBERT	Cap Sogeti Sélection

HELIAS

Jacques BERTHELOT
Chairman


Joseph HURTUT
Deputy General Manager

Guy EREL	AFM

GROUP SESA

Jacques ARNOULD
Chairman and Chief Executive Officer

Michel FIEVET
Managing Director

André SACHS
Deputy Managing Director

Fernand PONCET
Manager Technical Development

Hervé CANNEVA
Manager Finance

Technicians generally place SESA at the crossroads of telematics and automation. Economists tend to waver in their description between an industrial enterprise and a services company. The fact is SESA occupies a unique position, quite apart from the traditional categories.

The diversity of the contracts awarded to SESA requires expertise in data processing, telecommunications, electronics and often even optics, acoustics and electromechanics. To carry out these projects successfully, SESA must first go to the heart of the problems presented by its clients, design technical solutions that are both reliable and cost-effective, supply and test equipment, analyze and then produce special equipment which may not yet exist on the market, develop the software, connect the computer to its environment (not only the usual terminals, but also radar, conveyers, robots, sighting devices or remote control trolleys), train the user to operate and maintain the equipment and finally deliver the complete, fully-functional system.

SESA may be hard to classify, but its business is easy to define in just two words: **Systems Integration.**

For nearly 25 years, SESA has been forging a solid reputation on the international market, especially in the fields of large military and space systems, public data networks (Transpac), telematics (the Interbanking Clearing System, the Electronic Directory) and computerized systems such as automated subway fare collection devices.

SESA's current profile includes 1600 employees, revenue of $200 million, with international representation in 5 European countries and systems installed in 41 countries worldwide.

In 1987, SESA became a full-fledged member of CAP GEMINI SOGETI, thereby rounding out the Group's range of services by contributing its extensive experience and know-how in Systems Integration.

Main support functions

Michel BERTON	Human Resources
Catherine BONDONNEAU	Budget Control
Christian CONSCIENCE	Technical Support
Gilles DEVAU	Legal Support
Annie LEBRUN	Personnel Management
José MARZAL	Logistical Support
Blandine THIROT	Public Relations

GROUP SESA SUBSIDIARIES

Pierre Gilles CAUMON
Chairman and Chief Executive Officer

ARVICA

Philippe LEGEARD
General Manager

Marc FABRE-GUETTES	Industrial DP Department
Rémy PHILIPPE	Management Systems Department

LOGISTA

Alain GHERSON
General Manager

Hervé CAPTIER	Manager
Jean-Marc HERB	Manager
Michel BALDASSERONI	Rhône-Alpes Branch
Alain CHAMPION	North Pas de Calais Branch
Bernard GRUAU	Ile de France II Branch

SCOFI

Alain du BEAUDIEZ
Chairman and Chief Executive Officer

Bernard KROTIN	Technical Manager
Hélène LAPALU	Marketing Department

COMMUNICATIONS AND SYSTEMS DIVISION

Jean-Marc CLAUDON
Manager

Yves PITON	Sales Manager
Jean-Jacques CHAUVIN	Technical Manager
Alain DUMONT	Managing Assistant

Olivier BARRE	Packet Switching Branch
Jean-Luc DESCHAINTRES	Southern-Mediterranean Branch
Gérard HINAULT	Defense Systems Branch
Yvan FISCHER	Network Accounts
Yves MAILLOT	Navy Accounts

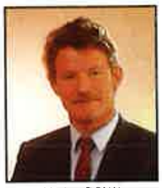
SYSTEMS DESIGN DIVISION

Yves VERET
Manager

Yves PITON	Sales Manager
Jean-Paul PELISSIER	Technical Manager

Philippe DESTIGON	Southwest Branch
Olivier ROSSIGNOL	DP and Air Systems Branch
Albert RAGOT	Joint Military, Civil Aviation and Space Branch

INFORMATION SYSTEMS DIVISION



Maxime DONAL
Manager

Alain GERSET	Sales Manager
Pierre KRAUS	Technical Manager

Xavier CHAMPION	Telecommunications & Services Branch
Jean-Claude DUBOURG	Telematics Branch
François HUCHER	Electronic Funds Transfer Branch

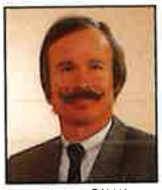
INNOVATION AND DEVELOPMENT DIVISION

Joseph GUEGAN
Manager

Jacques RASCOL	Sales Manager
Daniel PREVOST	Technical Manager

Richard BARROY	Studies and Development West Branch
Raymond COMMAULT	Multimedia Branch
Hubert NOYER	Operational Systems Branch

INDUSTRIAL DP DIVISION

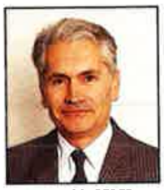


Laurent BALLY
Manager

François DJINDJIAN	Sales Manager

Christian BERLEUR	Transportation Department
Jean-Marc LANFRANCHI	CIM Department
Dominique SYLVESTRE	Energy Department

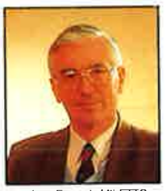
SESA CONSULTING



Gérard SCHREDER
Manager

Jean-Pierre LEVY	Deputy Manager

HARDWARE AND SUPPORT DIVISION



Jean-François MILETTO
Manager

Bernard BALLAND	Deputy Manager

René CHOFFAT	Hardware Design and Development Department
Philippe WINSBACK	Installation and Maintenance Department

SESA BENELUX

Jean-Pierre DORLHAC
General Manager

Iosif DASCALU	Services Branch
Robert DUCOFFRE	Industry Branch

SESA DEUTSCHLAND

Daniel BERTHOMIEU
General Manager

Wolfgang KOEHLER
General Manager

Dr Jorg HEILMANN	Munich Branch
Hans-Christof KALLER	Ratingen Branch
Dr Dieter NOGA	Hamburg Branch
Herwig ILGENER	Industrial Systems Department
Volker JODELEIT	Telecommunications Department
Jürgen LUTZ	Public Services Department
Horst Diether WAGNER	Banking and Systems Department

