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MICRO-ELECTRONICS MONITOR

N.B. Special in this issue is an article on the commercialization of integrated circuits in developing countries by Dr. M.R. Murthy of Semicon Tech, Bombay, India.

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I. NEWS AND EVENTS

Japanese memory chips win another round

America's leading electronics companies have abandoned an attempt to regain control of a vital microchip market. A joint venture set up by seven companies to make dynamic random-access memory chips (DRAMs) collapsed after only months of existence.

The American joint venture, called US Memories, was set up last June with the aim of breaking Japan's dominance of the market. The companies intended to make their own state-of-the-art DRAMs, capable of storing 4 megabits of data. The venture was unable to find the investment of $150 million that it needed, nor did a commitment from American computer manufacturers to buy its products materialize.

Meanwhile, the six top Japanese electronics companies are between them investing 600 billion yen (more than £2.6 billion) this year on new production lines. They will be producing 4-megabit DRAMs by the million this spring, and engineers are confident that they can produce the next generation, 16-megabit chips, in the same plants. Samples will go to customers next year - just when US Memories hoped to begin making 4-megabit chips.

The Americans are not alone in their alarm at this prospect. The European Commission decided to set minimum prices for DRAMs to protect the handful of European companies still in the business.

Japanese scientists and engineers are now preparing the technologies needed for yet another new generation - 64-megabit chips.

Japanese companies account for virtually all the trade in DRAMs, worth some $8 billion a year, although the computer giant IBM makes huge numbers for its own products. The maximum capacity of a mass-produced DRAM has jumped 4,000-fold over the 20 years of the industry's life, from 1,000 bits to 4 megabits. IBM and Toshiba of Japan already sell computers with 4-megabit DRAMs inside. The next race is to produce more than a million of the chips a month. Toshiba says it will do it by March, Hitachi by June. (This first appeared in New Scientist, London, 27 January 1990, the weekly review of science and technology)

US beats Japan to the 16-Mbit DRAM

Contrary to expectations, the two largest American DRAM makers, IBM and Texas Instruments, are scheduled to be producing 16-Mbit DRAMs at the same time or before the leading Japanese DRAM producers. To accelerate their programs they have fabricated their first devices in production, not laboratory fabs.

IBM has been accused of lagging in developing the 16-Mbit DRAM, probably because it has not published much about its research.

IBM is making 16-Mbit devices on existing production lines, on 5 in. wafers. But 8 in. wafers will be used as they enter production. IBM President, Jack Kuenler, said the fabrication has demonstrated manufacturing feasibility "and will enhance our competiveness" with the global semiconductor market.

And inside TI several sources believe they will for the first time be the first to produce a new DRAM generation. TI has recently made its first 16-Mbit devices, in its DMOS IV fab in Dallas. Spokesmen indicated that starting fabrication in a production environment will save lots of problems later that would have occurred by transferring from a laboratory environment. Its first production units will use a 0.6-micron process. In 1992 production of the devices will be converted to a 0.5-micron process.

Statements by Japanese DRAM makers in recent months also puts their earliest production of the 16-Mbit devices in late 1991. NEC is expected to be the first in Japan shipping devices in the latter half of next year while Toshiba is expected to begin shipments in the fourth quarter. But IBM is indicating it expects to be producing the devices on 8 in. wafers in the third quarter of next year, while TI's schedule is for the fourth quarter of 1990. No DRAM producer besides IBM is expected to begin production on 8 in. wafers.

TI is now alternating its DRAM developments between Dallas and Miho, Japan, because it does not have enough resources at one site to carry out development of two generations of DRAMs concurrently. TI's 4-Mbit device was developed in Japan, then transferred to Dallas. TI is alternating between Japan and Dallas. The TI 64-Mbit DRAM will be developed in Japan.

TI has simplified the trench arrangement, used to separate the memory cells, to reduce leakage currents. In earlier devices, the transistor which refreshes the cell sat on top of the capacitor in the trench. Compensating for the leakage through this transistor proved too complicated so the company has adapted its design.

The result is a 16-Mbit cell structure that is a more straightforward evolution from the current 1-Mbit structure. Much has been learned about the fine structures around the capacitor to save area, so the 16-Mbit structure actually looks simpler than the previous 1-Mbit and 4-Mbit schemes. Much of the same equipment will be used, and production will begin in the DMOS IV fab in Dallas.

As with the IBM design, the TI unit will use 3.3V to power the memory array, with the overall chip using 5V. They can offer the lower voltage as the main power source if the shift to lower voltages occurs, as expected, during the 16-Mbit generation in the mid 1990s. TI will not offer any 16-Mbit devices in DIP packages.

IBM's design has on-chip ECC, is used to dynamically correct for bit failures, and will be transparent to the system the devices are used in. The ECC is unique in not degrading the speed of the device.

This 16-Mbit design also includes a register-controlled means to select organizations of X1, X2, X4 or X8 bits. The selection can be made at the wafer level. The IBM design uses a trench technology very similar to its current 4-Mbit design that is in full production. (Source: Electronics Weekly, 7 March 1990)

Neural networks ditch digital ways

A revival of techniques long since abandoned by mainstream computing may soon help to improve neural networks.

Computer scientists in Nottingham and Edinburgh are using analogue, rather than digital, computing to produce a neural network on a chip which they believe will solve problems much faster than its digital equivalent.

Neural networks reflect the brain by using a network of processors which represent neurons, or nerve cells. The most common design has three layers with each neuron linked to those in adjacent layers. Those in the two outer layers are also linked to inputs and outputs.

Software adjusts the strength of each link as the network learns the particular task it is asked to do. It recognizes particular patterns of inputs, and produces consistent outputs in response. For example, a neural network might recognize the patterns of text on a page and send out a corresponding instruction to a voice synthesizer to read out what is written.

Most of today's research in this field uses simulations in software rather than creating a physical neural network in hardware. A program running on a single processor calculates the state of each of the links between the neurons. This is a time-consuming process.

The team at the University of Nottingham plans to test is research in the autumn, when it will build chips containing the equivalent of about 100 neurons and 10,000 links. It is impractical to provide several hundred connections to a chip, so the group will send around 100 linking signals down one line. The chip will need only two wires to control its hundreds of inputs and outputs.

At the University of Edinburgh, the technology is more directly inspired by biological neurons. It also relies on analogue, rather than digital, computing to encode the signals linking the processing elements on the chip by varying the length of the interval between electrical pulses. (This first appeared in New Scientist, London, 24 March 1990, the weekly review of science and technology)

Fast-talking data link

The opening of a high-speed data link between the US and continental Europe has given a fillip to international collaboration among scientists. The existing transatlantic data links have until now allowed only thousands of bits of data to be transmitted per second. The new link, called fatpipe, has a capacity of 1.5 megabits per second, the equivalent of 200,000 characters per second. IBM, Merit Computer Network and MCI, an American telecommunications company, are providing the equipment and software for the link. They are also making space on an existing transatlantic optical fibre for fatpipe. They would not say, however, how much they are spending.

The advantage to scientists is that files will travel faster than before. In addition, computers on one side of the Atlantic will respond more quickly to commands from those on the other side. By increasing capacity, more researchers will be able to communicate with each other at the same time.

Initially, fatpipe will improve data links between US physicists and their colleagues at CERN, the European Centre for Particle Physics in Geneva. Eventually, CERN will serve as a centre to receive data from fatpipe and then distribute it around a network called the European Supercomputing Network. (This first appeared in New Scientist, London, 24 March 1990, the weekly review of science and technology)

WMO will play important role in natural disaster reduction

The World Meteorological Organization (WMO) will play an important part in the International Decade for Natural Disaster Reduction (IDNDR) and in internationally co-ordinated responses to environmental emergencies, such as nuclear accidents. IDNDR was designated by the General Assembly of the United Nations to begin on 1 January 1990. WMO's Global Telecommunications System will be used to disseminate rapid and relevant information on nuclear accidents to the world. The system also permits weather, hydrological and other atmospheric information to be transmitted around the world within time ranges of three to four minutes (for example, from Vienna to Tokyo). WMO's role in the IDNDR will be to strengthen international, regional and national warning systems for tropical cyclones, other severe storms and floods. (Source: ACCIS Newsletter 7 (6), March 1990)

UN agency launches environmental warning system

The UN Environment Programme (UNEP) says it is now ready to provide a reliable early warning system on the health of the planet, using a mammoth computer data base it has been compiling for the past five years. The idea is to use data on the state of the environment gathered from all over the world. This will enable it to alert Governments and scientists to environmental threats and their most likely causes and cures.

Michael Gwynne of UNEP is optimistic about the potential of the data base system. But he is also wary, because the information it holds could become crucial in resolving some of today's most contentious political issues.

For example, the data base produced a graphic representation of the acidity of rain falling in Western Europe. These types of data could prove important in establishing liability if nations are ever called upon to compensate each other for the environmental hazards that they cause.

UNEP has been running a global barometer of the state of the world's environment for some years under the Global Environment Monitoring System (GEMS). The programme collates a huge variety of environmental statistics, including information from satellites and monitoring agencies on the ground. It tracks pollutants as they travel through the air and sea, and keeps an eye on shifting patterns of land cover, and the state of the atmosphere, the climate and endangered species.

Over the past few years, UNEP has been plugging the data that GEMS collates into its new data base, known as GRID (the Global Resource Information Database). This data base is capable of storing 60 to 70 gigabytes of information. It sits at the heart of a network which currently has three regional centres - in Bangkok, Geneva and Nairobi. The system is fed information via existing communications networks. The plan is that eventually all countries will be able to file environmental data in the data base.

Each piece of data in GRID is classified according to its geographical reference, enabling the system's operators to provide a simple graphical representation of many hundreds of pieces of data, using regional maps of the world. These maps could show, for example, the extent of the rainforests being burnt in Brazil and the pattern of roads and towns under construction in the area.

GRID has already helped to tackle important environmental and conservation problems. In 1987 it was used to review the quota system for limiting ivory exports from Africa, and to set these at sustainable levels. The project revealed unexpectedly that often the protected zones did not coincide with the areas where the elephants were living. (Extracted from New Scientist, London, 10 March 1990, the weekly review of science and technology)

Information network created

The United Nations Criminal Justice Information Network (UNCJIN) is an electronic network for information services, electronic mail and information dissemination among governmental and non-governmental organizations on criminal justice and crime prevention issues. It is linked world wide through a major computer organization called TCN (Telecommunications Co-operative Network). Members of UNCJIN are offered services which include electronic mail; international calendar, news and updates on legislative and court decisions; a library of reports and international crime statistics; newsletters and reports from criminal justice organizations; gateways to other major commercial data bases; fax and telex services among others. Other services are also available from TCN at additional fees.

Initial membership fees include a $US 100 refundable deposit and $US 20 for the first month's account maintenance fee. Members are billed for monthly fees, storage and usage. For more information on this network and a membership application, contact UNCJIN Accounts Manager, Telecommunications Co-operative Network, 505 8th Avenue, Suite 1805, New York, NY 10018 (Tel.: 1 212 714-9780). (Source: ACCIS Newsletter 7 (5), January 1990)

BITNET headed for new frontiers

Researchers in Eastern Europe should soon be able to collaborate with their colleagues in the West using a computer network. The US Department of Commerce informed CREN - the Corporation for Research and Educational Networking - that it had no specific objections to making the BITNET computer network available to research institutions in Eastern European countries.

BITNET has become an increasingly popular way for scientists to communicate with one another. BITNET founder, Ira Fuchs, says the political changes in Eastern Europe convinced him that the time was right to seek permission for those countries to join the network.

BITNET or its counterpart, the European Academic and Research Network (EARN), has received applications from the Soviet Union, Czechoslovakia, Hungary, Poland and Bulgaria to establish network sites. Fuchs hopes that it will also be possible to extend services to China. Yugoslavia already has a BITNET site. (Extracted from Science, Vol. 247, 2 February 1990, p. 520)

Lobbying comes into fashion

Despite protestations, the European Community is going to be the chief legislative body for Europe after 1992. This will mean increasing amounts of Brussels intervention, forcing companies in turn to play the system.

This means that the case for lobbying, either as a company or a sector of the industry, is stronger today than ever before. Certainly, the environmental groups have not been slow in making their views known in recent times.

Failure to present one's case in Brussels also means that your company could be locked out of a range of co-operative ventures, involving grants. And the good thing about grants is that you do not have to pay them back.

There is little that the individual company can achieve on its own to influence proposals, let alone keep abreast of all the work being undertaken by the committees and working parties. So it is better to join a good trade organization, which is affiliated to a European body. The European Commission prefers to talk to organizations rather than individuals.

For example, Unix International is an industry body set up to look after the interests of Unix operating systems users. Their membership includes software vendors and hardware manufacturers. One of the reasons for basing itself in Brussels is to hopefully influence Directorate-General XIII in getting the EC to adopt the latest variations of Unix.

Once you have decided to undertake the task yourself, it is important to monitor everything that happens in your area of interest. There are a number of data bases you can subscribe to, which will flag up items of particiular interest as they come before the Commission.

There is Agence Europe, for example, which offers this type of service. It is based in Brussels (Tel.: 010 322 219 0256), and the service costs between £700 and £800 a year. The European News Service also provides a similar service.

Euro-watching has become a full-time business, employing around 2,000 lobbyists in and around Brussels. They besiege a Commission staff of 11,000. Lobbying is very much a seller's market right now, because Governments, organizations and firms are on the receiving end of so much legislation.

This is where the skilled lobbyist takes over from the amateur. They select the permanent European Parliamentary committees and the members attending them, in the same way as a racing expert studies a list of runners at Newmarket. They realize that the Community aims for consensus, and that every view has to be taken into account before a proposal goes forward.

A good lobbyist will have a degree of influence with at least one member on a committee or a working party, if not a European Member of Parliament.

Experts are called in to advise the committees. But they often represent a particular view or opinion.

A common criticism of lobbyists from EC staff is that they go for overkill, and produce much too much paper to support their case.

The Community's approach to standards is two-fold - acceptance of national standards, like BSI, where they apply, and an attempt to achieve an acceptable European standard at the same time. Two bodies are involved in this endeavour - the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC).

If you are prepared to wade through the mass of paper coming out of Brussels yourself, and you have the time to do so, you will need a considerable amount of patience. One has to learn the mechanisms of the Community. It is almost true to say that you have got to know what you are looking for before you start.

Most of the data you want, to bring you up to date, will have been written down somewhere by someone.

It is a good idea to go in the first instance to one of the EC information offices, or to your local business library based in the nearest city.

There is a school of opinion among the Euro-watchers that if you have not already made your preparations, then do not bother - it is too late. If you do decide to follow the Euro trail, remember, you cannot buck the system, it has been tried, and it does not work. (Source: Electronics Weekly, 10 January 1990)

EC court thwarts Commission's communications policy

EC plans for an open telecommunications market across Europe have been set back by a ruling from the EC's own court of justice.

The Advocate-General has recommended the overturning of a European Commission directive which aimed to force open the terminal equipment market to free competition.

The Commission issued the directive in May 1988 under article 90 of the Treaty of Rome, which limits the power of State monopolies.

Although Governments are not opposed to this measure they are against the Commission usurping their power to determine national telecommunications policy.

France and Spain challenged the directive in the court and now the Advocate-General has come down in their favour. The judges are not bound to follow his advice but usually do so.

He found that the Treaty of Rome does not give the Commission the power to set regulations in this way, but only allows it to challenge alleged breaches of competition rules.

An official in Sir Leon Brittan's competition directorate, which had a series of other directives it wanted to issue if the judgement had been in its favour, says the Advocate-General's opinion "makes life more difficult".

However, he says the Commission will "vigorously implement the competition laws". Earlier this month the Commission forced the Belgian national telecommunications authority to lift its restrictions on the uses of leased data circuits.

This was the first use of competition laws against a telecommunications authority - and an event which looks set to become a familiar one if the judges follow the Advocate-General. (Source: Computer Weekly, 22 February 1990)

Hackers may drive EC from Brussels

The European Commission is considering moving its entire computer operation in Brussels to its Luxembourg site because of poor system security and lack of computer crime and data protection laws in Belgium.

The Commission has revealed that it suffered at least six attacks last year from hackers who erased files and caused other nuisance.

As a result the Commission introduced a closed user group system in Brussels and Luxembourg.

It is now building two remtoe communication centres, in Brussels and Luxembourg, to house communications processors which will handle links with the outside world but prevent callers infiltrating the closed user group system. This project will take two years to complete.

Luxembourg is already the hub of the Commission's computer systems under a long-standing agreement by the Council of Ministers. The site has four mainframes, Amdahl, Siemens, ICL and Bull machines, housing large data bases of Community information. The data ranges from the administration of milk quotas in the Community to the supply of uranium to member States.

The site is linked by an X.25 network to Brussels, traditionally the administrative base of the Community. (Source: Computer Weekly, 1 February 1990)

The World Bank's open network

For years, the World Bank has been connecting the industrialized countries with developing nations in need of financing. So it might not seem remarkable that it recently got equipment from a trio of world-class computer companies talking to one another.

The World Bank is tying together the financial and portfolio management systems currently on IBM equipment, with Digital Equipment-based treasury and office automation systems and loan administration systems running on Unisys A-Series hardware. Using common networking protocols and a specially crafted implementation of the internationally accepted X.400 message-handling system (MHS), the bank has achieved a working version of open networking.

From the beginning, the bank has been working toward using the Open Systems Interconnection (OSI) protocols to connect its systems. OSI protocols may be the lingua franca of computer communications - much as the gold standard was to international currency exchange. Yet, unfortunately, OSI is moving too slowly to accommodate the bank's interconnection needs. The bank had connected the financial systems on the three computers before complete OSI products were available from the vendors.

The World Bank has adopted some unusual methods for implementing the new networking scheme. Since Digital and Unisys each provide communications products that support IBM's Systems Network Architecture (SNA) and Logical Unit (LU) 6.2 protocols, the Bank is using SNA as the network foundation - at least until all three vendors implement equivalent OSI protocols. X.400, an OSI-endorsed message store-and-forward specification, provides the same basic ability to communicate among applications.

To achieve its goal, the Bank developed two SNA-based interconnection services spanning the three primary computer environments: first, file transfer services using SNA Network Job Entry (NJE) protocols and, second, application-to-application messaging services using internally written software based on the X.400 messaging protocol and LU 6.2 peer-to-peer protocol.

Both of these services rely on an SNA backbone network interconnecting the three environments. The connections are made through specialized communications processors - a 3725 for the IBM 3090, an SNA gateway-ST for the Digital VAXs and a CP2000 for the Unisys A17. SNA protocols are supported by each vendor. (Reprinted with permission of DATAMATION magazine[c], 15 February 1990. copyright by Technical Publishing Company, a Dunn and Bradstreet Company, all rights reserved)

II. NEW DEVELOPMENTS

American laboratory claims breakthrough in optical processing

Scientists at AT&T's Bell Laboratories in New Jersey have built what they claim to be the world's first digital optical processor, a device which processes information with light instead of electricity. The group stresses that the work is only experimental at this stage, but that it represents a significant step towards the development of optical computers. These would rival today's electronic computers by handling information considerably more quickly.

AT&T's optical processor consists of four arrays, each comprising 32 optical switches, called S-SEEDS (symmetric self electro-optic effect devices). The switches are the optical counterparts of transistors in electronic integrated circuits. The processor carries out calculations by alternating the switches from on to off, or vice versa.

Each array also carries two tiny laser diodes, which emit electromagnetic radiation with a wavelength in the near infrared region. The diodes provide a source of light which splits up into many parallel beams. The four arrays are separated by lenses and masks that act as "wiring" between the arrays. These are essentially glass panes with patterns of transparent and opaque spots that transmit light selectively.

The team at AT&T acknowledges that its work builds on earlier research carried out at Heriot-Watt University in Scotland, although the American group is using more expensive semiconducting materials in its devices which require less power. This feature is important. It means that the devices generate less heat, so scientists can pack them together more closely.

Michael Prise, one of the team at AT&T says that he hopes over the next six months to build a larger processor deploying more than 2,000 switches on arrays operating in parallel.

The two groups plan to collaborate in research to develop further the technologies they need for optical computing. They plan to apply for funds from one of the European Commission's joint research programmes. (This first appeared in New Scientist, London, 3 February 1990, the weekly review of science and technology)

Optical drive stores 6.55-Gbytes of data per disk

Sony Europa's double density, high-speed 12 in. writable optical disk drive, the Sony WDD-600, can store up to 6.55-Gbytes of data per disk.

Sony believes that its accelerated testing techniques have shown that the optical disks have an operational life of more than 100 years. The alloy recording method contributes to the physical/chemical stability and long life of the disks.

The 12 in. disks are made of an injection moulded polycarbonate substrate which protects the thin metallic recording layer. This protects the stored data against moisture and changes in temperature. The disks are available in two formats: the WDM-6DA0 disk, which has CAV format and the WDM-6DL0, which is in CLV format. The CLV disks have a capacity of 6.55-Gbytes and a seek time of 400 ms and CAV format disks have a 4.36-Gbytes capacity and a seek time of 180 ms.

The drive allows a data sustained transfer rate of 0.6-Mbytes/s when reading data and 0.2-Mbytes/s (with verify on) when writing to the disk. The average disk load/unload time is 1.2 s. (Source: Electronics Weekly, 7 March 1990)

Optical device for future optical computers

Morton Association (UK) has developed the Holographic Logic Element, an optical device that uses holography to perform Boolean functions. The real image of a hologram is used. The device is said to be ideal for applications as processors in future optical computers. The patent describes how to achieve the following functions: AND/OR, NAND/OR AND/NOR. The device uses two superimposed holograms and operates on two input signals. It is possible to superimpose more than two holograms if the exposure times are carefully chosen; this could lead to the superimposing of 10 holograms to function in decimal notation. (Extracted from Photo Spectrum, January 1990)

Trip the light plastic

Silicon is the key ingredient in a new class of plastics with unusual optical properties and photochemical reactivity. The creation of Timothy Weidman and his colleagues at AT&T Bell Laboratories in Murray Hill, N.J., they are a departure from familiar plastics, most of which are based on carbon compounds. The transparent yellow plastics, called polysilynes, have properties that make them useful as thin-film optical waveguides over silicon wafers.

Polysilynes consist of a sheetlike network of silicon atoms, each bonded to three other silicon atoms and one organic group. Exposure to ultraviolet light lowers their index of refraction from about 1.65 for pure polysilyne to as little as 1.45 (that of window glass), with the amount of alteration being proportional to the wavelength of exposing ultraviolet radiation. The new plastics are most transparent between 0.6 and 1.0 micro-meter - the near-infrared region that includes those wavelengths emitted by helium-neon and gallium arsenide lasers.

The processing would resemble present techniques: coating a chip with polysilyne, masking those areas intended to be waveguides, and exposing the rest to ultraviolet light.

Weidman is now working on stabilizing their index of refraction, and improving the losses. (Source: Spectrum, January 1990)

New light source for optical communications

Fujitsu Laboratories (Japan) has developed a new integrated light source, which may allow multigigabit transmission in optical communication systems. The response speed of the new device is twice that of conventional integrated light sources, with three times the light output. Hindering of high-speed long-distance transmission due to laser wavelength unsteadiness is said to be eliminated with the new device. (Extracted from Photo Spectrum, December 1989.

Artificial retina gives computers "human" sight

Toshiba has developed an artificial retina to give computers a vision system which will react as quickly as human eyes. The research team hopes to reduce the amount of processing needed to form an image by mimicking the operation of animals' eyes.

Automatic vision systems, used for remote controlled inspection and pattern recognition, rely on semiconductor components such as charge-coupled devices.

These are based on arrays of light-sensitive elements each of which produces an image. The computer processing the image will have up to 400,000 signals to form into a single picture.

Human eyes form a single image on the retina, the innermost coating on the back of the eyeball. The coating consists of a series of light sensitive cells and nerve cell layers which transmit electric pulses to the brain where the image is formed.

Toshiba's researchers have mimicked this layer by producing a nickel plate with disk-shaped holes across it. A membrane, between 50 and 100 angstrom thick and consisting of films of phospholipids and azobenzines, is formed in the holes, which measure 100 μm in diameter.

In living retina, the membranes hold proteins called rhodopsins which contain dye molecules called retinals. When light hits the retina, the retinals change shape and, in turn, this changes the shape of the rhodopsins.

The membrane's polarity changes and passes an amplified electrical signal on to nerve cells. These cells pass the signal on to the brain.

Toshiba's membrane uses artificial dye molecules called azobenzines, instead of proteins, which change shapes in the same way as the retinals. The electrical resistance and capacitance of the membrane change, altering the flow of current passing through it from an oscillator circuit. This provides an electronic signal, which can be detected and processed by a computer.

The single signal produced by the retina should allow much faster processing, because there is no need to amalgamate a large number of pulses from separate picture elements. The research team have produced electrical signals from light using the membrane but still have work to do before a commercial system can be developed. (Source: Electronics Weekly, 17 January 1990)

Instructions reach one billion

A Norwegian computer company has teamed up with Motorola to design a reduced instruction set computing (RISC) chip capable of processing one billion instructions per second.

