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Special in this issue: An article on cooperation between science, state and industry - the research institute for application-oriented knowledge processing (FAW - Ulm) by Drs. D. Karagiannis and F.J. Rademacher.

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I. NEWS AND EVENTS

TIPS on locating developing country partners

TIPS, an information service run by the United Nations Development Programme (UNDP), which is aimed at expanding technology and trade transactions of developing countries, can assist companies seeking developing country partners.

TIPS offers daily bulletins on different sectors and a query service to match supply and demand. The sectors covered are: agro-industries, biotechnology, building materials, business opportunities, chemicals, electronics, energy, fisheries, food processing, machinery, mining, packaging, pharmaceuticals and textiles.

A database containing more than 35,000 records on North-South offers and requests is maintined by TIPS. Its national offices, which are in daily contact with companies, are based in countries whose populations represent more than two thirds of the global developing country population. It opens a window on a very large market.

Companies wishing to have their requirements registered in the TIPS database and featured in its bulletins should get in touch with their nearest TIPS office or the following address: TIPS, Via Panisperna 203, Rome 00184, Italy. (Tel.: +39 6/482 6967; Fax: +39 6/482 8838). (Source: ACCIS Newsletter, 9(2), July 1991, page 4)

Environmental Health Information Network

The World Health Organization's Regional Office for the Eastern Mediterranean runs a Regional Centre for Environmental Health Activities (CEHA), which in 1988 launched an Environmental Health Regional Information Network (CEHANET).

Supported by the Canada-based International Development Research Centre (IDRC), CEHANET has been characterized as a "mission-oriented" regional information system. A formal structure has been established, with institutions functioning as national focal agencies and collaborating centres. The ultimate goal of the project is to establish a financially sustainable information network for the countries of the Eastern Mediterranean Region.

Systems and tools have been developed, including the Arabic Interwater Thesaurus, a CEHANET procedures manual, and criteria for the selection of materials for inclusion in the CEHANET database. Bibliographic control is managed using CDS/ISIS. Copies of the database are distributed on diskette to national centres that use the same package.

CEHANET services include the regular publication and distribution of: CEHA Contents - bimonthly current contents of journals in the CEHA library; CEHA Newsletter - quarterly; Environmental health regional bibliography; Regional directory of environmental health professionals and institutions - updated as needed; special bibliographies on current environmental health issues.

Document delivery and photocopying services are also on offer from CEHA, which in addition trains environmental health library and documentation staff in the countries of the region through regional and national training workshops. Furthermore, it provides access to external environmental health databases through on-line links and CD/ROM.

For further information, contact: Coordinator, WHO Regional Centre for Environmental Health Activities, PO Box 926967, Amman, Jordan. (Tel.: +962 6/827535-36; Fax: +962 6/827533; Telex: 23447 WHOEM JO). (Source: ACCIS Newsletter, 9(2), July 1991)

UNCED Information Service

The UNCED (United Nations Conference for Environment and Development) Secretariat is setting up an information service that will play an important part in preparatory work for its conference in Rio de Janeiro, Brazil. The UNCED Information Service (UIS) will include information about the major ongoing and planned activities on environment and development in various international organizations.

The UIS database will also hold information on organizations, their activities and related documentation, and will be categorized according to the issues and cross-sectoral objectives to be considered by the Earth Summit in 1992. The database is expected to have a key role in the preparation of Agenda 21, a document which is supposed to define and describe what human beings want from their environment and how they expect to develop.

UNCED expects that the database will hold information not only on the various organizations within the UN system, but also on all other relevant national and international organizations. The database will be accessible via modem and will allow for other kinds of electronic communications and conferencing. Non-computerized media will also be used to disseminate information to those without computers. For further information, contact: Janos Pasztor, United Nations Conference on Environment and Development, BP 80, 1231 Conches, Switzerland. (Source: Network '92, March 1991)

IBM brings copycats in from the cold

IBM, the American computer giant, has offered Eastern Europeans a way to legalize "pirate" copies of software for IBM mainframe computers. Until the end of October users could pay IBM a fee of DM 10,000 (£3,000), which will legalize pirate software until 1993. Alternatively, pirated programs can be exchanged for legal software and IBM support services at about 30 per cent of the normal price.

Pirate programs are more common than legitimate ones in Eastern Europe, partly from necessity: software for the IBM 370, the computer system covered by IBM's proposal, was until recently prohibited for export to all Eastern European countries except Yugoslavia. Now exports are legal, but prices for legal software still discourage Eastern European users.

IBM's offer is designed to make honest customers of potentially big buyers. Other computer companies express doubts, however. The American software company Microsoft has abandoned such amnesties in its efforts to control piracy. (This first appeared in "New Scientist", London, 27 July 1991, the weekly review of science and technology)

The US and Japan sign new semiconductor trade pact

A recently-signed US-Japanese trade agreement is targeted at opening at least 20 per cent of the Japanese chip market to foreign competitors by the end of 1992.

The Semiconductor Industry Association (SIA) praised the new agreement. The SIA said the accord will eliminate the foreign market value system for setting IC prices. It also creates a "fast-track" deterrent to dumping. The new pact runs for five years. At the end of the third year both Governments will decide whether to keep or end the agreement.

The pact was effective 1 August 1991. It replaces a previous one adopted in 1986. Its principal guidelires address the 20 per cent market share and a fast response to dumping allegations.

In October 1990 the SIA and the Computer Systems Policy Project (CSPP) jointly presented the US with a proposal for a new agreement. This signalled the first time that device suppliers and their major customers worked together to design and advocate a common trade initiative.

A subtle benefit of the agreement is that it will empower Japanese managers to take a closer look at US products. The US Government is charged with monitoring progress on the pact. Ultimately, the openness of the Japanese market hinges on how willing Japanese buyers are "to consider American semiconductors when designing their products". (Extracted with permission from Semiconductor International Magazine, August 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

US plans global virus swat team

An international security alliance is being formed in the US to foil computer hackers and virus authors.

The US Government is studying a proposal put forward by leading US Government agencies that would involve Government agencies in France, Canada and Australia in an alliance sharing security information. IBM, DEC, and Unisys would also be involved.

The US State Department is expected to issue approval for US Government agencies to be involved with foreign government agencies.

The idea for the international alliance first arose at a meeting between computer security experts at NASA and the US Department of Energy in late 1989. The two organizations were battling against a virulent virus released by a group called Worms Against Nuclear Killers. Other US Government agencies including the Defense Communications Agency, the National Institute of Standards and Technology, various US law enforcement agencies and major network users such as Boeing and Carnegie Mellon University want to join the group. The French Space Science agency and government agencies in Canada and Australia also want to be part of the alliance.

The alliance plans to offer membership to US and foreign organizations provided that the founder members approve. It also wants to share ways of improving computer security, prevent infection from virus programs and stop unauthorized access.

The alliance itself is still trying to figure out a secure way of sharing sensitive information without it getting into the hands of hackers. (Source: Computing, 13 June 1991)

Japan's thinking computer goes on show

Japanese computer scientists demonstrated a powerful computer designed to handle concepts and symbols rather than simply crunch numbers as most computers do. The computer, unveiled at the International Joint Conference on Artificial Intelligence in Sydney, is one of the ultimate products of Japan's ten-year-long fifth-generation computer project. But it falls short of the goals set at the beginning of the project: computers that could understand natural speech and respond to imprecise information using their own knowledge databases.

Scientists from the Japanese Institute for New General Computer Technology (ICOT) developed the computer, known as the Parallel Inference Machine (PIM). The software to run the machine in real situations has not yet been developed, but Shunichi Uchida, ICOT's research manager, says the PIM demonstrates that true fifth-generation computing is attainable.

Some scientists, however, doubt the value of pursuing fifth-generation computing. The sceptics believe that the real challenges are in developing software for real applications.

The system displayed by Uchida and his colleagues in Sydney consisted of a PSI-3 computer workstation, designed to work with the PIM, which was linked to the PIM computer in Tokyo by satellite through Internet, the international computer network.

The PIM is a so-called massively parallel computer - it handles tasks by dividing them up between a large number of identical processor chips. Most computers are serial: they have a single processor which carries out instructions one after another in quick succession.

The PIM has 1,000 processors, which together can perform 200 million logical inferences per second, or Lips. Previous PIM prototypes were capable of only 5 million Lips. A Lip is roughly equivalent to 100 instructions on standard computers.

While the PIM was designed by ICOT scientists, it was built by Fujitsu. Five experimental PIM prototypes are under development at ICOT, each with a different computer architecture so that scientists can compare them.

At present, a team of 30 Japanese scientists is in Canberra installing two PSI-3 workstations at the Australian National University (ANU) as part of a one-year agreement to try out the PIM in a working research environment. The ANU machines will be linked to the PIM in Tokyo. Similar agreements are in place between ICOT and three US institutions.

According to Uchida, these collaborations form part of ICOT's strategy of internationalizing its research. He sees this as an important component of the next five-year phase of the fifth-generation project, which is now under negotiation. (This first appeared in "New Scientist", London, 7 September 1991, the weekly review of science and technology)

Superconductivity "theory" proves a dud

A theory which has been widely used to explain superconductivity at high temperatures has been disproved, according to some of the world's leading experts in the field.

Allan MacDonald, from Indiana University in the US, and Dung-Hai Lee from the IBM Laboratory at Yorktown Heights, told a workshop in Sydney that the results of four recent experiments in the US had all disproved the so-called anyon theory to explain superconductivity.

The anyon theory proposed that there were tiny energetic particles, named anyons, which carried electric current without resistance along the layers of copper oxide contained in superconductors. However according to MacDonald, experiments have shown that the anyons did not exist.

Peter Fulde, director of the Max Planck Institute of Physics in Stuttgart, says that theories of high temperature superconductors are now back at the beginning. (This first appeared in "New Scientist", London, 20 July 1991, the weekly review of science and technology)

II. NEW DEVELOPMENTS

Computers face up to "Grand Challenges"

Parystec (Aachen, Germany) will build a supercomputer that can operate at about 0.5 teraflops, i.e., a million million calculations/second. A computer that could perform at teraflop speeds could simulate the human brain, model Earth's climate or model the flow of turbulent liquids or process the information in the Human Genome project. These massive tasks are known as "Grand Challenges". The firm hopes to develop modifications that will allow it to produce a true teraflop computer by the end of 1993. (Cray Research has announced its goal of producing a teraflop computer in 1994.) The new computers would be a thousand times faster than supercomputers now available. They will be massively parallel computers. The half-teraflop computer planned by Parystec will use 16,000 transputers. The full teraflop computer will have over 65,000 processors. The same basic design will be used by Parystec for computers of a variety of sizes, for various customers and applications. The T9000 transputers used in the computer will transmit packets of information linked to an address. The packets will be able to take any route available to reach their destinations. The previous generation of transputers required preset routes. The T9000 transputer has not gone into production yet, but Parystec hopes to have enough transputers available to build 30 of its GC-S/16K computers in 1992. (Extracted from New Scientist, 29 June 1991)

Scientific supercomputer

IBM has launched a scientific supercomputer that can handle 2.5 billion calculations/s. IBM's Power Visualization System uses a parallel arrangement of 32 Intel i860 microprocessors for its computing power. The unit quickly retrieves information using an array of disk drives. IBM set up a 'skunk works' team consisting of several scientists and computer designers in January 1989 to speed development of its visualization system. The team received their own venture financing and independent management. As a result, the new computer was developed in two and a half years, much quicker than other projects of similar complexity. The company's visualization system allows scientists to manipulate data in ways previously unattainable by generating images in minutes instead of days of computing time. The system has been used by Honda engineers to instantly see the effects of changes in design for new cars. IBM's system has also been used by scientists to study the deterioration of the Earth's ozone layer via computer animation. (Extracted from New York Times News, 25 July 1991)

Molecular computing research

The US Naval Surface Warfare Center is researching molecular computing, which could result in small, energy-efficient devices with a large amount of computing power. The Navy research is focusing on bacteriorhodopsin, a light-sensitive chemical, with the aim of developing a spatial light modulator that would be a key part of future optical computers. The Navy feels molecular devices could be used for holographic memories, which store 3-D images in optical computers. Such a device would have applications in the Tomahawk missile guidance system. (Extracted from Defense News, 1 July 1991)

New cooling technologies under development

As electronic devices become smaller, more densely packed and faster, new cooling technologies are also being developed. Standard heat dissipation schemes are insufficient for cooling of new generation computers and other electronics, so technologies including embedded micro heat pipes, actually individual heat pumps offering cooling several times more efficient than conventional convective methods, have been developed. Solid-state thermoelectric coolers made of a set of semiconductor couples can be connected in cascade fashion to provide a wider temperature differential.

MMR Technologies (Mountain View, California) has produced an open-loop nitrogen gas device, an example of a microchannel cooling method in which a coolant is passed through approximately 50-micron-size channels cut into the chip. 3M (St. Paul, Minnesota) has devised a liquid heat sink in which a high dielectric fluid is sealed in a multi-layered flexible plastic bag that can be

pushed against a circuit board and provides protection from mechanical jolts as well as dissipating heat. Jet impingement is another cooling method, offering heat transfer coefficient increases up to an order of magnitude compared to conventional convection. Direct immersion and liquid cold plates have also been employed, as well as schemes that use two or more of the new methods. (Extracted from Machine Design, 11 July 1991)

New cooling system may permit use of superconductors in PCs

Fujitsu Laboratories has developed a cooling system that might allow the use of superconductors in personal computers. The system will allow superconductors at -296°C to work in close proximity to semiconductors operating at room temperatures. The new system places the semiconductors around and below the cryostat used to keep the superconductors cold. (Extracted from New Scientist, 6 July 1991)

Nanoelectrics

Nanoelectrics - in which transistors are "grown" in silicon - is the future of semi-conductor development. Scientists are making materials and devices by piling up elements in layers as thin as a single atom. Tiny transistors can thus be packed tightly, which allows for the development of powerful circuits that run faster than current chips. As semiconductors get smaller, scientists will have to deal with the phenomenon of "quantum tunneling", which occurs when electrons pass through solid matter and electrical barriers that, in bulk materials, would be thick enough to prevent their passage. Quantum transistors will be so small that they cannot be made of bulk materials. In theory, their switching speeds would be a thousand times faster than anything currently available. A technique called band-gap engineering appears to be the best way to harness quantum electronics. Such engineering seeks to control the orbit, or band, of an electron so that it jumps to the highest orbit, where it can conduct electrical signals. (Extracted from Business Week, 29 July 1991)

Atom-mover opens era of nanoelectronics

A new era of semiconductor micro-electronics could soon be opened up by a technique that has been developed by scientists at the IBM Research Division for manipulating individual atoms of silicon.

Using a scanning tunnelling microscope, the scientists have successfully removed both individual and clusters of silicon atoms from a surface, and subsequently deposited them at a predetermined site.

According to IBM, the new technique opens up the possibility of constructing electronic circuits out of individual components that may be as little as one atom or molecule in width.

Last year, physicists at IBM's Almaden Research Center in San Jose, California, successfully used a scanning tunnelling microscope to move individual atoms of xenon gas around on a surface with such precision that they were able to write their company's name.

The latest results indicate that it is also possible to use the same microscope, which was itself invested by IBM scientists who later shared the Nobel prize, to prise individual atoms free of the strong chemical bonds that tie them to their neighbours.

According to the company, the techniques described in the paper may provide ways of modifying existing molecules by moving around the individual atoms that make them up. Eventually it may even be possible to build individual molecules an atom at a time, something which could have widespread applications not only in electronics but, for example, in the pharmaceutical industry.

The technique may facilitate the fabrication of new types of electronic devices, and the result would be to open up a new era of semiconductor micro-electronics, "nanoelectronics". (This first appeared in "New Scientist", London, 20 July 1991, the weekly review of science and technology)

Floating flywheel

A frictionless, floating flywheel, levitated above a high temperature superconductor, has been developed by Masato Murakami of the International Superconductivity Technology Research Center (Tokyo). High temperature superconducting ceramics operating at -150°C or so can repel magnetic fields. The flywheel is an aluminum disc weighing 7.5 kg. It contains some permanent ring magnets. Electromagnetic induction can set the flywheel spinning at 3,600 rpm. A 3-m diameter flywheel weighing 500 kg could store 10,000 W-hours of energy. A stainless steel prototype could be ready in 1992. (Extracted from New Scientist, 13 July 1991)

Atomic nib rewrites data storage record

An American scientist has unveiled a new technique for storing data with a capacity far higher than any existing methods. The technique could allow a device to store 10 billion bits of data - the equivalent of more than 31,000 pages of typewritten text - per square centimetre of the recording medium.

The best memory chips on sale at the moment can store just 4 million bits of data, while hard magnetic discs squeeze in 10 million bits per square centimetre and optical discs around 5.5 million bits per square centimetre.

The technique stores small quantities of charge in a thin layer of insulator using an atomic force microscope. The AFM, invented in 1986, can produce images of the atoms on a solid surface by resting an extremely fine metal tip on the surface and then dragging it back and forth over an area of the surface. The motion of the tip as it moves over atoms can be electronically assembled into an image of the surface.