SESA ESPANA

Georges ESCOLA
Deputy General Manager

SESA ITALIA

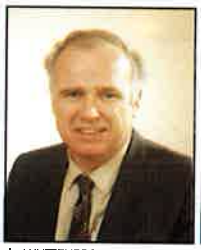
Gennaro DE STASIO
General Manager

Giulio CHIARINI	Deputy General Manager

Giulo CHIARINI	Systems DP Division
Marcello ANTICHI	Networks Division
Vincenzo GIOVANITTI	DP Systems Division

CAP GEMINI EUROPE

Christer UGANDER
President



Aad UIJTTENBROEK
Senior Vice President

Chris van BREUGEL
Vice President

Adolfo CEFIS
Vice President

Kaj GREEN
Area Vice President

Jean RONCERAY
Area Vice President

Tom PATTI
Vice President
Controller

Werner ZÜLLIG
Vice President
Administration and Finance

Paul HOFMANN
Vice President
Business Development

During 1987 Group Europe reached a revenue of approximately 1.5 billion French francs with a total staff of over 3,300 at the end of the year. This represents a 46% growth in revenue over 1986, and it means that, over the last 5 years, Group Europe has achieved a compounded yearly growth of 38% in revenue and 31% in staff.

These results have been obtained through:

- a continued internal growth in almost all countries in which we are operating,
- the successful integration and full-year impact of the acquisitions made in late 1986 in Germany and Italy,
- the starting up in 1987 of new companies in Denmark (CAP GEMINI DANMARK) and Finland (CAP GEMINI SUOMI).

It means that, as we enter 1988, we are covering–outside of France–11 countries in Western Europe representing approximately 95% of the potential market for software services in that area.

Of this total potential market we estimate our share to be about 3%, ranging from almost zero in the countries in which we have just started, to around 13% in Holland (owing to our two Dutch companies PANDATA and CAP GEMINI NEDERLAND).

With a current market share of 3% and a continued estimated market growth of about 20% per year, it is obvious that our potential for future growth is very important: even with 35% yearly growth, our market share in 1990 will still be less than 5%.

So, our plans are to continue our expansion through:

- a strong growth of our current business,
- an expansion of the range of services we offer in order to cover the full spectrum of software services, from the first strategic information system studies to operation of the installed systems,
- the addition of specialities in both our clients' business sectors, (banking, insurance, manufacturing, distribution, public services, etc.) and in technical areas (telecommunications, computer integrated manufacturing, artificial intelligence, software maintenance, etc.).

Our purpose is to continue as a leading international information systems supplier dedicated to serving our clients' needs and to providing a full range of top quality software services.

Main Support Functions

Jean-Claude AMIEL	Director Data Communications Support
Meinard DONKER de MARILLAC	Director Communications
Jeff ENGLAND	Director Human Resources
Klaus FEKETE	Director Conversions Support
Harry KOELLIKER	Director Finance
Kai MARTHINSEN	Director International Sales
Jean PRADES	Director Technical Development

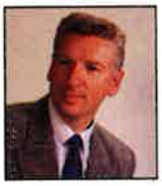
OPERATIONAL COMPANIES OF CAP GEMINI EUROPE

PANDATA — NETHERLANDS

Aad UIJTTENBROEK
General Manager

Ton KNOTSCHKE
Deputy General Manager

Eric PLANTE
Deputy General Manager



Paul FOCKENS
Deputy General Manager

Bert NOLLEN	FM
Janet CLARK	AM
Hans WEENINK	Personnel Manager
Jilt SIETSMA	DTSM

PUBLIC SECTOR DIVISION

Eric PLANTE	Division Manager
Norman van ES	Amsterdam/Rijswijk
Gert de WIT	Amsterdam
Peter BARBIER	PTT
Jaap van DUFFELEN	Rijswijk
Geerlof LODE	Zwolle

TRADE AND SERVICES DIVISION

Hans TIJSSEN	Division Manager
André van de VLIS	Amsterdam
Menno NORDER	Zwolle
Jos MELSSEN	Eindhoven

INDUSTRY DIVISION

Peter BUISMAN	Division Manager
Jaap BOON	Amsterdam
Theo PETERS	Zwolle
Martin la HAYE	Eindhoven
Theo SANDERS	Eindhoven Bis

ORGANIZATION AND INFORMATICS

Wim van de GEIJN	Division Manager
Hans van de HOEVEN	Business Systems
Joop VLIEG	Network Systems

INFORMATICS INSTITUTE

Guido van SPALL	Division Manager

PRODUCTS

Derk DUIT	Division Manager
Hans RICHTERS	Office automation Management
Ronald LANGERHORST	Computer aided software Engineering

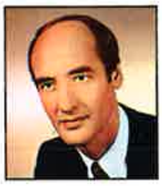
CAP GEMINI BELGIUM

Jean MILAN
General Manager

Jacques BALIGANT	DTSM
Yvonne STORME	AFM

Aimé D'HELFT	Brussels Public Sector and Finance
Jean PEETERS	Brussels Private Sector
Robert MALOMGRE	Antwerp

CAP GEMINI DEUTSCHLAND



Bernd LANTERMANN
General Manager

Baerbel von ASCHWEGE	AFM

Werner BONGARTZ	Düsseldorf
Paul-Josef LEUSCHNER	Frankfurt
Volker CALLSEN	Hamburg
Ulli NOLLE	Munich
Ulrich REITER	Stuttgart

CAP GEMINI IBAT — GERMANY

Michael GASPER
General Manager

Jurgen STEINFORTH	DM

Reiner KONITZ	Braunschweig
Manfred SCHIEMICHEN	Erlangen
Gerd Wilfried HOCKENHOLZ	Essen
Norbert FRIESEL	Karlsruhe
Stefan PFEIFFER	Ulm
Manfred PREUTH	Products

CGS UK

Kaj GREEN
General Manager, acting

Brian OXLEY	DTSM
Prakash AGARWAL	AFM

Sandy CLAIREAUX	Public Services
Gerald PLIMBLEY, acting	Information systems
Gerald PLIMBLEY	North