Dolphin Server Technology has licensed Motorola's 88000 instruction set to allow it to develop a chip based on emitter-coupled logic (ECL), which will be able to run at 125 MHz, four times the speed of Motorola's fastest device. Dolphin will build machines based on the new chip by 1992. (Source: Electronics Weekly, 17 January 1990)

Improved 80386 chip

Intel is sampling the 20 MHz version of its 80386 SX processor which improves performance over 16 MHz version by up to 40 per cent.

The new 16-bit bus 80386 processor has an improved cache controller. It is manufactured using Intel's Chmos IV process technology which reduces the processor's power consumption by more than 30 per cent and allows it to be used over a wider temperature range. A lower power version for laptop PCs can also be operated at a reduced frequency of 2 MHz when in stand-by mode.

The 20 MHz 386-SX family includes the 386-SX processor, 82340 SX AT chip set, 82385 SX cache controller, 387 SX maths co-processor and 82596 SX lan co-processor.

The family is supported by development tools that include the new ICE 386 SX-20 MHz in circuit emulator, compilers, assemblers and utilities. (Source: Computing, 8 February 1990)

TI adds intelligence to 8-bit chip

Small microcontrollers are getting brighter. Texas Instruments (TI) has added to the growing number of 8-bit RISC devices by including an intelligent timing controller on its latest TMS370 chip.

TI is aiming the device at systems which do not need 16-bit processing power but control several tasks running at different speeds. The timing control module, called PACT, uses innovative techniques to speed up the standard TMS370 processing core.

Peripheral processors on microcontrollers run at different speeds and usually each needs a separate clock circuit. PACT replaces these timers with one fast frequency generator working with delay software to produce all the clock signals. The PACT module also uses six 32-bit instructions to process timing commands.

TI claims that this will allow the devices to execute ten million instructions per second. (Source: Electronics Weekly, 7 March 1990)

Compression chip improves displays

Video data compression could soon be used to improve the performance of desktop computer displays with the development of a data compression/decompression chip from Silicon Valley start up C-Cube Microsystems.

The company, which was formed by engineers from digital signal processing specialists Weitek and Radius, claims the new chip is at least a year ahead of Japanese competitors.

It is believed that in future personal computers and other graphics display systems will have the improved signal processing performance of data compression as a matter of course.

The new chip, the CL550, works in real-time and can compress 25-Mbytes of image data down to 1-Mbyte of data in one second. It uses the industry standard compression algorithm specified by the Joint Photographic Experts Group, whch is backed by leading computer companies such as IBM and DEC. (Source: Electronics Weekly, 28 February 1990)

New chip for superfast computers

An 11.4-Gbit/per second chip (a world record speed) has been developed by scientists at the Bochum Ruhr University, Federal Republic of Germany. The new chip would be suitable for superfast computers, wideband telecommunications or radar technology. The previous record speed of 10-Gbit/per second was achieved by chips developed for optical communication systems. The university has also developed a silicon/germanium heterobipolar transistor, which has achieved a current conversion factor of up to 5000 compared to only a tenth of this power developed in spring 1989. (Extracted from Handelsblatt, 23 December 1989)

Superchip developed

Motorola has developed a computer chip with TRW that supplies the power of a supercomputer and can repair itself. The so-called CPUAX Superchip contains 4 million transistors and can process 200 million calculations/second. The chip contains all the parts needed to be a computer and purportedly can accomplish tasks currently done by huge machines. The United States Navy will make the first use of the SuperChip, possibly for on-board aircraft, missiles and satellites. The new chip is being termed a breakthrough product because it is the most densely packed in the world and can repair itself when wired to another chip - called a "satellite chip" - which monitors the SuperChip's functioning. If problems develop, the SuperChip can switch to extra built-in circuits. (Extracted from Wall Street Journal, 5 January 1990)

New high density magnetic disc developed

IBM's Alamaden Research Center (San Jose, CA) has developed the ability to place 1 billion data bits on 1 square inch of magnetic disc, the largest amount of density achieved for magnetic technology. Densities 15-30 times lower than the new system are typical for commercial hard magnetic discs. According to the researchers, a new type of magnetic head for data reading is central to the IBM device. The new IBM head contains magneto-resistive substances that alter magnetic field resistance. (Extracted from New Scientist, 13 January 1990)

High efficiency solar cell

Varian Associates, Palo Alto, California, has developed a multijunction terrestrial solar cell with a 27.6 per cent solar-to-electric conversion rate. The conversion factor represents the highest "one sun" value ever reported, according to the Solar Energy Research Institute, in Colorado, which measured the cell. The one-sun value indicates it was measured without concentrated sunlight. The cells are made using standard epitaxial technology, photolithography and are GaAs/AlGaAs based. The wafers are square, about 4.5 cm on a side, while the finished cell is typically 2 x 2 cm. A one junction cell requires between 3-5 μm of materials, while a two junction device, like Varian's, may need up to 10 μm, according to Dr. Jan Werthen of Varian's R&D Center.

The advantages of a multijunction solar cell is that its multiple cells have different light acceptance characteristics, known as bandgaps. The bandgaps permit the multijunction cell to absorb a broader part of the solar spectrum more efficiently than a single cell.

Prior to Varian's latest cell, the best conversion efficiency recorded for a multijunction terrestrial cell was 23.9 per cent efficiency, also with a cell developed by Varian. The cost of the solar cell substrate is about $20/in.^{2}.

While Varian has an ongoing solar cell effort, Dr. Werthen admits the technology is still looking for a market. "At the moment, the only market is for calculators, watches and some remote village applications in third world countries", he told Semiconductor International.

Meanwhile Sandia National Laboratories, Albuquerque, N.M., has reported a peak solar-to-electric conversion efficiency of 20.3 per cent, a new record for a photovoltaic concentrator module.

The experimental concentrator module is an arrangement of 12 plastic lenses that concentrate sunlight to 100 times normal onto 12 silicon solar cells. (Reprinted with permission from Semiconductor International Magazine, January 1990. Copyright 1985 by Cahners Publishing Co., Des Plaines, IL, USA)

Bacterial memory help

Random-access computer memories are being improved with help from bacteria. A Syracuse University researcher has found that a bacteria found in the Dead Sea can be used for such an improvement. The Halobacterium halobrium microbe's pigment is providing the basis for short-term computer memories. Bacteriorhodopsin, the name of the pigment, is a miniscule solar cell. It transforms sunlight into energy by altering its shape. Alternate exposure of the pigment to red and green light at the temperature of liquid nitrogen enables molecules in the pigment to function the same way as silicon chips. (Extracted from The Economist, 4 January 1990)

Silicon techniques are used by sensors

Silicon is spreading. Manufacturing techniques developed to make chips can be adapted for use in other parts of the electronics industry. The latest example is an etching process used by STC Technology, Ltd. (STL) to develop tiny pressure sensors.

STL has granted a licence to the Druck company in Leicester, United Kingdom to manufacture the devices, and early samples should be available later this year.

The use of silicon in pressure sensors is not new. Silicon is a useful material because its behaviour is not plastic at normal temperatures. It is easy to shape and it can be made sensitive to certain physical properties, including strain.

There are three basic techniques for measuring strain with silicon devices. Piezoresistive layers are used in miniature microphones; capacitive devices are formed by etching a flexible diaphragm above a fixed substrate; and resonant effects across silicon "bridges" which were chosen by the researchers at STL.

Piezoresistive and capacitive devices typically have accuracies of 1 per cent, a factor of 10 worse than resonant devices. The resonant sensors can operate over a wider temperature range and consume less power, typically nanoWatts instead of miliWatts.

The drawback with resonant devices is that they have proved difficult to manufacture. As a result, their use has been confined to high cost applications which need the extra accuracy. STL's silicon resonator should avoid this problem by using etching techniques in production.

The company chose a boron-doped etch stop technique to hollow out a hole under a strip of semiconductor. The shape of the strip can be controlled very accurately if boron is used as the etch-resistant dope. A diaphragm or bridge is left after etching suspended between two supports.

The picture shows STL's resonator. The bridge is held in tension and excited at its resonant frequency. If a force is applied to the device, the tension will change and the change in resonant frequency can be measured accurately. The output signal can be tracked using digital electronics.

Druck will manufacture a device which fits into a package 5 mm square. A sensor for use in benign environments should be marketed by the end of the year. In its present form, the design will not work well in damp environments and a more robust device is under development.

Druck has been producing pressure sensors for some time and will make the devices at an expanded silicon fab in Leicester. The results of STL's development work will be manufactured in the United Kingdom rather than being exploited by an overseas partner.

Millions of person hours are spent every year by chip companies increasing the sophistication of silicon production. The techniques they develop will continue to solve more esoteric problems if researchers are willing to adapt the technology. (Source: Electronics Weekly, 21 February 1990)

New superconductor

DuPont has obtained a patent for a thallium-lead based superconductor that eliminates the flux creep problem characteristic of other superconductors. It is still too soon to discuss possible applications for the new superconductor, but the material might be used in wires and thin films, according to DuPont. DuPont has also obtained the rights to research on yttrium-barium-copper oxide 1-2-3 superconductors from the University of Houston.

The new thallium-lead based superconductor is superconductive up to [illegible] C, the upper temperature limit for any existing high-temperature superconductor. It also possesses natural flux-pinning characteristics. DuPont's patent covers combinations of copper, lead, thallium, strontium, calcium and oxygen. Many superconductors lose their [illegible]-resistance when exposed to non-stable high magnetic fields. Attempts to stabilize the fields by pinning them resulted in the development of special [illegible] materials at AT&T Bell Laboratories. AT&T used a precursor containing extra copper and oxygen atoms to produce minor defects in the structure pinning the force lines. Similar results were obtained by neutron bombardment of the materials. However, DuPont's superconductor possesses similar properties without the need for special treatment. (Extracted from Chemical Week, 31 January 1990)

Chemists find the easy way to make a conducting polymer

Several polymers are able to conduct electricity. One, which is known as poly(sulphur nitride), can replace gold in electronic devices when it is made into films and threads. But the material has proved difficult to make. Now, however, chemists have found a new and safe way of making poly(sulphur nitride).

Arthur Banister and his colleagues at the Univerity of Durham can make poly(sulphur nitride) by simply passing an electric current through a solution of a "ring" compound, $S_5N_5^+Cl^-$. Previously, poly(sulphur nitride) could be formed only from tetrasulphur tetranitride (S_4N_4), which is explosive and dangerous.

To conduct electricity, a polymer must have a specific structure. Along the chain of atoms that form its backbone, there must be double or triple bonds. It is through such bonds that electrons flow. A polymer that has single bonds only - such as polythene - cannot conduct a current.

If a polymer is to be perfectly conducting, the material must allow electrons to move freely, as in a metal. Electrons in the polymer must be able to move along its strands, and also to move sideways to parallel strands if they encounter a break in the material.

Poly(sulphur nitride) is the polymer that comes closest to this ideal. Along its chains there are shared sulphur-nitrogen double bonds, and between them sulphur-sulphur contacts.

Chemists discovered poly(sulphur nitride) in 1910, noting even then that it had a "metallic" lustre. The material remained a chemical oddity, however, until 1975, when scientists at IBM found that it becomes a superconductor at [illegible] kelvin. The discoverers proved that polysulphur nitride was a true metal, despite containing no metal atoms.

Chemists measure conductivity in siemens per centimetre (S/cm). Films of polysulphur nitride have a conductivity of [illegible] S/cm, while crystals have a conductivity as high as 1,000 S/cm. If the material is subjected to high pressure, the conductivity increases to more than 10,000 S/cm. Crystals of polysulphur nitride then conduct electricity as well as the metal mercury.

One problem with polysulphur nitride is that it tarnishes slowly in air. However, if it is used to fabricate electronic components, it will be enclosed. Several Japanese companies have already taken out patents for polysulphur nitride as a conducting resin, and as a material for lightweight electrodes for batteries and solar cells.

Polysulphur nitride can replace gold in light-emitting diodes, or LEDs, and it gives better results. When the polymer is used, LEDs which are based on zinc sulphide increase their output of blue light by 100 times.

Banister and his colleagues have only just made public their work because they took out a provisional patent on their discovery in 1988. Now, however, the patent has elapsed. They could not find a British company to back the project.

Meanwhile, Dr. Thomas Bein and his team at the University of New Mexico in Albuquerque have taken lumps of an electrically conducting polymer called polypyrrole and found a way to tease out individual chains of it which are no more than one molecule thick. He hopes that these strands can be used as the "wires" for molecular circuits.

At the same time, Dr. Bein might have hit on a way to avoid the bugbear of molecular electronics: the unwanted interference between their wires, which is called "cross-talk". At the molecular level, the packing of a circuit's components will be so dense that such cross-talk between them could drown out all other speech. Somehow the individual molecular components will have to be shielded from each other.

The secret of Dr. Bein's success is a group of substances called zeolites - the alumino-silicate minerals which are found in clays (although they can also be man-made). Zeolites have large pores in their crystalline structures. These let small molecules travel around inside the zeolite. Once there, some - such as iron and copper - can displace the sodium ions that are part of the zeolite. These metals can then catalyse chemical reactions in the zeolite's molecular channels.

In order to get pyrrole to form chains a single molecule thick, Dr. Bein let the chemical seep into the pores of two different zeolites - one with the sodium displaced by iron and the other with the sodium displaced by copper. He found that both zeolites changed colour from yellow to green and finally to black - a sure sign that the individual pyrrole molecules had joined end-to-end to form a polypyrrole.

But what exactly had formed? Was it the elusive thin chains of polypyrrole that he was serching for, or merely easily made lumps of polymer? Dr. Bein argued that if they formed inside the zeolite's labyrinthine molecular channels, the chains of pyrrole would consist of [illegible] one molecule thick (because the zeolite's pores would prevent the polymer from making [illegible]).

Dr. Bein claims that the polypyrrole has [illegible] formed inside the channels. He gives several reasons. First, it takes longer to make polypyrrole when zeolites are around than when they are not - the extra time being taken for the pyrrole [illegible] to seep inside the pores. Second, no polypyrrole could be found on the outside of the zeolite crystals. Third, and perhaps [illegible], the zeolite containing the polypyrrole turns out not to conduct electricity. If polypyrrole had been coated on to the outside of the zeolite it ought to do so. Nevertheless, polymer is certainly there: [illegible] if the zeolite is dissolved away, polypyrrole which conducts in the usual way is released.

Far from being upset that his polymer may lose its power to conduct electricity, Dr. Bein is pleased: he may have found a way to stop cross-talk. He thinks that the chains of polypyrrole are insulated and isolated from each other by the zeolite. The fact that the chains do not conduct may merely be because they are short. He may be able to grow longer chains or add other atoms which help such polymers to conduct. (Sources: New Scientist and The Economist, 17 March 1990)

IDT has developed half-micron process

Integrated Device Technology has developed the technology and put in the facilities to achieve its long-stated goal of entering the ranks of the semiconductor industry majors in the 1990s.

IDT will soon have the first chips out of a new plant in San Jose made with half-micron CMOS and BiCMOS processes. Half-micron processing is not expected to become a mainstream chip industry technology until 1993. The first products made on the process will be fast Megabit static RAMs and RISC microprocessors. (Electronics Weekly, 7 March 1990)

MMIC devices with X-rays

Hampshire Instrument and Sanders Associates have successfully fabricated gallium arsenide MMIC devices using X-ray lithography. This work is part of the DARPA-contracted national X-ray lithography programme.

Sanders's engineers exposed the critical gate level on the MMICs with the Hampshire Series [illegible] X-ray Stepper using commercially available photoresist. They made the [illegible] to [illegible] design rules using Hampshire's reticle process and Sanders' e-beam lithography system.

The X-ray fabricated devices are high performance microwave FETs used for [illegible] to [illegible] GHz broadband applications. In this work, the devices with larger, less critical features were fabricated with optical lithography, demonstrating an ability to mix and match X-ray and optical lithography. (Reprinted with permission from Semiconductor International Magazine, January 1990. Copyright 1990 by Cahners Publishing Co., Des Plaines, IL, USA)

Midget machine puts recording on a new track

In the guise of a humble dictation machine, Sony will soon launch a digital tape recorder which is fundamentally different from any existing technology. The new recorder relies on electronics rather than precision mechanics to play back the digital code recorded on the tape.

Sony developed the system for use in a small dictation machine, which will go on sale at the end of this year. The pocket machine can record two hours of digital mono sound with the quality of FM radio. The cassette is the size of a large postage stamp. If it is successful, Sony could in future apply the technology to other types of digital recorder - for computer data, hi-fi stereos and even videos.

In a conventional digital audio tape recorder, tiny recording heads on a rapidly rotating drum scan the tape obliquely to lay down parallel, helical tracks, like the threads of a screw. Each track is less than 14 micrometres wide, a quarter of the width of a human hair. To play back, an electronic servo system steers the heads over the track pattern to an accuracy of micrometres. The servo must compensate for changes in tape caused by stretching or variations in temperature, and for errors when different machines are used for recording and playback.

The new system records helical tracks in much the same way, but divides the digital data into numbered blocks. To play back, no attempt is made to follow the tracks accurately. The heads move at twice the speed used for recording and sweep over the general area of the tracks, reading at least four at a time. So the same data can be read four times over. All the data read are stored in memory chips, where they are reassembled in the correct order and the redundant blocks discarded.

Relieving the heads of the burden of accurate tracking means that the mechanism can be much simpler. Instead of lacing the tape round the drum, as in a video recorder, the new system simply moves the drum into the cassette and against the tape, as in a conventional audio tape recorder. (This first appeared in New Scientist, London, 3 February 1990, the weekly review of science and technology)

Submicron speed writing

The first high-speed electron-beam exposure system (EBES) machine for manufacturing sub-micrometer optical or X-ray lithographic masks or for writing directly on semiconductor substrates is now available commercially from Lepton Inc., Murray Hill, N.J. According to President Martin P. Lepselter, his EBES machine can directly write 10 levels of a 15 centimetre wafer in an hour compared to most machines' one level in a day.

Instead of heating a source until electrons boil off to produce the exposing beam, the electrons are stripped from a single crystal of zirconium-doped tungsten by a high electric field - something never done before in a lithographic machine, said Lepselter. The resulting source generates a spot 1/8 μm in diameter and with a current density of 1,600 amperes per square centimeter. The spot exposes one pixel of photoresist in 1 nanosecond, and draws lines an order of magnitude faster than other machines.

Second, the spot is shifted from place to place by a control chip converting position and on-off digital data into an analog signal at a data rate of 500 megahertz - another order of magnitude faster than other machines, Lepselter said. This speed is owed in part to the spot's ability to move in a multidirectional vector scan instead of a traditional raster scan. (Source: Spectrum, January 1990)

Video supercomputer

The world's first video supercomputer has been developed at the David Sarnoff Research Center (Princeton, NJ). The video supercomputer, called the Princeton Engine, allows high-definition TV and video applications to be designed in real time. The development time for these applications can apparently be cut "from weeks to hours" with the Princeton Engine. A massively parallel system, the Princeton Engine has 1,024 16-bit microprocessors tightly coupled to a real-time TV signal processor with I/O circuitry. A high-resolution screen displays the results of "what if" calculations performed by developers, using a windowing, graphical user interface. (Extracted from Computerworld, 22 January 1990)

Cyberspace (Norcross, GA) has introduced a 6.2-lb laptop with a hologram screen visible only to the user. The machine uses "Private Eye" technology developed by Reflection Technologies (Waltham, MA). The radiation-free "screen" has a 70-x-10 resolution and requires a 1-x-1-x-3-in. eyepiece headset. The image appears about 2 feet in front of the user and allows the person to perform other tasks while looking at the screen. (MarketComp, January 1990, p. 56)

New architecture increases neural computer speed

Fujitsu Laboratories (Japan) has developed a computer architecture that can increase the speed of a neural computer by 400 times. It juxtaposed 256 digital signal processors in parallel. Each of the processors represents a single neuron or computational unit. Previous neural network architectures presented problems because a great number of connections was needed to transfer data from 1 layer of neurons to another. The Fujitsu research team got around this by adopting a so-called "ring register" protocol. Their work suggests that the new architecture could be used to make a neural computer with a speed of 500 million connection updates/second, compared to 1.25 million connection updates/second for the US-made ANZA-plus and DELTA neural computers. (Extracted from Japan Economic Journal, 20 January 1990)

Japan puts neural computers to work

One of the main barriers to computing in Japanese may soon be overcome. Researchers at Toshiba have developed a "neural" word processor which the company says may be on the market in less than three years. The complexity of the Japanese language has always been a major impediment to the development of word processors in Japan, but Toshiba believes the problem may be solved using neural networks.

Word processors are still relatively rare sights in Japanese offices. However, sales of Japanese-language machines are growing quickly, and will reach 2.7 million in the current financial year, according to the Japan Business Machine Industries Association.

Toshiba's word processor would be the first commercial application to come out of an intense burst of interest by Japanese companies in neural computing. Neural networks consist of many simple processors, each linked to all the others, in a pattern similar to that of the human brain's neurons and synapses.

A team at Toshiba's Central Research Laboratories at Kawasaki, near Tokyo, has applied neural computing techniques to the problem of homonyms in written Japanese. Homonyms are words with the same pronunciation and phonetic spelling, but entirely different meanings.

Written Japanese is a mixture of three alphabets; two phonetic scripts called kana, consisting of 46 characters each, and a set of several thousand characters called kanji, which are borrowed from Chinese. It is possible to write every word in the Japanese language in either phonetic script. Telegrams, for example, are written in this way. But the phonetic alphabets are inelegant and make for slow reading.

Kana can also be highly ambiguous. The spoken word "kanji", for example, can mean "manager" or "feeling" as well as "Chinese character". All three are spelt identically in kana, but have different kanji characters. Some kana words have 10 or more possible meanings.

Hence the difficulties for the makers of Japanese word processors. Companies that make office word processors solve the problem with a kana keyboard and good software. Whenever the program spots a group of kana that could represent a kanji word, it flashes up a list of possibilities on the screen from which the user can choose. The result can be fast, but the constant interruptions are annoying. An ordinary computer cannot tell which of a list of 10 kanji words is likely to be the correct one. The best that most word processors can manage is to repeat the choice that was made previously in the same document.

Toshiba's neural word processor can make a much more informed guess. Its choice is based on the weighted relationships between the 10,000 words that are stored in a simulated neural network mimicking an array of "neuron" processors in a normal, serial computer. The network links each word with a weighted value according to the likelihood of it showing up in the same passage of text. For instance, the words for "trial and error", a common idiom in Japanese, are strongly linked.

The system needs a lot of preparation. It depends on a data base of 500 pages, which defines the weighting between words according to a particular user's needs. An engineer, for example, needs entirely different weighting from that of a lawyer. The team plans to build a commercial version with a smaller data base.

The present system works on a 32-bit computer. The team believes it will be possible to put the system into a relatively modest personal computer. Toshiba has been working with neural networks for about three years. Strictly speaking, its approach has been a hybrid one, creating the appearance of a neural computer in a conventional machine.

But to use such simulated neural networks is only an interim solution. Researchers will be able to produce a much faster machine if they can develop a neural computer in hardware, but this will be much harder to achieve. In 1989 Hitachi reported that it had built a wafer of silicon containing a neural network of 576 processors. The main difficulty is packing in the vast numbers of connections needed between different processors. This will make electrical connections impractical if researchers are ever to try building networks with anything approaching the brain's 14 billion neurons.

Meanwhile, Japan's Ministry of International Trade and Industry is planning to launch a national research project on neural computers in the spring. The project is likely to run for 10 years, with research beginning in April 1991. It will effectively replace the Fifth Generation Computer Programme, which has been working since 1982 to create artificial intelligence using a more conventional approach to parallel processing. All of Japan's large computer makers are likely to join the scheme. (This first appeared in New Scientists, London, 6 January 1990, the weekly review of science and technology)

Lifelike computer hits on a brainwave

A model of 10,000 brain cells has spontaneously produced signals similar to those given out by the brains of animals at rest. The model's developers, scientists from IBM and Columbia University, New York, say the signals give them confidence that their design closely matches the complex connections between the neurons of animal brains.

The team began work on its computer model nearly 10 years ago, using a network of about 100 cells. Since then, the researchers have used the model to find clues to the origins of disorders such as epilepsy.

The current design imitates the hippocampus, which is essential in the function of memory and is also involved in the development of disorders such as epilepsy. The success of the model should help the team to understand more about the mechanisms by which people think, learn and remember.

The model could also have implications for computer scientists who are designing neural networks.

The team designed the connections between its simulated network of neurons by using drugs to block selected routes between the cells of real brain tissue to simplify the network. The team tested how often the signals got through those connections which were still open, and worked out a statistical value for the most likely number of signals each cell must have received. The researchers then wrote a software copy of the network of links, based on these results, for 10,000 cells.