The new technique was described by its developer, Robert Barrett of the Edward L. Ginzton (ELG) Laboratory, part of Stanford University in California, during a conference at Interlaken in Switzerland. One of the main limitations of the device is the speed of writing and reading the data. At the moment, it can only read 100 kilobits per second, but this could be improved by using many tips in parallel. (Extracted from New Scientist, 24 August 1991)

Fast superconducting circuits

Superconducting circuits that switch based on bundles of magnetic energy are 1,000 times faster than electron-based switches. Circuits made at the Institute of Radio Engineering & Electronics (Moscow) are able to switch 30 billion times/sec. This speed could be improved by a factor of 10 if the circuits could be made smaller. This is 100-1,000 times faster than conventional semiconductor chips. The circuits are faster because they shift just single quanta, rather than lots of electrons. And the magnetic quanta are not scattered by the material as electrons are. The magnetic circuits can be placed very close to each other. Since they consume very, very little power (1 billionth of a watt), the switches need not be spread out to dissipate heat. Single quanta also represent ones or zeros of binary digits very easily, rather than assigning an arbitrary voltage level. Richard Humphreys of the Defence Research Agency (Malvern, UK) also says that magnetic logic circuits need not be told to wait until all the data is ready. (Extracted from New Scientist, 6 July 1991)

Prototype chips produced by X-rays

IBM has built an X-ray machine whose intense X-rays will replace light beams to etch circuits in computer chips much finer than circuits on today's chips. The billion-dollar gamble is an attempt to keep IBM and the US from becoming dependent on Japanese computer chips. The X-ray process will become essential to US competitiveness in fields ranging from military weapons to consumer electronics in the second half of the decade, according to IBM. However, the X-ray technology may be too expensive and complex to replace the use of light, and a more economical X-ray method based on laser beams will be developed soon enough to make the IBM machine obsolete, according to researchers.

The 27-ton X-ray device, the culmination of an eight-year research effort, is a collection of superconducting magnets arranged in a ring to concentrate and suspend a beam of electrons. As the electrons travel around the circle at almost the speed of light, the radiation emitted is focused on chip wafers to etch the circuits. Currently, the tiny circuit lines etched on silicon chips using beams of visible light can only be as thin as the wavelength of visible light, and exotic visible light systems already make it possible to produce another generation or two of memory chips without turning to X-rays. However, X-rays will be essential to make chips that can store 256 million bits of information, according to IBM. IBM plans to produce prototype chips using the new method by the end of the summer of 1991. (Extracted from New York Times News, 19 July 1991)

Chip uses light instead of electrons for off-chip communications

Researchers at Texas Instruments (TI) have developed and demonstrated a highly-integrated microchip that is targeted to transmit information between chips using light instead of electrons and copper wire. The technique could dramatically boost computing speed when incorporated into working systems, perhaps in the next five to ten years.

TI feels that many of the most challenging barriers to computer performance lie not in the chips themselves but in the way chip packages are mounted on printed circuit boards and connected with one another. James Yuan, a TI research manager directing work on alternatives to traditional interconnect technologies, points to the fundamental physical limitations of copper.

Because of the speed advantage light holds over electrons, one optical interconnect could replace as many as 32 pins in a conventional chip package, TI said. And, of course, high-speed optical connections can be packed more densely on a circuit board.

Experts have estimated that existing optical interconnects used for computer-backplane applications require approximately 20 per cent less board space and use 20 per cent less power than functionally equivalent electrical interconnects. For monolithic integrated optical circuits, the power savings could be considerably higher.

According to TI, the device - an optoelectronic integrated circuit, or OEIC - is the first monolithic integrated circuit to combine silicon CMOS logic circuitry with an array of eight gallium arsenide infrared light-emitting diodes.

Because traditional silicon and GaAs manufacturing techniques are incompatible, TI produced the monolithic OEIC using a co-integration process called gallium arsenide on silicon, developed in its Dallas research laboratories and first demonstrated in 1988. (Source: Computer, June, 1991)

New IBM multichip module claims wiring density record

IBM researchers have developed a very dense multichip module (MCM) of co-fired glass ceramic. The 127.5 mm^2 (5 sq_2 in.) MCM packs 121 ICs, mounted just 9.9 mm^2 from each other.

The MCM is claimed to represent an industry record for wiring density at 844 cm/g^2. It will be used in the company's new System/390 mainframe computer.

Package design is an evolution of IBM's proprietary "Thermal Conduction Module" (TCM), invested in 1980. In the new MCM, the chips are bonded directly to a 63-layer slice of the IBM-developed glass ceramic. Thin copper wires interconnect the ICs. The dense wiring, threaded through two million vias of the layers, adds up to 42.67 m of wire/cm^2 of package. The cooper replaces the molybdenum wire used in earlier TCMs. The new glass ceramic substrate is a replacement for the older alumina-ceramic base.

IBM says the new glass-ceramic MCM features the lowest dielectric constant of any ceramic in commercial production. This enables electric signals to travel from chip to chip about 25 per cent faster than the package it replaces. The module also boasts a "perfect" thermal expansion match with the silicon chips that are bonded to it. (Reprinted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA 1991.)

Charge-coupled device chip

Toshiba has developed fabrication technology that is used in trial production of a charge-coupled device chip for compact video cameras. The chips are used to convert optical signals into electrical video signals and replace bulky electron tubes in conventional video cameras. Minute electric terminals are formed on the chip and on a glass plate, which are bonded together. (Extracted from Asian Wall Street Journal, 22 July 1991)

NEC video chipset

Researchers in Japan have developed a three chip video compression system which meets the International Standards Organization's H261 specification. NEC's devices can take 90 Mbit/sec data and compress it to 64 kbit/sec for transmission during video conferences.

NEC claims that the chipset can execute 250 million calculations per second. The central processing device consists of 1.13 million transistors on a die measuring 13 x 15.5 mm. To feed the data to the device fast enough to perform the compression, the chipset uses SRAMs rather than the DRAMs used in traditional video systems. (Source: Electronics Weekly, 10-17 July 1991)

Germans develop 12 inch silicon wafer equipment

The production of systems that are capable of growing 12 in. silicon wafers has commenced at Leybold in Germany. The company is understood to be the only organization in the world that is currently capable of manufacturing a commercial mach.e that can pull 12 in. silicon crystals. Leybold claims to have already received an unstated number of orders for the machines, each of which weighs about 15 metric tons.

The introduction of a new generation of wafer size can typically halve the production cost of a chip, but relatively few manufacturers are yet equipping their plants for production using 8 in. wafers. Leybold's move suggests that chip makers may skip a wafer size generation by moving directly from 8 in. to 12 in. wafers without the 10 in. size ever becoming widely employed. (Reprinted with permission from Semiconductor International Magazine, May 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA.)

Bulk high temperature superconductors

Lawrence Berkeley Laboratories has developed a method to make bulk quantities of high-temperature superconductors, a new class of ceramic-like materials that conduct electricity with almost no resistance at temperatures around -190°C. The patent (US 5,024,992) was awarded to Donald Morris, a visiting scientist at Lawrence Berkeley. It covers a method for making bulk quantities of 1-2-4 materials, which are less brittle than others but difficult to make in bulk except in a thin film format. The new bulk method uses oxygen pumped through the furnace at extreme high pressures, which forces the components to form oxide coatings that contain all three of the required elements: yttrium, copper and barium. The semiconductors are currently made by combining the three elements with oxygen in an extremely hot furnace. This method, however, forms some oxides with no superconductive capacity unless it is used to form very thin films. (Extracted from New York Times News, 13 July 1991)

New superconducting material developed

A thallium-cuprate superconductor - which is said to have a record-high superconductivity transition temperature - has been developed at the Superconductivity Research Laboratory, Tokyo (Japan).

The new superconducting material is a thallium-copper oxide that exhibits the so-called Meissner effect - the most recognized signal of superconductivity - at 130°K and the zero-resistance temperature at 126.9°K, according to Hisao Yamauchi, a laboratory director.

In the new development, raw oxide powders were mixed to the nominal composition of thallium 1.7, barium 2, calcium 2.3, copper 3 and oxygen 7. Nearly single-phase 2223 samples were obtained by sintering the mixture for about five hours in flowing oxygen gas. The sintered samples were then encapsulated in an evacuated quartz tube and post-annealed at 750°C for 250 hours to achieve the record conductivity transition temperatures.

The research project was conducted by a team of researchers of the laboratory headed by Yamauchi and Tetsuyuki Kaneko, research scientist. The laboratory is part of Japan's International Superconductivity Technology Center. (Extracted from American Materials Market, 10 July 1991)

Gallium arsenide phase is superconducting

Researchers have discovered that the semiconductor gallium arsenide (GaAs), when synthesized under certain conditions, contains an unusual phase that becomes superconducting at 10°K. If the new phase can be identified and synthesized at will, the discovery could have a major impact on micro-electronics. One possibility envisioned is the construction of a GaAs chip containing semiconducting and superconducting layers separated by an insulating GaAs layer. Scientists have been unable to fabricate such a chip using existing materials. The new superconductor was discovered accidentally by Eicke R. Weber and co-workers in the materials science laboratories of the University of California, Berkeley and Lawrence Berkeley Laboratory. Isolated "islands of superconductivity" were found in layered GaAs samples grown atom-by-atom by molecular beam epitaxy at relatively low temperatures (about 200°C). The islands comprise about 0.01 per cent of the sample and occur in arsenic-rich regions of GaAs. (Source: Chemical & Engineering News, 24 June 1991, p. 20)

How SQUIDs were found where crystals meet

Imperfections in the crystals of high-temperature superconductors could be the key to new devices. Researchers from the US company Conductas of Sunnyvale in California have managed to exploit the fact that "grain boundaries" - the regions where two crystals with different orientations meet - in superconductors exhibit a property known as the Josephson effect.

Genuine Josephson junctions are a sandwich of an insulating layer between two superconducting layers. In the junction, electrons can cheat and "tunnel" through the insulator to produce a current. This current is very sensitive to magnetic fields, so the junction can be used as a switch that is turned on and off by a magnetic field. Alternatively, it can act as a magnetic detector by monitoring the amount of current. Such detectors are called superconducting quantum interference devices, or SQUIDs.

John Rowell, acting president of Conductas, has said that his company has made SQUIDs using grain boundaries as the Josephson junction.

To make their SQUIDs, researchers employ techniques used to make semiconductor devices. They take a substrate material and deposit onto it a thin film known as the "seed layer". Because of its crystal structure, the seed layer adopts a twisted orientation relative to the substrate. They then add a buffer layer and grow a layer of the superconductor on top. The twists in the seed layer cause the grain boundaries in the superconductor to orient themselves so they act as Josephson junctions. Conductas has used this technique to make an "integrated SQUID magnetometer" for detecting tiny quantities of magnetic flux.

Another approach has been reported by Archie Campbell's research group from the Interdisciplinary Research Centre in superconductivity at the University of Cambridge. Campbell and his co-workers used a narrow beam of high energy electrons to slice through a superconducting film. When they tested the film, they discovered that the damaged slice acted as an insulator and that the film showed Josephson properties. The group is working to find a superconductor which forms a perfect insulating layer when damaged by the electron beam. (This first appeared in "New Scientist", London, 6 July 1991, the weekly review of science and technology)

Better electrical flow reported in prototype superconducting device

Bellcore researchers have demonstrated that it is possible to layer extremely thin films of superconducting and non-superconducting materials, aligning individual atoms in a precise and predictable way so that critical electrical connections between the layers can be improved.

Using a modified version of the Bellcore-developed pulsed excimer laser deposition process, the scientists grew prototype devices made up of atom-thin layers of superconducting yttrium-barium-copper-oxide and non-superconducting praseodymium-barium-copper-oxide. Each layer of these compounds contains "planes" of linked copper and oxygen atoms. These planes carry most of the electrical currents in, and through, the superconducting and non-superconducting materials. The technique has the potential to make Josephson junctions more controllable and more easily reproduced, pointing the way to mass-produced devices. (Source: Computer, July 1991)

Buckyballs charge ahead

The search for commercially-viable fullerene superconductors may be warming up. Scientists at Allied-Signal say they have detected superconductivity in a doped fullerene at a transition temperature of 42°K - a result which tops previous reports of fullerene superconductivity by about 10°K.

Buckminsterfullerene, the 60-carbon "soccer-ball" molecule, has been creating quite a stir over the past few months. Superconducting fullerenes, which had been doped with potassium, were first reported earlier this year. Subsequently, Japanese researchers came up with a caesium/rubidium-doped fullerene which showed signs of superconductivity at 33°K.

Now a team led by Ray Baughman and Zafar Iqbal of Allied-Signal, with collaborators from Arizona State University and Morris Research at Berkeley, is turning up the heat. The researchers have submitted their latest work to the US journal, Science. A patent has already been filed.

Their new result was obtained from a fullerene "co-doped" with rubidium and thallium. The scientists found that co-doping with thallium and potassium also raised the transition temperature, but less dramatically.

Baughman believes that the temperature increase can be attributed to an expansion in the fullerene crystal lattice, and a subsequent increase in the density of states at the Fermi level, caused by the insertion of thallium with the alkali metal into the spaces between C_{60} balls.

In theory, a further increase in the distance between "buckyballs" should raise the attainable transition temperature. The group has already done X-ray diffraction studies, which do show "a very significant lattice expansion" in the potassium/thallium co-doped material. (Source: Chemistry & Industry, 19 August 1991)

New form of GA crystals

Semiconductor researchers in California have found a new form of gallium arsenide crystals. The compound is already used commercially as a semiconductor. Materials scientists associated with the University of California (Berkeley, California) used a special way of growing almost perfect crystals in a vacuum. An unusually-rich form of gallium arsenide was produced. Researchers discovered an intriguing phenomenon when the gallium arsenide was cooled to -263°C. The crystals became superconducting, which traditionally is not the case with semiconductors. Gallium arsenide has long been thought to have great potential, but in 1991 the compound has just 1 per cent of the market. Supercomputer giants such as IBM and Cray envision gallium arsenide as a possible substitute for silicon, and are doing their own research on the material. (Extracted from The Economist, 21 June 1991)

Miniature amplifier combines benefits of semi- and superconductors

Micro-electronics & Computer Technology (Austin, Texas) has developed a miniature amplifier that can combine the benefits of semiconductors and superconductors in the same computer. The unit will allow the production of much faster computers. The new amplifier, which is so small that 1,000 amplifiers can be placed on

a single computer chip, will provide a needed link between superconductor transistors and semiconductor chips. Superconductors are extremely fast but work on very tiny voltages while semiconductors, which require more electricity to work, provide memory storage capabilities that superconductors lack. (Extracted from New York Times News, 3 August 1991)

Small green-light emitting laser

Matsushita Electronic has devised what is claimed to be among the world's tiniest lasers emitting green light, about 20 per cent of the size of standard lasers of the type. The device includes a GaAlAs semiconductor laser that triggers a YAG crystal emitting in the IR region at 1,064 nm, which radiation is frequency doubled by a nonlinear optical crystal to output 532 nm green light. The laser, which needs no heat sink, is rated with an output of 3 mw and noise characteristic of -135 dB/Hz. (Extracted from Japan Electronic Engineering, July 1991)

Implant and RTA in Japanese BiCMOS process

Engineers at Mitsubishi Electric Corporation have come up with an implanted 0.6 μm complementary bipolar and metal oxide semiconductor technology (dubbed CBiCMOS). They do not use epitaxial silicon, but form well and buried layers with multiple-energy ion implants and rapid thermal annealing (RTA). This work was reported at the recent IEEE Custom Integrated Circuits Conference.

Briefly described, the Mitsubishi engineers use three process steps after field oxidation to prepare the wells and the buried layers of all active devices:

- The n-well is formed by phosphorus ion implantation at three energies.
- In NMOS and pnp areas, p-well and p^+ buried layer are formed by boron ion implantation at two energies.
- Under PMOS and npn areas, an n^+ buried layer is formed by the high energy phosphorus ion implantation.

The Mitsubishi engineers explained that both the n^+ and p^+ buried layers act as subcollector for each bipolar transistor, provide latch-up hardening and provide soft error immunity. Since the p-well p^+ buried layers of the pnp NMOS device are isolated from the substrate, dual power can be applied to linear circuits.

To simplify the process flow, the emitters for npn and pnp transistors are formed by a self-aligned contact doping technique in the CMOS part of the process. CMOS gates are 0.6 μm wide and 15 nm thick.

Leakage current tests showed that RTA reduces the occurrence of defects induced by the high dose and high energy ion implantations. (Reprinted with permission from Semiconductor International Magazine, May 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

British SOI technology employs porous silicon

The Defence Research Agency's Electronics Division at the Royal Signals and Radar Establishment (RSRE) at Malvern in the English Midlands is developing a silicon on insulator (SOI) technology using porous silicon. Scientists at this British Government Defence establishment believe that this technology can achieve device performance criteria which cannot be equalled by other microchip fabrication techniques. When compared with bulk CMOS, SOI offers higher operating speeds, higher density circuitry, lower power consumption, greater radiation hardness, and the ability to operate at high temperatures.