CAP GEMINI ESPANA

Philippe DANGLADE
General Manager

Federico SOTOMAYOR	Vice President
Luis GONZALEZ	DTSM

Rafael ORTEGA	Madrid

CAP GEMINI SUISSE

Peter WEBER
General Manager

David SANTANDER	AFM

Fritz WOODTLI	Basle
Walter WEISS	Bern
Maurice LEHMANN	Geneva
Alain MARECHAL	Lausanne
Annette SEGESSER	Zürich Finance and Services
Kurt HEYER, acting	Zürich Commerce and Industry

CAP GEMINI NEDERLAND

Chris van BREUGEL
General Manager

Hans BOOM
Deputy General Manager

Rob STARREVELD
Deputy General Manager

Arie EDELMAN	AFM
Jan PIETERMAN	TSSM
Daan RIJSENBRIJ	DTSM
Louk WINKELHAGEN	MSSM

PUBLIC SECTOR DIVISION

Henk BREMER	Division Manager
Theo BOUWMEISTER	Branch 1
Nico COENEN	Branch 2
Rob BAKKER	Branch 3
Henk BREMER, acting	Consulting

INDUSTRY AND TRADE DIVISION

Wim HEUKELS	Division Manager
Hans VISSER	Branch 1
Dick van EEDEN	Branch 2
Theo GIELIS	Branch 3
Hans van LEEUWEN	Consulting

BANKING AND INSURANCE DIVISION

Hans BOOM	Division Manager
Johan WAAIJER	Branch 1
Bert de VRIES	Branch 2
Vincent LUCAS	Consulting

SPECIAL PRODUCTS AND SERVICES

Cor ALBERTS	Division Manager
Jop DUYVENDAK	Training
Arnold BRUGGEMAN	Operations

CAP GEMINI GEDA — ITALY

Adolfo CEFIS
General Manager

Enrico RUSCA	MSSM
Christopher COLEMAN	AFM
Maurizio FOTI	AM

CENTRAL GOVERNMENT DIVISION

Ettore ZANAZZO	Division Manager
Luigi de la PENNE	Deputy Division Manager
Pietro ROSSI MARCELLI	MSSM
Roberto SAFFONCINI	Government
Paolo GIORGI	Railways

INDUSTRY AND LOCAL ADMINISTRATION DIVISION

Claudio TELONI	Division Manager
Manlio PETRIS	Milan
Daniele CAVALLERO	Turin

CAP GEMINI BRA — SWEDEN

Lars Olof NORELL
General Manager

Gunnar ALDEN	DTSM
Eva KARNEHED WERNE	AFM
Lars OLSSON	Technical Training Manager

Torsten PRAHL	Finance
Stefan OLOWSSON	Public Sector
Tore HAGENBLAD	Industry
Leif BJORDELL	Central
Berndt OSMUND	West
Hans WIRFELDT	North

CAP GEMINI DATA LOGIC — NORWAY

Kaj GREEN
General Manager, acting

Arne OEN
Deputy General Manager

Jens-Petter MATHISEN	TSSM
Dag POULSSON	AFM
Svein WEINHOLDT	DTSM

Erik RINGSBY	Oslo 1
Leif BREKKE	Oslo 2
Erling HANSSON	Oslo 3
Bjorn SOEVIK	Bergen
Per HETLAND	Stavanger

AFM	Administration and Finance Manager
AM	Administration Manager
FM	Finance Manager
MSSM	Marketing and Sales Support Manager
DTSM	Development and Technical Support Manager
DM	Development Manager
TSSM	Technical Staff Support Manager

CAP GEMINI SUOMI — FINLAND

Markku SILEN
General Manager

CAP GEMINI DANMARK

Jan JOHANSSON
General Manager

CAP GEMINI SYSTEMS SOFTWARE — DENMARK

Bo LARSEN
General Manager

CAP GEMINI AMERICA

Robert J. SYWOLSKI (*)
Chairman,
CEO and President
of CAP GEMINI AMERICA

Nic P. NEUMANN (*)
Executive Vice President

Ronald EZRING (*)
Executive Vice President

Paul J. FORREST (*)
Chief Financial Officer

A. Maria SMITH
Vice President
Specialized Services

James J. WOODWARD
Vice President
Technical Development

Bruce D. POSNER
Controller

Susan M. JORDAN
Vice President
Human Resources

FOR CAP GEMINI AMERICA, 1987 was a year of expansion and achievement, highlighted by a number of significant milestones. We completed the year with revenues in excess of $134 million and more than 2,000 employees.

Sycomm Systems Corporation, acquired on December 31, 1986, was successfully integrated into our operations, and contributed to our growth in 1987.

In keeping with our determination to grow, we focused on expanding our penetration into markets with highly concentrated DP installations. In addition, a review of the regional and branch configuration resulted in the implementation of a new organizational structure, consisting of two Areas with defined regional and branch responsibilities.

In order to support future expansion, two new Regions were established, with nine Branches created through sub-divisions of large, existing Branches. Four satellite offices were created in new geographic areas. Meeting the demand for specialized services, eleven Branches were dedicated to industry or technological specializations, bringing the specialized total to almost one-third of our Branches. Going into 1988, CGA will have 10 Regions and 38 Branches

Conversion Services, one of CGA's specialities, experienced strong growth. Also during 1987, CAP GEMINI AMERICA was designated as an IMAP, under IBM's Authorized Marketing Assistance Program, for the applications-enabling products DB2, SQL and CSP. The program provides an opportunity for CGA to expand its technical and applications specialities. This relationship, as well as our Conversion IMAP with IBM, has moved us ahead in these important areas.

We reached another milestone in the latter part of 1987, when we established the framework, support systems and training capabilities for a company-wide emphasis on responsibility projects. The addition to our traditional professional services offerings is consistent with CGA's strategic objectives to provide solutions to business problems while managing projects requiring technologically integrated and advanced techniques.

CAP GEMINI AMERICA is positioned for continued growth and success in 1988. Our organizational structure provides a strong foundation for the growth of our basic professional services offerings as well as our value-added project capabilities with continuing emphasis on responsive, high quality services to our clients.