The model runs on an IBM 3090 supercomputer, and includes descriptions in software of the anatomy of each single neuron and the team's best estimate of the way any two neurons interact. This can be used to study the way large collections of brain cells function as a group. The apparently random connections between these cells and the chaotic interplay of messages between them is a long-standing mystery of neuroscience.

Computer scientists who are designing neural networks might make use of some of these discoveries to bring their computers even closer to an impersonation of the human brain. (This first appeared in New Scientist, London, 3 March 1990, the weekly review of science and technology)

Josephson-junction microcomputer

A Josephson-junction-based microcomputer has been developed at Japan's MITI Electro-Technical Laboratory (ETL). The RISC-based computer consists of four chips and processes most instructions in 1 ns. Power consumption for the microcomputer is some 6.2 mW, which is some 1/1,000 the power consumption of most semiconductor devices. The four components include a 4-bit register and arithmetic/logic unit, programme sequence controller, RAM and [illegible] The device runs at 1 Mflops despite the fact that each unit operates in the picosecond range, because measures taken to avoid inductive cross-talk have slowed down the speed of the chip dramatically. However, researchers claim that power switching obstacles can be resolved and the architecture can be raised to more than 32 bits. The niobium-based Josephson junctions exhibit superconductivity at near absolute zero temperatures. If high-temperature superconducting materials are introduced in the near future, a Josephson-based system that operates using liquid nitrogen could appear.

Hitachi and Fujitsu have both developed 1-chip Josephson-based microcomputers with some 12 instructions stored in an on-chip ROM module. According to Y. Nakajima, NEC research information leader, Josephson-based devices have the potential to be much faster than any other known device structure, but are much more expensive. S. Takado, ETL chief of superconducting electronics section of the electron devices division, claims that Josephson-based devices can be made more easily than can very high-frequency semiconductor devices. (Extracted from Electronics Engineering Times, 25 December 1989)

BiCMOS processes

Not all BiCMOS processes combine bipolar and CMOS technology to the same degree, as the process used may be heavily influenced by the designer's experience with the bipolar or CMOS processes. For example a designer experienced in CMOS may view BiCMOS as an enhancement to a CMOS process. BiCMOS is generally used to increase performance while decreasing process complexity. Memories and ASICs are the main use of high-performance digital BiCMOS; the best known type is the SRAM. Before the advent of BiCMOS bipolar was used to create SRAMs, but these were power hungry and were usually limited to a density level of 64-Kbits. CMOS SRAMs provided densities up to 1-Mbit, but further speed improvements would require shrinking geometries to 0.5 micron or below. Supercomputers, high-end graphic workstations and minicomputers require SRAMs with densities greater than 64-Kbits and access times under 25-ns. BiCMOS DRAMs have also been introduced, having access times near 35 ns. These have eliminated the need for cache RAMS in some systems. BiCMOS gate arrays are also finding wide applications. Other areas that BiCMOS may be suitable for include RISC processors, mixed analog-digital, precision analog, high voltage telecommunications, data acquisition and automobile electronics. (Extracted from Electronic Engineering Times, 25 December 1989)

Micron-sized vacuum tubes

Bellcore Laboratories (Livingston, NJ) has advanced the technology of creating micron-sized vacuum tubes. The vacuum tubes are expected to increase computer speeds tenfold. Silicon cones with needle points of 1 nm can be produced as silicon is oxidized. The needles are the primary electron emitting elements needed to make micron-sized vacuum tubes that can operate at high speeds in severe environments. According to H. Gray, naval research laboratory scientist, industry will be attracted to the Bellcore design because of its simplicity. (Extracted from Research and Development, December 1989)

New GaA crystal growth process

A new process for growing low-defect gallium-arsenide crystals has been developed at the Lawrence Berkeley Laboratory at the University of California. The process uses an advanced vertical freeze technique, and is able to produce crystals that have a 5-10 times fewer defects than crystals grown conventionally. The defect density of the devices produced with the new process is on the order of less than 1,000/sq cm. Tests have also shown that the new process provides uniformity of electrical resistivity and doping distribution throughout the wafer. (Extracted from Photo Spectrum, December 1989)

New lithography system developed

GW Instruments (Somerville, MA) has developed a lithography system with the University of Rochester (Rochester, NY). The system uses a scanning electron microscope (SEM) to provide low-cost electron beams. Computer-control functions were also added to the system via the digital interfaces of the SEM. Commercial fabrication using electron-beam lithography costs some $1 million in tools, but the newly developed system requires an investment of under $90,000. Various high-resolution applications are performed with electron-beam lithography. It is also used to make optical components for optoelectronic ICs. A Tracor Northern X-ray imaging system was used in the development, and process control programmes were used to control the hardware and allow the SEM to be used as a submicron lithography tool. Macintosh computers were used to write patterns with the SEMs. Graphics packages made such pattern generation easy. The new process can be used on larger- or small-scale production. (Extracted from Research and Development, December 1989)

New flat-panel display technology developed

Transparent tin oxide conductor films for high-resolution active flat-panel displays have been produced at the University of Ulster. The technology has allowed researchers to develop fine-patterned tin oxide pixel electrodes, offering resolution improvement of an order of magnitude over conventional methods. A vacuum plasma process using a chlorine/argon mixture reactant gas is the key to the technology. Indium tin oxide has traditionally been used, but it is more expensive and more difficult to deposit than tin oxide. (Extracted from Electronic Engineering Times, 25 December 1989)

III. MARKET TRENDS

Biometric security devices

Sales of biometric computer security devices will pass the $25 million mark by 1991 and grow at 40 per cent per year, according to a Frost & Sullivan report. Sales of biometric security devices have not yet topped the $25 million mark.

Biometric security systems measure such traits as fingerprints, speech patterns, the patterns of blood vessels in the back of the eye, and the dynamics of writing a signature, which are unique to each individual. They then digitize the information and store it in compressed form. With the exception of voice-verification systems, all biometric security devices require the physical presence of an individual. In addition, the systems are not completely reliable. But the growing threat of computer hackers and the falling price of biometric computer security devices is influencing the sales of these systems. (Extracted from Computerworld, 8 January 1990)

Growth of CIM market

The computer-integrated manufacturing (CIM) market should reach $81.3 billion in 1992, against $53.8 billion in 1988, according to Dataquest (San Jose, CA). The North American CIM market should reach $25.4 billion by 1991, compared to $17.8 billion in 1987. CIM market segment annual growth through 1992 should be as follows: Monitoring and control, 17.2 per cent; network and data-input, 42.7 per cent; software integration services, 15.4 per cent; procurement and distribution, 15.8 per cent; assembly systems, 11.7 per cent; planning systems, 14.8 per cent; total automation applications, 10.9 per cent. According to Automation Research (Medfield, MA), the US systems integration (SI) services market should reach $4.4 billion in 1993, compared to $1.7 billion in 1988. The automative industry accounted for 25.6 per cent of the 1988 SI services market, with aerospace at 22 per cent, electronics at 20.4 per cent, and the machinery, electrical and fabricated metals industries accounting for the rest. Developments include networking the system using the Manufacturing Automation Protocol (MAP) standard, cheaper and more powerful platforms (i.e. workstations, industrial controllers), software-based integration tools (i.e. IBM's Distributed Automation Edition), user-friendly operator interfaces, and partnerships and joint ventures between CIM hardware and software vendors. (Extracted from Systems Integration, December 1989)

US computer equipment market growth

The US computer equipment market will grow by 7 per cent in 1990, reaching $71.5 billion, compared to an 8 per cent growth in 1989, as slowing growth in the minicomputer and mainframe markets continue to drag down the entire segment. Some parts of the industry, however, will continue to grow, such as technical workstations, which are expected to grow by 46 per cent, and minisupercomputers, which are expected to grow by 33 per cent. The software market continues to be strong, and will increase by 20 per cent in 1990 to $30 billion. The data storage device market is expected to grow more than 14 per cent in 1991.

Cutbacks in defense and capital spending have created an ominous outlook for the computer industry. Defense spending cutbacks have particularly damaged the supercomputer market. Entry-level supercomputers have also challenged traditional supercomputers for market share. Personal computer and personal workstation functionality will accelerate in 1990, according to International Data (Framingham, MA). New markets will be opened to workstations, as innovations and pricing make these markets available. Technical workstations are expected to grow to nearly $5.8 billion showing a growth of 46 per cent. The PC market is expected to grow by 10 per cent in 1990, over 1989's 8 per cent growth rate, partly due to the crossover into traditional workstation applications. (Extracted from Electronics, January 1990)

Market analysis and restrictions on trade

The Software for Market Analysis and Restrictions on Trade (SMART) was recently developed by the International Economics Department (IEC) of the World Bank and the United Nations Conference on Trade and Development (UNCTAD) to strengthen the negotiating capacities of developing countries. The system provides data and software that can be used in a personal computer for the analysis of conditions of access into external markets. The SMART system also facilitates the participation of developing countries in international trade negotiations, such as the Uruguay Round.

Users can load and manage country-specific trade, tariff and non-tariff barrier data. They can browse data, create requests for aggregates, produce reports and simulate effects of tariff liberalization on trade patterns. Market data are currently available for most country members of the Organization for Economic Co-operation and Development (OECD), Mexico, Korea and Hong Kong. New markets will be added. The system provides SMART o line help, overview and tutorial facilities.

SMART is now being used by over twenty developing countries. Further development of the system, as well as dissemination and training, is being undertaken with UNDP financial assistance. Its use is restricted to governments, the research institutes designated by them and international institutions. Further information from Samuel Laird, IEC, The World Bank, 1818 H Street, N.W. Washington, D.C. 20433, or Rene Vossenaar, International Trade Programmes, UNCTAD, Palais des Nations, 1211 Geneva 10, Switzerland. (Source: ACCIS Newsletter 7(6), March 1990)

Slowdown fuels push in chip technology

Flat or declining is how all the pundits see the world semiconductor business for 1990. From Tokyo to Taiwan to California, from DRAMs to ASICs, the word is that no one should expect to increase their sales figures, their market share or their margins.

All except for the Koreans. Samsung, Hyundai and Goldstar plan to plough on regardless, ramping production, taking markets from the Japanese, building new factories and re-equipping old ones.

In Europe, things may be a little different with modest market growth expected in its two strongest areas - communications (7 per cent) and military (5 per cent). Also there may be some special cases who will continue their meteoric 1989 growth such as Harris (417 per cent), Mitsubishi (135 per cent), Matsushita (104 per cent), Siemens (64 per cent), and Fujitsu (61 per cent).

However, technology push will be taking over from market pull in 1990. For instance new generations of microprocessors: the 486, 68040, 860, and blisteringly fast new RISC chips in both CMOS and ECL will set new standards for equipment performance and will demand new generations of all the other chips to match the speed and increased capacities of the new micros.

Technology push will also come from the new generation of memory chips - 4-Mbit DRAMs and EPROMs, Mbit SRAMs and Flash, which are all going to be produced in high volume during the year.

Those new technologies should push the way towards the £200 laptops and desktop supercomputers of the mid-1990s, while rapidly developing expertise in mixing analogue, digital, bipolar and CMOS on one chip should lead the way towards end-of-decade chuck-away portable telephones and pocketable video cameras.

For Europeans, the pride will come in seeing how the programmes of JESSI impact the fortunes of Philips, Siemens and SGS-Thomson. Philips did badly in 1989 - losing 5 per cent share in a 10 per cent growth year - but its large reliance on discretes and analogue should ensure that its business remains solid in 1990.

But the thing about Philips is that it remains a top ten company while avoiding the biggest markets - DRAMs SRAMs and proprietary micros - and taking its entry into EPROMs with extreme caution. Philips could show staggering growth if it went hell-bent for one of these markets - or all of them.

Siemens is extremely wary of revealing figures on its DRAM production. It is not thought to be anywhere near the scale of industry leaders like Toshiba and NEC, but it has a reputation for making very high quality high reliability Mbits which may protect it from the worst effects of declining prices.

Much will depend on Siemens' 4-Mbit which, if early to market, as high quality as the Mbit, and reproducible in high volume, could propel the company into the top ten in 1990. Everyone who roots for European technology will be wishing Siemens luck.

SGS Thomson is looking in many ways to have the strongest potential of the three. It is not strong in DRAMs but it is in everything else and in addition to a well-rounded product portfolio it has a balanced strategy for expanding into both Asia and America. Boss Pistorio is such a professional SGS-Thomson is now looking like a potential second Motorola - and there is no higher praise than that. (Source: Electronics Weekly, 17 January 1990)

Desktops mature as majors take grip

1990 will be the year that the desktop computer business starts to mature. The big suppliers will gain a firmer grip on the market-place, with opportunities for fast growth among the small companies looking much slimmer.

There are several indicators for this scenario. Word from the component distribution business reveals that orders for devices like dynamic random access memory chips are lower this year, the computer business being one of the largest users for such chips.

US company Compaq, itself one of the growth success stories in recent years, has already predicted flat orders for the first couple of quarters. These factors, added to the general business climate in all major world markets, suggest that only the established forces in desktop machines will be able to hold their own.

The boom in computer sales in Europe over the last few years will start to slow down, as customers wait for the latest technology to come of age and spending becomes tighter. This puts greater emphasis on corporate muscle and a diversified business to support a shrinking market growth rate.

Convergence between desktop categories such as personal computer and workstation will also complicate the issue. Falling hardware prices and greater value for money gained from desktop machines will allow both workstation and PC makers to compete in markets which were traditionally separate.

Giants such as IBM will benefit most from the changes. IBM will develop a po er computing division with the relaunched RT series of workstations and the successful and versatile PS/2 machines forming its kernel. While many see IBM as entering the high-end desktop market four years too late, there is still plenty of time for it to claim much of the field.

Hewlett-Packard along with DEC and established vendors such as Apple and Compaq will continue to grow. HP and DEC have the diverse businesses to support any part which under performs. Compaq and Apple have narrower product portfolios, but will capitalize on the market's strong brand awareness of their offerings.

Ability to fund future research and development will also be a key factor. Again the big firms will come out on top and some of the huge Japanese firms, such as Sony, will bid for a share of the action.

Companies which experienced problems last year will probably continue to suffer. Sun Microsystems will be the most likely casualty of IBM's workstation drive and PC vendors such as Amstrad will continue to slide. Many others will retain niche positions in the market, without carcking the big time.

One technological development to become clearer in 1990 will be the need to find a new computing model to push performance and speed even further. Many observers feel that with the 100 million instructions per second limit HP will pass this year, only the use of technology such as parallel processing will point to new performance goals. The Transputer and Intel's 1860 device look the only likely parallel processors able to compete.

Yet for some time to come, the older computers will sell best. Machines based on Intel's 80286 chip will shift more units in PC terms than any others and the users are probably waiting for issues like open systems and the further growth in the Unix operating system arena to be clarified before taking a bigger plunge.

The shake-out long foreseen in the computer business will also start this year, with some companies disappearing and others being absorbed. The recent Japanese push to invest in the US computer industry will extend to Europe as well. The market overall is still buoyant enough to sustain many companies for some time yet. (Source: Electronics Weekly, 17 January, 1990)

Western dp courts the Eastern Bloc

The Eastern Bloc could soon become the natural successor to Far Eastern cheap manufacturing countries such as Taiwan and Korea, as Western firms rush both to invest in the relaxing socialist regimes and to grab any business there that is going.

USSR, Hungary, the GDR, Poland and shortly Czechoslovakia and Romania will all have eager allies knocking at every door, including high-technology firms wanting to start up on their doorstep.

So far since Christmas, NEC, Tandem, AT&T, Data General and US PC firm Inovation International have all been in talks to either establish bases in one or other of these countries or to use their services.

AT&T lit the way, asking for permission to use one of the Russian satellites for phone services in and out of the Eastern Bloc.

NEC plans to open offices in both Poland and Hungary to sell data communications equipment. Previous NEC sales to these countries have been out of its Austrian office while NEC's headquarters in Japan has always handled business with the Soviet Union directly. NEC also hopes for a number of subcontracts in the highly publicized trans-Siberian project to run a fibre-optic cable right across Russia.

Tandem has been approached by "several sources," from Hungary, and it already has active sales operations in Russia, while one Polish company, Unitra/Cemat has landed a deal with US firm Ziti to export four-inch silicon wafers. The two companies have spent almost two years establishing US quality control standards into the wafer fabrication process.

Data General is already shipping handfuls of small MV minicomputers to Russia while awaiting an export licence for more powerful systems. (Source: Computing, 11 January 1990)

Europe plans to secure micros

European self-sufficiency in microprocessors by 1995 is the aim of an ECU 350 million proposal called "EMI" (European Microprocessor Initiative) backed by 12 of Europe's largest electronics companies.

The proposal, which will be presented to the European Commission for funding under the JESSI section of the ESPRIT programme, will give rise to fears of "Fortress Europe" within Japanese and American companies. However, the major European equipment makers have been anxious for some years about the security of their supplies of microprocessors.

As well as the top European chip companies, Philips, Siemens and SGS-Thomson, some of the leading European equipment companies like Olivetti, Bull and Alcatel have joined the project.

Two UK-designed processors will form the basis of the EMI project. One is the Inmos transputer designed in Bristol and now owned by SGS-Thomson; the other is the Acorn ARM microprocessor designed in Cambridge and now owned by Olivetti of Italy.

It is believed that the proposal envisages that a totally new processor will be designed based on the transputer and ARM chips and will probably utilize a 64-bit architecture.

European worries about the supply of American microprocessors started in the early 1980s when expected European second sources of Intel and Motorola micros at Siemens and Thomson did not materialize. Later on both the US companies decided to pursue a single source policy with their processors which added to fears about a possible discontinuity of supply.

Since then there has been a wave of new RISC (reduced instruction set computing) microprocessors from non-traditional US sources, and Philips and Siemens have both taken licences to second source them. However RISC micros still lack the software base and general acceptance accorded to the traditional CISC (complete instruction set computing) micros.

There have also been new microprocessors from Japan. NEC has produced the "V" series and a new micro being built by Hitachi, Fujitsu and Mitsubishi with a novel architecture called TRON. These have not, as yet, been widely adopted even in Japan.

The new "Europrocessor" project consequently looks like an insurance policy for the Europeans against the Americans or Japanese failing to establish their new versions of micros, or failing to support them, or simply failing to supply them. Alternatively it can be seen as another brick in the wall of Fortress Europe. (Source: Electronics Weekly, 14 March 1990)

United we stand divided we fall

Longstanding barriers in the chip industry are falling fast between the Japanese, Americans and Europeans all piling in to pool information and resource.

US giant IBM is apparently poised to join the European chip R&D consortium JESSI; in return, it is expected that Philips, Siemens and SGS-Thomson of Europe will join the US chip R&D consortium Sematech.

American/Japanese links are proliferating with Motorola/Toshiba, Texas/Hitachi, Intel/NMB, and AT&T/NEC.

Clearly, if European R&D consortia can pool resource and information, then it would be a short step to widening that pool of information and resource to include Japanese R&D consortia like Sortec. That would leave only Korea and Taiwan as significant independent chip producers and it is extremely unlikely that they would not join up as well.

The net result would be a world-wide pooling of resource for chip R&D. If that is to be the destiny of the chip industry it would take away the issue of process technology as an element in a chip company's competitiveness. Companies would compete on the service issues while the intellectual issues of radical innovation or design breakthroughs would be the province of small teams or individuals.

With R&D undertaken on a global basis, and the intellectual issues addressed on a personal basis, the marketing could be carried out on a "managed trade" basis. That means fixed prices and agreements that each economic block - Japan, US, EEC - has to buy the same amount of semi-conductors as it sells.

Already we have seen examples of this with fixed prices under the "fair market value" system put in place by the US/Japan trade pact and the "reference price" recently established by the EC and an agreement that the US share of the Japanese semiconductor market should be allowed to rise to 20 per cent.

There is a snag to all this regulation, price-fixing and management by big companies and Governments. The snag is that in some cases small organizations do a better job than large ones. It is frequently observed that the small chip companies of Silicon Valley are more innovative than large chip firms.

Nineteen years ago Intel was a three-year-old 250-man company that had just invented the DRAM, the EPROM, the SRAM and the microprocessor and had got the MOS process to work three years before anyone else could - the greatest record of innovation in the history of the chip industry.

It could be that whatever big business and Governments decide will be subverted by the ability of small firms to produce better products than big firms and to sell them on a "free trade" basis anywhere in the world.

It is possible that the old struggle in the chip industry between the successes of human creativity when allowed free expression, and the failures of big business when it tries to control creativity in order to profit from it, will continue to be waged as fiercely as ever. (Source: Electronics Weekly, 14 March 1990)

Waiting for the massive media event

It takes new technologies years to find their way into commercial products - or so wisdom has it. For the cd-rom this is certainly the case.

But by the end of this year these storage devices will be an increasingly common part of PC systems, driven on by declining prices and sophisticated multimedia applications.

At the recent Fifth International Cd-rom Conference in San Francisco experts predicted cd-rom drives to fall in price to as low as $300 by the end of this year. Several major PC manufacturers have plans for low priced PCs with inbuilt cd-rom drives bundled with multi-media applications.

The technology allows a conventional sized compact audio disk to contain over 600Mb of data in the form of sound, graphics and text. The data is read by cd-rom drives, many of which can do double duty and play compact audio disks.

Up until now, there have been few cd-rom based applications and drives have cost as much as $1,200 each. But that is about to change.

Microsoft has licensed a product called Director 2.0 from Macromind. This will allow a future version of Microsoft Windows to run multimedia applications designed for a Macintosh to be played on an IBM PC or compatible. This opens up larger markets for developers producing cd-rom based multimedia applications by reducing the risk of having to choose either to develop applications for Macintosh or IBM PC users.

A basic multimedia platform would consist of an 80286 running at 10 MHz or faster with high resolution graphics, 2-Mb of memory, hi-fi audio capability, 30-Mb of hard disk, floppy drive, cd-rom drive, a mouse, a midi port and keyboard. All this for under $2,000.

Sources close to Microsoft report it is working with Fujitsu to bring into the US a low priced 80286 based PC with an inbuilt cd-rom drive. Microsoft has already developed a special version of its MS DOS operating system that is designed to support the drives.

One of the first companies to license the operating system is Headstart Technologies, a US subsidiary of Philips. Headstart plans to sell a low priced PC with a cd-rom drive, hard disk and high resolution graphics. It will bundle this with a large amount of multimedia applications for less than $2,000.

Fujitsu already sells a multimedia PC in Japan, but it is incompatible with US standards.

Intel is planning interactive digital video which promises full motion video and animation in multimedia applications. DVI has the support of Microsoft and IBM and competes with a different type of technology called compact disk interactive, which is being developed by Philips and Sony. By the year 2000 Intel says its chipset will be incorporated into the microcode of a general purpose microprocessor. This means all standard PCs will have inbuilt multimedia capabilities.

Apple, which has tried to get the multimedia market jump-started for several years, did not announce any major products, but says it is cutting the price of its cd-rom drive by 25 per cent to $899. The Apple CD SC has been one of the highest priced cd-rom drives on the market and has been unpopular because of reliability problems. Apple's multimedia plans seem unclear. Its Multimedia Laboratory, which has produced interesting experimental multimedia projects, is reported to be operating with a skeleton staff and no new projects are reported to have been planned.

Sony introduced a system that allows users to produce their own cd-rom disks from a desktop system. For about $30,000, large corporations will be able to produce their own disks. Sony says the system will be available in the second half of 1990.

While the conference had fewer major announcements than in previous years, the industry seems to be holding its breath to see if 1990 is the year of the cd-rom.

Market research company Dataquest thinks it will be and predicts drive sales will be much better this year thanks to systems like the Headstart PC.

What is still missing are multimedia applications that will captivate people and persuade them it is worth upgrading their PCs with cd-rom drives or even worth buying one of the new multimedia systems.

Technological advances are helping to bring down the price of multimedia systems to a level where they are affordable to a much wider number of customers. This larger potential market should encourage a welter of applications from innovative developers.

Although 1990 may not be the year cd-rom drives and multimedia applications become a standard part of PC systems, the time cannot be far away. (Source: Computing, 29 March 1990)

Company News

Siemens chips in on IBM's 64-Mbit plan

IBM has teamed up with the last surviving European memory chip maker, Siemens, to develop a 64-Mbit memory chip.

Intel has also made a memory chip deal, but with Japanese manufacturer NMB Semiconductor. This deal will allow Intel to buy chips from NMB and sell them to US computer makers.

Both projects follow the collapse of US Memories, a consortium of top US companies seeking to win some of the dynamic random access memory chip market back from the Japanese.

In 1989 Japan held 66 per cent of the world market, which was valued at $9,300 million according to market research company Dataquest.

The joint venture between IBM and Siemens plans to go into live production by the mid-1990s. Dataquest says the partners could have to spend $7,000 million to design a 64-Mbit chip, build a factory and eventually market the product.