The full isolation by porous oxidized silicon (FIPOS) technology involves the formation of porous silicon by the chemical processing of selected local areas on a wafer of pure silicon. The porous material is oxidized to form the insulating silicon dioxide and the required devices are formed in isolated islands (typically 0.1 μm in thickness) of silicon left in the silicon dioxide layer. This enables high speeds to be obtained in fully depleted transistors. Improvements in performance should be a direct result of the full dielectric isolation between adjacent devices. (Reprinted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

New technique to build electronic devices

IBM research may suggest a way to build electronic devices a single atom at a time. Using a microscope, IBM scientists were able to move individual silicon atoms from a surface and place them in precise locations. The company says the new technique has potential applications in its plan to build electronic circuits with parts that measure only one atom or molecule across. Present-day circuitry is measured in microns, which are at least one thousand times coarser than atomic-scale devices. Yet to be devised are mass-production techniques for making the tiny circuits and the shape the miniature parts themselves would have to take. Besides electronic applications, IBM said its new method could show a way to modify existing molecules by moving around their component atoms. This procedure would have applications in pharmaceutical and genetics research. (Extracted from Wall Street Journal, 12 July 1991)

Swiss develop MCM substrate

A programmable interconnect substrate for multichip modules (MCM) has been developed in Switzerland. Called POLYSTRATE, the material is the result of a cooperative effort between Oerlikon-Contraves AG and the Institute of Quantum Electronics (Zurich, Switzerland).

The key to the interconnect's programmability are the homogeneously-distributed conductor crossovers with air gaps. The substrate's 2530 crossovers/cm^2 offer a network that permits components to be directly interconnected. (Reprinted with permission from Semiconductor International Magazine, August 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Russians develop ASIC minifab

A group of scientists have developed an automated minifab for cutting turn-around time on ASICs and prototype VLSI circuits. While a

quick-turn minifab is not dramatic news in the US, these scientists are Russian. I. Berg and colleagues report that the modules in the minifab perform a number of related planar processes in miniature reactors. Each module features a sealed Class 1 environment. Wafers are shunted from module to module in hermetically-sealed containers. The minifab is completely automated, from CAD to process technology.

The typical minifab, they note, requires 200 m^2 floorspace and 100 kV of electricity to operate. The use of reagents and gases has been kept to a minimum, they say, to comply with environmental constraints. Consumption of key reagents is under 1 ℓ/24 hours.

All standard planar processes have been included. A typical minifab, they report, consists of 15-30 modules, depending on the type or circuits to be produced. An X-ray lithography module is now under development. It will be capable of exposing wafers through masks on identical modules, eliminating the need for outside maskmaking services. The Russians are affiliated with the Perspective Research Institute "Nauchny Center", Moscow. (Reprinted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Chinese 1:1 lens from CaF_2

Engineers at the Shanghai Institute of Optics and Fine Mechanics in China have developed a new 1:1 broadband deep-uv catadioptric lithography lens. It is made from fused silica and calcium fluoride.

The lens has a numerical aperture of >0.40 and a field diameter of 58 mm. Reportedly, the bandwidth is >10 nm. This lens can use either an unnarrowed excimer laser or mercury short arc lamp source. The associated wafer exposure system aligns without compensation components. (Reprinted with permission from Semiconductor International Magazine, May 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Ceramic films formed by light

Hitachi (Tokyo, Japan) has devised a low temperature method of forming ceramic films by means of irradiating with light. The new process can produce high-quality ceramic films on plastic and metal substrates, not possible with the conventional sol-gel process that requires heating to 350°C-400°C, and also allows film formation on big and complicated surfaces. Instead of heating, the Hitachi process uses light irradiation in a two-step process with the first stage involving irradiation of a solution of metal alkoxide to produce an inorganic polymer precurson. In the second stage, the substrate is dipped into the solution and the resulting film exposed to high-frequency UV light to produce ozone, which oxidizes the film. The company used the process to make a tantalum pentoxide ceramic film, and was able to form strip films 10 microns wide and control thickness at 0.01 micron resolution. Besides uses in electronic devices, applications may be seen in making protective, anti-reflective, and superconducting films. (Extracted from New Technology Japan, July 1991)

3-D BiCMOS

A group of engineers at Purdue University School of Electrical Engineering, West Lafayette, Indiana, have developed "a novel three-dimensional integrated BiCMOS process". This is the work of Rashid Bashir, Suresh Venkatesan and Professor Gerold Neudeck, and Semiconductor Research Corporation support.

Overall, this new BiCMOS process is promising because it offers reduction in area, flexibility for speed or power applications, novel collector contact, equal current drive for PMOS and NMOS devices with same width and length, and a self-aligned seed-hole for the CMOS.

Bashir explained that epitaxial lateral over-growth to achieve silicon over existing oxide - a silicon on insulator structure (SOI) - is a key process step. Selective epitaxial growth (SEG) and epitaxial lateral overgrowth (ELO) techniques allow the independent optimization of the CMOS and bipolar device parameters.

An important feature of this BiCMOS structure is the independent control of the bipolar collector-emitter breakdown voltage; this allows for the design of BiCMOS process for speed or power applications.

Significant for nearly complete elimination of latch-up, the Purdue engineers fabricate the CMOS part of the structure with an inverted PMOS device in the SOI silicon stacked over an existing NMOS device in the substrate silicon. The PMOS device has a dual-gate that gives high current drive because of the two gates and because of total depletion and bulk inversion in the silicon region.

The seed-hole for the 3-D CMOS is self-aligned to the bottom gate. This eliminates a crucial lithography step and hence reduces active area. The entire BiCMOS structure reduces the active area by at least one-fourth, due to the novel polysilicon contact to buried layer of bipolar, stacked CMOS device, self-aligned seed-hole and inherent merging of the devices. (Reprinted with permission from Semiconductor International Magazine, August 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

SOI bonded wafers make better A-D ICs

A group of engineers at Fujitsu's Advanced Standard Products Division, Kawasaki, Japan, have developed a bonded-wafer-SOI (silicon on insulator) CMOS process for analog-digital ICs.

Briefly described, these engineers make their special wafers by bonding an ordinary silicon wafer with 1 μm-thick silicon dioxide to another unoxidized silicon wafer. Then they grind the wafer with the silicon dioxide layer to a thickness of 3 μm, thus making the active layer of the bonded wafer.

With bonded wafers, the Fujitsu engineers use a conventional IC fabrication process only adding a trench isolation process step. Overall, they believe this straightforward process provides a manufacturing advantage.

An "exposed" buried polysilicon structure provides shielding. Such substrate isolation completely separates the digital and analog portions. As the demand for smaller and lower-cost electronic systems increases, the industry will need better fabrication techniques for analog-digital circuitry; suppressing interference noise between analog and digital circuits will become increasingly important. (Reprinted with permission from Semiconductor International Magazine, August 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Georgia Tech integrates Si, GaAs ICs via "Lift-off"

Georgia Institute of Technology (Atlanta) researchers are growing GaAs devices atop a GaAs substrate, then transferring them to a silicon IC. This process, they say, should produce lower-cost optical devices integrated directly on silicon.

The Georgia Tech team is using an epitaxial lift-off process, developed recently by Bellcore, but modified to address cost and manufacturing issues.

After the GaAs ICs are lifted from their substrate, they are placed on a transparent polyimide sheet. Then they are cut apart, aligned and transferred to the host substrate. The researchers liken this method to old-fashioned rub-on lettering.

The goal of this process is to enable the mass production of integrated opto-electronic circuits. One advantage of this method is low manufacturing cost, since it enables the GaAs opto circuits to be placed only where needed on the silicon chip. Currently under study is how to use automated alignment equipment to deposit the GaAs "chiplets" onto host wafers. The chiplets can be deposited on nearly any smooth host substrate, including silicon, glass and lithium niobate, where GaAs cannot be directly grown.

The process hopes to overcome the difficulty in building components capable of switching or generating light on silicon devices. The lack of an effective technology for placing light modulators/generators on silicon has slowed progress in computing devices that mix electrical and optical I/Os, the team says. Moreover, growing films on relatively large silicon wafers is more costly and more difficult than growing them on GaAs wafers. (Reprinted with permission from Semiconductor International Magazine, August 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Recording sound without breaking it to bits

An American chip maker has developed a memory chip that can store sound in analog form - without first having to convert it into digital code. The chip acts like a tape recorder with no moving parts. The current model can only store 16 seconds of sound but it has already found applications in mobile communications, talking alarms and speech synthesis devices for disabled people.

The chip called the ISD 1016, was developed by Information Storage Devices of San Jose, California. It offers "one integrated circuit where others take half a dozen to convert the signal from analogue to digital, store and reconvert it", says Ron Hankins, president of Interconnect Specialists of Florida, which is using the chip to store sound in its mobile phones.

The new chip uses a memory technology known as EEPROM - electrically erasable programmable read-only memory - which is nonvolatile: it does not lose the data when the power is turned off.

Each bit in an EEPROM memory consists of a transistor which has an extra conducting layer in the middle of it which acts as a capacitor - a store of electrical charge. Filling the capacitor layer with charge alters the conductivity of the transistor. Digital information can be stored in an EEPROM by using the full or empty states of the capacitor layer to represent the one or zero of binary code. The ones and zeros can be read by measuring the conductivity of each transistor bit.

The new chip, instead of having the capacitor layer simply full or empty, uses intermediate values. When the sound is sampled, each amplitude measurement is translated into a quantity of charge on one of the capacitor layers. To read back the sound, the conductivity of each transistor is measured. The chip can distinguish 230 levels of conductivity.

The sampling of the sound takes place on the chip itself, as does smoothing the reconstructed sound and most other recording and playback operations. No other processing of the sound is required - all the system needs is a microphone, speaker, switches, a few resistors and capacitors and a 5-volt power supply. Digital EEPROMs, on the other hand, require extra chips to convert the signals from analog to binary and back.

The chip stores 16 seconds of analogue sound of near-telephone quality on a 128-kilobit EEPROM, whereas in digital form the same sound would require a 1-megabit chip. The chip's makers claim that a message will last at least 10 years and that messages can be re-recorded over 100,000 times. A version of the chip with a capacity of one minute is expected by the end of the year.

The recorded sound does not have to be played back sequentially. For example, a number of words could be recorded and a digital controller attached to the chip could construct a variety of messages according to need.

The chip is already being used in the US in a number of applications. A radio station in the tornado region of the south is using it to broadcast a weather alert, replacing a tape-recorded version. A number of companies are developing battery-operated speech synthesis devices for the handicapped. A security firm is using the chip to incorporate voice messages into its burglar arms.

Interconnect Specialists is using the chip in a store-and-forward repeater for hand-held radio communications. This allows two-way communications using only one frequency. The company is also producing an answering device for mobile phones which can store one message. (This first appeared in "New Scientist", London, 21 September 1991, the weekly review of science and technology)

Digital circuits spawn slimmer camcorders

Hitachi has found a way of making video camcorders even smaller and lighter. Solid-state image sensors in the new camcorders convert light from the lens into an analog electrical signal, which is then immediately converted into digital code.

The processing work which prepares the picture signal for recording on tape is carried out while the signal is a string of digital ones and zeros. And because it is much easier to squeeze digital circuits onto a single chip than analog ones, this reduces the amount of circuitry needed. The digital code is converted back into an analog signal just before recording onto tape. So the system is still compatible with existing recorders.

Processing the signal in digital form also makes it easy to create special effects. The Hitachi camcorder can magnify selected parts of the image by up to 64 times to create an electronic zoom effect in addition to the optical zoom provided by the camera lens.

Hitachi will use the same technique to let people shoot widescreen video films, for display on the new wide-screen TV sets now going on sale. The camera has an image sensor which has a width-to-height ratio of 16:9 instead of the conventional 4:3 shape. The digital circuitry compresses the wide image from the sensor into the conventional 4:3 shape by scanning the picture lines more quickly than usual. So the tape records a picture signal which is squashed. To replay the picture on a widescreen set, the recorder expands the image by scanning across the screen at slower speed. (This first appeared in "New Scientist", London, 14 September 1991, the weekly review of science and technology.)

III. MARKET TRENDS AND COMPANY NEWS

Market trends

Into the unknown

There is a crisis now afflicting the global computer industry. Manufacturers from the mighty IBM to the tiny Norsk Data of Norway have committed themselves publicly to computer systems based on standard, off-the-shelf components which operate in a uniform manner. An analogy with the motor industry is unavoidable; for the first time since the modern computer industry was founded 30 years ago, every computer manufacturer is planning to use the same kind of engine (microprocessor), the same kind of fuel and size of tyres (operating systems); the steering wheel and controls (keyboard and screen layouts) will be in the same place whatever the make of machine. As with cars, customers benefit from moves to standardization through lower prices and systems which are easier to use.

New evidence of the crisis in the global industry emerges daily. There has been:

- **A sharp decline in profitability.** Virtually all computer companies saw profits decline last year. Groupe Bull of France lost some FFr7 billion (£690 million), the largest by any computer company in a single year. Unisys of the US lost $436.7 million) (£252.4 million).

- **Continued consolidation.** In the first six months of the year, AT&T acquired NCR, the fifth-largest US computer maker, and ICL, now 80 per cent owned by Fujitsu of Japan, bought Nokia Data, the information systems arm of the Finnish Nokia Group.

- **Frantic restructuring.** The majority of companies are struggling to bring overheads in line with expenses by cutting jobs. IBM, for example, has eliminated some 30,000 over the past years. Apple said it planned to cut 10 per cent of its workforce.

- **Price-cutting on an unprecedented scale.** In May 1991 IBM cut the prices of its high-performance workstations by up to 60 per cent - some models were reduced from $130,000 to $52,000 - in response to fierce competition. Their new series of mainframe (large-scale) computer systems, known as Summit - for the first time in IBM's history - are being discounted to stimulate sales, rivals say. What is causing increasing despondency around the world is that none of these measures seems so far to have done much to restore growth in revenues and profits.

The computer industry is caught at the confluence of a number of significant trends which are bringing about profound and irrevocable change. After 15 to 20 years of sustained turnover growth, often at rates of more than 20 per cent a year, the industry has come to a sudden, shuddering halt in the US and much of Europe. There is no sign the growth of earlier years will ever be resumed. There is no guarantee that any of today's players, with the possible exception of IBM, will survive intact. Many will not. Even Fujitsu, NEC and Hitachi, developing as they have in a substantially protected market, have yet to face the challenge of open systems and the reduction in margins that will bring. There are now two computer industries existing in parallel but with little in common. The new industry has markedly different characteristics from the old. The hardware is essentially a commodity, built from off-the-shelf components. The operating software is also standard. Costs are lower for standard systems than for proprietary systems. A £2 million machine of five or six years ago now costs £10,000. The improvement in performance for a given price furthermore is growing at some 20 to 25 per cent a year. The old industry faces a stark choice: either reduce costs faster than the annual improvement in performance or go out of business. Traditional companies have to adjust to imitate the new industry based on common standards if they are to survive. (Source: Financial Times, 5 June 1991)

Electronics industry to see slow growth in 1991

With the war in the Persian Gulf now over, business and consumer confidence should begin to pick up enabling the electronics industry to eke out single digit growth this year. In general, Cahners Economics has lowered all of the electronics forecasts for 1991. The experted recovery for late 1990 and early 1991 never fully materialized. Instead, the economy slipped into a recession as consumers and businesses reined in spending as a result of the Iraqi invasion of

Kuwait and the credit squeeze. This weaker spending and investment will contribute to sluggish overall growth in the electronics industry this year. New orders for most of the electronics sectors saw weaker-than-expected growth in the fourth quarter - a better reflection than shipments of the overall softening in the economy. Our forecast called for total electronics orders to rise 1.7 per cent in the fourth quarter of 1990 compared to a year ago. However, demand curtailed sharply and orders dropped 7.3 per cent. For all of 1991, orders will see a milder 3.1 per cent gain. Total electronics shipments should bottom out in the first quarter of 1991 and slowly rise in every quarter thereafter. Shipments will climb only 2.8 per cent this year. While 1991 will see slower growth than anticipated earlier, we do expect stronger electronics growth in 1992. A recovery will begin in the second half of this year. While we can blame the current electronics slowdown on the Gulf Crisis and the resulting crash in consumer and businss confidence, at least the industry has been cushioned by strong exports due to a weak dollar. (Reprinted with permission from Semiconductor International Magazine, May 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

$80 billion chip market seen for 1994

Statistics released by the Semiconductor Industry Association (SIA) show the world-wide semiconductor market with double-digit growth through 1993, then slowing slightly as the market tops $81 billion in 1984. This data comes from World Semiconductor Trade Statistics Inc. (WSTS), the SIA trade statistics reporting program whose participants include world-wide semiconductor manufacturers.

The WSTS data projects total semiconductor shipments by all world manufacturers increasing 12.5 per cent to $56.8 billion in 1991. Then, shipments will increase 16.9 per cent to $66.5 billion in 1992 and 12.7 per cent to $74.9 billion in 1993. Growth in 1994 will slow to 8.3 per cent.

Doug Andrey, SIA's director of industry statistical programs, says, "The expansion of the semiconductor market through 1993 will be fuelled by growth in the microprocessor, semicustom and memory product markets. The industry will experience double-digit growth over the next few years as new applications in products, such as computers and high definition television increase the pervasiveness of semiconductors in everyday life."