Main Support Functions

Sandra L. DUVALL	Manager Corporate Communications
Joanna ELLIS	Director Human Resources
Jack L. GOODSITT	Legal Counsel
Luc-François SALVADOR	Conversions Services/Director of Operations
Bruno F. SICURANI	Financial Administration
Kenneth T. SULLIVAN	Assistant Controller

(*) Members of CAP GEMINI AMERICA Management Committee

OPERATIONAL REGIONS OF CAP GEMINI AMERICA

NORTH AREA

Ronald EZRING
Executive Vice President

MIDWEST REGION

Richard E. EARLEY (*)
Senior Vice President

John V. NOVAK	Chicago Commercial
Kerry J. BAHNICK	Chicago Insurance and Finance
Susan S. LARSON	Denver
Eugene J. FRANZ	Illinois Technologies
Joseph S. KILANOSKI, Jr.	Kansas City
Jerry R. LADD	Omaha
Jon E. JENSEN	St. Louis

NORTHCENTRAL REGION

Gerald J. QUARTANA (*)
Senior Vice President

Wayne D. OSTRUSZKA	Milwaukee Financial
James P. WALKER Vice President	Milwaukee Manufacturing
John A. SWANSON	Minneapolis Financial and Commercial
Joseph M. REILLY	Minneapolis Manufacturing and Services

NORTHEAST COMMERCIAL REGION

Ronald EZRING, acting
Executive Vice President

Ernest G. BAGO	New Jersey Commercial
Donald A. SCHATZ	New York Commercial

NORTHEAST COMMUNICATIONS REGION

Thomas M. KLIMUC
Regional Vice President

Barry L. SHULER	New Jersey Business Communications
Thomas M. KLIMUC acting	New Jersey Technologies
Craig D. NORRIS	New Jersey Telesystems

NORTHEAST FINANCIAL REGION

Martin KORNBLUH
Regional Vice President

Michael S. ORNSTEIN	New York Banking and Insurance
Martin KORNBLUH acting	Northeast Financial
Matthew J. BEZINSKI	New York Brokerage, Banking and Insurance

SOUTH AREA

Nic P. NEUMANN
Executive Vice President

NATIONAL MANAGEMENT CONSULTING GROUP

John PINK, Vice President acting

CENTRAL REGION

Glen E. MILLER
Regional Vice President

Thomas H. CARLSON	Cleveland
Glen E. MILLER, acting	Dayton

MID-ATLANTIC REGION

Walter E. ZAHNLE
Regional Vice President

Steven N. LANDSMAN, Vice President	Baltimore
Walter E. ZAHNLE acting	Philadelphia
Leonard C. ANDERSON	Richmond
William M. FLANNERY	Washington, DC
David S. STYPULA, acting	Wilmington (satellite)

SOUTH REGION

John R. HAMON
Regional Vice President

Roger L. SPITZ	Atlanta General/Commercial
J. Michael MASON	Atlanta Insurance, Communications and Finance
Douglas C. BERRYHILL	Jacksonville (satellite)
Douglas C. BERRYHILL	Orlando
Steven R. SWANSON	Tampa

SOUTHWEST REGION

Michael SCHERMER
Regional Vice President

Douglas C. BOSWELL	Dallas Commercial
William S. WIMBERLEY	Dallas Energy
John De FILIPPO	Houston

WEST REGION

Abbott H. EZRILOV
Regional Vice President

Abbott A. EZRILOV acting	Los Angeles
LaVelle DAY	Portland
Terry L. FRAZIER	Seattle

CAP GEMINI SOGETI'S PROFESSIONALS

The greatest resource of a Services Company is its people; they represent its most precious asset, even though it is one that will not figure on any of the financial statements in the Annual Report.

As of December 31, 1987, Group personnel numbered 10,593. Compared to December 31, 1986, this represents an increase of 3,735 people, or 54.5%. These figures correspond:

- on the one hand to the internal growth of the workforce, i.e., the creation of 1,445 new jobs, or about twice the number created during the previous year (743);
- on the other hand, to the addition of the staffs of companies joining the Group in 1987. Foremost among them is SESA, whose workforce at December 31, 1987 was 1,550.

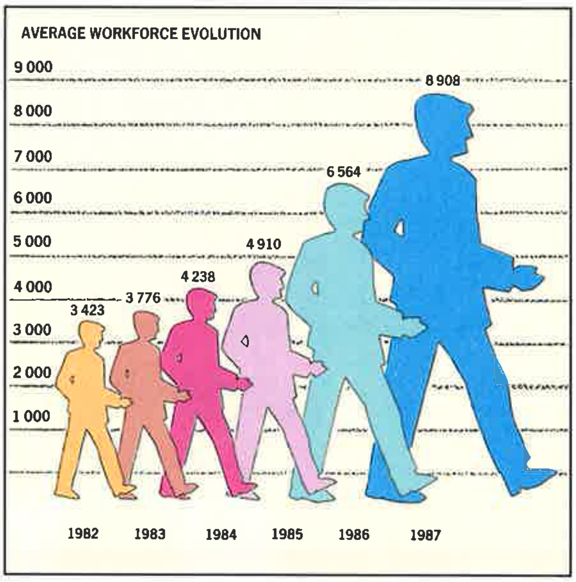
The average headcount for 1987–calculated by taking into account the consolidation period for each company–was 8,908 employees. Compared to the same figure for 1986 (6,564), this represents a growth of 35.7%.

The professionals at CAP GEMINI SOGETI are young. Their **average age** has remained remarkably stable over the last ten years, which indicates that the situation is very much the same in the new companies entering the Group. As of December 31, 1987, the average age was 32.2.

The **educational level** of the Group's professionals is very high, an obvious necessity in light of the increasingly complex problems it is being called upon to solve. About two-thirds of its professionals have received various post-graduate degrees from top colleges and universities in Europe and the United States.

As a result of numerous promotions (1,822 during the past year), Group professionals are rewarded not only for the enrichment of their technical knowledge, but also for their ability to assume responsibility.

Finally, the Group offers equal professional opportunities to men and women. At the end of 1987, the percentage of women in the workforce was 25.4%.



A CAREER WITH CAP GEMINI SOGETI: A PATH TO PROFESSIONAL DEVELOPMENT

Since its beginnings, the Group has instituted a clear and ambitious professional development policy, which emphasizes the quest for personal progress and which offers its people the opportunity to plan for their futures intelligently. CAP GEMINI SOGETI has based this policy upon the following principles:

▪ **Recruitment guidelines** which strictly define the technical competence required for each qualification, but which also favor candidates best suited to careers in a large professional services company; i.e., those with imagination, creative sensibility, the taste for hard work and ambition.