Observers say the project could let IBM into Europe's JESSI (Joint European Submicron Silicon) project. The JESSI members, Siemens, GEC, Plessey, Philips and SGS-Thomson, have been unwilling to include US companies because European manufacturers have been excluded from US projects.

Intel, another member of the ill-fated US Memories venture, is to be the major shareholder in a new company, Intel/NMBS Drams Fabrication, which it is forming with NMB Semiconductor.

NMB had a 3.1 per cent share of the world market in 1989, with sales of $280 million. Most of its business was in North America. Its manufacturing process was bought from Inmos when the European company retired from the memory chip market. (Source: Computer Weekly, 1 February 1990)

Four down - sixteen to go

The production of 4-Mbit DRAM devices started according to schedule in the last quarter of 1989 at the Siemens Neuperlach facility in Munich, Federal Republic of Germany. Production of this device will be ramped up this year both at Munich and at the Siemens facility at Regensburg.

The technology for the high density 4-Mbit DRAM chip is based on 0.8 μm design rules (a human hair is 50 per cent thicker) with a chip size of 91 mm^2. It includes three-level polysilicon, a titanium/titanium nitride barrier, and a trench cell capacitor. Each trench cell stores one bit, the total storage capacity being equivalent to 250 typed pages which can be read in under a second.

The Siemens 1-Mbit DRAM, which preceded its 4-Mbit device, is now in full scale production at the Regensburg facility. About 20 million units were produced in the fiscal year ending September 1989. During the current financial year production may reach 43 million.

Success in the 1-Mbit DRAM project led Siemens to commence working on the design of a 16-Mbit DRAM in 1988. In the following year test batches proved the viability of the 16-Mbit trench cell concept and the two level metallization design. Production of this 16-Mbit DRAM is scheduled to commence in the last quarter of 1992. The first products will have a chip size of 142 mm^2 - this is little more than a 50 per cent increase in chip size over the 4-Mbit devices for four times the memory capacity.

As the 4-Mbit DRAM cell was shrunk for the 16-Mbit design, isolation of the diffusion areas around the trenches became a serious problem, since distances from trench to adjacent trench and from trench to active areas are in the range 0.7 μm to 1.0 μm. A highly doped p-well could improve the isolation of trench diffusion areas, but this would be at the expense of the transistor performance. In addition, there would be a limitation of the trench depth owing to the need to make the p-well concentration at the bottom of the trench adequate to avoid punch through.

These problems are being overcome by the Siemens research facility in Munich which has developed a 16-Mbit DRAM cell based on a stacked capacitor. This capacitor is located in an isolated trench using a three dimensional cell structure. The storage node of the capacitor consists of an arsenic doped polysilicon spacer in the trench connected to the source of the transfer gate by a buried trench contact.

One of the main factors controlling the choice of 16-Mbit DRAM cell technology is the need to obtain sufficiently small leakage. Siemens has shown that its "Super Shrink Trench Cell" is a viable 16-Mbit DRAM candidate so far as leakage limitations are concerned. (Source: Electronics Weekly, 21 February 1990)

Siemens Nixdorf link

A long-awaited restructuring of Europe's computer industry began with Siemens taking control of Nixdorf, its compatriot computer maker.

Siemens has taken a majority stake in Nixdorf and the two companies are pooling their computer businesses into a new joint venture called Siemens-Nixdorf Informationssystems. Siemens' move creates the second biggest computer maker in Europe with annual European computer sales of around DM 12 billion (£4 billion), exceeded only by IBM.

Many expect the shake-up in Europe to continue with pressure mounting on British electronics group STC to do something with its ICL computer off-shoot, while Olivetti of Italy and France's Groupe Bull look around for partners to help them survive in an increasingly cut-throat market.

More consolidation will almost certainly happen, but the pressures forcing Europe's computer makers to come together have little to do with what happened.

Nixdorf was in trouble and it needed help. Sales were growing but lax management had allowed costs to go out of control. Profits which peaked at more than DM 300 million (£100 million) two years ago, have collapsed with the company turning in an estimated loss of at least DM 600 million (£200 million) and possibly as much as DM 1 billion (£330 million) last year.

Siemens motives for coming to the rescue are less clear. Siemens gains very little new technology and few in-roads into new markets. Analysts point to the fact that Siemens' computer business is slanted towards large mainframes and that it is not so strong in minicomputers and personal computers (PCs) which is Nixdorf's speciality.

Furthermore, Nixdorf does not give Siemens access to any major new geographical markets. Indeed, most of the newly merged company's sales will be in the Federal Republic of Germany and are heavily biased towards the banking and retailing sectors.

The most likely explanation for Siemens' action is that it wants to bag up a large chunk of the domestic computer market for itself and block foreigners from getting a toe-hold by picking up Nixdorf.

However, the move has put consolidation of the European computer industry firmly on the agenda for 1990. In particular it has renewed speculation about the future of Britain's ICL, owned by STC. A merger or partnership could allow it to boost profits by sharing research and manufacturing costs and increase sales by gaining access to new markets. The most frequently mentioned suitor for ICL is Olivetti.

Around half of ICL's revenues and half its profits come from mainframes. But these profits are put at risk by the increasing power of microprocessors and the emergence of standards such as the Unix operating system. These are bringing the low-margin commodity economics of PCs into minicomputers and will soon affect mainframes.

Accordingly, ICL is moving away from its reliance on mainframes in particular and hardware in general.

Its hardware offerings are moving towards microprocessor-based Unix systems which range from desktop workstations up to multiprocessor machines with mainframe-like power.

ICL's software and service business is growing fast and is likely to be more profitable than its hardware business in the long term. This will increase the pressure on the company to rationalize its hardware business by finding a partner to share the burden; a job that should be easier now that the product line has been revamped.

Which is exactly what is happening to another UK computer company Apricot, not called ACT. Last week, the company revealed plans to separate its hardware-making operation which keeps the Apricot name from its expanded software and services business. ACT is now looking for a partner to take a stake in the Apricot computer making business.

But whatever UK and European computer makers do to re-organize themselves, the real battle for control of the world's computer market is being fought out between the Americans and the Japanese.

So maybe Siemens' attempt to close up the drawbridge and shut out foreign computer makers is not such a dumb move. (Source: Electronics Weekly, 17 January 1990)

Memory chips

Everywhere, big chipmakers have joined up with foreign rivals to design, make or sell the chips called dynamic random-access memories (DRAMs).

American and European techno-nationalists have long been obsessed with Japan's control over the supply of DRAMs, an essential component of most sophisticated electronic gadgets.

Nobody thinks that the Japanese will cease to be big in the DRAM market. But for the first time it looks as if Japan's domination of the market at the end of the 1980s may have been a fleeting episode in the history of electronics.

The most recent cross-border deal to be struck is between Intel of California and NMB, a subsidiary of Japan's largest maker of miniature ball bearings, Minebea. NMB is a newcomer to DRAM production and the company has had trouble marketing and distributing its high-quality chips. NMB needed a partner to reach its customers. Who better than Intel, America's largest independent chipmaker?

In exchange, Intel, which quit the DRAM market during the semiconductor recession in 1985, has gained exclusive rights to sell NMB's memory chips, cushioning the company and its American customers against shortages of DRAMs even if Japan's biggest DRAM producers cut back output.

Challenges to Japan's biggest chipmakers are also coming from South Korean companies. Samsung, Lucky Goldstar and Hyundai have been piling on capacity. According to Dataquest, sales of Korean-made DRAMs grew by almost 80 per cent between 1988 and 1989 while the market grew by 36 per cent. Samsung's DRAM sales almost quadrupled, to over $1 billion between 1987 and 1989.

All this extra DRAM capacity has pushed down the price of memory chips spectacularly. The biggest Japanese producers have two options: leave their new competitors behind by leaping ahead to the next generation of DRAMs or make more valuable chips such as microprocessors, whose price is less volatile.

Neither strategy will be easy. American companies have a strong edge in microprocessors (one reason why Toshiba was willing to swap its DRAM technology for access to some of Motorola's microprocessor knowhow). Leaping ahead to the next generation of DRAMs will be colossally expensive. Designing and manufacturing the new four-megabit DRAM will cost each company some $2 billion. The cost for each succeeding generation could almost double, while the period between generations will shrink to three years. The current world market for all types of DRAMs is worth less than $10 billion in annual sales. Japanese companies are often willing to invest so heavily because, as manufacturers of electronics and computer gear, they themselves are big consumers of DRAMs.

But with such vast sums at stake in a cyclical market, even the investment-happy Japanese need to reduce their risk by finding partners.

That is why Hitachi joined up with Texas Instruments to design the next generation but one, the 16-megabit DRAM. Even the world's largest chipmaker, IBM, announced at the end of January that it would collaborate with Siemens on the generation after that, a 64-megabit DRAM which should come into production around 1995. Both these partnerships could become permanent memory-chip double-acts.

Ironically, one recent all-American collaboration to make memory chips failed even before it got off the ground.

Memory chips are consumed all over the world. There is little reason for them not to be designed, made and marketed by companies all over the world too. For example, NMB, Intel's new partner, bought the designs for its first memory chip from Inmos. NMB is Japanese. Intel is American. And Inmos? This obscure little company was born and bred in the UK. (Source: The Economist, 3 February 1990)

IV. APPLICATIONS

Tapeless recording systems

Tapeless recording for recording sound allows engineers quick and accurate access to any part of a recording. The technology also allows for manipulation of each sound. Tapeless recording systems (TRS) use a combination of RAM and hard magnetic disk. TRS is now being used in recording, editing and in live performances. In editing, for example, a single note can be replaced with perfect accuracy (when a singer needs to redo a single high note, for example). Rewinding tape and splicing in a single note would be very difficult. Overdubbing with TRS also does not cause any degradation in the tape. With TRS, a single sound can also be altered slightly and overdubbed, so that, for example, a single voice can be made to sound like a choir. TRS can also be used to link digital sound to other signals, as in the film "Who Framed Roger Rabbit", when the music is linked to switches to operate the keys of two pianos. Background music for live performances can be controlled from backstage to match the action on stage in a way not possible with taped sound.

New England Digital's Synclavier tapeless system allows sound from a band or singers to be recorded and then controlled by a single performer from a keyboard or guitar. There is always the risk, however, that the disk drive will break down (or be stolen) or that the data stored on disk will be erased. (Extracted from New Scientist, 6 January 1990)

Counterfeiters find a new tool: the personal computer

Police discovered a trove of high-technology gear at a private home in Vicksburg, Mississippi that included a document scanner, a laser printer, an IBM-compatible computer and a disk filled with digitalized cheques, drivers' licences and department store IDs.

The counterfeit case, which is pending in two state courts, may be the most elaborate and costly example yet of a new form of fraud: desktop forgery. Using the methods of desktop publishing, desktop forgers can cheaply and easily create official documents that are virtually indistinguishable from the real thing.

The technique is remarkably simple. First, the forger uses an optical scanner to turn a legitimate document into a digital image stored in the computer's memory. Then, using a so-called paint program, which is an electronic version of an artist's drawing kit, he alters the image to suit his purposes - for example adding zeroes to the dollar amount or deleting the payee's name and substituting his own. Finally, the altered document is printed out on a laser printer or, for best results, on a professional typesetting machine.

According to James Cavuoto, editor of Micro Publishing Report, based in Torrance, California, and author of a new study that describes the scope of the problem and offers tips for detection, desktop forgers can doctor a wide range of documents: passports, birth certificates, immigration cards, stock certificates, credit-card receipts, purchase orders, drug prescriptions and letters of reference. Academic transcripts are particularly susceptible because college students have easy access to the necessary equipment.

There are plenty of ways to defeat the desktop forger. The Standard Register Company in Dayton, for example, sells a complete line of aids, from artificial watermarks that can be seen from an angle but are invisible to document scanners, to specially treated paper stock that, when tampered with, displays the word VOID in English, Spanish and Latin. But the counterfeiters do not seem daunted. A man in Boston used computer-faked cheques and purchase orders to buy computer equipment. A couple in Phoenix made the rounds of the local liquor stores and cheque-cashing agencies with phony cheques stamped with a variety of corporate logos. And late last year political activists in California distributed some 2,500 copies of the Los Angeles Times wrapped with a fake front page. One "article" criticized US involvement in El Salvador, and another column apologized for the Times's news coverage of events there. (Source: Time, 26 March 1990)

PC security

As far as most personal computer users are concerned, the basic aims of computer security are usually quite simple: to prevent the computer being stolen, to prevent access to the computer by any unauthorized user, to ensure back-ups are always available for program files and data files, and to ensure that confidential data is available only to authorized users. This list can be extended according to circumstance.

All floppy and hard disks have finite lives. Unfortunately, it is all but impossible to predict exactly when a disk will begin to show errors. The only rational solution is to store multiple copies of all important files.

Utility programs are available which offer back-up facilities far superior to those normally provided with the operating system. For MS DOS, the best of these are probably Fastback Plus and the back-up utilities in the PC Tools package.

All important files should be backed up to floppy disk daily - more frequently if they have been radically altered. Hard disk storage should not be viewed as permanent. A complete back-up copy of the hard disk should be taken every week. This can be used to reload the structure of the hard disk content in case of hardware failure.

Other security measures, like always locking the PC when not in use and hiding the key, or putting away a portable computer in a secure place, seem almost too pedestrian to mention.

However, the fact that they are so obvious means such precautions are all too often forgotten. Locking your PC should become as much of a habit as locking your front door.

Always lock up a portable computer in a secure place when it is not in use. It sounds stupid, but many thefts of portable computers are performed simply by picking up the computer from a nearby desk and carrying it away. For a desktop computer, simple physical measures can help to prevent theft. Many companies sell cable and lock systems which attach to the keyboard, the monitor, the processor unit and the desk at which the computer is used. They prevent the hardware being carried away. Without a movement alarm, there is of course nothing to prevent a determined thief removing the desk and the computer together, but this is likely to be too conspicuous in most environments.

Improvements beyond these basic steps all cost money. Available security products can be split into two distinct types: those that are purely software based, and those that require some special hardware. The classic image of PC security is of a plug-in card which controls access to the PC, and ensures that disk files are stored in encrypted form. Such facilities can prevent a computer being used by unauthorized people. A processor on the plug-in card can ensure that software executing on the PC is not permitted to access the security features, and amend them or bypass them. Such hardware-based security products cost much more than £100. (Extracted from Computing, 15 March 1990)

IBM's CIM products

IBM has introduced wide-scale computer-integrated manufacturing (CIM) products under the name CIM Advantage. They use a new CIM architecture and cover more than 50 software and hardware products that were either developed by or for IBM. It allegedly encompasses all industrial operations processes, including CIM data integration, data communications, engineering systems applications, and factory and process operations. Components of the system include the CIM Communications and Data Facility (CIM CDF), which supplies data management, and the 6090 Graphics System, for CAD/CAM applications. Another component is the Plant Floor Series, which includes PlantWorks, an application enabler, and PlantControl, which supplies continuous flow manufacturing management. (Extracted from Control and Industry, December 1989)

Flat screens

The flat-panel displays used in laptop computers today and in the picture-thin television sets of tomorrow are changing their spots. The panels themselves have suddenly become bigger and brighter and their picture elements ("pixels") vividly coloured. When it blossoms, the market for these inventions will be dominated by Japan.

For the past two years Japanese manufacturers have been perfecting 10-inch colour panels based on a new version of the old liquid-crystal display (LCD). First used in calculators and watches in the 1970s, LCDs have a material trapped between two layers of glass that flips from being a transparent liquid to an opaque solid whenever a small current is applied.

The best thing that can be said about LCDs to date is that they use little power, making them ideal for portable devices. To make them more readable, manufacturers have been embedding tiny lights behind the screen; some have even added filters to give the impression of colour. But the laptops with coloured screens that have been launched recently by Fujitsu and NEC are the final fling of an older type of LCD that offers 8-16 murky colours. The new "active matrix" LCDs give a picture that is pin-sharp and bright, and painted from a palette of 256 colours, like a conventional television set. Sharp and NEC have both announced plans to go into full production. The first of Japan's new colour LCD plants will be in full swing later this year.

The new active-matrix versions, with their much brighter and more colourful displays, are aimed at bigger markets - from laptop computers and fax machines to portable videorecorders and television sets. In five years the 40-inch flat television set could at last be hanging on the wall. By then, annual sales of full-colour LCDs could reach over $7 billion.

Japanese electronics firms are expected to have at least 70 per cent of the market, for one simple reason. They have an arm-lock on nearly all the underlying technologies. Making active-matrix LCD panels is similar to mass-producing large-capacity memory chips, only trickier. Western firms that have had trouble matching Japanese chipmakers will be even harder pressed to meet their prices for LCDs. Japanese firms are also benefiting from two big Government projects. A $20 million programme sponsored by the Ministry of International Trade and Industry aims at learning how to manufacture a full-colour LCD screen with 6 million pixels - i.e., one big enough for a flat 40-inch HDTV (high-definition television) set. The Ministry of Posts and Telecommunications has a $24 million industrial programme to develop a tiny HDTV projector.

Potentially, active-matrix LCDs are no more expensive to make than the other flat-panel displays, but they are still twice the price of the cathode-ray tubes used in television sets. However, they are far less bulky and need just a fraction of the power. The only other flat-panel display that comes close in performance is the beam-matrix design - a cross between an LCD and a squashed cathode-ray tube - which was developed by RCA in America and refined by Matsushita in Japan. But squashed tubes are inherently more difficult to make and are not as sharp as the active-matrix LCDs. Once the latter are in production, their price is expected to fall dramatically. A 10-inch colour panel today costs over $1,700; within five years, say Japanese manufacturers, it will be $250.

Though similar in many ways to a big memory chip, making an active-matrix LCD is a good deal more difficult. For a start, the device has a glass base instead of a silicon one. The techniques used by semiconductor makers depend on cooking their silicon chips at 1,000°C or more. That would melt the LCD's glass base and fry most of its components. Also, the biggest "wafers" of silicon used for making memory chips are only 6 inches in diameter; these are later diced up into hundreds of individual chips. The new generation of LCD panels will need to be made one at a time on sheets of glass that are 10 inches wide.

Between them, Japan's top LCD suppliers spent around $400 million last year on tools for making the new colour LCDs. This year industry watchers expect them to pour a further $550 million into manufacturing equipment. (Source: The Economist, 17 February 1990)

Realizing CASE's potential

Structured methods for systems development were first conceived in the late 1960s as a way of improving productivity for programmers. It was not until the mid-1970s that the innovators began addressing the more complex areas of requirements gathering and analysis with any success. It was even later, in the early 1980s, that papers were published detailing practical strategies for applying these techniques for large and complex systems, throughout the whole development life-cycle.

CASE tools were first developed in the late 1970s as single user stand-alone analyst workbenches and were really no more than diagramming tools.

Now, the latest generation of CASE tools are more sophisticated multi-user, integrated systems with powerful checking facilities and code generation functionality.

It is this latest generation of CASE tools that have put paid to the critics who refuse to accept the new concepts.

We must consider why that, with the advent of CASE, so many views have been changed in favour of structured systems development.

First and foremost, today's structured techniques aim to produce cheap, and thereby easily dispensable, models of the real system without having to go to the expense of producing the real thing and only then finding out that it fails. CASE tools help us to deal with models that represent the large distributed systems that are being developed nowadays; but that is all they do.

Exponents of structured techniques have quite a job convincing users, during the early life-cycle phases, that the models do in fact truly represent their system and that there is no need to worry that coding has not yet started. Developers have to convince the users that there is no need for the physical, high-tech representation, until much later on.

It is an interesting irony that the very thing that has made structured techniques universally acceptable is the advent of the automated tools to support the models that are produced.

What the developer must do is to remember that while the CASE environment will provide a number of excellent advantages over the pencil and paper method it must be seen as the tool and not the method.

Unless a formalized structured approach is adopted in the development of a system then that system will ultimately fail. A development fails when key expectations are not met. Everyone involved in the development of a system will have expectations, however intangible. The project manager has the unenviable task of disproving the old saying that tells us that "you cannot please all of the people all of the time". A structured approach, giving detailed models, representing real life occurrences, might and if it is a really big system, it will help to use a CASE tool.

It is important that an organization standardizes the format of these specifications so that training and guidance can be given and the job of communicating with interested parties is made easier. To make this easier we can employ a CASE tool to support these models and standardize their format. But, we should be sure that we do not just produce models in a certain way to match what our CASE tool will accept, because if there is a better representation, then we must find a tool to support it.

Some people think that it is the use of CASE tools that will speed up the process of systems development and give us better quality systems. It is the structured approach that gives us the radical improvements in quality and productivity. CASE tools will add a further factor of improvement for large systems, but a small factor in comparison.

A system development effort should also include the post-implementation costs of maintenance. For unstructured system developments this is often as much as 80 per cent of the overall cost. Structured developments come out at about 20 per cent and this is bearing in mind an equal pre-implementation effort for both developments. This benefit is mainly due to the way in which the system is broken down into maintainable, reusable components. CASE tools do not currently help much on these concepts, it is down to the application of method.

It is essential that an organization has a single rigorous structured development methodology, integrated within a CASE environment and that comprehensive standards define how these tools and techniques can be used throughout the entire development life-cycle.

The tool is the method's servant and although it is powerful, it still serves, not masters. (Extracted from Computing, 8 February 1990)

Traffic control

Rain, roadworks, breakdowns and sales all affect the movement of traffic through the UK's towns and cities.

The delicate balance between free-flowing traffic and traffic jams is maintained by a series of control systems. The simplest are the controllers in boxes by the side of the road near traffic lights which record impulses from sensors in the road detecting the passage of vehicles and use this information to change the state of the traffic lights they control.

Before computers became available this was the most sophisticated form of control but in the 1960s the wider use of computers enabled traffic lights and controls to be monitored on an area basis. The control boxes were used to transmit information to a central control office and received instructions in return.

The technology moved quickly so that, within a few years, whole cities were controlled by computerized systems.

One approach was to analyse traffic flows and arrive at a set of weighting factors which optimized flow through the city under different conditions. Typical situations would be the morning rush hour, the evening rush hour, mid-day, evenings, etc. The traffic control staff selected the appropriate scenario and the system took over from there.

Since then, the main developments in area control have been to make the algorithms more adaptive, to take account of the million and one changes that can affect the traffic in a large city.

Other advances have been in the control room itself, using displays to give operators an up-to-the-minute picture of events, and making it easy for them to modify the operation to take account of emergencies. Some of the systems that were installed nearly 20 years ago are still in operation.

At about the same time as these early control systems were being developed, motorway signalling schemes were being installed.

Today developers are trying to improve these systems by giving the motorists more information and increasing the integration between the collected data and the control mechanisms.

An idea some local authorities are looking at is computerized road pricing in towns and cities. These systems have detect sensors in vehicles, and generate a charge according to the time of day, the area concerned and a number of other factors. The aim is to make it so much more expensive to drive through areas of major congestion that you take alternative routes instead.

Plessey installed such a system in Hong Kong. It was technically a success, but raised a number of political problems.

An alternative which has been considered is to use a smart card in vehicles, which gets debited by different amounts according to signals received as you travel. But this raises other problems.

While such a system is feasible in Hong Kong, it is a very different matter when considering the same approach for a city like London.

For a start, the sheer scale makes it unlikely to be economic. There are countless routes in and out of London and they would all require some form of sensor to be installed. Add to that the division into areas within the main boundaries and how to make sure that every vehicle has a sensor and an account, or how to cater for visitors and tourists.

The most likely method to tackle a traffic problem like that in London would be to use computers to read number plates. There are already image processing systems which can identify car numbers from photographs and it is only a matter of time before the process is good enough to pick out blurred and muddy number plates.

Money is already being spent on developing traffic control systems which route vehicles around congested areas. A contract was awarded last year to a consortium of GEC, Logica, the RAC and W. S. Atkins for a pilot autoguide system in London.

The consortium's system requires the motorist to key the destination into a unit on the dashboard, these data are relayed to a central computer. The computer notes the motorist's position and advises on the quickest route to the destination. Because the computer is continually monitoring progress, using radio beacons, it can constantly update its route data base with actual journey times and route traffic round obstructions.

The prices of this type of system are likely to be of the same order as car phones are today, with an expected price of £250 for the dashboard unit and £50 per year for a subscription to the service. The scheme should be operational by 1993 and may be the start of a multi-million pound market for in-car information systems.

There was strong competition for the contract from a consortium of Plessey, Siemens and the Automobile Association. They may yet win a contract for another pilot scheme, possibly outside the boundaries of the M25. Siemens has installed a pilot scheme in Berlin.

The benefits of the Autoguide scheme have been investigated by the Transport Road Research Laboratory by analysing routes actually taken by drivers, and then calculating the time they would have taken if they had used the "best" route. The expected gain is typically in the range of 5 to 10 per cent. This may not sound much, but it can take two hours to cross London in the rush hour, so a saving of even 5 per cent is a help. More to the point, it may reduce the amount of traffic by the same amount. If so, it may have a knock-on effect as delays can increase dramatically for a relatively small increase in traffic.