The SIA statistics show nearly even growth in all regional markets, with a slight edge in Japan. (Extracted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

System integration revenues expected to rise

Computer-systems integrators revenues are predicted to total $44.8 billion by 1995, compared to $20 billion in 1990, according to Frost & Sullivan. The top systems-integration vendor by size is IBM, followed by Electronic Data Systems and Anderson Consulting; these firms all generate sales of $1.2-1.45 billion per year. Making large customized systems more pleasing are the enhancement of cost-benefit ratio of computer products, the increase of de facto industry standards and the offering of powerful software development tools. Eventually the limiting factor on systems integration is the organizational alterations needed to take total advantage of it rather than technology; a hidden cost is worker retraining. (Source: Technology Update, 22 July 1991)

Technologies that sustain

Information, biotechnology, materials and manufacturing, and energy are experiencing a revolution that will yield advance technologies which will sustain rather than destroy the Earth, an environmentalist said. Robert L. Olsen, a senior consultant with the Institute for Alternative Futures, explained, "... an environmentally-advanced technology will emulate the characteristics of nature itself". It will be sustainable, capable of satisfying present needs without jeopardizing future generations, and it will be able to be used by all people for all time without exhausting resources or having unacceptable environmental consequences, he added. Society will soon make the choice between destructive and sustainable technology then virtually every technology we use (now) will be redesigned and rebuilt during the 21st century. "Whole new forms of technology will come into existence," according to Olson. "Within 50 years, nearly everything that passes for high-tech today is likely to be a museum piece," he added. (Source: Industrial Engineering, August 1991)

European green report spotlights red-faced IT

The computer industry has fared badly in a European report on managers' attitudes to the environment.

Researcher DRT International revealed that 15 per cent of the IT companies it surveyed had been penalized for breaches of environmental legislation.

Although the IT sector showed a relatively high percentage of companies with formal environmental policies - 69 per cent compared to an average of 55 per cent - and many with external advisors, only 62 per cent of suppliers had changed their products and processes to meet the requirements of environmental legislation. This compared to a survey average of 80 per cent.

IT was below average in eight categories. It came second to bottom on the question of how important environmental issues are to company strategy. Only 23 per cent of respondents said environmental issues were critical and 8 per cent said they were unimportant.

Only 54 per cent of IT companies had specific plans to change their environmental policy compared to a survey average of 70 per cent and only 31 per cent required their suppliers to change or guarantee environmental quality compared to the average of 43 per cent.

DRT analysed 250 large industrial and commercial companies from 16 European countries,

including Poland and Hungary, and 15 industrial sectors ranging from finance, retailing, chemicals and oil to textiles, transport, automotive and building.

The recently formed Software Manufacturers Association is urging the computer industry to use environmentally-friendly packaging instead of expanded polystyrene which contains chloro-fluorocarbons. Substitute materials could include recycled cardboard. (Source: Computing, 11 July 1991)

Electronics markets show spark

Growth in demand for adhesives, sealants and coatings in the US electrical and electronics sector is forecast to exceed that of the economy as a whole as US producers become more competitive internationally.

Sales are forecast to rise 31 per cent from $1.82 billion in 1990 to $2.38 billion in 1995, according to a new report from Frost & Sullivan International. Hybrid coatings sales, for example, are predicted to grow by 73 per cent from $80 million in 1990 to $138 million in 1995. Sales of die attach adhesives will rise by 67 per cent, from $58 million to $97 million. PCB coatings sales will rise 42 per cent and assembly adhesives 38 per cent.

By contrast, the large wire coating applications sector will see growth of 20 per cent to $910 million in the period while potting/encapsulating applications hold the middle ground with projected growth to $471 million in 1995, a 32 per cent rise.

Polyimides growth will be particularly strong at 55 per cent. Cyanoacrylates and polyxylylenes will also grow strongly but polyester and ethylene copolymer growth will be weak. (Source: European Chemical News, 2 September 1991)

Flat panel display sales forecast

Sales of flat panel displays world-wide will increase to $9.3 billion by 1996 compared to $4 billion in 1990, according to Electronic Trends Publications (Saratoga, California), with consumer goods using 40 per cent of the devices, or sales of $3.8 billion by 1996, and computer use accounting for sales of $2.8 billion worth of displays. Although Japanese companies dominate the market now, much of the technology got its start in the US, and a number of US companies are working on new directions in technology and seeking niche markets for their devices. Photonics Technology (Northwood, Ohio) has developed high definition colour displays for military use, employing proprietary double-substrate high resolution barrier colour AC plasma technology. Their new 17-in. and 19-in. displays can handle more than 262,000 colours, with resolution similar to consumer televisions, as well as flicker-free images and allow wide-angle viewing. Further development of devices with resolution as high as 2,048 times 2,048 pixels, and analog and digital video interfaces up to 200-MHz is planned. (Extracted from Design News, 5 August 1991)

Multichip module industry will soar by mid-decade

Multichip modules (MCMs) are not the billion-dollar business some experts predicted, yet. According to a newly-published report, however, they are moving briskly in that direction.

By the middle of this decade, says Electronic Trend Publications (Saratoga, California), MCMs will achieve a compound annual growth rate of 33.9 per cent. They will also generate sales of $665.8 million by 1994. The market is currently worth about $207 million, ETP claims.

What makes MCM packaging so enticing? Since conventional packages are eliminated, MCM die can be grouped very close together. This offers several benefits. Most notable, perhaps, is a decrease in the time it takes for an electrical signal to move from one chip to another.

MCMs is a market "destined to capture a large share of all micro-electronics". MCMs today are being compared to where surface mount technology stood 10-15 years ago. Almost 90 per cent of the $207 million in revenue generated with MCMs last year was used by captive markets. The merchant market, today, stands ready to blossom.

MCMs costly to make

Leading the MCM technology bandwagon are military contractors and computer systems makers. They head current applications - largely because MCMs are so costly to manufacture.

The good news, according to the report, is that MCM prices will decline because of increased production. Today the price range is $50-$100 per square inch. After 1995, look for that to drop into the $20-$30 per square inch area. Lower prices will make MCM technology more attractive to consumer and automotive markets. (Source: Semiconductor International, July 1991)

Soft options

Fiercer and fiercer grows the competition to dominate the next generation of desktop computing. On 4 September 1991 Sun Microsystems, leader in the small but fast-growing market for workstations (the sort of high-powered machines that engineers and scientists use), announced plans to create a version of its Unix operating system for the most powerful IBM-compatible personal computers. With personal computer-makers like Compaq and Apple trying to develop challengers to Sun's workstations, Sun is now pushing its technology back down into the high-volume world of PCs. The result will be fierce and fascinating competition.

All three groups now vying to set the standards for tomorrow's computing - one led by Sun, the ACE consortium led by Compaq and Microsoft, and the new alliance of IBM and Apple - agree that the features needed for next-generation personal computers are roughly the same as those available on workstations today: fast processors, nice graphics, the ability to juggle many tasks at once and built-in support for networking. They differ, however, in their strategies for

repackaging these technologies to suit the needs of secretaries and executives instead of the computerphiles who mostly use workstations today.

While Sun is pushing a single operating standard, its rivals have decided to offer a choice. Compaq and the rest of the ACE consortium are backing two next-generation operating systems. One is a version of Unix developed by the Santa Cruz Operation, a small software firm, and Digital Equipment. The other is a new operating system being developed by Microsoft, the world's biggest software company. Microsoft promises that its system will be as powerful as Unix, but easier to use and better adapted to cope with the huge amounts of software already written for personal computers. As for IBM and Apple, details of their plans remain vague.

The key to success for all three groups is attracting to their operating systems the best developers of applications software - the word-processing, communications, spread-sheet and other programs that actually make computers do useful things.

Few of the products that will decide this competition are yet on the market. Sun is likely to be first to market; IBM-Apple last. Indeed, Sun may well take an early lead in the number of machines running its operating system - particularly if it manages to get the PC version of its Unix to the market, as planned, in the summer of 1992. The race, however, will be a long one. (Source: The Economist, 7 September 1991)

Surface mount device market continues upward trend

Because the use of surface mount technology (SMT) for printed circuit boards miniaturizes the assemblies on the one hand and guarantees economical insertion through automation on the other, it will continue to be successful in the future.

Yet a fundamental prerequisite for SMT is the optimum matching of components, processing robots and techniques (especially for insertion and soldering) with one another. However, no other electronics sector has managed to achieve this level of coordination as well as SMT. Market researchers feel that by 1992, 62 per cent of all printed circuit boards manufactured world-wide will be completely or partially inserted using surface mount technology. Although assessments of the current SM market and its probable future development differ greatly from one appraisal to the next, everyone agrees on one thing: SM technology will remain dynamic and will achieve almost explosive growth rates, even during periods of economic decline.

The ongoing transition from conventional insertion assembly using wired components to surface mounting of printed circuit boards gave rise to ongoing growth in SMT of 3 per cent despite an overall slump in the electronics industry. The industry is expected to rebound again during the second half of this year and not only will PCB manufacturers profit from this expected boom; increasingly more design, routing and assembly jobs are being awarded to service companies and subcontractors. At an annual growth rate of 12 per cent, this market sector alone is expected to achieve sales of more than $19 billion by 1993. (Source: AMT, June 1991)

Company news

IBM and Apple set up camp

In one of the most important developments yet in the consolidation of the US computer industry into a handful of competing camps, the two main US personal computer manufacturers, IBM and Apple, have signed a letter of intent to cooperate in developing hardware and software for the next generation of desk-top computers.

If successful, the alliance promises to provide computer users with faster desk-top machines, capable of doing many tasks at a time. Although other consortia are also working to this end, the competitive spur provided by the new link-up may accelerate the appearance on the market of faster machines. It should also become possible to use Apple's Macintosh machines as terminals to work on IBM mainframes, producing easier-to-use computing networks for the many computer users who have grown accustomed to Apple's graphically-based systems.

With the costs of research and development in the computer industry forever rising, and the profit margins of the major companies being squeezed by the advent of smaller companies selling cheap "clones" of the leading designs, the formation of strategic alliances has become a general trend.

The most significant feature of the wide-ranging IBM and Apple technology agreement is the announcement that the two companies will work together to develop a new personal computer operating system, using object-oriented programming techniques. This operating system will be designed to run on a range of different machines.

The agreement's other main component is the decision to further refine IBM's state-of-the-art reduced instruction set computing (RISC) microprocessor, one of the fastest microchip designs available. Motorola will develop more compact and cheaper versions of IBM's RISC chip, for use in future IBM and Apple computers. Greater computing speed may allow future desktop computers to run programs combining text, graphics and video - so-called "multimedia" computing.

While most industry analysts agree that successful collaboration between IBM and Apple would redefine the landscape of the US computer industry, there is still some scepticism about the likely success of the arrangement.

Contracts to formalize the collaborations described in the letter of intent have yet to be thrashed out, and several much-heralded computer industry alliances signed in the past have not yielded significant results.

The new IBM and Apple link may pose more problems than most prospective alliances, simply because of two companies' differing business styles. (Source: Nature, Vol. 352, 11 July 1991)

A European collaboration for IBM

International Business Machines (IBM) and Siemens of Germany will join forces to manufacture next generation computer memory chips, a move aimed at challenging Japanese domination in that market. The news came on 4 July, just one day after IBM announced a major collaboration with Apple Computer to develop personal computers and workstations.

The IBM-Siemens agreement is likely to alter the balance of the chip-making industry world-wide, and particularly in Europe. It ends the chance of a merger or close collaboration between Europe's three major semiconductor manufacturers, Siemens, Philips Electronics of the Netherlands and SGS-Thomson Microelectronics of France and Italy - a strategy urged by some as a way to create a purely European semiconductor concern able to compete on equal terms with US and Japanese companies. But because IBM and Siemens are leaving the door open for other partners, their agreement may allow European chip-makers access to state-of-the-art technology and could eventually increase Europe's competitiveness in the semiconductor field.

IBM and Siemens will expand an existing IBM semiconductor plant in France to produce 16-megabit dynamic random access memory chips, or DRAMs. The two companies will share the $700 million cost of construction. The chips will be made according to an IBM design and with IBM manufacturing technology; Siemens will provide engineers and expertise. Production should begin late next year. (Source: Nature, Vol. 352, 11 July 1991)

Texas Instruments lose to Siemens

It has been announced that Siemens have signed a "letter-of-intent" to purchase the industrial controls division of Texas Instruments Inc., of Dallas, Texas. This deal will enable the German-based multinational to expand their American market share by acquisition of the indigenous TI: it also gives them an immediate "invented here" (USA) look. They inherit the production facility based in Johnson City, Tennessee, which employs approximately 1,000 people and another 300 involved in sales and marketing around the world. (Source: AMT, June 1991)

Europeans want IBM to share its technology through JESSI

The French-Italian SGS Thomson Microelectronics Co. has requested the Joint European Submicron Silicon (JESSI) organization to ensure that new technology developed through the participation of IBM in JESSI will be shared among the European manufacturers.

Although the collaboration between IBM and Siemens of Germany on 64 Mb DRAM devices is strictly not part of JESSI, European manufacturers hope that the participation of IBM in two JESSI projects will result in its R&D resources being shared with all the JESSI participants and not just with Siemens. IBM is reported to be planning to extend its collaboration with Siemens for the eventual development of devices even more complex than 64 Mb DRAMs. (Reprinted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Europeans plan LCD collaborative venture

Philips (The Netherlands), Thomson (France) and AEG-Telefunken (Germany) are planning to collaborate in the development and manufacture of large LCD displays. The British GEC group is likely to join them. The supertwist, active matrix and ferroelectric LCD technologies developed at the GEC Hirst Research Laboratory near London could be employed in large displays, while GEC Plessey Semiconductors of Swindon has the technology to produce LCDs in volume, and English Electric Valve Co. (EEV) of Chelmsford (a GEC associate) has also worked on LCDs for many years.

The European Commission (EC) is prepared to back precompetitive collaborative projects under its ESPRIT and EUREKA initiatives, since it is felt that these displays will be a key component in future electronics equipment. The EC is concerned about the absence of any European manufacturing of large LCDs, while the manufacturers regard this time of recession in semiconductor production as an opportunity to cash in on the increasing LCD market. (Reprinted with permission from Semiconductor International Magazine, July 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Siemens-Nixdorf fails to meet its objectives

Europe's largest computer maker, Siemens-Nixdorf Information Systems, has warned it will continue to make a loss for the rest of the year.

Siemens-Nixdorf originally said it would become profitable within a year of its formation, but in March 1991 the company reported a DM 380 million loss for the half-year.

Officials in Paris say it is now unclear when Siemens-Nixdorf will move into the black, but added that the loss for the second quarter of this year will be less than the first quarter.

The company was formed last year when the two German groups Nixdorf Computer Group and Siemens' data and information division merged their operations.

Siemens says that despite being burdened by its vital semiconductor activities, the streamlining of its Nixdorf activities and its investment in East Germany, it can still look forward to matching 1990's revenue in 1991. (Source: Computer Weekly, 11 July 1991)

GPS ties up ASICs with STM

GPS of the UK and the Italian-French combine SGS-Thomson Microelectronics are to standardize their ASIC cell products in a move which may expand to other semi-custom areas like sea-of-gates and field programmable gate arrays.

GPS's total ASIC sales are nearly three times bigger than SGS' sales. GPS is the world No. 12

in ASIC sales according to Dataquest and SGS is No. 21. Last year's Dataquest estimates for the two companies' ASIC sales were $156 million for GPS and $66 million for SGs.

Starting with 0.7-micron standard cells, the agreement is expected to move to 0.5-micron sea-of-gates gate arrays and FPGAs. For the moment it envisages interchangeability of standard cell designs at the mask database level and the development of electrically-compatible 0.7-micron processes at both companies.

The agreement allows both companies to tap into European Commission funds specifically provided for transnational R&D cooperations.

Starting in the first quarter of 1992, the first standardized products from the merged GPS/SGS operation will be 0.7-micron standard cells. That level of process capability is about six months ahead of what GPS would have had without the agreement.

If both companies can get their 0.5-micron process financed partly by the EC without having to develop, manufacture and market RAMs, then they have got a very good deal.

But the biggest advantage is likely to derive from customers' realization that both companies have credible upgrade paths for their ASIC processes for the next three or four years.

That problem may not have been so acute for SGS because it is already plugged into an EC-funded half micron process development project - the Joint European Sub-Micron Silicon Initiative (JESSI), but GPS is not in the process development part of JESSI and recently lost its integrated process research capability at the former Caswell Research Laboratories. (Source: Electronics Weekly, 10 July 1991)

IV. APPLICATIONS

Logic PLDs debuts

The first member of the HIPER 5,000 line of complex programmable logic devices (PLDs) has been released by Plus Logic, featuring the industry's first flexible LSI-sized blocks of programmable SRAMs. But focusing on more than function and performance, Plus Logic is also pushing prices down to match those of equivalent standard ICs and gate arrays.

Plus Logic claims 18,000 equivalent usable gates for the HS110, with system clock rates to 40 MHz.

Prices are set under $50 each in quantities of 1,000. Standard products the 5110 can replace are in the price range of $25 to $60 each and competing with 40,000-gate sea-of-gate arrays in the range of $30 to $70 each. This puts complex PLDs in price competition with gate arrays and standard ICs, at volume prices, for the first time.

The HIPER scheme uses a layout of four to 16 blocks, basically the same as Plus logic's previous products, with function blocks inter-connected through a programmable matrix. But now the gate count is nine times greater and there are three types of big blocks - control logic, memory and data path functions.