▪ A **training policy** which guarantees to everybody– even though based on methods that may differ from one country to another or from one company to another–ongoing and individual training in accordance with that person's experience and the probable development of his or her career. At CAP GEMINI SOGETI good training means the best possible preparation for work on clients' projects. Conversely, these same projects are the professionals' training ground for gaining experience and acquiring new skills. It is this interaction between internal and on-the-job training that is one of the real keys to the professional development of the Group's technicians and, consequently, to the quality of the services it can ultimately provide to its clients.

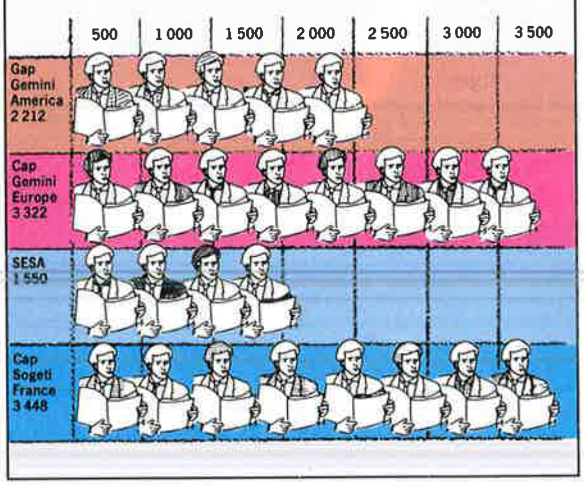
▪ **Insistence on technical quality,** which is satisfied by the use of specific working methods and tools which, in turn, assure the desired level of professionalism; by the experience of the project leaders; by the supervision and assistance of the technical managers; by the auditing of large projects and complex systems, etc.

▪ **Guidelines for promotion** which offer exceptional career opportunities to all, and which operate on the principle that CAP GEMINI SOGETI will recruit from the outside only after being fully convinced that none of its own professionals can fill the spot.

▪ A considerable **Research and Development** effort in high-tech data processing areas, the aim of which is to develop and transfer know-how throughout the Group. This effort is seen, for example, in the activities of Cap Sogeti Innovation. Its teams are made up of professionals from the various Group companies, and they subsequently return to those companies to train their colleagues in the new skills they have acquired.

▪ A **communications policy** that offers Group professionals numerous avenues for contact as well as all required technical information (e.g; branch and company meetings; technical meetings; internal company and branch publications; COGITAS, the internal magazine of the Group; the Annual Report, etc.).

GEOGRAPHIC DISTRIBUTION OF THE WORKFORCE
as of December 31, 1987 (exclusive of the holdings)



PRINCIPAL LOCATIONS

HOLDING

Head Office: Grenoble
CAP GEMINI SOGETI
6 Bd. Jean Pain B.P. 206
38005 Grenoble Cedex
33 (16) 76.44.82.01

Finance: Lyons
CAP GEMINI SOGETI
190 Rue Garibaldi
69003 Lyon
33 (16) 78.62.20.44

General Management: Paris
CAP GEMINI SOGETI
Place de l'Etoile-11 Rue de Tilsitt
75017 Paris
33 (1) 47.54.50.00

PRINCIPAL LOCATIONS IN FRANCE

PARIS	Cap Sogeti France	Place de l'Etoile-11 Rue de Tilsitt 75017 Paris	33 (1) 47.54.50.00
	Cap Sogeti Opérations		
	Cap Sogeti Exploitation	5/7 Avenue de Bouvines 75544 Paris Cedex 11	33 (1) 40.24.10.10
	Cap Sogeti Formation	Tour Mattéi - 207 Rue de Bercy 75587 Paris Cedex 12	33 (1) 43.46.95.00
	Cap Sogeti Industrie	92 Boulevard du Montparnasse 75682 Paris Cedex 14	33 (1) 43.20.13.81
	Cap Sogeti Innovation	118 Rue de Tocqueville 75017 Paris	33 (1) 46.22.60.27
	Cap Sogeti Instruments	15 Rue de la Vanne 92120 Montrouge	33 (1) 46.56.52.08
	Cap Sogeti Logiciel	129 Rue de l'Université 75007 Paris	33 (1) 45.55.91.57
	Cap Sogeti Sélection	Tour Mattéi - 207 Rue de Bercy 75587 Paris Cedex 12	33 (1) 43.46.95.00
	Cap Sogeti Systèmes	14/20 Rue Leriche 75738 Paris Cedex 15	33 (1) 45.39.22.25
	Cap Sogeti Tertiaire	26 Rue de la Pépinière 75008 Paris	33 (1) 42.93.22.00
	Hélias	6 Rue Pierre Legrand 75008 Paris	33 (1) 46.22.32.31
	Arvica	25 Boulevard des Bouvets 92000 Nanterre	33 (1) 47.67.02.18
	Sesa	30 Quai De Dion Bouton 92806 Puteaux Cedex	33 (1) 49.00.40.00
	Logista	30 Quai De Dion Bouton 92806 Puteaux Cedex	33 (1) 49.00.49.00
	Scofi	30 Quai De Dion Bouton 92806 Puteaux Cedex	33 (1) 49.00.40.00
BORDEAUX	Cap Sogeti Systèmes	31 Rue de l'Ecole Normale 33073 Bordeaux Cedex	33 (16) 56.02.00.57
BREST	"	Z.I. du Vernis - Saint-Anne du Portzic 29200 Brest	33 (16) 98.05.44.54
CAEN	"	9 Rue Général Giraud B.P. 41 14010 Caen Cedex	33 (16) 31.85.12.69
DIJON	"	14.N. Rue Pierre de Coubertin-Mirande 21000 Dijon	33 (16) 80.66.69.40
GRENOBLE	"	6 Boulevard Jean Pain-BP 206 38005 Grenoble Cedex	33 (16) 76.44.82.01
	Cap Sogeti Innovation	Chemin du Vieux Chêne-Zirst 38240 Meylan	33 (16) 76.90.80.40
	I.T.M.I.	Chemin des Près - Zirst 38240 Meylan	33 (16) 76.90.33.81
LILLE	Cap Sogeti Systèmes	276/6 Avenue de la Marne 59700 Marcq en Baroeul	33 (16) 20.72.95.09
	Logista	Parc Club des Près 31 Rue Denis Papin 59650 Villeneuve d'Ascq	33 (16) 20.56.05.50
LYONS	Cap Sogeti Systèmes	190 Rue Garibaldi-B.P. 3166 69212 Lyon Cedex 03	33 (16) 78.62.20.41
	Logista	110 Avenue Jean Jaurès 69007 Lyon	33 (16) 78.69.00.62