So far, all the different systems have been installed in more or less independent entities. The really interesting developments in the future may lie in the integration of the various systems. Sussex University has used artificial intelligence techniques to develop an automated Traffic Information Collator.

In each case, the messages are interpreted by a message analyser, which passes them in a pre-defined form to an incident recognizer. The message analyser has to cater for abbreviations, jargon, incorrect grammar, unknown words and misspellings. The incident recognizer creates a data base of incidents and uses rules to assess relationships between messages and decide which ones relate to existing incidents.

Another module, the tactical inferencer, assesses the incidents, decides on their likely effect, duration and area, and passes the information to the broadcaster module which handles the business of generating the warning messages.

It seems likely that such techniques will be used in future to link the various disparate systems together. Initially, police messages would be interpreted and passed to Autoguide, area control systems and motorway signalling systems, as well as RDS. Autoguide and area pricing systems could, in turn, pass data to the area traffic control systems and a security system could request a police interception at the next motorway turn-off.
(Extracted from Computing, 15 February 1990)

Storage

Digital audio tape cassettes, able to store one Gbyte of data, could be ideal for users' back-up requirements. Keith Jones explains the advantages of dat and charts its progress from audio luxury to IT workhorse.

As the storage capability of 5 1/4-inch fixed disk drives approaches the one Gbyte level, users of workstations, file servers and small systems start to need back-up technology to match this capacity.

The user requirement is for a back-up device onto which a Gbyte or more of data can be dumped from disk, preferably overnight in unattended mode.

A growing line-up of storage product vendors are offering solutions to this problem in the form of drives that can record at least one Gbyte onto a compact, low-cost digital audio tape, or dat, cassette. To give an idea of its size the tape inside the cassette measures less than 4 mm across.

The cassettes cost little more than about £10 each and measure 2 x 3 x 3/8 inches.

As well as being smaller and cheaper than the well-established 1/4-inch cartridge back-up medium, dat cassettes can hold much more data - four times as much as cartridges conforming with the QIC320 specification and nine times the amount held by QIC150 cartridges.

The big drawback with dat is not the cost of the tapes, but of the drives.

The biggest endorsement for dat so far has been an announcement from Digital Equipment Corporation in November 1989 that it will offer dat technology for unattended back-up with its small systems, including work-stations, file servers and small multi-user machines. Availability will start in mid-1990.

Attractions of dat drives listed by DEC include ruggedness and reliability as well as the potential for future size reduction.

DEC supports a format for recording data on dat cassettes called Digital Data Storage, DDS, which has been developed by Hewlett Packard and Japan's Sony.

About 18 months ago an alternative format called Data/dat was defined by a group of vendors led by Hitachi. The biggest difference from DDS is Data/dat's support for rewriting random groups of data, a facility referred to as update in place.

HP launched a 5 1/4-inch DDS drive in May 1989. Designated the HP35450A, its streaming data transfer rate of 183 Kbytes per second can back up 1.3 Gbytes in less than two hours. It comes with a SCSI interface and HP quotes an uncorrectable error rate of less than one in 10^{15} bits.

HP also sells two complete DDS subsystems for use with its own computers, the 1300S with an SCSI interface and the 1300H with HP's own HP-IB interface.

Sony Europa at Staines announced a 5 1/4 inch DDS drive for the SDT-1000 in November 1989. (Extracted from Computer Weekly, 22 February 1990)

V. COMPUTER EDUCATION

Electronic classrooms

Long familiar to readers of science fiction and technology hype-reporting, the electronic classroom has for the past two years been a reality to students at the University of London. It is, unsurprisingly, rather more mundane than the fantasy suggests. Indeed, it has so far turned out to be almost exactly like the classrooms in which generations have learnt and dozed.

The University of London is in many ways a perfect testbed for the electronic classroom. It is composed of 14 colleges, scattered across London and surrounding counties. Each college sets the curricula for its own degree courses, and teaches them largely with its own faculty. The university's experiment in electronic learning, an advanced video-conferencing network called LIVE-NET, helps the colleges to enjoy the benefits of membership in the university and retain their independence.

Given its potential consequences, LIVE-NET is a relatively cheap experiment. Developed jointly with British Telecom LIVE-NET cost about £1 million ($1.6 million) to set up, and £60,000 a year to run. It has so far been taken up most enthusiastically by those lecturers and members of university committees who would otherwise have had to spend long hours shuffling between one college and another.

LIVE-NET's developers have concentrated on making the technology simple and unobtrusive. Though many video-conferencing systems require special studios, LIVE-NET's cameras and monitors can be set up along the wall of a normal classroom. Professors teach a roomful of live students, but other roomfuls can listen in. Fibre-optic links with a capacity equal to about 30 conventional telephone lines carry signals between seven sites in London and the suburbs. Each classroom both sees and hears all the others.

Clever central switching allows, for example, two sites to participate in a faculty meeting while the other five are linked into a class on metamorphic rocks. But the screens can also carry things which are hard to display in a standard classroom.

With such basic technology working, LIVE-NET's developers are ready to go further. One idea is to link with other European universities via the Olympus telecommunications satellite. Another programme is looking at electronically linking classrooms in America and London. A third idea is to use LIVE-NET's computer links to deliver pictures of things that can be seen nowhere on earth, nor in space.

Combining clever computing graphics with advanced modelling techniques has opened a new field called scientific visualization. Many of today's students have already watched computer-created simulations of what a rotating four-dimensional cube might look like, or of how molecules interact in chemical reactions. Electronic links to the expensive computers which perform such tricks - such as the links offered by LIVE-NET - might let tomorrow's students manipulate those simulations instead of just gawping at them from afar. (Source: The Economist, 31 March 1990)

INRES-South to involve users closely

Most INRES-South data comes from registration forms which are available at all offices of the United Nations Development Programme (UNDP) or from INRES-South in New York. Other UN and intergovernmental organizations contribute additional data from their own data bases.

INTERMAN, the International Management Development Network, which is based in the International Labour Organisation (ILO), provides information on training programmes in management.

The training branch of the United Nations Industrial Development Organization (UNIDO) provides information on industrial training programmes in developing countries, while INRES will maintain the data bases on industrial training on their behalf. The INRES-South data base is therefore particularly strong in these two fields.

The number of institutions registered with INRES-South is about 5,000. The number of requests for information and data base inquiries continues to grow, and now exceeds 100 a month.

Among the main users of INRES-South are institutions or firms in developing countries, which use the referral service to identify potential partners for co-operation, and Governments wishing to identify qualified contractors for their development projects. The UN Development System, in particular the Food and Agriculture Organization (FAO) of the UN, uses INRES-South to identify developing country contractors in technical co-operation projects or to locate institutions offering appropriate training programmes.

Others use the service as a source of data on partners in technical co-operation among developing countries or other information networks. Some field offices of UNDP report that INRES-South has become their main source of information on the training and expertise available within their own countries. Governments also use INRES-South information in preparing documents on the technical co-operation capacities of their country. More important is the fact that many inquiries now originate from organizations that deal with technical co-operation.

A selected number of UNDP field offices will be provided with microcomputers equipped with the data base. They will take responsibility for processing inquiries that might come from government departments, Chambers of Commerce and Industry and non-governmental organizations (NGOs). Collaboration with UNDP units that have shown an interest in using the INRES-South data base will be intensified. The objective is to have the data base directly accessible to the Office of Project Services, UNDP's NGO Division and staff of the United Nations Development Fund for Women.

Increasingly, INRES-South will perform the role of a true information referral service and even go beyond this, becoming an intermediary between the user and supplier of training and expertise. In doing so, INRES will rely not only on its own computerized data base on the capacities of developing countries, but would also use information made available from other data bases and networks dealing with the needs of the developing countries.

VI. SOFTWARE

Neural networks tool

Berkshire Software Company (Lynbrook, New York) has introduced Neuralog, a development tool for neural networks. The tool, written in Borland's Turbo Prolog, runs on the IBM PC or compatible. It can be used for education and training, research and exploration, or for development of neural network programs. Neuralog uses the back propagation algorithm. It requires at least 256 Kbytes of RAM and a dual-sided floppy disk drive. (Extracted from Computer Data, January 1990)

Japanese neural software

Toshiba hopes to develop neural software to operate in the highly complex Japanese language. A prototype word processor developed at Toshiba would be able to distinguish various homonyms, which have the same pronunciation but different meanings. Written Japanese uses three scripts. The two phonetic scripts (kana) each have 46 characters, but the kanji alphabet has several thousand characters, borrowed from Chinese. Telegrams use only the phonetic scripts, but even these can be ambiguous. Existing word processing machines use kana characters, and if the characters spell out a word for which there are kanji characters, those appear on the screen for the operator to choose. But the word processors cannot tell which kanji character is likely to be the right one.

The new Toshiba unit, which might be commercially available in three years, links kanji words to other words that might be used in various contexts, so the machine can determine which word is meant. A word processor to be used by a lawyer, however, would have to weight the words differently than a word processor to be used by someone in another profession, for example. The system could work on a modest personal computer, according to Toshiba, since in reality the approach has been to use neural network tactics on a conventional machine. Word processing could be done much more rapidly if an actual neural computer were developed. (Extracted from New Scientist, 6 January 1990)

Scottish software may run voice-controlled computer

A computer system which can recognize continuous speech, launched by researchers from Edinburgh, may form the basis of a personal computer controlled by voice. The American computer company Apple are planning to adapt some of the approaches used in the new system for its own computers.

Mervyn Jack, director of Edinburgh University's Centre for Speech Technology Research, says that work with Apple began several months ago and that an agreement on collaborative research is expected soon.

John Lewis of the Mac Users Group, an independent body that represents people who use Apple's personal computers, said that if the system can overcome the hurdle of recognizing continuous speech it would be a "very significant development", widening the MacIntosh's "already friendly interface".

The hardware in Edinburgh's system, known as "Osprey", consists of two standard computer boards which plug into the back of an IBM personal computer. The first converts the voice signal into a digital form and then analyses the signal to pick out the key frequencies of speech. In this simplified form the signal is passed to the second board. This holds four transputers, self-contained computers which combine processing, memory and communications on a single piece of silicon.

The transputer board converts the key frequencies into "phonemes", the characteristic sounds of speech of which there are 44 in the English language. It then tries to identify the pattern of phonemes into the words of its vocabulary and then checks the syntax of the sentences to see that it makes sense. The developers of the system claim it can understand any voice speaking clearly in English. It is reasonably successful with urban Scottish, they added, and they are currently working on additional software which will improve its understanding of regional accents.

Osprey's developers claim it can be adapted to suit any application. Users would type in a working vocabulary of 300 words. Osprey then looks them up in a 20,000-word dictionary of phonemes and it is ready to use. A major advantage of Osprey is that it requires no laborious training. Other systems often need to be tutored by each user. (This first appeared in New Scientist, London, 17 March 1990, the weekly review of science and technology)

First multilingual agricultural research CD-ROM released

The Consultative Group on International Agriculture Research (CGIAR) has released "Food, Africulture and Science", the first in a series of CD-ROMs which will eventually constitute a full agricultural library with 6,000 titles. Trilingual aids in English, French and Spanish on floppy disks accompany the CD-ROM.

Among the titles included are a farmer's primer on rice growing, field problems of beans in Latin America, potato research, agriculture-aquaculture farming systems, trends and projections of food in the third world and sorghum breeding.

This new CD-ROM will be distributed free of charge to interested institutions in developing countries by international agricultural research centres and will be sold in the United States for $US 99 from Knowledge Access International, Mountain View, CA 94043. For more information, contact CGIAR, c/o World Bank, 1818 H Street N.W., Room N5063, Washington, DC 20433, USA (TP + 1 202 334-8031) or Knowledge Access International, 2685 Marine Way, Suite 1305, Mountain View, CA 94043, USA (TP + 1 415 969-0606). (Source: ACCIS Newsletter 7(5), January 1990)

Software information

A guide to selected application software developed by the organizations within the United Nations system will be published by ACCIS in spring 1990.

These software programs have been developed by the organizations for external distribution and as such are maintained and supported by them through various services including documentation, installation, training or other user help services. Approximately 80 software programs with applications ranging from agriculture, atomic energy, demography, economics, industry, statistics and telecommunications to more general data base management will be included. (Source: ACCIS Newsletter 7(5), January 1990)

Dealings in design

Software engineers are working overtime to bolt large pieces of complex code into existing product lines. Expect to hear announcements about merged products from Britain's Racal-Redac which acquired simulation specialist HHB Systems, US chip design giant Cadence which is swallowing fast simulator vendor Gateway and Valid Logic, which made Analogue Design Tools the latest in a long line of acquisitions. Cadence will put on weight during the year as it expands into printed circuit board design software.

On the technology front, expect to hear a lot about logic synthesis, open systems and the VHDL chip design language. Logic synthesis software takes the hard work out of electronic design by automatically generating circuit details from logical descriptions of what the electronics must do.

Synthesis is a complicated technology that is expensive to develop so even the bigger computer-aided engineering (CAE) companies are buying in synthesis tools from smaller, more specialist companies. For example, Dazix has done a deal with custom chip maker VLSI Technology.

The bigger CAE companies are also working to open up their systems so that their software can talk to third-party tools. Last year, Mentor Graphics unveiled its "open door" policy of encouraging specialist software companies to port onto Mentor systems. That process will continue. Last week Mentor Graphics acquired chip design specialist Silicon Compiler Systems, putting it head to head with Cadence. Mentor has just completed a major rewrite of its main code which has allowed it to port to a second platform, Sun.

Computer giant IBM will soon be unveiling its new reduced instruction set computer (RISC) technology RT workstations, and several CAE players will be announcing ports onto IBM RT machines this year: Valid and Racal-Redac will be among the first.

Big electronics contractors, under pressure from the US Department of Defense, need to develop design which can be expressed using the DoD-backed VHDL hardware description language. Most companies will have VHDL products on the market this year, most of them will be based around translation software that turns VHDL code into something that proprietary simulators can understand.

Britain's Racal-Redac hopes to make use of its fast workstations and data base-driven CAE software to embed rules-based artificial intelligence into the frontend. This should automatically make designs easier to test and manufacture. (Source: Electronics Weekly, 17 January 1990)

COBAL gets set for an object-oriented future

The world's oldest and most widely used commercial programming language, COBOL, is to get a face-lift after 30 years, with the development of an object-oriented version.

The move by the world's biggest computer suppliers is also expected to ensure commercial acceptance of the object-oriented approach - claimed to raise productivity two to tenfold.

US COBOL standards body Codasyl has met with COBOL suppliers including IBM, DEC, NCR and EDS and PC COBOL specialists Micro Focus and Realia to lay the groundwork for the new COBOL.

Development methods expert Ed Yourdon, now an object-oriented champion, says there was a unanimous feeling that an object-oriented version is needed by next year at the latest.

Object-oriented programming overturns traditional approaches by focusing attention on data rather than program logic. Advocates claim it makes programming easier and more natural, and softwear easier to re-use.

COBOL was developed 30 years ago and accounts for an estimated 70,000 million lines of code in use world-wide. It is being worked on by an estimated three million programmers.

Proposals have already been submitted to Codasyl, which is due to produce a new COBOL standard by 1995, by Micro Focus, Realia and Hewlett-Packard. (Source: Computer Weekly, 15 February 1990)

Ventura talks to the Russians

Soviet and East European personal computer users may soon have access to Cyrillic versions of a wide range of Western software products.

Aptec International, the export trading division of Appropriate Technology, has launched versions of Rank Xerox's Ventura Publisher and Ventura Professional Extension in Cyrillic, Microsoft's Cyrillic Windows 1.2, and a range of keyboards, printers and monitors equipped with Cyrillic fonts.

Dataquest figures put the level of PCs in the USSR at just 100,000 at the end of 1989. Current forecasts estimate that the Soviet Union will need a further 28 million PCs by the end of the century, importing 200,000 to 300,000 over the next year.

Desktop publishing will prove one of the most lucrative PC software markets for Western companies.

The USSR publishes 8,500 different newspapers, 5,300 journals and 83,000 books a year, but none of its 200 publishing houses is computerized.

Aptec also hopes its products will appeal to Russian speakers who live in the UK. It is offering training courses on Russian Ventura through sister company Appropriate Learning. (Source: Computer Weekly, 11 January 1990)

The transformation of software development

Trapped between growing demands for more innovative applications and the need to maintain swelling catalogs of aging existing systems, software development managers are searching as never before for a break with the past. From the Department of Defense to Wall Street to Silicon Valley, managers are saying it is time for software engineering to grow up. They want to transform the process of making software from what, for the last 45 years, has been essentially a manual, craftwork-like process held together with rigid, bureaucratic controls into a more automated, rigorous and predictable engineering discipline.

To that end, software managers and their companies over the last decade have opened their cheque books and their organizations to a long list of new software development tools and techniques: fourth-generation languages and prototyping; structured programming and object-oriented techniques; graphics-based design and analysis tools; new data-oriented methodologies; and, finally, integrated computer-aided software engineering (CASE).

Altogether, Input Inc. estimates that $5 billion of the $94 billion that US companies spent on software last year went to buy applications development tools. The Mountain View, California, market research firm figures that spending on tools is growing at a 19 per cent annual clip, making it one of the hottest segments of the computer industry.

Each of those new tools and techniques is supposed to play a role in transforming software development, recasting its corporate role from bottleneck to business enabler and change agent. The idea is to streamline the overburdened traditional software development and maintenance life cycle by emphasizing user-developer interaction in the analysis and design phase of the process. That is done through the use of a variety of prototyping techniques and new graphics-based tools, which enforce methodologies and produce diagrams that model how the business works, what the application does, what kind of data it uses and how the processes and data interact. Developers then use those diagrams to create reusable storehouses - or repositories - of a business's data types and processes that can be used by automated code generators to produce programs capable of executing even the most complex of transactions.

By streamlining and automating the life cycle, managers hope to improve both productivity and quality. Generators eliminate the need to create COBOL code by hand and ensure standard, structured programs that are easier to maintain. In fact, once the central repository is created, programs could be developed and maintained strictly at the analysis/design and specification levels. And, since users are active participants, the design and specifications would more accurately reflect the needs of the business. No more writing COBOL code by hand.

In a few leading edge companies, things seem to be working just that way. At DuPont, the use of an iterative development approach, coupled with heavy user involvement and CASE tools, has produced more than 400 new programs with no failures and helped reduce maintenance by 70-90 per cent.

Other software managers say they have successfully created what amounts to automated software factories around isolated applications or in individual business units. Trans World Airlines Inc., for example, completely rewrote its Information Management System (IMS)-based frequent flier program application in DB2. The project took 15 months using a data-driven methodology and integrated CASE tools. Users can now add new functions to the application in four to eight hours that used to take up to eight weeks. In isolated cases, other users have reported fivefold productivity gains in new product development.

For all the spending on new development tools and despite the growing list of success stories, however, experts say the average software manager has only just begun the job of transforming the development process. Although most managers are acutely aware of the need to revamp the traditional software life cycle and seem intrigued by the idea of automating much of the process, action at most companies has been tentative, and progress so far has been evolutionary rather than revolutionary.

Indeed, according to Software Productivity Research Inc., software productivity today is lower than it was in 1950. By applying a variation of IBM's function point productivity metric, the Cambridge, Mass., consulting firm has estimated that IS software productivity on average increased by 100 per cent in the 1950s and 1960s, improved by 50 per cent in the 1970s and by only 33 per cent in the 1980s. SPR predicts that

33 per cent in the 1980s. SPR predicts that IS software productivity will improve by only 50 per cent in the 1990s. SPR President Capers Jones blames much of the slow improvement rate on lack of management attention to the standardization necessary for software re-use and the need for improved communication among programmers.

If most software development organizations are failing to improve productivity fast enough, it is not because their companies are not aware that something is amiss. IS executives say rising maintenance and development expenses have drawn the attention of top executives, particularly in an era of consolidation and downsizing. And IS's frequent inability to predict project delivery dates or nail down user requirements is especially glaring at a time when new systems are considered key strategic factors with the potential to determine a business's success or failure.

If the issue of software productivity has risen to near the top of the CEO's worry list, and IS is spending more than ever on tools to modernize the software engineering process, why are productivity and quality not improving faster? IS executives say there are many reasons why software factory pilot projects - even many successful ones - have failed to transform corporate-wide software development processes. Among them:

- Many of the tools needed to automate the process are immature or not yet available;
- Managers say many programmers simply are not interested in changing the way they develop software. Programmers are resisting the notion of giving up the fun of coding to spend time working with users on designing and analysing applications;
- Many organizations have neglected to develop fundamentally good software management practices without which automation of the process is usually ineffective or impossible;
- Upper management often tends to view new tools as a quick fix. When they find out that the tools lead initially to lower productivity and that the problem calls for sustained attention, top managers often lose interest;
- Many IS managers are simply not convinced that all phases of the process - particularly design and analysis - can be effectively automated.

Experts say management and organizational roadblocks must be dealt with first.

Many development shops actually went through the exercise of agreeing on a methodology in the late 1970s and early 1980s. But, experts say, a lot of them have since failed to enforce its use.

That was the case at AT&T a couple of years ago when an IS group supporting development of a new calling card service started looking into automating the software development process. The idea was to improve quality while meeting a tight deadline.

The group eventually adopted the methodology, selected some CASE tools that supported it and completed the system, which will support 40 million AT&T customers when the company's new calling card is rolled out later this year.

But it was not all smooth sailing for the AT&T group. In fact, it had to overcome a litany of problems and challenges typical of many software process automation projects. The 200-programmer group had to fill in the blanks of missing management policies, and it faced programmer resistance to the new tools and techniques. Ultimately, it was forced to pioneer a new organizational approach to development.

But, experts say, management is often unwilling to accept these kinds of organizational changes, which often result from the extensive business and data modelling necessary to automate the software development process.

Effective transformation of the software development process across an organization requires sustained management attention. Even where teams achieve initial success with automated tools, executives say it can take years to bring about organization-wide change.

Too often, say developers, management is seduced into believing that new automated products such as CASE tools are the answer. Sweeping announcements promote that impression.

In decentralized organizations, sometimes the only way to win organization-wide support for automating software development is for individual business units to prove on an application-by-application basis that the new tools and methodologies work.

Managers say cultivating such grass-roots support is usually an uphill battle, particularly because many programmers resist the changeover to the new tools.

In the end, many managers say they have had to go through their development organizations and identify which programmers seem willing and able to adapt to the new tools and approaches.

But the payoff from automation, in addition to faster code generation, can be a closer relationship between developers and users and a better user understanding of what kinds of data and processes are available for new applications or functions. The problem is managers are asking programmers, who historically have been judged and valued by the amount of code they could produce, to spend most of their time analysing and designing applications and working with users. Experts believe automating software development will not significantly cut into demand for development professionals. Still, many programmers seem to see the tools and techniques as a threat to the creativity they enjoy and to the control they exercise in their jobs.

Smart companies attempting to engineer a transformation in software engineering are starting with extensive training and change management education for programmers and managers. Such efforts can be expensive and time-consuming.

VII. COUNTRY REPORTS

European Community

IBM joins in JESSI

IBM Europe is joining Europe's JESSI chip research program, according to a spokesman for the JESSI secretariat in Munich.

Precise details of which projects will be involved have still to be agreed, although IBM is almost certainly interested in DRAM memory chip technology.

An IBM spokesman hinted that IBM will be making some of its advanced chip-making technology available to the JESSI program in return for membership.

IBM's move appears more political than strategic. It wants to be seen to be supporting Europe's chip-makers. (Source: Electronics Weekly, 7 March 1990)

ESPRIT research programme

Europe's largest research initiative is beginning to show benefits, both for the Community and the participants. The pre-competitive research programme into microelectronics, information technology and application technologies, ESPRIT, appears to be on course.

Phase I ran from 1984 to 1988, funded by £1 billion. More than 200 projects were part-funded by the Commission, involving 450 different partners - more than half of whom were manufacturers.

Among these companies were some 170 companies classified as small to medium-sized enterprises (SMEs), employing less than 500 people.

Phase II runs from 1988 to 1992 and has double the funding of the first phase. Companies participating in phase II are now being told whether their proposals have been successful or not. Four hundred new projects have been selected at a total cost of £2.6 billion.

Companies interested in participating in EC programmes such as ESPRIT should monitor the computerized data base, BC-Net for leads. The Community's Offical Journal also lists upcoming Calls for Proposals. Then it is necessary to find suitable partners and to present proposals in writing. (Extracted from Electronics Weekly, 7 March 1990)

France

Still a step from "Eureka"

French companies may be shying away from the Eureka programme for marketable European high-technology innovation because of inefficiency. This is one of the conclusions revealed in an independent "operational audit", commissioned by the Government, of about half of the 127 projects in which French industry has a share.

Nevertheless, the survey, carried out by IDS consultants, says that Eureka is "an undeniable success", with 297 active projects.