The 5110 borrows control logic blocks from Plus Logic's 2020 device, which has been in production for two years, the firm's patented Universal Interconnect Matrix (UIM), and adds newly developed configurable memory blocks to form a device aimed at applications where considerable amounts of well tailored data storage functions are needed to be intimately involved with logic.

In the 5110 there are four memory blocks, each with the equivalent of 4,000 usable gates. They may be formed into FIFOs, LIFOs, register banks or simple SRAMs. There are also four control blocks with 500 gates each. Each memory block can be cascaded in width and/or depth. All the rational combinations of the four blocks are possible such as a 64 x 9 FIFO, a 64 x 18 register bank and a 64 x 9 SRAM - all in one 5110 device.

The UIM connects any of the outputs of all blocks to any or all of the input signals of all the blocks. The memory can be connected from the pads or from the UIM, thus available to internal and external logic. Control signals' polarity and definition are decoded, and therefore are useful in any desired interface scheme, such as Motorola or Intel bus control configurations.

The memories are configured without using the control logic blocks, allowing access to the memories through other higher-speed logic. The FIFO can be operated at 33 MHz at both ports, yielding a possible data rate of 132 Mbytes/s. Typical memory configurations include intelligent FIFOs, buffered memory controllers, and register files. (Source: Electronics Weekly, 12 June 1991)

Computer voice for disabled

A prototype computer for the severely disabled - driven entirely by voice commands - is being developed by a collaboration between linguists and technologists at Hatfield Polytechnic in the UK. The system will be entirely keyboard free and considerably cheaper than existing alternatives. Although there are so-called hands-free systems currently on the market, these are unsuitable for the disabled as they require the keyboard to be used every time an error has been made. In addition they cost about £13,000, making them inaccessible to the majority of the disabled population. The new system would be available for about £5,000. Over the past three years the Hatfield team has conducted research into the real needs of disabled computer users. To eliminate the need for an able-bodied helper, ready to use the keyboard every time an error is made, the researchers have developed a voice-operated "undo facility". "Every action can be undone via a spoken command". The system also offers limited dialogue responses, so if it is unsure of a particular command, it will offer likely options. (Source: The Times Higher Education Supplement, 6 September 1991)

Battle of the chips

The T9000 is the first of a new generation of high-performance chips from Inmos. The 32-bit Risc microprocessor has 10 times the computing power of the company's next most powerful device, the T800. It has a peak performance of 200 mips and 25 megaflops at 50 megahertz. Designed to link easily, transputers are ideal for parallel computing, in which many processors work on a single task simultaneously, increasing speed.

Many see parallel processing as the future of computing. The transputer is the answer to the prayers of those who need vast computer power but lack the resources of a conventional super-computer. Ken Wallace of Oxford University is using several dozen transputers to drive a computer simulation of the human arm in a project aimed ultimately at understanding the brain better. Without the transputer, the project would have been impossible. There is a wide range of applications for the transputer. They deal with robotics, fluid dynamics, medical imaging, speech recognition, remote sensing, process control, soil analysis, underwater acoustic communication and machine condition monitoring. (Source: Daily Telegraph, 12 August 1991)

Computer-guided crewless ships

Within a generation, fleets of unmanned cargo vessels could be sailing the seas like the Marie Celeste, with a radar as lookout and a computer at the helm. No human hand will touch the tiller from the moment the ship leaves its berth until it reaches its destination. A Japanese ship, the 10,000-ton ore-carrier Shiija Merchant, recently completed two days of unmanned trials in the perilous 20-mile-wide strait between Japan and Korea before returning undamaged to the port of Kagoshima, in a voyage that was planned and executed by onboard computers. Unmanned ships could become a reality for two reasons - cost and safety. Even though crews are smaller than they used to be, wages, heating, lighting and food remain a big expense, and 80 per cent of collisions between ships are caused by human error. Automatic guidance would be far safer. The ship's course would be programmed into an onboard computer before it sailed, similar to an aircraft autopilot. The ships progress across the ocean would be tracked by a gyrocompass, which could make necessary corrections, and the course would be planned, where possible, to avoid bad weather. The ship's owner could feed fresh instructions to the ship via satellite, even in mid-ocean, if the course or destination had to be altered. At its destination, separate berthing systems, also computer-controlled, would be used to bring it safely to its mooring. Collisions would be avoided by using radar plotting and avoidance systems, which would detect approaching vessels and make the course changes, in line with existing sea regulations. (Source: The Times, 29 August 1991)

MacTooth does the filling in

Dentists are now being offered computer software that can help them keep a graphically coloured computer chart of all the work they do on a patient's teeth - and do away with written records and paperwork. The MacTooth software, developed by Degree Zero, of London's Harley Street, runs on the latest Apple Macintosh Mac LC machine. When a new patient joins the practice, the details are recorded on the computer by the receptionist. After that, the dentist records details of treatment by using the mouse. He or she clicks on to the diagramatic representation of a particular tooth on the screen and then fills in part of the tooth with a specific colour to represent a treatment. A silver splodge denotes an amalgam filling, while a bright yellow splodge denotes a gold one. Once the treatment is complete the software translates the colours into codes from which it can generate the patient's bill and other paperwork. The computer also produces a spreadsheet of the practice's accounts for the auditors. (Source: Financial Times, 26 April 1991)

Luggage on a long leash

A computer system for ensuring airline passengers and their baggage always board the same aeroplane has been developed by the British Technology Group and Brals (baggage reconcilation and location system), a company funded by BTG and Symtech Information Technology. The system can isolate the baggage of passengers who fail to board a flight, in case the unaccompanied bag contains a bomb. It can also help to eliminate misrouted luggage. Baggage checked in by a passenger is given a unique number in barcode form and numerals. This is recorded in the Brals computer and linked by a seat number to the passenger. From that moment each piece of baggage and its owner can be identified as they move towards the aircraft. The computer checks the baggage and passengers on each flight and produces a screen display or printed report showing that for every bag loaded, there is a matching passenger. The system enables baggage to be located quickly where a passenger transfers from one flight to another. (Source: Financial Times, 8 March 1991)

Novel use of an electric motor

An electric motor run in reverse could serve as an electric generator for remote areas in the third world, according to Intermediate Technology (Rugby, UK). The generator could be set up anywhere where there is water running down a fairly steep hillside. In some developing countries, cheap electric motors and water pumps are readily available, but electricity is not. Small hydropower generators that are available are usually not very reliable. Water pumps can be run backwards as turbines to rotate the central magnet of an attached motor to spin. This produces an electric current. If a water pump is not available, waste materials available in most places could be used to create a simple turbine. The turbines are powered by water flowing downhill through a small pipe. Capacitors must be used to smooth out the voltage being generated. The technique of converting a motor to a generator should be cheaper than buying a purpose-built generator up to 20 kW, according to Intermediate Technology. The converted motors will also be far more reliable. An electrical controller to switch excess electricity into heaters could also be made locally. (Extracted from New Scientist, 29 June 1991)

Applying memory cards

An evaluation kit from Databook Inc. can help to develop memory card applications in a wide range of systems and environments. Relying on non-volatile solid-state memory, the credit-card-sized 3-mm-thick cards are being used to replace rotating magnetic memory in such equipment as notebook computers and other consumer and industrial terminals.

More than 180 computer, software and semiconductor makers have adopted standards developed for the cards by the PC Memory Card

International Association (PCMCIA) in the United States and the Japanese Electronics Industry Development Association (JEIDA).

The US$ 595 kit includes the kit maker's ThinCardDrive memory card drive, a memory card, a connector and mounting hardware, software that runs on a desktop personal computer, and a manual containing both hardware and software design information as well as background information on the joint US and Japanese standard and general "industry trend" information. Contact: Pete Robson, Databook Inc., Tower Building - Terrace Hill, 112 Prospect St., Ithaca, New York 14850-9952 USA. (Source: IEEE Spectrum, July 1991)

Texas raises a rival to the transputer

The American computer giant Texas Instruments has moved into one of the few areas of computing where Britain is still ahead of the pack - parallel processing. The company has launched a new chip as a competitor to the British-designed parallel chip, the transputer.

Both chips are microprocessors with which built-in memory and communications link so that they can be easily linked to similar processors to form parallel computers. This novel form of computer can process large amounts of data very quickly by dividing up tasks between a number of identical processors - anything from two to thousands. Conventional serial computers carry out their tasks one after another using a single very fast processor.

Texas's announcement was of a new standard for modules to carry the chip which will make it suitable for general parallel processing. The modules are small circuit boards, about 10 centimetres long and 6.5 centimetres wide, which carry a C40 chip plus extra memory and connections for communications and control of the chip.

The modules and other hardware devices are not being developed by Texas itself but by smaller companies that specialize in parallel computing. Most of these are in Britain. Similarly the software is mostly being developed in Britain. Some of the hardware and software being developed will allow transputers and C40 chips to work together in the same computer. (This first appeared in "New Scientist", London, 31 August 1991, the weekly review of Science and Technology)

Smart cards

The microprocessor card (also called the "smart card") is a device, frequently the size of a conventional credit card, that contains integrated circuit chips. These cards can be used to perform a variety of computer-related tasks in areas such as financial transactions and personal database activities. It has been predicted that by 1993, over 200 million cards will be produced annually.

History

Although the main patents are over 10 years old, the real technical and commercial activities related to microprocessor cards started only in 1984-1985. At that same time, several manufacturers started offering a certain number of products that were reliable and reasonably priced and aimed at a limited number of applications. These can be called the first-generation microprocessor cards. The first users were telecommunication administrations in Europe, some social security administrations, and a few professional groups - e.g., banking and insurance - and there were some limited experiments (student cards, health cards, and city-transport-fare cards).

These experimental applications proved both the great interest in the device and the functional limitations of the first-generation cards. That led to the development of a second generation. The major areas of technical improvement are memory size, sophisticated data management, processing speed, data security, and the capability for a given card to handle new, not yet fully-defined, applications. This was the first step towards the definition of a smart card as a general-purpose tool in the field of data processing.

These new developments started in 1987-1988 and resulted in the current availability of some original products, extending the domains of application of the card. The estimated number of smart cards produced in 1990 is over 70 million. It is likely that this number will be multiplied by three before 1993. But the most significant development is the requirement for more powerful components, especially because of the increasing number of portable data files being used. While in 1990, 91 per cent of the microprocessor cards were used for financial transaction applications, it is expected that in 1993, only 50 per cent will be so used and that 25 per cent will be used for applications involving portable databases.

The major technical issues involved are:

- Physical standards;
- Micro-chip design;
- Communication interface and protocols;
- External devices;
- Data security;
- Software problems;
- Application development techniques;
- Integration into large information systems;
- Ethnical and social issues.

Of course, this list of issues is not complete, but it clearly indicates that the card raises key problems in many vital areas of informatics.

Security

Until now, cards offered security as a result of the applications being strongly encapsulated. No doubt, more ambitious cards or applications will require new concepts and new techniques. For example, a multi-application health card will be used by physicians, nurses, hospital administration and services, social security, emergency services, etc. Much of the stored data must be shared by more than one user - but, of course, not all of it. A complex security scheme has to be provided.

A big security issue is the proof that the bearer of the card is the correct one. Personal identification numbers (PINs) are frequently used with banking cards and other similar applications.

The future microprocessor card will improve the quality of the proof and the security level by using one or more biometric identification schemes. Those schemes must be dynamic, to prevent "ageing" of initial measurements.

Right now, programs are stored in a ROM, but microprocessor cards could be flexible enough to allow the owner to "import" new applications himself or take copies from his bank, company, or hospital. Then, the security problem focuses not only on data but also on code. As everyone knows, viruses can cause great damage to PCs or mainframes. But what about a virus in a million banking cards? Future microprocessor cards must be able to protect their data files and programs with on-card security virus-control hardware or ROM software, to prevent any modification or loss. (Source: IFIP Newsletter, Vol. VIII, No. 3, September 1991)

Intel unveils rugged PC

A rugged, rack-mountable microcomputer from Intel Corporation's Systems Group in Hillsboro, Oregon, strikes a happy medium between garden-variety PCs and expensive machines that meet military specifications.

Priced at $4,000 and designed for original-equipment manufacturers, the model 302i is based on a 25-MHz Intel 386 microprocessor. It comes in a standard 19-in. rack-mountable chassis. Positive-pressure, filtered air flow keeps dust out. Its hard disk is shock-mounted for vibration protection and add-in cards are held in place by a locking bar to keep them from detaching if the computer is in a vibration-prone environment.

The 302i also offers a high level of serviceability. Any component in the system can be replaced in less than eight minutes with a screwdriver. The CPU board is tray mounted and special connectors are used to make servicing easier.

Other features include 64-Kbytes of cache memory, eight expansion slots, a 230-W power supply, two serial ports, one parallel port, and PC-AT compatibility. (Source: Electronics, August 1991)

Benchmarq's chip maximizes battery life

A power-management chip from Benchmarq Microelectronics Inc. is designed especially for battery-operated computers, cellular phones and instruments.

The bq2001 Energy Management Unit provides accurate, reliable power metering, fast charge control, and sophisticated system-management services. Battery-conditioning routines, for example, can restore lost capacity resulting from extended storage or mistreatment and inhibit the so-called memory effect that plagues NiCd batteries.

Fabricated in 18-V bi-CMOS, the bq2001 operates at 5 V but handles systems up to 12 V. It consumes 700 nA. An internal micro regulator powered by the main battery provides backup for a clock and other low-current ICs. When a system's battery is removed, a small lithium cell powers the bq2001. It costs $10. (Source: Electronics, August 1991)

Chips read or write at touch of a probe

A new way of tagging and identifying parts and products has been developed by Dallas Semiconductor Corp.

The MicroCan Touch Memory data carrier embeds a rewritable memory chip in a steel can the size of a dime and reads it with a probe using a 1-wire signaling scheme. Up to 4-Kbit versions of the DS199X are available.

Data transfer takes place at 16 Kbits/s and a cyclic redundancy check (CRC) algorithm based on a 48-bit serial number assures data integrity, especially during write cycles. Secure versions of the devices with 64-bit passwords are also available. An evaluation kit costs $75 and the devices about $3 each. (Source: Electronics, August 1991)

Computer system designed to cope with harsh conditions

Designed for use in harsh industrial environments, the new personal computer system from Intek Electronics has gaskets, a sealed disk access door and a removable air filter to exclude contaminants.

The computer base unit is housed in a desktop or rack-mounting steel enclosure that helps protect against rough handling and tampering.

The whole PC is mounted on an isolated chassis plate to reduce vibration, and electrical interference is minimized by the steel case and an integral mains filter.

An environmental monitoring card can be installed in the CPU or monitor enclosure. This detects overheating, a blocked filter or a fan failure, as well as low mains voltage, missing cycles, or complete mains failure.

The system is based on an Olivetti PCS-86 with V30 processor, 640 KB RAM, 3.5 in. floppy disk and 20 Mb hard disk. 286 and 386SX versions are also available. Contact: Intek Electronics, Mold, Clwyd; Tel.: 0352-85603. (Source: Manufacturing Chemist, September 1991)

Instant photo copier

The electronic still picture camera developed by Canon has still not caught on, probably because most people want to carry snapshots in their purse or wallet, or put them in an album. Now Canon plans to install video printers in shops so that people can pay for on-the-spot printing of their snapshots.

Canon's Ion camera records 50 images on a 5-centimetre magnetic floppy computer disc. The images can then be displayed on a TV screen. Video printers, which make copies of TV images, cost over £1,000 and the picture quality does not justify the outlay for amateur photographers.

Canon hopes that by the end of 1992, over 1,000 shops throughout Europe will be offering the printing service. The shop printer is controlled by a personal computer which allows the photographer to specify the framing and cropping of the selected image. Each colour print takes about two minutes to make, and costs around 75 p.

(This first appeared in "New Scientist", London, 14 September 1991, the weekly review of science and technology)

Real-time operating systems

Real-time operating systems are being increasingly used in such areas as industry, space exploration, air traffic control and medical imaging. To attain the quickest response possible from real-time hardware as well as some degree of programming flexibility in the software, numerous utilizers have developed their own real-time kernels. Real-time operating systems are finding employment in several unique uses. This includes the logging sector in which economic and environmental crises are forcing firms to get the most out of fewer resources. Thus numerous logging firms are automating their sawmills in an attempt to raise throughput and the quantity of useful timber products produced by every tree. The characteristics making real-time operating systems relevant for sawmill control (multitasking, guaranteed response and compactness) are also vital in numerous space science uses. (Extracted from Mechanical Engineering, July 1991)

Transputers speed up medical diagnosis

Jose Gonzalez and Jesus Lopez at the Polytechnic University of Madrid have made a prototype computer system to diagnose skin diseases which produce blisters, using a network of transputers. Normally, doctors would need to consult medical textbooks to evaluate such cases. The diagnosis is based on signs, symptoms and other features. Symptoms could include fever, which patients suffer because of illness, whereas signs are features such as the colour of blisters.

Gonzales and Lopez have related the signs and symptoms observed to the possible diseases responsible by using a so-called Bayesian causal model. This starts with several likely diagnoses, and analyses the medical evidence to decide which disease is likely to be affecting the patient. The doctor types into the computer the symptoms and signs and the diseases which could be responsible, and the computer responds with figures which correspond to the likelihood that each diagnosis is correct.