MARSEILLES	Cap Sogeti Systèmes	Les Bureaux Borely-bât A 40 Avenue de Hambourg-B.P. 332 13271 Marseille Cedex 8	33 (16) 91.25.11.00
	Sesa	Le Milano - 241 Avenue du Prado 13008 Marseille	33 (16) 91.78.23.32
METZ	Cap Sogeti Systèmes	Le Technopôle 2-BâtB 8-Rue Graham Bell 57000 Metz Queulel	33 (16) 87.37.11.23
MONTPELLIER	"	Allée Jules Milhau Immeuble Le Triangle 34000 Montpellier	33 (16) 67.92.20.17
MULHOUSE	"	14 Boulevard de l'Europe 68100 Mulhouse	33 (16) 89.45.10.60
NANCY	"	25/29 Rue de Saurupt 54000 Nancy	33 (16) 83.51.43.96
NANTES	"	Immeuble Horizon-12 Rue Gaëtan Rondeau 44200 Nantes Beaulieu	33 (16) 40.47.80.23
NICE	"	179 Boulevard René Cassin 06200 Nice	33 (16) 93.21.01.41
ORLÉANS	"	33/35 Avenue de Paris 45000 Orléans	33 (16) 38.53.86.50
	Logista	10 Quai de la Madeleine 45000 Orléans	33 (16) 38.43.24.28
PAU	Cap Sogeti Systèmes	16 Rue Montpensier 64000 Pau	33 (16) 59.84.71.85
REIMS	"	Galerie des Sacres 18, rue Tronsson-Ducoudray 51100 Reims	33 (16) 26.47.38.38
RENNES	"	ZACE de la Rigourdière-Immeuble Apollo Rue de la Rigourdière 35510 Cesson Sévigne	33 (16) 99.83.85.85
	Sesa	Zirst Rennes Atalante 3 Rue du Clos Courtel B.P. 1897 35018 Rennes Cedex	33 (16) 99.63.50.50
ROUEN	Cap Sogeti Systèmes	Place de la Verrerie-Centre Régional Saint Sever-Immeuble le Montmorency 1 76100 Rouen	33 (16) 35.63.50.45
SENLIS	"	17 Rue Léon Fautrat 60300 Senlis	33 (16) 44.60.06.71
STRASBOURG	"	20 Place des Halles Tour Europe 67000 Strasbourg	33 (16) 88.32.22.42
TOULON	Sesa	314 Boulevard du Maréchal Foch 83000 Toulon	33 (16) 94.91.11.19
TOULOUSE	Cap Sogeti Systèmes	Immeuble Péripole 1 Chemin du Pigeonnier de la Cépière 31081 Toulouse Cedex	33 (16) 61.40.55.58
	SESA	Parc Technologique du Canal 1 Avenue de l'Europe 31400 Toulouse	33 (16) 61.73.46.91
VALENCE	Cap Sogeti Systèmes	Le Métropole 2-10/12 Rue du Parc 26000 Valence	33 (16) 75.42.56.19

AFFILIATED COMPANIES

Group BOSSARD
12, rue Jean-Jaurès
92807 Puteaux
33 (1) 47.76.42.01

CISI
31, avenue de la Division-Leclerc
92260 Fontenay-aux-Roses
33 (1) 40.91.50.00

PRINCIPAL LOCATIONS IN EUROPE

FEDERAL REPUBLIC OF GERMANY

BRAUNSCH-WEIG	Cap Gemini Ibat	Wolfenbutteler strasse 33 3300 Braunschweig	49 (531) 72 096/097
DÜSSELDORF	Cap Gemini Deutsch-land	Grafenberger Allee 54/56 4000 Düsseldorf 1	49 (211) 67 50 05
ESSEN	Cap Gemini Ibat	Moltkestrasse 29 4300 Essen 1	49 (201) 26 620
FRANKFURT	Cap Gemini Deutsch-land	AM Salzhaus 4 6000 Frankfurt 1	49 (69) 29 00 71
	Sesa Deutsch-land	Bockenheimer Landstrasse 24 6000 Frankfurt	49 (69) 71 00 50
HAMBURG	Cap Gemini Deutsch-land	Kanalstrasse 44 2000 Hamburg 76	49 (40) 227 09 54
	Sesa Deutsch-land	Kanalstrasse 42a 2000 Hamburg 76	49 (40) 220 15 25
KARLSRUHE	Cap Gemini Ibat	Kaiserallee 62 (Postfach 210543) 7500 Karlsruhe	49 (721) 55 80 63/64
MUNICH	Cap Gemini Deutsch-land	Ridlerstrasse 35 A 8000 München 2	49 (89) 51 99 10
	Sesa Deutsch-land	Schleissheimerstrasse 205a 8000 München 40	49 (89) 308 10 75
NUREMBERG	Cap Gemini Ibat	Staffelsteinerstrasse 3 8500 Nuernberg 90	49 (911) 348 25
RATINGEN	Sesa Deutsch-land	Airport Center Gothaertstrasse 4 4030 Ratingen 1	49 (2102) 47 50 70
STUTTGART	Cap Gemini Deutsch-land	Zettachring 12 7000 Stuttgart 80	49 (711) 71 50 053
ULM	Cap Gemini Ibat	Rosengasse 26 7900 Ulm	49 (731) 67 000/009