According to the survey, projects may still be "very vague" when they are accorded Eureka status; sometimes evaluations are inadequate and may be contested; some of the projects do not have obvious industrial applications (contrary to Eureka's 1985 Hanover Charter) and, sometimes "alibi" partners are brought in to conform to the rule of transfrontier collaboration, although their involvement is not essential.

Companies also criticized the way government grants are managed. More than 89 per cent of respondents complained that backing was not guaranteed for the duration of the project. Sixty per cent felt it took too long for the authorities to agree projects and to sign a contract. About half said the sizes of grants promised by the Government were vague and non-committal, while differences in the ways partner countries finance projects can cause stops and starts. Finally, when there are several sponsors, financial management becomes over-complicated.

To counter these criticisms, the interministerial Eureka committee, presided over by Research Minister Hubert Curien, has taken steps to tighten up the administration. More emphasis will be placed on the initial evaluation of proposals, helping companies to define their projects. And once a project is accepted, its evaluation committee will continue to steer developments during its passage to production.

A greater responsibility has also been given to ANVAR (Agence Nationale pour la Valorisation de la Recherche), the governmental agency set up to promote technology innovation. ANVAR will help companies to find foreign partners - one of the main reasons small companies seek Eureka support - and will serve as cashier when there are several sponsors.

The Eureka committee also wants to see greater diversity in the fields of technology covered. So far the most successful projects have been in the electronics sector, such as microchips (JESSI) and high-definition television. In 1990, a push will be made to find new projects in seven target areas: the construction, automobile and railway industries, pharmaceutical and biotechnologies, telecommunications, agriculture and the environment.

The French Eureka programme has also moved out of its probationary period when a new statute established a permanent organization committee, headed by Secretary-General Henri Guillaume. (Source: Nature, Vol. 343, 25 January 1990)

India

Help in avoiding industrial accidents

A personal computer-based package has been developed to help make improved decisions on the environmental assessment of process industries with regard to risks. Initially undertaken to help in screening proposals of large process industries in the state of Maharashtra, India, this package allows reorganization of layout to minimize the risks in an interactive mode.

The process industry is seen as consisting of various clearly identifiable "units". The programme quantifies the economic damage and societal risks associated with each unit due to fire, explosion and toxic releases. The economic damage is quantified in terms of Maximum Probable Property Damage (MPPD) and the societal risks are quantified in terms of Fatal Accident Rate (FAR). The layout of the units can be optimized in terms of other information in the neighbourhood area to minimize both MPPD and FAR.

The package development in dBASE III^{TM} is menu driven and has full interactive facilities of data entry, validation, help and graphics. The layout routine in the package allows the user to mimic the map co-ordinates to show various plant positions, next plot boundary and various utilities, such as schools, hospitals, public housing, public roads, utility roads, offices, control room, and other hazardous installations.

The package, acronymed as "MINRISK", is under continuous development and many more features are expected to be added in the future.

For more information contact:
Dr. Prasad Modak, Indian Institute of Technology, Powai, Bombay 400076, India. (Source: ACCIS Newsletter 7 (6), March 1990)

ICCC 90

The International Council for Computer Communication (ICCC) was founded in 1972 as a non-profit organization whose objective is the advancement of computer communication throughout the world. Sponsorship of the ICCC international conferences, held every alternate year, is one of the principal activities of the Council.

The ICCC is an affiliate member of the International Federation for Information Processing (IFIP).

ICCC 90 is being hosted by the Department of Electronics (DOE), and the Department of Telecommunications (DOT), Government of India.

A series of conferences on computer communication beginning with Networks 80, have been milestones, marking scientific, technical and industrial development in this part of the world. They have given a significant impetus to developments in information technology in the developing world.

The ICCC Special Conference on Computer Communication for Developing Countries-CCDC '87, was another landmark. It promoted an enriching exchange of ideas among technologists, academicians and policy-makers from the world over. Further information from Ms. Saroj Chowla, Organizing Secretary, ICCC 90 Secretariat, CMC Limited, A-5, Ring Road, South Extension Part-I, New Delhi-110049, India.

Indian electronics

During the seventh five-year plan from 1985 to 1990 the combination of the Prime Minister and the realization that high technology was the key to the future saw a burgeoning of programmes and projects in the high-tech field.

Because of the country's lack of infrastructure in the high-tech area it soon became clear that importing expensive foreign electronics was having a disastrous effect on the country's balance of payments so, broadly speaking, two actions were taken. Heavy penalties were imposed on imported electronics (along with all other imports) and steps were taken to allow the country to produce its own products to fulfil the demand for electronic goods.

While this policy is generally welcomed by the electronics community, its broadness does pose problems. Subsystems, raw materials and components all have to be brought in and are subject to heavy duties and endless bureaucracy. To ease this problem tax-free "windows" and special rules for 100 per cent export-orientated companies were introduced.

A special committee also reported last autumn with a new range of proposals to aid high-technology. These proposals, if adopted, would help increase the flow and production of semiconductors and other "building block" type parts for Indian industry.

But the problems are deeper than the high cost of raw materials. There is a culture within Indian society of low margin production. It is not unusual to find a firm which will readily turn out boards in numbers which can be counted on the fingers of one hand. So, paradoxically, in a country whose expanse contains its own problems, one of the other handicaps of its electronic industry is the small size of the average production unit.

The Department of Electronics (DoE) estimates that of the 2,500 electronic production units in the country just 60 are in State control, accounting for a third of the industry's output, while 400 are in organized private hands contributing another 60 per cent. The 2,000-plus firms left make up just 10 per cent of the output and this does not take into account out-workers and units so small they remain unregistered.

Another side-effect serving such a large domestic market is that the need or urge to export is sapped because the home market is so vast. For years India had a problem supplying the needs of its own country let alone expend effort in selling overseas. This has left several marks on the industry and its products which now make exports harder.

First of all is the size of the average firm and the product range it supplies. Because ranges are so limited most business is done firm-to-firm. India is a country where the distributor is practically non-existent.

Quality is also an area in which India cannot win. Some industry sources say that Indian quality is just not up to the mark because equipment makers have had it too easy for too long. Other (Government) sources say outside buyers are shocked by the prices of many Indian components because the specifications are so high the product becomes expensive.

More tempered voices say Indian manufacturers simply do not need to export because that vast market is still hungry for goods. Outward appearance can also be a major put-off for foreigners.

All of these problems are things which have been identified by the Indian authorities and solutions are being sought and passed on to the industry through a vast array of industry bodies, export agencies and promotional councils.

The seventh five-year plan (1985-1990) has seen the industry grow at a rate of nearly 40 per cent a year to this year's level of Rs 70,850 million (£23.6 billion).

Exports have also been booming with overseas sales of Rs 1,150 million (£383 million) in 1983 transformed into exports of Rs 4,750 (£1,584 million) in 1988. Software and the tax windows for 100 per cent exporting companies have also provided much of the growth.

To provide more home-grown parts for this boom the Government's push on components has taken effect with 90 per cent of components for consumer goods now being supplied by other Indian firms. About 80 per cent of communications products are supplied with indigenous parts while other areas such as professional electronics equipment can source just 50 per cent of parts at home.

During the last five-year plan the DoE has spent some Rs 4,090 (£1.4 billion) supporting various projects and programmes boosting employment in the sector from 130,000 to 250,000 plus many other indirect jobs.

Televisions, radios and cassette players have provided India with its first mass market electronics product and the country has shown how it can rise to the challenge of producing products efficiently and at the right price.

On the back of this manufacturing book the components and materials industry has seen its production increase by nearly 50 per cent a year. Of great concern has been the computer business. While it is recognized that computers need to be introduced, simply spending dollars on foreign equipment is unacceptable.

Imports see-sawed between 1986 and 1988 from Rs 2,000 million (£666 million) down to Rs 720 million (£240 million) and back up again to Rs 2,000 million. Imports were hard to come by and were often special cases.

Indians will soon be able to buy the people's computer, a PC XT compatible machine produced in India. About 100,000 are expected to come onto the market this year at Rs 10,950 (£3,700) apiece.

Communications has also undergone a revolution. It was not so long ago in India that the waiting list for a telephone was around 15 years. By the mid-1980s there were still just five telephones for every 10,000 people. Now there are over 5 million in the country and despite over 1.2 million being installed since 1985 the waiting list has grown from 1.2 million to 1.5 million.

Datacomms has also taken off well with many networks in the metropolitan areas. Here as with many countries liberalization has begun. It started with consumer equipment but this has now been extended to switching equipment of up to 2,000 lines and rural switching equipment. Sources in India also suggest that orders for main digital switches will be opened up to supplement the State's efforts to digitalize the public switched network.

Indians are confident about the future for their country and are keen to point out that they intend to take on the likes of Hong Kong, Korea, Singapore and Taiwan.

With a more acceptable level for the rupee on international money markets, the creation of free trade zones, the liberalization of markets, soaring labour costs in traditionally low-cost areas, the importance of brain power to add value without heavy capital investment and the eradication of red-tape, the confidence looks well placed. (Source: Electronics Weekly, 14 March 1990)

Japan

Japan readies Sigma stations

Five years of Japanese industry co-operation in the Sigma project will come to fruition in April with the release of a standard range of Unix workstations running a standard range of software development tools. And they are likely to be unleashed in Europe within months.

The project, on which Japan's Ministry of International Trade and Industry has spent an estimated $200 million and in which 193 companies have co-operated, was launched to address the death of software development in Japan by designing a standard hardware and software environment to encourage applications development.

The new hardware will run a standard set of 50 integrated software development tools which will run on all workstations. But various software developers have developed a number of hardware-specific tools to run on the different workstations that will be sold by 10 manufacturers. Also, about 30 software vendors will market their own software on Sigma stations.

The planning manager for the Sigma project has announced that a new company would be formed before April to support, modify and enhance the system, while the project will continue to work to extend the coverage of the system interface.

Recently the Japanese Information Technology Promotion Agency, which runs the project, announced that it will standardize on AT&T's Unix System V.4 rather than the rival Unix from OSF. (Source: Computing, 11 January 1990)

Counterpart to "frontiers"

Japan's Ministry of International Trade and Industry (MITI) is about to launch a sequel to the Human Frontiers science programme. But unlike Frontiers, which is aimed at basic research on the brain, the new project is aimed at the development of manufacturing technology, an area in which Japan is a world leader.

The Intelligent Manufacturing System (IMS) project is the brainchild of a committee of academics, industrialists and MITI officials headed by Hiroyuki Yoshikawa, dean of the Faculty of Engineering at Tokyo University. The committee, established last year, proposes the establishment of an international research centre in the United States or Europe with funding of about $1,000 million over 10 years. In the committee's proposal, which was explained to Government officials of the United States, Europe and Australia, the Japanese Government and private sector will provide about 60 per cent of the funds and other countries the rest.

The institute will develop fully automated manufacturing systems, including product design, intelligent robots for product manufacture and automated systems for retailing and distribution. An important element will be to develop standardized systems that can be interlinked and used anywhere in the world.

Research at the proposed institute will be divided into about 100 projects over the 10-year period, each with budgets of about $7-10 million.

Yuji Furukawa of the Department of Mechanical Engineering at Tokyo Metropolitan University, one of the project organizers, says that about 100 "core member" companies will donate £85,000 to finance the conceptual design of IMS. Already 50 companies, including Toshiba, FANUC (one of the world's leading manufacturers of machine tools and robots), Kawasaki Heavy Industries and "several big US companies", have formally or informally agreed to join. The Michigan-based Society of Manufacturing Engineers has agreed in discussions with Furukawa to act as a "window" for the project in the United States.

Organizers of the project are asking for project proposals from companies, universities and research organizations in Japan and overseas to be submitted by 30 June at the latest. If all goes according to plan, an international committee of academics drawn from the United States, Europe, Japan and possibly other countries will assess the proposals and draw up firmer plans for the project at a meeting on 3 and 4 June in time for MITI to submit a budget request for fiscal 1991 in late August. (Source: Nature, Vol. 343, 8 February 1990)

Korea

Korean $3.96 million facelift

Supercomputers are high on the list of priorities of the South Korean Ministry of Trade and Industry, which wants Government and industry to invest $39,500 million over the next four years to create a local high technology industry.

The plan is for 40 per cent of the total to go into research and development and the rest in production facilities. Korean laboratory facilities are primitive, and there are no funds for basic research. At present, research and development takes only 2 per cent of gross national product, and this figure is double the 1984 level. The target is 3 per cent in 1994.

Apart from supercomputers on a five-year time scale, priorities include: a scientific satellite by 1992 and a communications satellite by 1996. The country is targeted to get into trade balance in microelectronics - exports were $4,900 million in 1987 - computer-controlled machine tools and optics as well as non-computer areas such as bioengineering, fine chemicals and aircraft.

The call for investment comes at a time when foreign businesses are turning away from the previous hotspot for low-cost manufacturing in the Far East.

Rising wages, violent labour unrest, particularly against foreign firms, currency instability and Government xenophobia has discouraged potential investors.

New company regulations have convinced potential joint-venture investors that their eventual control over their investments would be reduced and from 1991 most of the existing 1,529 foreign companies in Korea, as well as newcomers, will no longer be eligible for the well-established tax reductions and exemptions. Only high-tech industries favoured by the Government will continue to enjoy these types of incentives.

The Government is seemingly unconcerned that foreign investment is slowing, perhaps in the belief that it will reduce this year's trade deficit of around $431 million, compared with a $476 surplus in 1988. (Source: Computing, 11 January 1990)

United Kingdom

Do-it-yourself searches for patents

The British Library is now giving patent searchers the chance to look through the American patent records themselves, using a data base on a CD-ROM disk. These disks, which are similar in principle to an ordinary compact disk, can store up to 600 megabytes of data permanently on a single 12-cm. disk.

In 1988, the US Patent Office in Washington DC began experimenting with a CD-ROM data base of information on North American patents. The US Patent Office now produces a commercial disk, called Cassis, which lists nearly 5 million records, including all the American patent documents dating back to 1790. Most importantly, the 1.5 million US patents issued since 1969 are indexed both by the patent holder's name and the descriptive title of the invention. Many entries are also accompanied by a synopsis of the technical content of the patent. The US Patent Office will press new disks every two months to keep the service up to date.

The British Library has installed a CD-ROM system in the Science Reference Library in London. It has been modified to work when fed a credit card of the type used in libraries to pay for photocopying.

Searchers can use the system without appointment and make unlimited printouts of the search results displayed on screen. They can also make unlimited copies of the search data onto floppy disk. The library is imposing only one restriction. To avoid the possibility of computer viruses being introduced accidentally into the computer, searchers must buy approved floppy disks from the library rather than use their own. (This first appeared in New Scientist, London, 24 February 1990, the weekly review of science and technology)

Managed data network service

British Telecom (BT) has introduced a new managed data network service in order to more accurately predict data networking costs. The service will run on BT's public data network PSS and will allow customers to send as much traffic as they wish in return for a fixed annual sum. The creation of this service is in response to a demand for more closely tailored customer services. BT will undertake network design and provide a nominated project manager and a system engineer. There will also be a singled dedicated fault reporting point with a four-hour response time and automatic escalation procedures. (Source: ACCIS Newsletter, 7 (5), January 1990)

United States of America

Applied technology institute planned for San Jose State

San Jose State University plans to establish an institute to provide education and training in semiconductor technology. The Applied Technology Institute was originally part of a proposal aimed at getting US Memories to site its proposed DRAM plant in San Jose, California. Recently, however, the chip consortium advised San José that it was not selected as the plant location. It disclosed, instead, that it was considering sites in Arizona, Colorado, New York and Texas. The Institute will be the first of its kind in the nation. The program will operate under the aegis of San José State University's Department of Engineering, with funding from the State. (Reprinted with permission from Semiconductor International Magazine, December 1989. Copyright 1985 by Cahners Publishing Co., Des Plaines. Il., USA)

USSR

USSR readies £1.5 billion DP plan

The USSR has doubled the amount it plans to spend on computers in its latest five-year plan just released.

It is also promising to offer a programme of support to commercial organizations that will make the UK Alvey and European Esprit initiatives look tightfisted. That is largely the view taken by Western experts as they try to assess the increase in computer expenditure in the Soviet five-year plan by the equivalent of £750 million to £1.5 billion.

This is in line with statements made a month ago by Soviet officials, that the USSR was on the way to becoming an "information society".

And it turns out that the Soviets are already keen on adhering to standards.

German reports quote Vjackeslav Korchagin, head of the State Committee for Computer & Information Technology GKVTI as saying the computerization programme will offer financial support to every Soviet organization, whether State owned, co-operative or joint venture, with the emphasis on installing according to internationally agreed standards.

And he went on to specifically mention the OSI as a body and promise it Soviet support.

The prospect of an open USSR with open systems procurement policy could lead to a massive surge of US and European interest. (Source: Computing, 4 January 1990)

ComputerLand in Moscow

Liberalization of the Soviet economy is bringing in lots of Western institutions. In January, the first McDonalds restaurant opened in Moscow. Now, the Soviet capital is getting its own branch of ComputerLand, the world's largest chain of franchised computer stores.

The opening of the new store, a franchise of ComputerLand of Europe, is to coincide with Comtek 90, a trade show in Moscow sponsored by ComputerLand. The Soviet store will carry major computer brands such as IBM, Epson, and Hewlett-Packard, but it can sell only models that clear regulations set by the US and its allies. Computer exports to the Soviet bloc are still restricted to machines with no more power than a basic IBM PC/AT. (Source: Business Week, 26 February 1990)

A bug for USSR's computers

The Soviet Union has an estimated 500,000 personal computers, less than 1 per cent of the 60 million or so in the United States. Its own industry is primitive. Until now Western restraint of supposedly "strategic" exports prevented the arrival of anything more powerful than a 1981-vintage IBM-PC-compatible. Now, at last, there is a hint of freer trade in most desktop computers.

That provides an ample challenge for capitalist creativity. One company with creative ideas is Phoenix Group International, based in Irvine, California.

In September 1989 the Soviets announced that Phoenix had beaten 16 other foreign companies for the privilege of setting up a joint venture with the Soviet Education Ministry to supply IBM-compatible personal computers. The first shipment of 1,000 is now being packed. Phoenix, a holding company which specializes in rescuing high-tech firms in trouble, has only about 70 employees and an annual turnover of $50 million. One day it hopes to sell the Soviets billions of dollars' worth of PCs each year.

Dollars earned how? Phoenix believes it has the answer. Another company in its stable has developed microbes which, it claims, can boost oil production dramatically. The Soviets, Phoenix says, are interested in buying these too. (Source: The Economist, 27 January 1990)

Research and development

Since the mid-1960s the East Bloc has developed its own range of computers, with the Soviet Union the driving-force behind the design and implementation of a 370-compatible "Unified System" - the ES range. Also standardized throughout the CMEA (COMECON) countries are 8086-based PCs and PDP-compatible 16-bit minis and, in growing quantities, VAX-like 32-bit super-minis.

The BESM and Elbrus mainframes, however, are outside these classifications because they resulted from purely indigenous research lines which were unconstrained by any desire to be software-compatible with the West.

Soviet supercomputing has its origins in the MESM ("SMall Electronic Calculating Machine"). This prototype was built in 1952 at the Institute of Electronics in Kiev under the pioneering design engineer academician S. A. Lebedev. The "Large" (Bol'shaya Elektronnaya Schotnay Mashina) model, or BESM, was its successor. A programme of development resulted in the transistor-based, 48-bit word-length BESM-6 in 1967.

Ten years later, new life was breathed into the old system when a revamped specification called for the introduction of more advanced hardware and software techniques to improve both the management of the machine and its throughput. A micro- programmed arithmetic co-processor enabled the developers to sustain compatibility whilst boosting the execution of both fixed-point and floating-point operations. A nominal rating of 1 MIPS was the result.

The restrictions imposed by a maximum of 768 Kbytes of RAM were eased through the introduction of virtual memory techniques. The operating system permitted both batch and time-sharing activity. High-level language implementations include Algol-60, Fortran Lisp.

At least 200 BESM-6s have been installed and the model is still in production at the Moscow Institute of Precision Mechanics and Computation Techniques (known as the Lebedev Institute, after the original designer). For potential buyers, a typical configuration sells for R 530,000 - about $850,000.

From a variety of sources, Computing has assembled the following data about the Soviet Union's supercomputer research and development.

1. Lebedev Institute, Moscow.
   Continuing research into the Elbrus range. Design chief: Institute director, Dr. A. G. Ryabov.

2. Institute for Cybernetics Problems, Moscow.
   Research into a Cray-1-type supercomputer under the sponsorship of the Ministry of Electronics. Director: Academician V. A. Mel'nikov.

3. Control Problems Institute, Moscow.
   In addition to the development of the PS1001 nuclear power station control system, this team is responsible for the PS2000 and PS3000 vector processors (66.4 to 100 MegaFLOPS?). Director of this Minpribor Institute is Dr. I. L. Medvedev.

4. Moscow State University.
   The Research Computer Centre has a 250-person team working on parallel dp systems under the direction of Dr. Malkeyev. This group is a major source of new ideas on the whole range of parallel processing (coarse-grained to fine-grained).

5. Institute of Cybernetics, Kiev.
   A group led by academician V. S. Mikhalevich at the "Glushkov Institute" is specializing in macro-pipelining architectures.

6. Novosibirsk, Siberia.
   A team of 150 specialists headed by Deputy Director V. E. Kotov has been developing the MARS-M super-mini since 1985. It is thought to be an open-ended parallel system in the supercomputer class.

7. Radio Engineering Institute, Taganrog, Ukraine.
   The ES2703 fine-grain parallel processor (up to 125 MIPS per node) is being developed here by a team led by A. V. Kalyayev.

8. Informatics Institute, Leningrad.
   Development under way of the ES2704 fine-grained parallel system using dataflow architectures (over 100 MIPS per node across 24 nodes). Design chief is Dr. V. A. Torgassev.

9. International Projects through CMEA (Comecon).
   Array processors, super-minis and shared-memory techniques are being studied in co-operation with the Bulgarians. Results include the ES2706 12 MegaFLOPS array processors which, in clusters of up to eight, may be connected to host minis or mainframes.

10. Spaceflight Control Centre, Moscow.
    The Spaceflight Control Centre is thought to be continuing its research into multiple-processor, fault-tolerant configurations.

(Extracted from Computing, 18 January 1990)

VIII. FACTORY AUTOMATION

Japan begins international project or the factory of the future

The Japanese Government is inviting experts on robotics and other manufacturing technologies from around the world to take part in a research programme costing $1 billion (£600 million) to design the factory of the future. The Ministry of International Trade and Industry (MITI), the government department widely credited with guiding Japan's economic miracle, will draw up proposals for the scheme, called the Intelligent Manufacturing System project, at an international conference in Tokyo in June. The project will formally begin in 1991 and will run for ten years.

Besides its generous budget, the project is remarkable for two reasons. First, MITI wants foreign partners to join at the outset, on more or less equal terms. Secondly, unlike most of Japan's international research ventures, which aim to acquire foreign know-how, Japan will be transferring its own world-beating expertise to less advanced nations. MITI estimates that Japan will contribute 80 per cent of the technology going into the programme - if it can persuade Japanese firms to share their secrets.

The big technical challenge is to find ways of linking up emerging technologies - such as artifical intelligence - with robots equipped with senses of sight and touch. The ultimate aim is to create factories entirely controlled by computers.

The aim is computer-integrated manufacturing (CIM), an ideal that has eluded engineers for years. Much of the Japanese-led research will concentrate on designing ways to allow different types of computer to communicate and share data. MITI believes that such incompatibility between systems is holding back the spread of technologies to automate factories; managers are reluctant to invest in sophisticated equipment if they cannot plug it into their existing systems.

The political driving force behind the project is Japan's need to reduce the tensions in its trade with the rest of the world. It aims to do so by sharing the technologies that enabled its companies to dominate the world's motor and electronic industries.

MITI's dream is to bring Japanese skills in technologies for mass-production together with Federal Republic of Germany and Swiss skills in building high-precision machinery. To these it will add the US's lead in computer software.

One important goal is to raise the prestige of manufacturing industry now that Japan's best young brains are following their Western counterparts by seeking careers in the financial and service industries. (Extracted from New Scientist, London, 3 February 1990, the weekly review of science and technology)

Polymers muscle in to robots

Using electrically stimulated soft polymer gels, Japanese scientists are working to develop artificial muscle systems for robots and other mechanical devices.

The devices are based on reversible, electric field-stimulated volume transitions in polyvinyl alcohol/polyacrylic acid (PVA/PAA) gels. When an electric current is applied to a PVA/PAA gel, it contracts; and when the current is turned off, the gel expands.

This action gives the gels muscle-like qualities that allows them to raise and lower loads repeatedly. To produce an "artificial muscle", Prof. Y. Osada and co-workers at Ibaraki University embedded two electrodes into a piece of PVA/PAA gel, and used a threat to attach the gel to one arm of a lever. The device lifted weights weighing up to 22 g attached to the other arm of the lever. Interestingly, the rate of lifting and the efficiency of the device increased as the load was increased from 5.5 g to 22 g.