John Connolly and Janet Edwards from Loughborough University of Technology added five transputers to a personal computer to speed up the analysis of speech defects in children. When a child appears to be having trouble learning to speak, therapists usually collect speech samples from which they diagnose the problem.

In the past, attempts to computerize it have been slow and rather demanding on the therapists, who have had to supply lots of linguistic information. Connolly and Edwards have reduced the burden by writing a dictionary for the computer, a formal description of English grammar and a parser, which assigns to individual words their respective roles in sentences and tracts of speech.

The programme with which the computer calls up words in the dictionary includes morphological analysis of words. This means that fewer words need be stored in the dictionary, but it also helps with one of the commonest grammatical mistakes children make. The five transputers speed up all these processes. As they are connected to each other, they can work on five different tasks at once or share a task.

Meanwhile, John Byrne and his colleagues at the University of Aberdeen analysed pictures of human retinas with a network of eight transputers. They wanted to examine changes in the retina as a result of diabetes, melanomas and old age.

"Ophthalmologists watch the flow of fluid through the retina," says Byrne. One way of revealing the flow is fluorescein angiography, in which a fluorescent chemical is injected into the blood vessels which supply the retina. This highlights the blood vessels on photographs.

Opthalmologists need to compare successive images, which can be taken from one second to two years apart. The images have to be matched up carefully, and may need to be moved, rotated or magnified, especially if the patient's eye moved between photographs.

To make matters more difficult, as the blood flows through the retina it washes out the fluorescein, changing the image's contrast. Only five minutes after the fluorescein is injected, it will have cleared from the major blood vessels and entered the surrounding membrane, making the background appear paler than before.

Byrne's team divides the images into picture elements, or pixels, so they can be manipulated by computer. To reduce the contrast problems they use a standard technique called edge detection, which reduces the image to an outline drawing of the blood vessels.

They align the images by taking two small areas of one image and rotating them until they match the second images as closely as possible. Each transputer tries one angle, and when the best match between the two images has been found the system fills in the remainder of the background and produces a final image.

Eight patients supplied a total of 100 pairs of images to test the system. A typical pair took 18 seconds to match using eight transputers, compared to 95 seconds for a single computer processor. The transputer network was only five times faster because of the time-lag while tasks are spread out between the transputers. (This first appeared in "New Scientist", London, 24 August 1991, the weekly review of science and technology.)

Back to nature for the next generation

Over the past 30 years, silicon electronic components have been at the heart of almost every computing device. Recently, there have been significant advances into the use of radically different materials for computing - materials based on the building blocks of life itself.

The materials being considered for these future computers - known as biocomputers - include proteins, enzymes, conducting polymers and a host of other organic materials.

Researchers at the Centre of Molecular Electronics at Syracuse University have recently developed optical computing devices based on proteins. The protein that is used for computing comes from a bacterium called halobacterium halobiurn. This protein performs computations by changing its molecular structure or state in reaction to light. When red light from a laser hits, it flips into a different state. When green light strikes it, it reverts back to its original state.

One of the first practical applications has been in the construction of optical random access memories. Here, a thin film of proteins is used, with individual elements accessed by an electro-optical scanner. The memories are cheap - about 25 megabits can be stored in an area of about 2 square centimetres - and the access times are fast.

Because of the fast access times - one to four nanoseconds - they are well suited to cache memories.

The Syracuse research group also has plans to produce three-dimensional optical storage devices - memory cubes - based on proteins. These devices are expected to surpass the storage capabilities of conventional memory devices by many orders of magnitude. This process takes advantage of the fact that the proteins have a large cross-section for absorbing photons.

Although the Syracuse researchers are using new biological materials for computing, they still work within the standard von Neumann computing framework. A more ambitious goal is to produce computers which use novel architectures based on biological systems.

Many protein molecules, especially enzymes, can lock into other molecules at specific sites, and are known as lock-key mechanisms.

Michael Conrad, professor of computer science at Wayne State University, advocates the building of biological computing devices which exploit basic pattern recognition capabilities. Although complete biological computers are many decades away, some of these lock-key processes are already used in biosensors, which are increasingly being used to detect a variety of organic materials ranging from blood sugars and hormones to complex amino acids such as DNA.

Japan in particular is expressing considerable interest. Its Government-led bio-devices project has poured millions of dollars into academic and industrial research programmes in an effort to develop advanced biosensors

Isao Karube's research group at Tokyo University has produced complex biosensors using genetic engineering techniques. For a sensor to warn of toxic chemicals, they cloned the gene for the enzyme that makes fireflies glow and implanted it in a bacterium. The bacterium, which is then linked to an array of photosensors, glows in normal conditions and grows dim when toxins are present.

Japanese expertise in biosensors is expected to play a major role in the proposed New Information Processing project. This Japanese project will have a level of funding similar to the Fifth Generation Programme and is expected to carry out basic research to produce computers based on biological principles.

Phil Bartlett, of the Chemistry Department at Warwick University, UK, has recently produced biosensors which may eventually be used as switching devices for biocomputers. These biological switching devices are activated by enzymes.

However, there are problems making enzyme-based biological computers. Some are caused by their environment-friendly, biodegradable qualities.

Some researchers want to carry the idea of biological computing further. Not only do they propose computers based on biological materials, but they also think that they should adapt through evolutionary processes such as mutation and natural selection. This approach is, in effect, implementing genetic algorithms in real genetic material. Critics argue that most of the important mutation processes do not occur at the gene level but at cell level, and that the construction of cell-based computing devices will not be feasible for many years.

One of the more immediate applications of biocomputing devices is their use as preprocessing systems for current computers. In particular, there is considerable interest in their use as artificial sensory organs - as noses and taste buds. Bartlett's group at Warwick University has used polymer-based sensors to sniff out various complex chemical substances including coffee, beer and cigarette smoke.

The sensors in the Warwick nose are linked to conventional computers where pattern recognition software discriminates between chemical substances. Immediate applications of this technology are expected to be in quality control in the food industry. Similar efforts at the University of Tokyo have produced systems which can detect hidden explosives or cocaine.

A more controversial, and potentially far-reaching, aim of biocomputing is to produce systems which can exchange information between humans and computers. A few prototype neural interface systems already exist and are being used in laboratory animals. But current devices still do not use biological materials, relying on conventional silicon chips instead.

David Edell, principal research scientist in health, science and technology at Massachusetts Institute of Technology, has implanted tiny silicon devices in the nervous system of rats to obtain detailed information of nerve outputs.

The neural signals are first picked up by the silicon device at the nerve endings and are then converted into a binary format which, in turn, can be used to control any computing device. Rats with these implants have been trained to respond with specific neural activities for particular stimuli. The outputs of the silicon devices - the binary codes - are then used to control various electro-mechanical devices. In some experiments, the rats have been trained to control the lights in their room and to control their water feeders.

It is hoped this line of research will lead to neurally-controlled aids for the handicapped. But Edell warns against premature optimism.

The reverse process of these technologies - the channelling of outputs from computers into the nervous system - is a far more difficult problem. Edell and his colleagues at MIT have done some preliminary experiments in this area using rats, but interpreting the results has been difficult.

One day this technology might evolve to a stage where the outputs of computer programs can be linked directly to the human nervous system. It might then be impossible to tell the difference between the real world and a neurally-coupled software environment. In other words, virtual reality systems may cease to be virtual. (Source: S. Goonatilake, Computing, 20 June 1991)

V. COMPUTER EDUCATION

Using microcomputers in training institutions

This guide to proposed microcomputer systems and applications for training institutions in developing countries has been produced by the International Trade Centre (ITC). It discusses the development of microcomputer systems and recommends hardware and software for typical training applications as well as the use of microcomputers for greater personal and institutional efficiency.

The guide also gives specific examples of applications, such as: visual aids; case-studies; teaching and lecture notes produced with desk-top publishing and graphics software; developing video imaging systems; expert systems in training; creating databases of training materials, programs and human resources; establishing electronic links between training institutions in developing countries, and using shared data banks.

The guide is free to developing country users; they and others should contact: International Trade Centre UNCTAD/GATT (ITC), Palais des Nations, 1211 Geneva 10, Switzerland. (Source: ACCIS Newsletter, 9(2), July 1991)

University offering packaging degree

San Jose State University is offering a Master's degree in engineering, with a concentration in micro-electronic packaging. This MSE programme, believed to be the first of its kind, began in January 1991.

Dr. Guana Selvaduray, programme coordinator and materials engineering associate professor at the San Jose school, says course work is expected to take two to three years to complete. Instructors include Selvaduray, Jack Belani of National Semiconductor and Consultant Eric Bogatin.

The first class is composed of 14 students. Two are full time, the rest come from local companies, including Intel, LSI Logic, Lockheed and Raychem. (Extracted with permission from Semiconductor International Magazine, May 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Bye bye blackboard

Computer-assisted learning will be the key to a mass higher education system, with a national scheme for writing the software. This meets a wary response from Heriot-Watt University, a recognized leader in computer-assisted learning and the use of technology in education. It is like inventing the motor car, and figuring that you can order a million of them when you have not done anything about building the roads. It is not just a question of software. You have to devise teaching systems. Their own vision scarcely lacks breadth: they foresee a major revolution in higher education as we move into the next century, with a massive shift towards self-learning, away from the talking-head lecturer and inflexible timetabling, and supporting developments such as distance learning and professional updating. Heriot-Watt believes interactive computing can revolutionize teaching and training, turning them into major technologies. New developments can be used to enhance learning, creating "ISLES", intensely supportive learning environments. These are workstations with multimedia systems integrating text, video and audio, allowing students to interact with the material, and to test their understanding, working at their own pace, and always backed by academic support. (Source: The Times Higher Education Supplement, 5 July 1991)

Best-seller

The best-selling computer into UK schools is the Acorn A3000 with about 30 per cent of the market of 106,000 classroom computers sold in 1990. Second is the Nimbus 186 selling about 20 per cent. The BBC Master is third at around 15 per cent. Nimbus comes fourth again with its PC clone 286 range capturing about 10 per cent and fifth is Acorn with the Archimedes 400 series, with around 8 per cent of the computers sold. But Acorn is claiming that its share of the sales of computers to schools in the last three quarters of 1990 was 55 per cent. Acorn says that 30 per cent were RM computers, 3 per cent Apple, 3 per cent Amstrad, and 9 per cent others, each taking less than 1 per cent of the market. Acorn says for every four A3000s it sold two Masters and one Archimedes 400 series machine. There are 430,000 computers in the United Kingdom's 34,000 schools and 106,000 were bought in 1990 compared with 105,000 in 1989. (Source: The Times Educational Supplement, 28 June 1991)

Retraining non-technical staff for IT posts

New pressures in recruitment, changes in management structures and the integration of IT into everyday business processes mean that more people than ever are looking to non-IT specialists to work on system development.

Women Into Technology has identified two growing trends in IT recruitment. One is for staff from user departments to be retrained to work in technical posts. The other is a longer-term trend to push more application development out to the relevant manager or group of users.

The main driving force behind both trends is the need to make IT relevant to business rather than force business to operate in the way systems dictate.

A change in requirement from IT has happened in part because of changes in technology. PCs and local area networks have brought more computer literacy and local processing power to users. Fourth generation languages and computer-aided software engineering tools are speeding and simplifying the development of applications.

Added to that is a certain frustration that many departmental users feel at the inappropriateness of systems foisted on them by the DP department. In many cases systems are late, too complex or not what users really want. The result can be that costly applications are misused, bypassed or junked altogether. Users have been known to find ways of working around an unpopular system manually.

It has dawned on senior management at last that it pays to involve users in the development of systems that they are going to be asked to use. The result is that more people are being recruited into the systems department who have non-IT backgrounds.

But there is more than one reason for that trend. A second pressure is that management structures and work patterns are changing throughout business. Organizations are getting flatter, more responsive and less reliant on tiered management.

The result is that whole layers of middle management are becoming redundant. Enlightened employers will not waste the investment they have made in those people over the years, but instead recruit them to work on system development. And greater reliance on IT is still having an effect on the jobs people do inside companies.

Instead of writing a note by hand, having it collected by a secretary who will type it and then having it collected by a postroom boy who will stamp it and send it out, managers can use electronic mail to send a message direct to the fax or PC of a colleague or customer.

Again, employers who have frozen their recruitment of graduates or trainees may well be retraining secretaries and service staff to take on more technical tasks. Both IBM and DEC have managed large projects of internal restructuring.

IBM has retrained administrative clerks and secretaries to take on technical marketing jobs, such as advising customers on which systems to buy. It is moving people away from personnel, financial and administrative jobs because it needs fewer people to handle those functions. It has stopped recruitment because it is being affected financially by the recession and changes in IT buying patterns, but it is also convinced that it can find the people it needs inside its organization.

Another reason for recruiting internally for IT jobs is that there is still a national shortage of relevant IT skills. There is also an imminent shortage of 18 to 24-year-olds that will affect everybody who is looking for trainees, for IT jobs or anything else. In this climate it makes sense to look carefully at the people who are being made redundant within the organization instead of spending on recruitment outside.

Leading on from that, recruitment and training budgets are being squeezed across the board. IT departments are being asked to cut back on costs. Again, it makes sense to look inside instead of outside under those conditions.

All in all, it is surprising that the trend to recruit from non-IT departments is only just becoming noticeable. The reasons why it did not happen earlier probably come down to the cultural wall between IT and user. IT is still seen as a "techie's" subject, more akin to rocket science than the management of human work processes. Many a conversation has come to an abrupt end when one or other person mentions that they work in computers. How and when that culture gap builds up is another subject, but studies show that recruitment advertising that talks about computer language skills and hardware platforms is one of the biggest turn-offs.

IBM's most recent recruitment advertising campaign, which was used 15 months ago, tried to reach a wider audience than "techie" programmers. It appealed for innovation and free thinking from people who were "from all business backgrounds who think of themselves not only as problem solvers but as innovators". According to IBM the advertisement attracted a tremendous response.

Some employers are looking to involve non-IT specialists in IT not only because they are under pressure to restructure, but because they genuinely believe non-IT people can bring positive benefits to the system design process.

The bottom line for employers is that recruiting non-IT specialists into IT makes good financial and managerial sense. By involving more users in the development of applications, IT departments will produce more relevant systems that are properly used and earn their keep. If the research is correct, "non-techies" have better interpersonal skills than programmers and can relate technology to business processes in a productive way. And increasing pressures on IT recruitment and training budgets may well force recalcitrant employers to consider the people who already work for them as business analysts, rather than to look outside. (Extracted from Computing, 13 June 1991)

VI. SOFTWARE

IBM promises users open database route

IBM has promised users a more open approach to database systems by making it easier for them to access products from rival suppliers.

IBM's Information Warehouse is a framework for managing information across an organization, which will allow customers to move to DB2 while retaining older databases, like IMS, or products from rival suppliers including Oracle and Ingres.

The Warehouse consists of a set of IBM-approved management systems, facilities and tools for data access. Most of these will be supplied by third parties.

The first two partners are Bachman Information Systems and Information Builders.

Bachman was selected for its reverse engineering and data-modelling experience. Information Builders will launch a range of Enterprise Data Access tools in mid-September.

The tools will allow users to extract data from different databases and move it to a temporary storage database. This can then be accessed using a standard method based on the SQL query language.