BELGIUM

ANTWERP	Cap Gemini Belgium	Mechelsesteenweg 127/131 2018 Antwerpen	32 (3) 218 77 52
	Sesa Benelux	51 Frankrijlei Anvers 2000	32 (3) 231 59 06
BRUSSELS	Cap Gemini Belgium	49 rue du Châtelain 1050 Bruxelles	32 (2) 649 96 40
	"	144 avenue Plasky 1040 Bruxelles	32 (2) 736 00 07
	Sesa Benelux	Av. Roger Vandendriessche 18 1150 Bruxelles	32 (2) 771 98 16
LIEGE	Cap Gemini Belgium	10A Quai Churchill 4020 Liège	32 (41) 42 74 63
LUXEMBOURG	"	Val Saint-André 28/30 1128 Luxembourg	32 (352) 44.10.87
	Cap Sogeti Systèmes	12/14 Boulevard d'Avranches 1160 Luxembourg	32 (352) 48.42.43

DENMARK

BIRKERØD	Cap Gemini Danmark	Datavej 48 3460 BirkerØd	45 (2) 82 10 11
	Cap Gemini Systems Software	Datavej 48 3460 Birkerød	45 (2) 82 10 11

SPAIN

BARCELONA	Sesa Espagne	Rambla Cataluna 123 08008 Barcelone	34 (3) 218 87 16
MADRID	Cap Gemini España	Velázquez 140 28006 Madrid	34 (1) 262 73 04

FINLAND

HELSINKI	Cap Gemini Suomi	Kaisaniemenkatu 1 BA 00100 Helsinki	358 (0) 17 69 55

UNITED KINGDOM

ALTRINCHAM	CGS (UK)	2 Victoria Street Altrincham, Cheshire WA14 1ET	44 (61) 941 19 22
YIEWSLEY	"	133 High Street Yiewsley,Mdx UB7 7QL	44 (895) 44 40 22

ITALY

MILAN	Cap Gemini Geda	Via Cesare Lumbroso 54 20137 Milano	39 (2) 54 23 343
	Sesa Italia	Via Benigno Crespi 70 20159 Milano	39 (2) 695 81
NAPLES	"	Via Arenaccia 128 80141 Napoli	39 (81) 780 80 43
ROME	Cap Gemini Geda	Via Flaminia 872 00191 Roma	39 (6) 32 87 351 39 (6) 32 83 312 39 (6) 32 79 377
	Sesa Italia	Centro Direzionale Cinecitta'2 Via Vicenzo Lamaro 21 00173 Rome	39 (6) 722 361
TURIN	Cap Gemini Geda	Via Santo Pio V/30 bis 10125 Torino	39 (11) 65 08 282

NORWAY

BERGEN	Cap Gemini Data Logic	Lars Hillesgate 30 5008 Bergen	47 (5) 31 11 17
OSLO	"	Rosenkrantz gate 16 0160 Oslo 1	47 (2) 42 07 60
SKIEN	"	Telemarksgate 8 3700 Skien	47 (3) 527 545
STAVANGER	"	Kirkebakken 10 4012 Stavanger	47 (4) 52 29 35
TØNSBERG	"	Havnegate 2 3100 Tønsberg	47 (33) 18 771
TRONDHEIM	"	Kjøpmannsgate 8 7013 Trondheim	47 (7) 53 37 65

NETHERLANDS

AMSTERDAM	Pandata	Joan Muyskenweg 48 1099 CK Amsterdam	31 (20) 68 29 91
GELDROP	"	Laan der Vierheemskinderen 7 5664 TH Geldrop	31 (40) 85 77 85
GRONINGEN	"	Queridolaan 5 9721 SZ Groningen	31 (50) 27 20 70
LEEUWARDEN	"	Brandemeer 33 8918 CT Leeuwarden	31 (58) 67 33 80
RIJSWIJK	"	Verrijn Stuartlaan 28 2288 EL Rijswijk	31 (70) 95 71 71
	"	Visseringlaan 19-23 2288 ER Rijswijk	31 (70) 95 72 21
UTRECHT	Cap Gemini Nederland	Adm. Helfrichlaan 1 3527 KV Utrecht	31 (30) 91 02 46
	Pandata	Catharijnesingel 52 3511 GC Utrecht	31 (30) 31 87 04
ZWOLLE	"	Burgemeester Roelenweg 33 8031 ES Zwolle	31 (38) 22 44 42

SWEDEN

BORLÄNGE	Cap Gemini Bra	Sveagatan 15 78130 Borlänge	46 (243) 851 85
GÄLLIVARE	"	Nord Cap Upplagsvägen 97200 Gällivare	46 (970) 165 00
GOTEBORG	"	Stora Badhusgatan 18-20 41121 Gothenburg	46 (31) 10 06 10
KARLSKOGA	"	Kungsvägen 33 69131 Karlskoga	46 (586) 503 80
LINKÖPING	"	Agatan 39 58222 Linköping	46 (13) 10 50 29
STOCKHOLM	"	Kungsgatan 38 11135 Stockholm	46 (8) 24 55 40
SUNDSVALL	"	Storgatan 10 85230 Sundsvall	46 (60) 12 55 40
UMEÅ	"	Skolgatan 73 A 90246 Umeå	46 (90) 12 55 30
VÄSTERÅS	"	Sigurdsgatan 6 72130 Västerås	46 (21) 11 55 40

SWITZERLAND

BASLE	Cap Gemini Suisse	Grosspeterstrasse 23 4052 Basel	41 (61) 50 08 00 41 (61) 50 13 13
BERN	"	Koenizstgrasse 74 3008 Bern	41 (31) 46 01 31
GENEVA	"	2/4 Chemin de Beau Soleil 1206 Genève	41 (22) 46 14 44
	Cap Sogeti Exploita-tion	8c avenue de Champel 1206 Genève	41 (22) 46 95 90
LAUSANNE	Cap Gemini Suisse	25 rue du Simplon 1006 Lausanne	41 (21) 26 31 33
ZURICH	"	Brauerstrasse 60 (F+D) 8004 Zürich (H+I) (Tech.Dev)	41 (1) 242 28 26 41 (1) 241 06 70 41 (1) 241 23 31