"Actuators for robots made of these soft gels will behave more safely, more carefully and more gently", Osada says. "They will not tear out the knob when they open a door, and they will shake hands softly instead of crushing a hand."

Osada also described a chemical valve consisting of a fixed, porous PVA/PAA membrane, and a device for the controlled release of drugs based on the gels.

Presently in the developmental stage, the next step toward practical application of the artificial muscle systems is to improve the efficiency of the chemical-energy-to-mechanical-work conversion, Osada says. (Source: Chemistry and Industry, 19 February 1990)

Quality leads to automation

Manufacturers and distributors of passive components agree that monitoring and maintaining the quality of surface mount components will be the main challenge in the coming year. The bulk of the work done by production staff will change from machine operation to process control as Just In Time (JIT) and automated techniques take over.

Circuit boards using surface mount components have many advantages over those based on leaded devices. The circuits are smaller and can be produced using component placement machines. This leads to cheaper finished boards, which is why the technique has been widely used by Far Eastern companies for some time.

Changing over to surface mounted boards is not a straightforward process. The automatic placement machines need components which meet very tight size tolerances and need the same amount of solder to make each connection. Poorly-sized devices will either fall off or be washed off the board during the soldering and cleaning processes. Low-quality components, subjected to direct heat during soldering, are likely to crack.

Board manufacturers need components of sufficiently high quality to ensure these problems do not occur. They are hampered by the absence of clear standards. Many are getting around this problem by inspecting and validating suppliers and their processes for themselves.

Checking suppliers thoroughly is also a key requirement of JIT. This puts the onus on the component manufacturer to monitor and maintain very high product standards. Some companies have found that the best way to achieve this is to adopt JIT manufacturing themselves. This involves insisting on the same high quality from their materials suppliers as they provide themselves.

By tracking components in batches through the factory, the customer can be supplied with precise information on the manufacturing conditions.

Problems with surface mounting are not only caused by the quality of the components but customers will turn to their suppliers first for explanations.

It will become increasingly important for manufacturers and distributors to be able to refer them back to documented test data provided when the components were delivered.

By combining greater automation with closer monitoring the manufacturers of passives will spend the coming year producing higher quality devices supplied with more data to tighter tolerances. (Source: Electronics Weekly, 17 January 1990)

IX. STANDARDIZATION AND LEGISLATION

Standardization

DBMS standards

Several ANSI standards committees are gathering to co-ordinate the creation of distributed DBMS standards. Such standards would provide guidelines for distributed DBMS offerings connected over networks. The Open Systems Interconnect Data Base (OSI/DB) task group is sponsoring the move. Three ANSI committees are working on the standards: one for DBMSs, another for applications development and a third for distribution across a network. The last group is likely to be the one to develop distributed DBMS standards, according to the OSI/DB task group. (Source: Networking World, 1 January 1990)

Unified SQL standard

A unified, industry-wide SQL standard is being developed by the SQL Access Group, a vendor group whose members include Ashton-Tate, Digital Equipment, Fujitsu America, Hewlett-Packard, Informix, Ingres, Metaphor, NCR, Oracle, Sun Microsystems, Tandem Computers and Teradata. The point of the SQL Access Group is to take the ANSI-standard SQL and make it interoperate through vendor agreements. Currently each SQL vendor uses different data-dictionary formats, error messages, communications protocols, etc. The plain vanilla SQL that the SQL Access Group is developing will enable users of SQLs to use the same query against multiple data bases. A prototype SQL is scheduled to be demonstrated by end-1990. (Extracted from Computerworld, 8 January 1990)

Standards for fast networking

Standards and new products for fast networking will make networks more important in the 1990s than personal computers, according to observers. Adding to this trend will be the development of Electronic Data Interchange and the Fiber Distributed Data Interface (FDDI) standard in 1990. Many vendors have development efforts for the 100 mbps FDDI standard. Adding to the growth of networks will be the use of graphical interfaces and the integration of voice and data. According to B. Metcalfe, the inventor of Ethernet, FDDI will be very popular by the year 2000. New applications in the 1990s will be geared toward high-speed networks. (Extracted from PC Week, 8 January 1990)

Euro-standards to be UK-compatible

Attempts to make European component procurement standards more attractive to UK manufacturers could bear fruit before the end of the year.

Proposals to make Europe's CECC certification system compatible with existing UK standards based on BS5750 should be published and put into practice before the end of 1990.

According to ECIF - the Electronic Components Industry Federation - which made the proposals, the aim is to make the CECC system more attractive to UK companies by making the qualification process closer to the UK system thereby avoiding costly duplication.

ECIF has made a number of proposals to CECC - Europe's electronics components standards committee - to encourage greater UK adoption of European standards.

ECIF is concerned that a greater commitment to European procurement standards by companies in France and the Federal Republic of Germany will give them an important advantage over UK-based rivals with the creation of a single European market.

The existing CECC qualification system is unattractive to many companies because its qualification process can be both time-consuming and wasteful with manufacturers required to seek approval for every product.

ECIF has proposed that qualification timescales which can be as long as four months should be reduced by up to 60 per cent, and also that CECC should be brought into line with existing UK standards as well as the European EN29000 and the world-wide ISO 9000 systems. (Source: Electronics Weekly, 28 February 1990)

1992 standards goalposts are on the move

The public debate about the single European market has focused on the heavyweight issues - federalism versus national sovereignty, monetary union versus competing currencies.

For the IT world 1992 seems to have little direct relevance, except for issues like telecomms re-regulation or the price fixing of Japanese chips.

But buried in the details are several important issues for computer users and suppliers. Public procurement and program copyright are among them.

In 1985 when the single-market idea was born 279 measures were identified that were needed to bring about a market without barriers to the movements of goods, capital, services and labour.

At the start of this year 142 of the measures had worked their way through the maze of negotiation and consultation, compromise and final agreement - some 51 per cent of the total.

The commission, which initiates policy in the EC, had already formulated its proposals on a further 119, leaving just 18 still to be considered.

Measures affecting the IT world fall into all three categories, some agreed by the EC's final decision-making body, the Council of Ministers, some still being argued about and others yet to be formulated.

The most important question for many users (and most important opportunity for suppliers) is the opening to tender of public procurement contracts.

The commission has been fighting for this for 20 years, and it is no small matter. The overall market is massive, worth about 400 billion Ecus a year (about £280 billion), equivalent to 15 per cent of the Community's GDP.

Of this total some 10 billion Ecus (about £7 billion) is accounted for by mainframe computer sales, which until recently were almost exclusively reserved for national IT champions - ICL in the UK or Siemens and Nixdorf in the Federal Republic of Germany, for example.

On top of the mainframe sales come supplies of minis and PCs, networking equipment and software. Under rules agreed last year, services such as computer consultancy must be put to open tender.

The rules also specify that contracts for supplies worth more than 100,000 Ecus (about £70,000) must comply with open systems interconnection (OSI) standards.

Public bodies, such as local authority IT departments, which fail to follow the rules could end up in court.

Nor are the rules applicable just to the obvious definition of public bodies. The rules adopted last year also apply to organizations that run networks, face little or no competition, or are issued special or exclusive licences by Governments.

The commission is also trying to extend the rules into four areas currently excluded - telecomms, transport, water and energy.

Like these, the question of computer program copyright is held up in the council while sticky problems like "reverse engineering" are debated.

The basic idea is to protect programs in exactly the same way as literary works, offering copyright to the author of a program.

Where a group is involved this protection is offered "in common". It is awarded to the person who commissions a program when it is created under contract, to the employer where it is created in the course of employment or to the person who generates programs using fourth generation software.

However, problems have arisen over defining interfaces and protocols which are to be excluded from protection and over reverse engineering - working backwards from a program's final shape to reconstruct its workings but without copying its component parts.

This problem arose because the commission's original proposal extended protection to the "expression in final form" of a program but not to its underlying principles.

The council decided in December to set up a wide-ranging study of these problems. Copyright for data bases is also subject to expert study, but this time in the commission.

The main problem is information that is in the public domain. Designing and compiling a data base is seen as an act of creativity worth copyright protection even if the data itself is already public, but defining the legal formulations needed is a Herculean task. So it has been referred to two sets of committees.

Two other areas presenting problems in harmonizing national laws are data protection and protection of electronic payments.

So far the commission has confined itself to recommendations rather than directives and little progress is likely before 1992.

Health and safety is another area affecting computer users. The council last year agreed minimum conditions for the installation and use of visual display units, specifying that employees should not have to work continuously without breaks and should be offered eye tests.

The rules will have to go back to the Parliament before they can be definitively adopted by the council, but they will certainly not be weakened during this process and should be ready within the next few months.

All in all the single market is acquiring a snowball character which will have an increasing effect on IT users and suppliers as 1 January 1993 approaches. (Source: Computer Weekly, 15 February 1990)

Legislation

Protecting software

The US has an overwhelming lead in the production of computer software around the world, commanding about 70 per cent of the global market. But that lead may be threatened in the absence of effective intellectual property laws, according to a recent report from the Office of Technology Assessment (OTA).

Software may be protected via three routes: copyrights, patents and trade secrets. Copyrights, the predominant form of protection, apply to the "expression" of ideas, whereas patents protect underlying ideas. Software, obviously, does not really fit into either category.

The questions raised are almost unimaginably complex. For example, the Supreme Court has not ruled on whether software is patentable, but it has ruled that computer-implemented algorithms deemed to be "mathematical" are not. This ruling alone supplies fodder for a growing number of legal battles, which feature arguments over distinctions between "mathematical" and "non-mathematical" algorithms, mathematical algorithms and numerical equations, equations and "laws of nature" or "basic truths", algorithms and "mental steps", and so on and on.

Software pirating, which some companies claim robs them of more than half of their potential sales, raises more endless questions. For example, if a team uses "reverse engineering" to unlock the secrets of a program so it can design a new one just like it, does that violate copyright?

The report, "Computer Software and Intellectual Property", notes that rapid developments in software technology make the whole subject a moving target for regulation. And "since there is no agreement on common terminology, it is difficult even to discuss protection issues with precision". Yet, how these issues are resolved will have an important influence on the shape of global competition in the coming years. (Source: Science, Vol. 247, 23 March 1990)

Allegations fly in EC copyright dispute

The two sides in the row over draft software copyright legislation are accusing each other of misrepresentation of views in attempts to get European IT firms on their side.

The draft proposal has caused controversy over the issue of so-called reverse engineering, which is used by experts to get at a source code.

The Council of Ministers has ordered the European Commission to review the legislation because of fierce lobbying.

One group, ECIS (European Committee for Interoperable Systems), is now accusing its rival, SAGE (Software Action Group for Europe), of distorting its views in order to scare companies into its camp.

SAGE rejects these charges, accusing ECIS of "mud-throwing to obfuscate the main issue".

ECIS and SAGE included Federal Republic of Germany software company Softlab and Spanish consortium Sedisi in its ranks when both had yet to make up their minds.

SAGE denies the accusation, saying both have formally asked for position papers.

The two sides agree with the legislation's goal of classifying programs as ideas in the same way as literary works.

But ECIS is against making hardware interface code copyright, since it claims this will stop open systems and strengthen IBM and DEC. ECIS includes Bull, Olivetti, Fujitsu, NCR, Amdahl, Amstrad and Oracle.

SAGE, which has 180 members including IBM, DEC, Siemens, Philips, Lotus, Word Perfect and Microsoft, claims the law as it stands allows software piracy by condoning reverse engineering. (Source: Computer Weekly, 18 January 1990)

X. RECENT PUBLICATIONS

Agricultural database available

The bibliographic data base CAB Abstracts (CABA) covers agriculture and related areas of applied biology. It includes more than 2 million records from agricultural literature and related areas of applied biology from 1972 to the present. The following areas are covered: agricultural economics and trade, crop production and protection (pest control), agricultural chemicals (pesticides, fertilizers), animal sciences and production, buildings and machinery, biotechnology, forestry and other related areas. The data base is updated monthly with approximately 12,000 citations.

CABA is produced by CAB International (formerly Commonwealth Agricultural Bureaux) Centre, Wallingford (UK) with agencies in Commonwealth countries, and is available online via STN International by JICST in Tokyo (Japan). For futher information, contact STN Help Desk in Karlsruhe, Federal Republic of Germany at 49/7247/808-555, via electronic mailbox STNmail (id: HLPDESKK) or by letter at STN International, c/o FIZ Karlsruhe, P.B. 2465, D-7500 Karlsruhe 1, Federal Republic of Germany. (Source: STN International Press Release 1-90, February 1990)

Two new ACCIS publications available

The ACCIS guide to the United Nations information sources on international trade and development finance, third in a series of ACCIS guides on information sources within organizations of the United Nations system on issues of importance for the global community, was published in February. It focuses on the main, as well as less obvious, sources of the United Nations information on international trade and development finance, including data bases and printed publications. It also provides descriptions of each organization, its overall responsibilities, its specific responsibilities in international trade and development finance and its structural units involved in this area. Addresses of select organizations outside of the United Nations system which produce information in these subject areas and a general index are also given.

Management of electronic records: Issues and guidelines was also published in February. This ACCIS report comprises products aimed at assisting United Nations organizations in addressing the challenges presented by the new information environment: a proposed set of GUIDELINES for managing electronic archives and records; a SURVEY of the use and status of electronic media in the organizations; a discussion of information technology STANDARDS as they related to electronic record-keeping; and a GLOSSARY of terms that figure prominently in those domains. This publication is intended to help United Nations organizations - and possibly others - to devise their own methods and procedures for coping with the impact of new technologies on archives and records management.

Copies of these two reports at the cost of $US 15 each are available from United Nations Sales Office in Geneva and New York.

International bibliography available

This reference source is an annotated bibliography of the publications produced by intergovernmental organizations ranging from the United Nations, the World Bank, OECD and EC to smaller organizations. The bibliography is divided into two sections: the bibliographic record and the periodical record. Also included are an Organization Index, a Title Index and a Subject Index. A separate section on "How to Acquire Publications" gives information on ordering the cited publications. The bibliography is published quarterly. The yearly subscription price which includes handling and shipping is $US 90 in the United States and Canada and $US 98 in other countries. Pre-payment is required on all orders. Orders and inquiries can be directed to Kraus International Publications, One Water Street, White Plains, NY 10601. (TP + 1 914/761-9600; TELEX 6711564 KRAUS UW; FAX 914/761-9467)

Online information in Europe

This 1989 publication describes the electronic information community, its preoccupations, its background and its areas of controversy. The book covers the online market, the data base industry, demand for information, information personnel and intermediaries. It can be ordered from EUSIDIC (European Association of Information Services), 9a High Street, Calne, Wiltshire, England SN11 0BS. (TP + 44(0)249 814 584; FAX + 44(0)249 813 656) at a cost of £20 for EUSIDIC members and £35 for non-members.

A guide to standards by Albert L. Batik and distributed by the American Society for Testing and Materials (ASTM)

This guides is a clearly-written introduction to voluntary consensus standards, for the individual as well as the organization that puts standards on its agenda.

The "Standards Developers" chapter provides addresses and brief descriptions for a wide range of national and international standards development organizations. Other chapters include:

- The History of Standards
- Development of Standards
- Importance and Application of Standards
- Problems in Using Standards
- Correcting Standards Problems
- Involvement in Standards
- Critical Source Information.

Librarians, supporting information specialists, engineers, and anyone who needs to know more about standards and the standards development process will find this new book useful.

129 Pages (1990); Soft Cover, List Price: $12.00, ISBN 0-9622523-0-1, PCN: 13-500089-64. Available from the ASTM, 1916 Race Street, Philadelphia, PA 19103.

XI. SPECIAL ARTICLE

COMMERCIALIZATION OF INTEGRATED CIRCUITS IN DEVELOPING COUNTRIES

by

Dr. M.R.L.N. Murthy*

February 1990

Abstract

Means by which the commercialization of integrated circuits (ICs) should be introduced to the policies of the developing countries, emphasizing small- and medium-scale industrial products, as well as the technological capacities of the developing countries.

Introduction

Microelectronics - which refers primarily to integrated circuits (ICs) ranging from small-scale integration (SSI) to very large-scale integration (VLSI) - is recognized as a vital ingredient of electronics equipment and systems. In fact, continuous increases in the level of integration is leading entire subsystems and even systems to being fabricated on a chip a few millimetre square in size.

Models for growth

The semiconductor industry first developed in the USA, followed by Europe, with Japan entering the race much later. Recently developing countries such as South Korea, Taiwan, Hong Kong and Singapore have all launched major activities in microelectronics. The development of microelectronics in these

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countries can serve as a useful model for planning the growth of microelectronics in other developing countries as well as newly industrialized countries (NICs). Japan may serve as a better model than the USA.

The Japanese model is characterized by a strong government control (Ministry of International Trade and Industry - MITI) for co-operative growth. The success of this model is proven by the fact that six Japanese companies figured in the top 10 companies of the world in chip production in 1988, with the first three positions being held by NEC, Toshiba and Hitachi.

The South Korean model is characterized by the emergence of the four conglomerates, namely Samsung, Lucky-Goldstar, Hyundai and Daewoo, which together sold chips worth $US 1.2 billion in 1988. The South Korean firms cater to the low end of the market vacated by the USA and Japan.

For example, they are filling the gap for 256K DRAMs as the Japanese shift to the manufacture of 1 MB DRAMs. Taiwan, Hong Kong and Singapore are relatively new entrants into this arena, but are fast making a mark through a programme of liberal policies and incentives.

By the beginning of the 1980s, the USA and Japan had established off-shore production lines for low end technologies mainly to cut down on labour costs. NICs took this opportunity and started assembly lines. Later on countries such as the Philippines, Malaysia and others followed in setting up assembly plants. According to a world survey it is expected that electronics production in the USA will come down from 55 per cent of world production in 1984 to 35 per cent in 1993. Of this production, 11 per cent is expected to be taken over by the rest of the world (ROW). (See figure 1).

Scenario of the IC industry in developing countries

Patterns of development in developing countries

The patterns of development of the electronics industry of a few representative developing countries such as Brazil, India and Korea are described in this section.

In the late 1970s and early 1980s, the advent of a new generation of computers, based on a standard set of silicon microprocessors, transformed the organization of the computer industry. In the USA new companies gained a foothold by competing successfully with IBM on the personal computer market. Even more interesting from the point of view of those interested in industrialization, was the spread of computer production capacity to NICs. Among these, Brazil and Korea were the most successful. Since their success was based on very different models of state policy, industrial organization and economic strategy, comparing the paths they chose should not only help us to understand these two countries but also help us to understand the problems confronting other developing countries interested in participating in high technology industries, as well as the options open to them.

Latin America has a relatively closed and domestically oriented industry and the structure of both industries is the result of state intervention.

Korea had substantial, internationally-competitive, locally owned production of consumer electronics, including components and final products. Brazil had a very small, uncompetitive, locally owned consumer electronics production, but was the site of substantial manufacturing investments by foreign owned computer TNCs. Despite the differences in the magnitude of the installed base in the two countries, the sectoral distribution of computer use is remarkably similar. First in encouraging local manufacture and later in demanding exports to balance the imports used to generate local production and sales.

However, TNC domination of the local market also made it more difficult for local firms to emerge and is therefore connected to the second difference in industrial organization between the two countries, the relative historical weakness of local private capital in Brazil.

Korean firms have advantages over Brazilian firms mainly because of their overall experience acquired through years of manufacturing internationally competitive consumer electronics products in the synergistic linkages and conglomerate economies of scale they gain from operating in telecommunications, semiconductors and consumer electronics simultaneously, as well as in marketing and financial skills.

Historical dominance of TNCs within the Brazilian market has shaped its current computer strategies, so Korean strategies have emerged out of the historic strength of giant locally-owned chaebol in consumer electronics production. In both cases, State action has been important in supplying an impetus to move beyond the historic status quo. In Brazil, the State was, of course, responsible for creating the space in which local producers could grow. In Korea, the State is currently providing strong incentives for the chaebol to move beyond low margin commodity products into the more risky area of larger machines.

It would be interesting to look at the developments in Korea in relation to another developing country, namely India.

The higher dependence on exports has helped Korea to raise exports and the resultant inflow of foreign exchange seems to have enabled Korea to look for higher levels of technology, which in the international market is a costly affair.

The public sector units which dominated the scene in India had to fall back on the Government for subsidies. Moreover the higher imports and consequent drain on foreign exchange would have acted as a factor retarding the acquisition of higher levels of technology.

Indian public sector units show greater orientation towards basic research. The Korean counterparts do more "reverse engineering" i.e., replicating imported parts and equipment. However, as already noted, in the post 1980 period, Korean firms have shifted their emphasis towards basic research. The above strategy enabled Korea to build up much more technological learning than India.

Export oriented strategy, a large-scale operation with a product structure dominated by comsumer elctronics and components, and rigorous R&D effort beginning with inverse engineering and then shifting towards basic research, is the pattern of Korean development, which signaled success, in contrast to the Indian approach, although India's industrial scenario was much better than Korea's in the seventies.

Technological capacities of various developing countries

In this section reference is made to the technological capacities of some developing countries while discussing the industrial scenario. Korea is today undoubtedly in a strong position as regards technological capacities, especially with reference to the integrated circuits industry.

Countries such as India, Brazil and China have a tremendous industrial infrastructure and a highly talented technical workforce, yet they still cannot match Korea in its technological capacities, especially in microelectronics. Nevertheless, it should be admitted that the technological capacities of these countries are in general high and all of them have very good potential for assimilating microelectronic technologies.

With the advent of ASIC fabrication and design centre concepts, more developing countries could acquire IC technologies. Several Arab countries including Algeria, Syria, Tunisia, Iraq and Egypt have the technological capacities to work on ASIC fabrication centres along with design centres but they presently have to depend on a collaborator for sophisticated silicon foundries. Most developing countries would have the technological capacities to set up ASIC fabrication and design centres.

Technology trends

In the area of technology development, DRAMs and SRAMs continue to be the key technology drivers. 1-Mbit DRAMs are not used in the same fine line processing technologies as are 4-Mbit DRAMs, which are shipped in prototype quantities. The minimum feature size has been shrinking steadily. The cutting edge production technologies of today is around 0.5 micron and is expected to be around a quarter of a micron by the turn of the century. Another development which is close to commercialization is Gallium arsenide (GaAs) on silicon, which unites the high speed and opto-electronic capability of GaAs with the low material cost and superior mechanical and thermal properties of a silicon substrate. The CRAY-3 supercomputer presently under development is expected to use almost all GaAs circuits. Fujitsu is committed to using high electron mobility transistors in a mostly GaAs computer.

In the area of packaging, Tape Automated Bonding (TAB) is fast gaining ground. TAB takes up an area from a third to tenth of the size of most surface mounts while providing lead protection, burn-in and testability. In a different direction, research continues on molecular electronics to sense the bio-chip.

As regards the progress of ICs in developing countries, these fall broadly into two groups. First, those countries where sufficient technical infrastructure is available to absorb the IC technology and have made a start with some wafer fab or assembly lines and the second group where competence exists to establish design centres and which are in the process of setting up wafer fab. To review this industrial scenario, in the first category India has been selected as it forms a typical case of a developing country that could be representative for this category.

Development of microelectronics in the Indian situation

LSI technology is the driving force of computer technology and India must develop the right strategy to develop in this important area. Immediate thrust will be given for the manufacture of Bipolar ICs required for consumer and professional applications as well as focus on Application Specific ICs (ASIC), which are increasingly being incorporated into electronic systems. In the case of both digital CMOS, Bipolar and composite integrated circuits, Application Specific ICs capability based on a cellular design approach is considered suitable.

Wafer level system integration will be the way the electronics industry will grow in times to come, due to the extraordinary advantages in quality, reliability, compactness, speed and reduced power loss. ASIC capability involves a system design of devices on specially created workstations. The merits of this design is density of packing, minimum pinouts and simplicity of layouts.

India has the companies of Semiconductor Complex Ltd. (SCL) and Bharat Electronics Ltd. (BEL) as the primary fabrication and design facilities. The country's major strength will, however, be in wafer level integration of circuits and systems, with the thrust on promoting ASIC design centres using state-of-the-art workstations and creating multi-user cell libraries.

Design chips could be fabricated either at SCL or BEL or other national experimental facilities such as Indian Telephone Industries (ITI), depending on the application and complexity. The finer geometry application could be contracted through suitable foreign fabrication facilities, till it becomes cost effective to create additional fabrication facilities or when demand grows large enough in the domestic and export market.

Current status

Current annual IC production is around 11 million silicon numbers valued at $US 8 million. It is estimated that the import of ICs into India in 1987 in various forms viz., chips, chips on boards and chips as part of subsystems, was around $US 50 million. The total percentage of semiconductors in Indian electronics equipment is around 5 per cent as compared to the international average of around 12 per cent.