The Warehouse is a direct challenge to DEC's Information Network, which allows users to access IBM's DB2 relational database. A key element of the strategy will be a new release of DB2. (Source: Computing, 12 September 1991)

PC versatility

Xerox researchers are trying to make it easier to use PCs, and increase their versatility. The work, being done at the company's Palo Alto Research Center, examines how personal computer users organize data when they work at a PC. The researchers then focus on the question of whether a PC might help. People work in the same manner but more effectively. Researchers are looking at the concept of "rooms" for organizing the universe of data within the computer. Each of the rooms houses the tools as well as the information necessary for a different kind of job. In order to switch jobs, the computer user would switch from one room to the other. (Extracted from The Economist, 15 July 1991)

Network version of DOS

Novell and Digital Research are jointly developing a network version of DOS. The two companies will offer integrated software that merges DR DOS 6.0 with client network software called the NetWare shell. They hope to offer users desktop systems that are simple to implement in the network environment and that let users tap into local area network (LAN), mainframe, and minicomputer information. A peer-to-peer network that supports LANs of 5-20 users will be one of the first offerings from the alliance. Novell is acquiring Digital Research under a stock swap deal. (Extracted from Information World, 22 July 1991)

Algorithm expands AI

NEC (Japan) has developed an algorithm that it thinks may greatly expand the scope of artificial intelligence systems. Existing neural networks can learn, but the new algorithm can reportedly elucidate sophisticated cause-and-effect relationships. It can even discern patterns for economic trends, earthquakes and weather conditions. It handles absolute as well as variable concepts, meaning that it can handle data for most situations encountered in real life. The algorithm can work through a range of thought processes and eventually pick the one that is most appropriate. NEC has also come up with a new computational technique that can reach an optimal solution without huge quantities of raw data. (Extracted from Nikkei Week, 13 July 1991)

Disc change will leave data stranded

The cheap and cheerful word processor that for many people was their first experience of computers, Amstrad's PCW, is to be launched in a revamped version. But the new PCWs will be completely incompatible with the old ones. When Amstrad launched the PCW in 1985, it was bundled with a printer and unashamedly marketed as an electronic replacement for the typewriter. Amstrad's biggest cost saving came from adopting a nonstandard floppy disc drive, the 7.5-centimetre (3-inch) format. Now Amstrad will switch to the larger 9-centimetre disc. A company representative says 7.5-centimetre disc and drive stocks have dried up. About one and a half million people have bought PCWs with the smaller disc drives. Users will have to buy an adapter which converts the printer port to a serial port and then, with the help of control software and matching leads, feed data out by wire to another computer, or find a computer facilities company which will copy data from the smaller to the larger discs. Inevitably this will be expensive. (Extracted from New Scientist, 31 August 1991)

A computerized encyclopaedia on art

The new Sainsbury Wing of the National Gallery offers some rather different pictures from the Rembrandts, Titians and Holbeins on display. In a marriage of computing power and design excellence, technology and art have come together in a manner that could draw many compliments. The "Micro Gallery" provides a new way of exploring the National Gallery's collection. Using 12 workstations, each with a touch-sensitive screen, visitors are able to interrogate an interactive encyclopaedia containing pictures of, and information about, the National Gallery's collection of more than 2,000 paintings. The system gives details of the artists' lives and techniques, and historical data to help put the collection into context. The Micro Gallery is designed to enhance the visitors' experience of the collection. "We did not want to put the workstations around the building because that would have been off-putting and would possibly have disturbed the viewing of the paintings. We did not want to mix information and the galleries. We want people to select the pictures they want to see and then, if they wish, they can print out a map showing where each picture is". The database is peppered with "popups", small notes that appear in the text. These help keep the entries concise and act as interactive footnotes or glossaries. They contain information on painting techniques, characters from mythology and notable patrons, as well as technical and religious terms. The cross-references can direct people to text or pictures, and a simple touch brings up the relevant page. A touch on a thumbnail picture moves the user to the full-picture screen with details of the painting. (Source: The Independent, 15 July 1991)

This parrot's dead

Microsoft has changed its operating system strategy again in response to market forces. Its new strategy is no surprise. It is: Windows, Windows, Windows. IBM and Microsoft co-developed OS/2 with the idea that it would take 90 per cent of the desktop operating system market by last year. Indeed, IBM made OS/2 the cornerstone of its Systems Application Architecture. But since the world was already moving towards "open system", SAA was obsolete when it was conceived, and it is now irrelevant. But having bet millions of dollars and its corporate credibility on SAA,

IBM cannot abandon it now. It therefore cannot abandon OS/2. Like our favourite dead parrot, it has to be kept nailed to the perch - at least until IBM can come up with a replacement based on Apple's superior Macintosh graphical operating system. (Extracted from The Guardian, 1 August 1991)

Farewell to fraud

Texas Instruments hopes to curb telephone fraud by checking callers' voices. The company estimates that, in the US alone, long-distance telephone companies lose more than $500 billion a year when people pay for calls using someone else's credit-card number.

The obvious solution is to check the caller's voice, but differences in audio quality between different telephones and lines add distortion which may fool the system. Texas Instruments suggests (in European patent 397 399) that when initially authorized to make credit-card calls, the card holder should have to speak a short, but secret, phrase down the line.

This is recorded in digitized form and stored in memory at the card control centre. Several recordings are made at different times over different lines, to average out characteristics of different lines and phones.

When asking for a credit connection, the caller must first speak the secret phrase. If they get it wrong they are obviously an imposter. If the words match, the control centre then compares the sound with the stored version. (This first appeared in "New Scientist", London, 25 May 1991, the weekly review of science and technology)

Baby translator masters 400 words

The dream of anyone who has struggled with a foreign language during an international telephone call would be an interpretation system that automatically translates conversations in different languages. Japanese scientists described a prototype of just such a system at an international conference on artificial intelligence in Sydney.

Akira Kurematsu, president of the ATR Interpreting Telephone Laboratories, a private research company in Kyoto, predicts that the real thing will be up and running early in the next century. Kurematsu says the ATR's prototype translates spoken Japanese into English using a synthesized English voice. The prototype has a vocabulary of just 400 words which are associated with a hypothetical scientific conference.

Within two years, Kurematsu says, the translator will "speak" 1,500 words, and within a decade he believes machines will be available to help telephone users in specific tasks, such as making hotel or conference reservations.

ATR is talking with scientists at Carnegie-Mellon University in the US and the German company Siemens about developing English-to-Japanese and German-to-Japanese translators.

According to Kurematsu, the ATR translator is composed of three basic parts. First a speech recognition component breaks the speech into small linguistic units called phonemes and predicts the next phoneme or word. Then the machine analyses and translates the information. Finally, a speech synthesis system produces the voice of the "interpreter". All these steps are completed by high-speed computers as the user speaks. (This first appeared in "New Scientist", London, 7 September 1991, the weekly review of science and technology)

MHIDAS on CD-ROM

US company SilverPlatter Information, Inc. has added the Major Hazardous Incident Data Service (MHIDAS) database to its OSH-ROM CD-ROM. MHIDAS is developed by the Safety and Reliability Directorate of the UK Atomic Energy Authority with support from the UK Health and Safety Executive, and provides key information on over 4,000 major accidents involving chemicals.

The MHIDAS database includes summaries of incidents involving hazardous materials that resulted in, or had the potential to produce "off site" impacts, including evacuation, casualties, or damage to the property of neighbouring populations. It contains almost 5,000 records covering over 4,000 incidents involving hazardous materials and incidents which had the potential to produce a significant impact on the general public. It covers incidents which occurred in over 95 countries during the last 25 years. Some earlier, well-documented incidents are also included.

The MHIDAS database joins OSH-ROM, which carries three bibliographic databases on occupational safety and health, including CISDOC, the database of the International Occupational Safety and Health Information Centre of the International Labour Organisation (ILO). For more information, contact SilverPlatter Information, Inc., One Newton Executive Park, Newton Lower Falls, Massachusetts 02162-1449, USA. (Tel.: +1-800-343-0064). (Source: ACCIS Newsletter, 9(2), July 1991, p. 2)

CD-ROMs multiply

In 1986 there were 94 different CD-ROM database titles in the world. The latest edition of TFPL's CD-ROM directory lists 1,522 discs, over 16 times more.

According to the 1990 directory, most CD-ROM titles (58.5 per cent) still come from US producers, with German (6.1 per cent), British (5.9 per cent) and French (5.3 per cent), publishers being the next most prolific. In all, 1,840 companies in 27 countries produced CD-ROM discs during 1990. Every country roughly doubled its publication output. The main subject areas for CD-ROMs are still biomedicine, general interest, science and technology, and banking, but areas such as drugs and pharmaceuticals, maps and government information are showing a marked increase. Education and training account for only 3 per cent of the total, and manuals (the application some saw as CD-ROMs' primary niche) only 0.6 per cent. The CD-ROM directory is available on CD-ROM and in print, both for the same price, £70. The disc uses KA-ware2 retrieval

software and is for use on PC compatibles. For further information, contact: TFPL, 22 Peter's Lane, London EC1M 6DS, UK (Tel.: +4471/251 5522; Fax: +44 71/251 8318). (Source: The Electronic Library, Vol. 9, No. 1, February 1991)

PADIS update

PADIS, the Pan African Development Information System, was set up in 1980 with the objective of establishing a regional information system in Africa. The system is a conduit for information and data on development information (centred around national, subregional and regional networks) to which member States will make voluntary contributions in order to share their management information experiences.

Headquartered in Addis Ababa, Ethiopia, PADIS is an extrabudgetary project, funded by the United Nations Development Programme (UNDP), which in 1990 conducted an evaluation of PADIS. The results are available in a report (RAF/86/053), which can be obtained from UNDP headquarters at One United Nations Plaza, New York NY 10017, USA.

Observations and findings from the evaluation are summarized in Economic and Social Council report E/AC.51/1991/3, 4 April 1991, available from the United Nations, New York. (Source: ACCIS Newsletter, 9(2), July 1991)

Macau institute for software technology

The United Nations University (UNU) is establishing a new research and training centre in Macau to assist developing countries with their computer-software technology needs.

UNU, the Governments of Portugal and the People's Republic of China, and the governor of Macau agreed to set up the UNU International Institute for Software Technology (UNUIST) in March 1991.

UNUIST is the first international institute devoted to helping build modern software technology capability in developing countries. Its central objective is to undertake research, advanced training and the application and dissemination of knowledge, as well as the development and adaptation of software relevant to the needs and capabilities of developing countries.

While the decreasing cost of mini-computers now makes them an affordable commodity for users in developing countries, appropriate software is in short supply.

Packages on the market are either general-purpose or specific application software that is popular and therefore commercially attractive to develop. However, there are many applications that are important to developing countries but for which they cannot afford the cost of producing the required software, or which are too specific to present a viable market for commercial developers.

There are a number of national or regional institutes for software technology, but none with an international perspective and none devoted to building a modern software capability in developing countries.

Furthermore, transferring software technology becomes more difficult as systems grow more complex, thus making the local development of some software essential.

Gaps in knowledge and competence between industrialized and developing countries are very substantial, but UNU expects the new institute to help developing country specialists reach the state-of-the-art in software technology.

Expected to start operating shortly, the institute's staffing costs will be met by a US$ 20 million UNU fund set up by the Governments of Portugal and the People's Republic of China, as well as the governor of Macau. The governor may make available additional funds to cover the institute's initial operational costs. (Source: Development Forum, May-June 1991)

Computers smooth the path to integration

A computer program which can carry out mathematical integrations or prove that the integration cannot be done must be the dream of every A-level pupil struggling with homework that seems to be impossible. In August 1991 those dreams came true, in the form of a program called Axiom, which has been under development for 13 years.

"You type in the formula", says James Davenport, professor of information technology at the University of Bath, "and the program types back the solution or a proof that it can't be done." He says this type of program allows people to solve problems that they simply could not attempt before.

Mathematicians began to look for systematic methods of integrating during the last century, but no real progress was made until the late 1960s. By 1981 Davenport had worked out a complete, systematic algorithm. If the computer works through the algorithm and comes up with no solution, there will not be one. But, according to Malcolm MacCallum, professor of applied mathematics at Queen Mary and Westfield College in London, Davenport's algorithm "was so horrible that nobody has implemented it in full".

Parts of the algorithm have been made into Axiom, developed at IBM's research laboratories in Yorktown Heights, New York. Axiom has already been used to control the camera on the commercial remote sensing satellite Spot.

Control of the satellite is so delicate and complicated that commands made by its human operators have to be tested before they are carried out. The effect of a command is turned into a series of mathematical equations, which are processed by Axiom. It ensures, for example, that pointing the camera at the Earth does not turn the solar panels away from the Sun, cutting off the satellite's power supply.

John Fitch, professor of software engineering at Bath and a colleague of Davenport's, said he no longer bothers with traditional integration but always uses the computer algorithm. He predicts that integration by computer "could revolutionize algebra as the calculator and log tables did". (This first appeared in "New Scientist", London, 3 August 1991, the weekly review of science and technology)

Documentation is on-line

Documentation stored on a CD ROM helps users of a Sun workstation to find answers to their questions on the computer, the SunOS Unix operating system, and the Open Look graphical user interface. This new on-line documentation, the System Software AnswerBook, is a single disc that contains more than 16,000 pages, or the equivalent of more than 20 reference manuals. A network server equipped with the disc gives all users of workstations on the network access to this information.

Unlike a manual, the System Software AnswerBook has search techniques that go into action once users type in their questions, such as "How do I read my electronic mail?" or "How do I install a new printer?"

Alternatively, users can employ the mouse to "click" on a table of contents entry and then click to the topic of interest. Similarly, with hypertext links, users can click on a cross-reference in the text and instantly jump to the related topic, even if it is in another manual. Another feature, "bookmarks", returns users to pages they wish to review.

An engineer whose company installed the product reported receiving 80 per cent fewer technical questions from the disc's in-house users.

A System Software AnswerBook disc for use on one workstation is priced at US$ 495. Additional workstations on the network can be licensed at $250. Contact: Sun Microsystems Inc., 2550 Garcia Ave., Mountain View, California 94043; Tel.: 415-960-1300; Fax 415-969-9131. (Source: IEEE Spectrum, August 1991)

Elemental information

While the periodic table has not changed recently, scientists have been collecting more and more information about the physical properties of each of the elements. Engineers who can make use of this data might consider a database management system called Proelement that contains over 12,000 facts and figures. These include physical, isotopic, electronic, chemical, spectral, nuclear, bonding, and nuclear magnetic resonance properties. Covering 103 elements and 481 isotopes, Proelement's menu-driven search system lets the user define the search criteria. Formatted output is also available.

The system runs on an IBM PC or a compatible and costs US$ 299.95. Contact: Intellibase Engineering Software Inc., 4053C Tates Creek Park, Suite 190, Lexington, Kentucky 40517; Tel.: 606-268-9896. (Source: IEEE Spectrum, June 1991)

NEJM on CD-ROM

Accessing medical information has become a quick and easy operation with Maxwell Electronic Publishing's release of The New England Journal of Medicine (NEJM) on CD-ROM. Physicians and health care professionals now have easy access of thousands of articles and references to the prestigious weekly medical journal.

The CD-ROM version, which Cambridge, Massachusetts-based Maxwell released in cooperation with the Massachusetts Medical Society, includes the complete text of all original articles, special reports, editorials, case records, and letters to the editor published in 10 volumes from 1986 to 1990. For researching back issues, the disc includes all NEJM citations and abstracts from the National Library of Medicine's Medline database dating back to 1966.

The NEJM disc can be accessed from an IBM or compatible PC with a CD-ROM drive using Maxwell's Compact Library software with BRS/Search. The software allows users to view specific volumes and issues, or to search through more than 250 issues simultaneously. An interactive search feature helps users locate the desired information quickly and effectively; the disc can be searched by key words and phrases, author, title, and subject.

The disc is now available for personal use at $395, and $550 for institutions. More information is available from Randi Straus at Maxwell Electronic Publishing, Tel.: (617) 661-2955. (Extracted from Information Week, 8 July 1991)

The power of parallelism

A new software package for Turbo C, C11, allows hundreds of independent run-time processes to smoothly cooperate on common resources, self-parallel functions, queues, lists, events, and time-outs. C11 constains all the C communications and classical synchronization mechanisms, along with a set of new features, such as a class of semi-automatic variables, run-time control variables, double access to process arguments, stack monitoring, private stacks and offsets. C11's dynamic priorities and scheduling facilitate inter-process cooperation.

The package, from Subtlesoft International, can operate over 7,000 switches per second on a IBM XT personal computer operating under DOS. It provides a natural platform for pure object-oriented programming, along with such common parallel-oriented problems as real-time control and communication software.

C11 costs US$ 333, and a demonstration kit is available for $33. Contact: Subtlesoft International, 4344 Bristol St., Pittsburgh, Pennsylvania, 15207; Tel.: 412-521-1158. (Source: IEEE Spectrum, July 1991)

Computer graphics give teletext a sharper image

Philips has come up with a way of broadcasting graphics, of similar quality to a personal computer, through a normal TV set. The technique is a great improvement on the crude graphics on current teletext systems such as Oracle and Ceefax. In future it may allow people to print out an up-to-the-minute newspaper from their TV with print quality similar to a normal daily paper.

Philips has simply added a standard piece of computer software, called a Post-script decoder, and some extra circuitry to the teletext circuits of a television. Postscript is a software language used to define text and graphics on a page and was originally designed for use with computer printers.

In the new system, the TV's teletext decoder works normally until is recognizes Postscript code. It then uses Postscript processing to draw the page on the screen. The software can generate images of any size, so it can adapt to any size of screen. The picture quality will be better on modern higher resolution TVs while still working on an older TV.

If a high-quality printer is attached to the TV, the original image will be printed in the quality it was originally created, irrespective of the quality of the TV screen.

At the Funkausstellung show in Berlin, images were being created on a Macintosh computer and displayed on one of Philips' new widescreen TVs. The demonstration used the new D2-MAC TV format which the European Commission is pushing as the standard for all future satellite TV broadcasting.

Philips considers D2-MAC particularly useful in this sort of data-intensive work. Each D2-MAC TV signal can carry eight mono audio channels and a data channel in addition to the TV picture. If less audio channels are needed more data channels can be used. (This first appeared in "New Scientist", London, 14 September 1991, the weekly review of science and technology)

Technology to improve applications

Microsoft is developing a technology that will make its applications more intelligent. The technology, dubbed Wizards, will enable applications to foresee what a user's next move will be. It will also propose a better way to perform a task. Wizards will allow an application to follow a user's actions and figure out what he will want to do next. As an example, the technology could allow a program to figure out when a user could benefit from learning a new command. (Extracted from Information World, 5 August 1991)

New management package

Micro Planning International will unveil a low-end Mac-based project management package. Micro Planner Manager can manage as many as 1,500 activities per project and can do budget control, cost optimization, and flow forecasting. Text from other Mac project management products can be imported into and exported from Micro Planner Manager. The package, which works with System 6.0.X and 7.0, lets users make their own symbols in Gantt charts and has an inner desktop for organizing. (Extracted from Information World, 5 August 1991)

Neural net software bypasses programming

Two new software packages, ExploreNet 3000 and KnowledgeNet, use neural network techniques to solve engineering and scientific problems without requiring any programming. Instead, the neural network processing scheme is set up through mouse-selectable icons.