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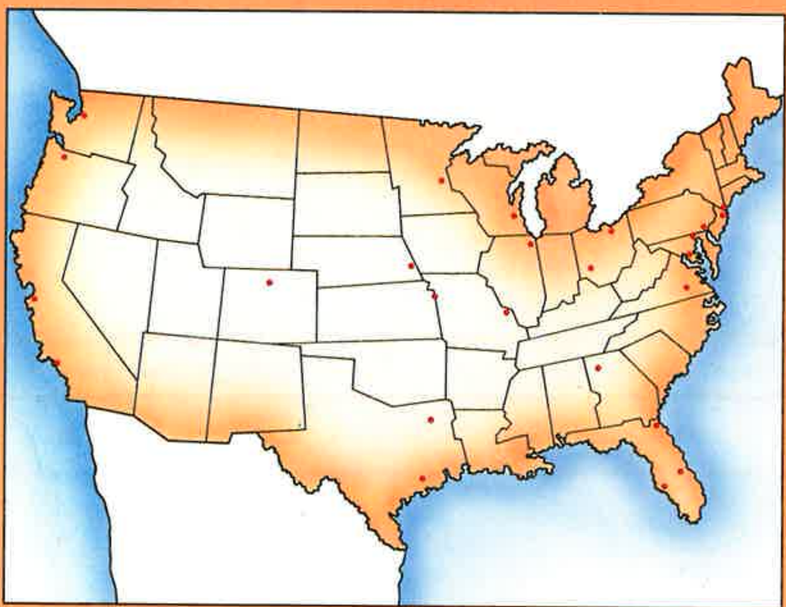
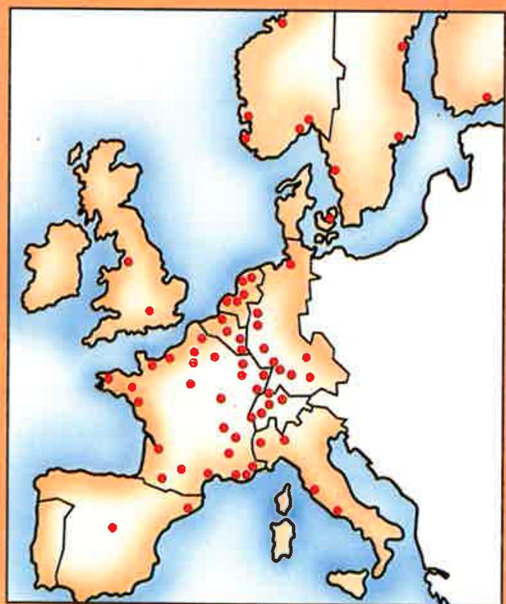
1 (201) 946-8900

PRINCIPAL LOCATIONS IN THE UNITED STATES

ATLANTA	1800 Century Boulevard Atlanta, GA 30345	1 (404) 633-2600
BALTIMORE	401 East Pratt Street World Trade Center Baltimore, MD 21202	1 (301) 837-0343
CHICAGO	2 Westbrook Corporate Center Westchester, IL 60153	1 (312) 531-1300
	901 Warrenville Road Lisle, IL 60532	1 (312) 810 0052
CLEVELAND	5800 Lombardo Centre Drive Cleveland, OH 44131	1 (216) 642-1491
DALLAS	2 Galleria Tower - 1600 13455 Noel Road Dallas, TX 75240	1 (214) 385-3290
DAYTON	3401 Park Center Drive Dayton, OH 45414	1 (513) 890-1200
DENVER	5299 DTC Boulevard Englewood, CO 80111	1 (303) 220-1700
HOUSTON	1700 West Loop South Houston, TX 77027	1 (713) 622-0105
JACKSONVILLE	6821 Southpoint Drive North Jacksonville, FL 32216	1 (904) 636-7800
KANSAS CITY	7101 College Boulevard Overland Park, KS 66210	1 (913) 451-9600
LOS ANGELES	606 S. Olive Street Los Angeles, CA 90014	1 (213) 624-0855
MILWAUKEE	10150 West National Avenue Milwaukee, WI 53227	1 (414) 546-4644
MINNEAPOLIS	7300 France Avenue South Edina, MN 55435	1 (612) 835-7779
NEW JERSEY	25 Commerce Drive Cranford, NJ 07016	1 (201) 272-7950
	Raritan Plaza III Raritan Center Edison, NJ 08837	1 (201) 225-7880
NEW YORK	369 Lexington Avenue New York, NY 10017	1 (212) 883-0900
OMAHA	10810 Farnam Drive Omaha, NE 68154	1 (402) 333-2863
ORLANDO	2700 Westhall Lane Maitland, FL 32751	1 (305) 660-8833
PHILADELPHIA	150 Monument Road Bala Cynwyd, PA 19004	1 (215) 668-4626
PORTLAND	6915 Southwest Macadam Avenue Portland, OR 97219	1 (503) 246-4777
RICHMOND	8100 Three Chopt Road Richmond, VA 23288	1 (804) 288-1422
ST. LOUIS	1034 South Brentwood Boulevard St.Louis, MO 63117	1 (314) 721-0123
SEATTLE	16400 South Center Parkway Seattle, WA 98188	1 (206) 575-4911
TAMPA	100 West Kennedy Boulevard Tampa, FL 33602	1 (813) 273-0059
WASHINGTON, DC	8381 Old Courthouse Road Vienna, VA 22180	1 (703) 734-1511
WILMINGTON	Baynard Bldg., Suite 209 Concord Plaza, 3411 Silverside Rd. Wilmington, DE 19810	1 (302) 478-3431





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Outstanding technical skills, a spirit of observation, patience, moderation, attention paid to the things of every-day life: all these qualities are required for the "Painters of Reality"– whose works Cap Gemini Sogeti decided to present in the 1987 Annual Report. These qualities are not very different from those which any good DP technician has to possess: when involved in sometimes complex projects, he has to utilize his technical skills in order to solve extremely concrete problems.

The works whose reproductions the reader will see in this Annual Report have been created by seven important contemporary artists:

Henri CADIOU
Pierre DUCORDEAU
GILOU
Paolo INTINI
Nadine LE PRINCE
Daniel MASSON
Jacques POIRIER

The reproductions of their works have been kindly placed at our disposal by the Galerie Alain Daune, 14 avenue Matignon in Paris. Those presented here have been selected by Cap Gemini Sogeti.

CAP GEMINI SOGETI