Manufacture of MOS ICs, was until recently primarily carried out at the Semiconductor Complex Ltd. (SCL) before the device manufacturing and process R&D facilities were destroyed in a fire in February 1989. Bharat Electronics Ltd. (BEL), Bangalore, primarily manufactures bipolar ICs. In the private sector, ICs of the SSI/MSI complexity are manufactured by the Hindustan Conductors Ltd. and Greaves Semiconductors. Spic Electronics Ltd. (SPEL), Madras, is essentially an assembly operation based on diffused wafers procured from abroad.

Microelectronics demand, production and exports

The Indian electronics industry is characterized by a microelectronics demand for a large variety of ICs in small quantities for commonly available and diverse circuits, designs and equipment, and systems based on imported know-how and components. It is estimated that for production of equipment worth $US 12 billion in the year 1994-1995, the demand for ICs would be about $US 650 million. Economies of scale would rule out meeting the entire demand for ICs through indigenous production. Current consumption and production data for microelectronics indicates that about 80 per cent of the IC demand in 1988 was met through imports. It is therefore felt that about 50 per cent of the demand in 1995 and also in the year 2000 would still be met through production. It would be possible to create an industry with large exports of about $US 300 million in 1995 and $US 1 billion in the year 2001.

These export targets might appear over ambitious, but they are considered necessary from the point of view of economic viability and also in the light of the Government's drive to curb foreign exchange drain due to the import of ICs. By the turn of the century, the microelectronics industry in India could be targeted to export more ICs than they import. The key ingredient for realizing this objective would be to provide all inputs to the microeletronics industry at near international levels, including interest rates, short- and long-term loans, along with preferential access of foreign investors to the Indian market through fiscal incentives.

Summary of the Indian situation

With all the basic technical infrastructure, manpower, R&D facilities and two semiconductor plants, commercialization of ICs has not been achieved. For India, the establishment of several ASIC centres with the support of one large silicon foundry on an economic scale of operations would be a better alternative for the commercialization of ICs.

Various developing country policies

The following are policies of various developing countries. Excerpts from the industrial policies of those countries relevant to the present context of commercialization of ICs are presented hereunder.

Philippines: The Department of Trade and Industry has initiated the formulation of ten-year industry sector plans for ten industry sector groups, including electronics/telecommunications, which is being pursued with maximum private sector participation. The plan also endeavours to strengthen the link between small and large enterprises through the promotion of common facilities and services and the promotion of subcontracting arrangements.

Thailand: The main industrial policy directions were the promotion of export oriented industries and the dispersion of manufacturing industries to provincial areas. The present policy for the VI Plan for 1987-1991 identified three major groups of priority industries:

(i) Export oriented industries; (ii) small and rural industries or industries located in areas outside Bangkok and its surrounding area; and (iii) engineering industries.

Exporters are financially supported by the rediscounting facilities of the Bank of Thailand and the newly established Export Development Fund. An export credit guarantee scheme is in the planning process. The Thailand Institute of Scientific and Technological Research (TISTR) functions under the Ministry of Science, Technology and Energy.

The TISTR management perceives the Institute's role as primarily that of an industrial research organization by adopting a quasi-commercial approach in providing specific assistance to Thai enterprises as well as guidance to the industrial sector regarding its potential development, e.g. through effective local resources utilization, and appropriate use of technological advances such as genetic engineering and biotechnology, microelectronics and solar energy.

Indonesia: Until recently a striking feature of Indonesian industrialization strategy has been its almost complete orientation towards the domestic market. However, now Indonesia has started emphasizing its exports. Export industries tend to be labour-intensive in Indonesia and therefore the emphasis on export oriented strategy is preferable for employment reasons. However, the structure existing for exports could be utilized to increase the country's export of assembled ICs, along the lines of the NIC countries.

Argentina: In 1977 the Government passed a new transfer of technology law which instilled a greater flexibility into the previous system controlling licensing contracts. In 1981, the new law was replaced by a system which virtually abolished State intervention in this field. Contacts between independent firms no longer require State approval, while those between parent and subsidiary companies are only subject to control in regard to royalty levels.

This atmosphere is conducive for the establishment of package industries with relatively high foreign investments.

Pakistan: The country is facing competition and is seeking a higher share of the world market by means of a stronger orientation towards export-led industrialization requiring, amongst others, progress in tariff rationalization, modernization of production, quality control and standardization efforts.

Furthermore, the Government has implemented new guidelines oriented towards improving the private sector's access to foreign currency resources and towards facilitating the transfer of modern technology from abroad. These new guidelines formulate specific standard conditions which, if they are adhered to, will subsequently no longer require clearance of foreign credits or royalty and technical fee agreements by the State Bank of Pakistan and the Ministry of Finance.

Malaysia: "Privatisation", a conscious attempt to reduce the relative size of the public sector and promote a new relationship between Government and business, is strongly influenced by what is perceived as the Japan (and Republic of Korea) "model" and also involves the gradual transfer to of private ownership and management of such public enterprises as railways, ports, airlines, telecommunications and other infrastructure services such as car parks and housing schemes and the establishment of Malaysian trading companies to handle export promotion more efficiently, on the model of the Japanese "sogo shosha".

Bangladesh: All public manufacturing enterprises since 1987 have been subject to commercialization and a comprehensive policy reform package with the objective of developing an integrated planning, budgetary and performance evaluation system is being developed through a UNDP-financed project within the context of RIP.

Dismantling of control and a generalized reduction of policy intervention is expected to permit the inherent dynamism of private enterprise to generate growth, increase foreign exchange earnings and inflows. The new policy packages have been developed with the close collaboration of international financing agencies.

As can be seen from the policies of the various developing countries mentioned above, they by and large stress and address themselves to the liberalization of rules to increase exports. The suggested means of commercialization of ICs such as ASIC centres and the setting up of assembly lines, as presented in the next section, are suitable to the new policies of these countries, which encourage exports and tie-ups with foreign collaborators for the acquisition of suitable technologies. As mentioned earlier, exports would not only help obtain foreign exchange but also establish international quality and prices, a yardstick for the commercialization of ICs. This, incidentally, increases the potential of these countries to take up the production of high technology products in the course of time.

Recommendations to realise commercialization of integrated circuits in developing countries

After a brief survey and analysis of the existing industrial scenario of ICs in various developing countries, as well as a study of the policies and technical capacities of various countries, the following recommendations are suggested:

- ASIC fabrication and design centre
- Establishment of consortia by developing countries for the setting up of wafer fabs and assembly lines
- Thrust on exports by creating the proper climate and liberalization of controls
- Establishment of assembly lines for ICs and focus on assembly of high technology devices at some point in the future
- Human resource development to update technology levels
- Establishment of feeder industries to manufacture raw materials in the small- and medium-scale sectors
- Vertical integration to manufacture equipment and a system to attract the market
- Identification of IC products for local needs for a given country and market survey
- Monitoring production yields, quality and extension of preferred export support.

Commercialization of ICs depends very much on an appropriate technology base, production base and market, both domestic and international. These relevant points are discussed within the context of developing countries.

ASIC fabrication and design centre

Conventional wafer fab requires a high level of technology, capital investment and market demand to match the output of the wafer fab with an economic scale of operations. Considering these factors, it seems that commercialization of ICs using such silicon foundries is unrealizable by many of the developing countries because of financial constraints. The rapid changes occurring in semiconductor technologies could be insurmountable hurdles. The ASIC route could be encouraging in such a scenario.

ASIC - Application Specific Integration Circuit. ASICs have a special relevance to developing countries since their electronics industries are characterized by the requirements of a large number of different circuits in small quantities.

ASICs permit an equipment or system designer to create an IC to suit his specific needs. This certainly leads to higher reliability, reduction of volume and finally a less expensive end-product as compared to designing a product with standard IC parts. ASICs are the fastest growing segment of the microelectronics industry and the trend is expected to continue because they provide security of design and competitive advantages in both cost and functionality.

Features of ASIC

- Low to moderate level of investment
- Design intensive
- Phasing of technology development for ASICs is more conducive than conventional VLSI technology
- Plays a vital role in supplying the much needed special ICs in professional equipment, defence and control electronics

ASICs are generally classified into programmable logic devices or arrays (PLD/PLAS), semi-custom ICs and full custom ICs.

Briefly, the ASIC involves design, standard cells or gate arrays, metallization masks, interconnects and packaging.

An ASIC centre can process all the steps and has only to buy standard cells or arrays from silicon foundries. ASICs are usually cost effective in the range of 1,000 to 100,000 pieces.

ASICs are a fast growing segment of the microelectronics family, as the microelectronics contents of systems are increasing and ASICs continue to provide a competitive advantage in both cost and functionality.

According to the findings of Dataquest, every dollar's worth of ASIC's sold generates a microelectronics sale of $US 5 and system sales of $US 30.

High volume customer specific products such as watch chips, microprocessors and controllers have the potential of developing new markets and producing good profits.

A low-cost PC system development effort should aim for a low price, of $US 200 to $US 250, which could be achieved by designing and fabricating ASIC glue chips or chip sets that can replace a large number of chips on the mother board. This can be realized by developing countries such as India, Brazil, China etc. Similarly, each country could develop special ASICs for need-based products, be it a watch, toy, medical electronics or an item identified as the commercially exploitable product of that country.

Establishment of a consortium by developing countries for wafer fabs

The option available is to set up a reasonably good wafer fab with current technologies, with a 1 to 1.5 micron feature size and an economic scale of operations with a matching packaging facility, which is extremely expensive and normally beyond the reach of many developing countries. However, the need for electronic devices containing ICs is increasing fast in every country and in all sectors: consumer, telecommunications, professional equipment and defence.

The unacceptable alternative to this investment is a continual financial drain on foreign currency reserves year after year.

The proposed solution for such a situation is to set up a consortium silicon foundry by like-minded countries. While this may perhaps sound strange in the field of electronics, this is an accepted norm resorted to by several European countries where they have established consortia in the fields of science and technology, be it a synchrotron laboratory, nuclear reactor for fundamental research or other centres for advanced research.

The reason for starting such consortia is again the inability of a single country to set up such advanced research centres which involve huge investments.

A world class silicon foundry could be established by a consortium of five or six neighbouring countries. Each country should have its own ASIC fabrication centres. The ASIC centres of member countries can order their standard cells and arrays from the silicon foundry and fabricate the products required for their own countries. This would enable the member countries to have both standard ICs and ASICs.

This arrangement not only leads to a successful commercialization of ICs, but also provides a unique opportunity for training of manpower and updating the technology, as well as creating the possibility of exporting certain ASICs. Since both talent and funds are pooled, a continuous upgrading of technology and moving from right to left of the cycle of the IC curve is possible. (See figure 2).

Thrust on exports by creating the proper climate and liberalization of controls

Export market: Acceptability of the product is one of the chief requisites for commercialization. It can take a long time to establish acceptability in the domestic market. However, once acceptability is achieved on the international market, even to a limited extent, it becomes far easier for the same product to be sold on the domestic market.

When a product is sold on the international market, especially in countries such as the USA, Japan or those in Western Europe, the credibility for quality is established which in turn can generate a larger domestic market.

Export information: It is not easy for a busy buyer abroad to obtain reliable and up-to-date information on sources of supply in a particular country. Thus that country can lose export opportunities by default for the simple reason that trade information is not easily available, even in international cities such as Hong Kong, or to persuade a serious prospective buyer to invest time and money on a visit to the country in order to explore sources. A certain amount of reliable and concrete information should be made available to the prospective foreign buyer.

Establishment of assembly lines for ICs and focus on assembly of high technology devices in future

Low-end technologies such as IC assembly lines have been established by the USA and Japan in third world countries to take advantage of low labour costs. It is well known that such operations in developing countries, especially those around the Pacific rim, such as Korea, Taiwan and Hong Kong, resulted in an instant success in the commercialization of ICs. Other countries, such as the Philippines, Malaysia and Thailand have also set up assembly lines. It is however important that an economic scale of operations be adhered to for commercial success.

For some small developing countries which cannot form a consortium, the best option would be to set up an assembly line and continue to take up high valued ICs and memories, moving from right to left of the IC cycle curve. Maintaining exports is the key factor for success. Thus government support when creating a proper business climate is very essential.

Human resource development to update technology levels

IC technology is not only a sophisticated technology, but it is known for its obsolescence. Links between IC industries and academic institutions, as well as R&D laboratories are essential in order to establish a good rapport and generate skilled manpower, assimilate and update technologies that can help the move into high technology and value-added products.

Establishment of feeder industries to manufacture raw materials in the small- and medium-scale sectors

To ensure the commercial success of an IC industry, the developing countries should set up a programme to reduce imports of raw materials by developing and manufacturing semiconductor materials, such as high purity chemicals, gases, photo-resist materials, epitaxial wafers and substrates. This will ensure availability of the much needed materials for the production of ICs and provide the cutting edge by reducing production expenditure.

Vertical integration of manufacturing equipment and a system to attract market pull

One of the most important factors for commercial success is market pull. There is a need for equipment and designers to guide the microelectronics industry in a profitable direction. It should be recognized that the value added is significantly greater in the process of integration of electronics components in equipment and systems. As explained earlier, an ASIC of one dollar results in 30 dollars' worth of system. This aspect of vertical integration can boost the commercialization of ICs in developing countries such as India, Brazil, China, etc., where there is a substantial technical infrastructure and a good level of equipment manufacturing capabilities exists.

Market and technology survey

A sectoral market survey of electronic products and systems for the region is an essential part of defining both a system and component development strategy.

The survey should cover electronic products and companies in consumer electronics, communications, computers, controls and instrumentation, in terms of both imports and local production.

The existing facilities may need to develop greater flexibility in incorporating a more diversified product mix. New designs may have to be introduced that are compatible with the existing technology, and current designs being produced should be enhanced.

Collecting and disseminating information on electronic and microelectronic activities in the respective country and assistance in carrying out the proposed market survey would be a worthwhile exercise at the first stage.

Application specific ICs, when they are properly identified, may present a good market, since in their case the cost is calculated not in terms of ICs alone, but other factors as well: design efforts, value added, etc.

Developing countries should establish a R&D line, or pilot line, to try out various processes, optimize production parameters and introduce innovations, manned by experienced and skilled personnel to thoroughly study the product and parameters.

Products for local needs

A good understanding of local needs and the ability to respond to local needs with specific microelectronics applications, form an important component for commercialization.

Specific designs developed locally may offer the best response to more pressing national needs; examples for such applications could vary in different countries. It could be a PC, TV or radio in countries such as India and China, with watches, calculators and souvenirs in tourism-based countries. Bilingual equipment such as terminals, PCs and printers are, of course, immediate needs in several countries.

It is known that there are both bipolar as well CMOS facilities in a number of developing countries, including India, Iraq and Algeria, to name a few, which for various reasons are under utilized. In most cases it is because of a wide ranging product mix while the products in demand are not required in large numbers, resulting in an uneconomical scale of operations of the wafer fab. This can best be remedied by pooling the various needs of the neighbouring countries, resulting not only in viability, but also in the commercialization of several products. The idea of pooling the needs of various developing countries by way of a consortium is explained elsewhere in this article.

Commercial success depends to a large extent on the demand for a manufactured product

Monitoring production yields, quality and extend export support of selected industries

A node agency could be set up as part of a governmental body whose functions would be to monitor and evaluate the parameters, such as production yield, quality improvement, consistency in the various batches of production and deliveries. Based on these evaluations, a company could be chosen and given incentives for expansion, in order to help provide the most needed organizational support to gain a competitive edge on the internal market. Even if a single company gets considerable assistance in realizing a commercial success on the international scene, it would set a fine example to be followed by others in order to achieve the same status.

This would also generate a competitive spirit, as well as make the entrepreneur clearly understand the criteria necessary to obtain government support for commercial success, either on the domestic or on international markets. This would greatly help in creating the much desired objective for achieving quality and optimum cost.

Export is extremely important, not only to earn much needed foreign exchange, but also to achieve international quality and prices for the product, while paving the way for the acquisition of higher technologies to manufacture sophisticated devices. The country aiming for the manufacture of high-grade devices, not only overcomes the inherent obsolescence in this rapidly changing field, but also attains a status by which it can continue to earn foreign exchange and keep updating the technologies, thereby moving from right to left of the IC cycle curve, as indicated in figure 2.

Products from medium- to small-sized industries

An analysis of the cost structure of the semiconductor industry indicates that especially in developing countries, over 55 per cent of the sales realization goes towards the procurement of imported raw materials. Thus the developing countries invariably siphon off more funds to the developed countries.

In developing countries such as India where the technical infrastructure and R&D facilities are available in various national laboratories, a significant programme for indigenous development and manufacture of raw materials and equipment has to be set up. The following is a list of raw materials that can be produced in medium-sized industries:

- Special ultra pure gases
- Ceramic packages
- Quartz ware
- Emulsion and chrome mask blanks
- Fine wires
- Lead frames
- Photo resists
- Epoxies and silicones.

The norms for medium-scale operations differ from country to country. However the raw materials presented above fall into the class of medium-sized industries. It is necessary for countries with an advanced technical infrastructure to set up such industries in order to save foreign exchange and provide easy access for the raw materials required for semiconductor devices.

It is generally believed that economies of scale do not justify the local manufacture of equipment for a semiconductor industry. However, sophisticated equipment, such as diffusion furnaces, bonders, metallization systems and moulding tools, are generally hand assembled with purchased and subcontracted parts in medium-sized companies.

With labour cost being much lower and the ensured value addition gained by assembling and integrating the systems with imported sub-assemblies and parts, considerable foreign exchange is saved. The capital equipment could be made available at far less cost when compared to imported value by establishing medium-sized industries to assemble equipment.

The savings in semiconductor equipment costs, as well as foreign exchange, would to a large extent contribute to the commercial success of the industry.

Design centres and software

ASIC centres are growing rapidly all over the world. Design centres and software shops can be developed as feeder units to ASIC centres. A design centre need not be the monopoly of a big semiconductor house. With a modest investment of $US 30,000 to $US 40,000, one can build a design centre to design a gate array. A design centre can work towards replacing a lot of boards with many components by a single ASIC chip, thereby reducing the system size, improving performance and reliability and particularly reducing manufacturing costs.

Design centres, software packages and work stations are some of the crucial cost saving sectors which are within the scope of small-scale industries.

Conclusions

Many developing countries have developed IC technologies, some of them on their own and a few by collaborative efforts. However, the majority of countries failed to establish bipolar and CMOS silicon foundries at economic scales of operation, resulting in unsuccessful commercialization of ICs, with notable exceptions such as Korea, Taiwan, etc.

With the development of ASIC there is new hope for these countries to commercialize ICs. In the opinion of the author, there are three main strategies that could be employed to realize commercialization of ICs in developing countries:

1. Develop ASIC centres with the support of one major silicon foundry working at an economic scale of operations in the country or collaborate with a large foreign silicon foundry.

2. A consortium: A conglomerate of five or six developing countries should form a consortium to set up a major silicon foundry with each country having its own ASIC centres.

3. Promote an aggressive export policy and take advantage of setting up assembly lines for ICs offered by developed countries and later on enter into high technology ICs.

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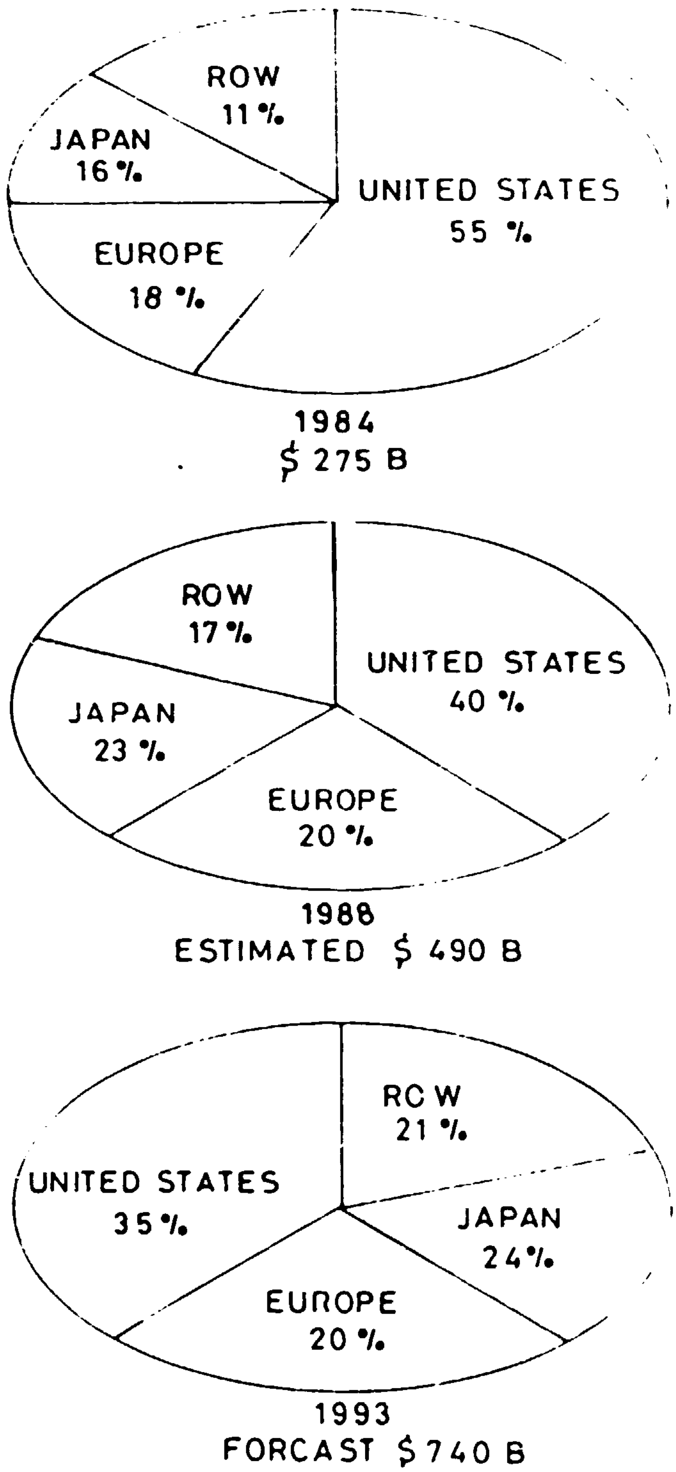
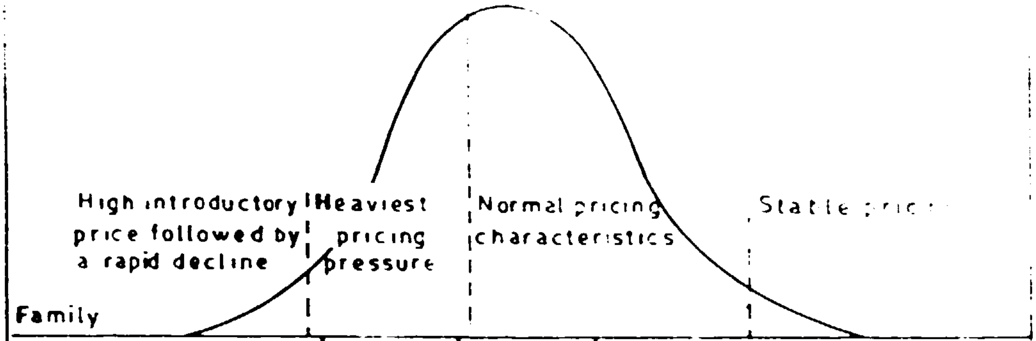


FIG 1 WORLDWIDE ELCTRONIC EQUIPMENT PRODUCTION



Family	INTRODUCTION	GROWTH	MATURITY	SATURATION	DECLINE (OBSOLETE)
RAMS	1M DRAM	256K DRAM	64K SRAM	16K DRAM	4 K DRAM
	256 K SRAM	64K SRAM	16K SRAM	4K SRAM	1 K SRAM
	64 K ECL SRAM	16 K ECL SRAM		4K ECL SRAM	1K ECL SRAM
ROMs	1M ROM	256K ROM	64K ROM	16 K ROM	4 K ROM
	4M ROM	512K ROM	128K ROM	32 K ROM	
	54 K PROM	32K PROM	16K PROM	8K PROM	4 K PROM
	1M EPROM	128K EPROM 256K EPROM	64K EPROM	32K EPROM	4 K EPROM 16 K EPROM
	64K EEPROM	16 K EEPROM		4K EEPROM	1 K EEPROM
		32 K EEPROM			
MPUs	32-bit MPU MPU-EEPROM	16-bit MPU	8-bit MPU		4-bit MPU
		DSP Single chip	DSP chip set		
Logic	EPALs EEPALs	ASTTL LSTTL ALSTTL	STTL CMOS logic	TTL	
Linear	CMOS op amp	Monolithic A/D Monolithic D/A Switching voltage regulator	Hybrid A/D Hybrid D/A BIFET op amp Series voltage regulator		Bipolar op amp
GaAs	1K SRAM Gate arrays	SSI, MSI logic MMIC			

DSP digital signal processor.

FIG.2 _ IC LIFE CYCLES

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