Because neural networks exhibit an adaptive behavior that lets them learn from data collected in the past, they do not need algorithms or rules in advance, nor must such things be developed. Instead of being programmed, these networks are "trained" by being exposed to repeated examples of and desired responses to the collected data. Once they are trained, they can "fill in the blanks" for missing data or make predictions.

While the ExploreNet 3000 can solve problems containing large data sets, KnowledgeNet is used in applications calling for yes/no decisions or multiple choices. Both packages require Microsoft's Windows 3.0 running in 386 mode. With Windows' multitasking capabilities, a user can train a neural network while doing other work in a separate window.

ExploreNet 3000 can be set up to process data according to any of 19 forms of neural networks. The icons needed for this processing include three types of modules: input/ouput, which specify input files, communicate with other programmes, and edit or display textual data; data processing, which contain the neural networks and perform the computations; and display, which allow data to be displayed in text, graph, or image form. Each module may be tailored to application requirements, defined, and tested.

KnowledgeNet's speciality is explaining some of the rationale behind decisions made by a neural network. That information is useful in determining how important any missing data are, what confidence to associate with a decision, and how much each individual input contributes to the decision. KnowledgeNet also comes with a sample programme, including a neural network, data, and rationales for making a variety of decisions.

A co-processor board, the Balboa 860, is also available that can speed applications involving large data sets or pattern recognition by up to two orders of magnitude. These include signal analysis in such areas as medical diagnostics, radar, and sonar, and pattern recognition in industrial process control. According to the manufacturer, HNC Inc., the products get results faster than traditional statistical analysis schemes or programming methods.

Because Balboa 860 brings mainframe computer performance to the execution of the neural network software, it can increase the scope of the modelling and analysis problems the user needs to tackle. Built around the Intel 860 RISC processor, the Balboa 860 board has power equivalent to 40 VAX machines.

ExploreNet costs US$ 1,495; KnowledgeNet - US$ 995; and the Balboa 860 costs $10,950. Contact: HNC Inc., 5501 Oberlin Dr., San Diego, California, 92121-1718; Tel.: 619-546-8877; Fax: 619-452-6524. (Source: IEEE Spectrum, July 1991)

After ASCII, Unicode

As international communications blossom, so does the need for standard methods of expression. Currently, most computers resort to the ASCII standard to encode alphabetic characters. With a pattern of 8 bits, ASCII can easily represent letters in the English alphabet, upper- and lower-case, plus many punctuation marks and math symbols.

But languages other than English have presented so many conundrums that 12 computer companies, including IBM, Apple Computer, Sun

Microsystems, and Microsoft, formed a consortium to devise a universal character code. They are calling the result Unicode.

Since ASCII can represent 256 unique characters it can accommodate several languages. The many other languages with more than 256 characters, however, present a much larger problem. To deal with them, the new Unicode employs 16 bits to encode each character, enabling it to define 65,536 different symbols.

Unicode can represent all the living languages in the world, plus classical Greek, according to its developers, in addition to punctuation and many math and special symbols. Even Chinese, Japanese, and Korean are within its reach, though Chinese alone requires over 30,000 characters. However, after studying the official ideogram listings of China, Japan, Korea and Taiwan, linguists determined that about two thirds of their ideograms are common to all or most of them. When the common ideograms are not duplicated, everything fits in the 64 K character space.

In November 1990, after five years of work, a final draft was submitted to the consortium members, who incorporated the effort as Unicode Inc. in January 1991. The review process ended in February. A standard ready for implementation was to be published in June 1991, according to Mike Karnaghan of Metaphor Computer Systems, another of the consortium's members. Contact: Ken Whistler, Metaphor Computer Systems, 1945 Charleston Rd., Mountain View, California, 94043. Tel: 415-961-3620. (Source: IEEE Spectrum, June 1991)

Computers get stoned on patent discs

In the name of publicity, the European Patent Office in Munich has inadvertently been sending clients a floppy disc carrying a computer virus. The disc contains a virus known as Stoned, which at present times garbles text on the screen and throws up messages saying "legalize marijuana".

The EPO has had to spend nearly £20,000 warning recipients of the disc all around the world not to use it and helping those who did to get rid of the virus. The office maintains that the virus did not get into its own computer network and that those people who were infected have suffered no loss of data. It is now mailing out a new version of the same disc with a pledge that it is safe to use.

The discs that caused the trouble run on standard personal computers. They contain publicity samples of an electronic version of the weekly Bulletin, which lists new patents and applications. The EPO intends to collate all the issues of the publication each year on a single CD-ROM disc.

In April, the EPO sent copies of the sample floppy disc to the 1,000 or more patent agencies, search firms and industrial companies which currently buy the Bulletin in printed form. It was soon inundated with phone calls from worried recipients who were losing control of their computers. The EPO had to set up a helpline to give advice over the telephone.

The office has spent the past three months trying to pin down the source of the virus, and now believes it came from an independent software company in Germany which helped with preparation of the disc.

The EPO found that the virus will only infect a computer if someone puts the disc in the disc drive before switching the computer on. A computer will automatically read any disc in its drive when it is switched on because it assumes it will find operating system software on it.

With the EPO's disc, the computer displays an error message warning that the floppy disc does not contain an operating system, but by that time the virus has already transferred itself onto the hard disc in the computer. From then on, at specified times - usually 10 a.m. and 10 p.m. - the computer displays its message.

Computers at Britain's Chartered Institute of Patent Agents were infected with the virus. The EPO's disc infected the CIPA office computer at Staple Inn Buildings in London and also the computer the secretary uses at home. Staff spent hours attempting to solve the problem with remedial software but they still have a nagging worry that some data may later turn out to have been corrupted. CIPA sent out its own warning to British patent agents and advised them not to format any new discs on infected computers so as not to spread the virus. (This first appeared in "New Scientist", London, 10 August 1991, the weekly review of science and technology)

Virus protection

Alan Solomon, a British expert on computer viruses, has filed a British patent application (2 231 418) for a system he claims will prevent viruses getting into a computer and storing themselves on the hard disc.

Although virus protection programs exist, the latest viruses defeat them because they store themselves in the sectors at the start of the hard disc that contain the code used when a computer is first switched on. So the virus can take control of the computer before any virus prevention program has a chance to start working.

Preventing the computer from recording to the hard disc would of course stop viruses storing themselves on it. But programs, like word processing, must continually write to the disc. The answer, says Solomon, is to stop the computer writing to the first sectors but not the rest of the disc.

An electronic circuit senses when the writing head is over the first sectors of the disc, and physically disables the head's recording circuitry while it is over those sectors. This means that the only way for manufacturers to record the necessary programs in these sectors when constructing the computer is to connect a wire which temporarily shorts out the sensor circuit. (This first appeared in "New Scientist", London, 25 May 1991, the weekly review of science and technology)

Software brings design engineers together

Design engineers in different locations can work together on a design that they all can see,

manipulate, and change at the same time on their computer screens, with new prototype software developed at Sandia National Laboratories. The interactive concurrent engineering (ICE) software allows high-resolution graphics output from a computer-aided design program, or from many other computer-aided tools, to be simultaneously viewed and manipulated by people in several locations. Each sees the design displayed on his or her screen and can have full control over it by using keyboard and mouse. The software can be implemented on any workstation supporting the X Window (Massachusetts Institute of Technology) environment. According to Sandia computer scientist Craig D. Dean, developer of the prototype, several years of work will still be needed to bring the software to the point where it could be made generally available in a production version. (Source: Chemical and Engineering News, 3 June 1991)

Programmers focus brainpower on parallel computing

The enormously complex problem of writing software for parallel computers will be tackled by computer scientists taking part in the British Government's Parallel Applications Programme. Parallel computers rely on many processors working simultaneously, which makes them faster than conventional computers which have just one processor.

The four-year, £34-million programme announced by the Department of Trade and Industry will meet the cost of setting up four new parallel computing centres based at the universities of Edinburgh, London, Oxford and Southampton.

Their purpose is to encourage the use of parallel computing in industry, and all their research will be done with industrial partners. No specific projects have yet been announced. Industry will provide half the funding in the first two years of the PAP, and more in the final two years.

Computers which work in parallel have been available for years. But despite their potential for processing large amounts of data quickly, parallel computers have been slow to catch on in industry.

One of the main reasons is the difficulty of programming chips which are working simultaneously. Even for computers with just one processor, it has been necessary to develop formal methods of writing to ensure that calculations are done at the right time and in the right order. With many processors working at once, the problems are compounded.

Some researchers are evaluating ways of getting computers to convert existing software so that it will run on parallel computers.

There is already a method of converting the software, providing that the original program has been written in a particular way. But if the problem is expressed mathematically, in a so-called precode, a computer can take over and produce the final program in any computer language, either for one or for many processors working in tandem. (This first appeared in "New Scientist", London, 13 July 1991, the weekly review of science and technology)

Software industry: developing countries' prospects bleak

The prospects for the low-wage manpower-rich developing countries in tapping the employment and income potential of the burgeoning software industry are not too bright, according to a recent study by the International Labour Organisation (ILO).

This is not because of any lack of technical expertise but because of a variety of bottlenecks such as the absence of infrastructural and other facilities, not to speak of the limited and costly access to hardware. The net result is that firms in industrialized countries prefer importing manpower from these countries to subcontract the work. A 1985 survey in the United States showed that foreign and naturalized people constituted 30 per cent of the scientists and engineers in computer and electronic industries, a proportion much higher than for all industries.

Although multinationals have in some instances set up software development centres in some NICs there is no ground to support the view that software and computer service opportunities will burgeon in the developing world. This does not mean that the industry will not become an important source of employment and income in these countries in the future. It certainly will, like in many industrialized countries. However, it is more likely to be a follower rather than an initiator in the overall progress of development.

The world market for software and computing services doubled in the first half of the 1980s to about $55 billion. It is expected to rise to $163 billion by 1996. The study states demands for packaged software will continue to grow rapidly universally while the demand for data-processing will decline significantly in its relative importance due to advancement of computer technology and software engineering.

The structural change in the software market will have an impact on the labour market. In the United States, for example, employment in the software and computer services industry increased from 0.8 million in 1972 to 1.4 million in 1980 and 2.2 million in 1987, averaging an annual rate of increase of 7.72 per cent. In Japan, where the number of employers in this sector grew from 158,000 to 335,000 between 1981 and 1986, the proportion of system engineers increased from 14.7 to 24.2 per cent and of programmers from 21.4 to 30.4 per cent over the same period.

So far, the trade in software and computer services has been confined within the OECD area, especially among its relatively more advanced members. Only small numbers of firms in NICs export computer services and some software products and their earnings are marginal. This need not necessarily mean that trade in software and computer services will continue to remain a preserve of the more advanced countries.

Among developing countries Brazil is by far the biggest market for computer services and software, estimated at $4,217 million in 1987. India's market for these services expanded rapidly to an estimated $337 million by 1987, that of Mexico, $130 million, South Korea, $147 million and Singapore $129 million. (Source: Amrita Bazar Patrika, 3 November 1990)

Making sense of the information age

Multimedia, data visualization and virtual reality could become the manager's tools for the future, helping to exploit information that every organization now collects and then fails to employ.

Data is raw fact and figures. Information is something that has meaning and it can take a multitude of forms. Data can be turned into information by applying intelligence to it. Our present systems are only able to convert a limited amount of the data we have available into information.

Our systems are not yet equipped to handle the major portion of the information proliferating in the world around us. It is estimated that computers address only about 20 per cent of an organization's information. The rest exists outside computing as free-form text, documents, images, three-dimensional models and other objects, video and sound recordings.

We are collecting and generating data at a rate that far outstrips our ability to make sense of it. Everywhere today there are data capture devices - monitors, sensors, data loggers, video cameras.

It is estimated that the US space programme analyses just 10 per cent of the terrabytes of data it is continuously gathering. Technical and scientific knowledge is said to be increasing at a rate of 13 per cent a year.

Our problem then is that while we are creating the raw material in abundance we are struggling with the tools to turn it to our advantage. But we cannot ignore the challenge presented by the raw material. Our survival could depend on it.

At the business level, information is a weapon. At the global level, we need to understand the data we collect on the environment to plan for its protection.

Traditional computing systems are symbolic processors, largely manipulating alphanumeric character strings. This limits both the content and our means of interpreting it.

If we are to get to grips with the volume and complexity of information we now face we have to look beyond symbolic processing to ways of marrying our advanced interpretive abilities and physical responses with the power of computing.

This then is the significance of the technologies of multimedia, data visualization and virtual reality. They are not amusement arcade sideshows but central to the future of information technology because they force back the boundaries of the human computer interface.

It is essential that we expand the bandwidth of the user interface if we are to comprehend and act on the information we are gathering. The new technologies do this by engaging more of our faculties and enabling us to interact with information as we interact with the physical world.

Multimedia presents us with sound and moving images and allows us to interact with information. Data visualization takes complex multi-dimensional data and converts it into pictorial forms we can interpret more easily. Virtual reality lets us step through the computer screen into information as if entering a parallel world.

"We have five senses. Multimedia at least adds more of our range of sense to the computer environment". Interactive multimedia is the best available mimic of human interaction," says Alan Cawson, professor at the school of social sciences at the University of Sussex. It offers both a means of conveying difficult ideas and of making accessible large quantities of related information. It makes less onerous the task of finding and absorbing information.

The driving force of multimedia so far has been from the supply side of information: education, training, marketing and the media. Multimedia's ability to access diverse information and present it in a lively multi-dimensional way makes it a forceful and flexible communications tool. It can also be extremely cost-effective.

Multimedia makes accessible what is known. Data visualization on the other hand seeks to discover what is hidden.

Originating in the scientifc world, data visualization uses the computation power of modern workstations and sophisticated graphics and simulation techniques to translate large volumes of complex data into pictures.

Traditionally used for applications such as stress analysis, fluid flow dynamics and geological surveys, data visualization is being seized upon as a means of quickly interpreting statistical, business and financial data.

Bringing new medical drugs to market is a drawn-out process which takes on average 12 years from the beginning of clinical trials to the drug's registration. Reviewing and analysing the results of the trials is a complex process involving sophisticated statistical as well as clinical interpretation.

Data visualization takes mass data and turns it into information from which the user can extract knowledge, says Graeme Webster, director designate of the proposed International Centre of Scientific Visualization. Webster believes the techniques have profound implications for the commercial sector.

Already financial institutions like Barclays Bank, The Bank of Kuwait and Chemical Bank are using data visualization products to help interpret the data feeds that bombard market traders. Single screens with clear simple graphics are replacing banks of terminals cross-hatched with figures that yield nothing without intellectual effort. Financial information services supplier Quotron Systems, for example, has developed a system for analysts and traders that replaces six terminals with one graphics and Windows-based screen.

Incorporating the Data-views visualization software from VI Corporation, the system presents market information in terms of graphical charts that are updated automatically as the data values change in real time.

These systems are taking advantage of the image processing and analytic abilities of the eye-brain combination. It would be a small step to include sound. At its simplest, audio alarms could signal when thresholds are crossed. Alternatively speech synthesis could be used to add a layer of verbal interpretation to visual presentations.

It is inevitable that data visualization and multimedia overlap. They pursue the common goal of an intuitive and powerful interface with information. A key development along this road is the introduction of the time dimension to the computer environment.

Graphics brought a spatial dimension to computers, introducing images and allowing data to be presented as charts and graphs. Sound and video are inherently time based of course, but much data has a time dimension too. Our conventional methods of representing time - as an axis on a graph, as a sequence of snapshots, and so on - are limited.

Animating time-based data enables us to understand processes and trends with greater insight.

Virtual reality widens the bandwidth yet again to add a physical dimension to the human-computer interface. It is the logical conclusion of the process which began with icons representing the desktop. It extends the metaphor of the interface to reality itself. In doing so it enables the user to not only interact with and interpret data but to experience and participate in information.

Virtual reality brings the broadest range of human faculties to bear on the computer. If the computer, using multimedia and visualization techniques, can deliver data in such a way as to take advantage of these faculties, we have the greatest chance of mastering the superabundance of information we face.

Virtual reality systems may be crude affairs at the moment, creating limited cartoon-like worlds. But it would be unwise to expect developments to follow the traditional development cycle.

The commercially available products are not just arcade games but include toolkits for creating virtual worlds and objects to go in them.

Early applications tend to be those where the virtual world mimics the real world, such as visualizing architectural designs.

It will not take much to substitute the computer-aided design (CAD) database with a database of, say, financial data. A trader could "walk through" market information, where stock performance and trends were manifest in a 3D form. Meanwhile virtual visual worlds are already being created from non-visual data at the UK National Advanced Robotics Research Centre at the University of Salford. The centre is developing a system for controlling a remote robot by telepresence - feeding human operators sufficient information about the remote environment so that they feel they are physically there.

The system takes feedback from non-visual laser range sensors on the robot and interprets this data visually in a virtual reality system. The operators see the task before them and operate the robot accordingly.

Again, in theory, the data could be any digital data but by presenting it in a virtual world the human can participate and interact with it in a wholly intuitive way.

It is interesting that board level directors who rarely deal with anything but information generally make least use of information technology. That may say something about the Luddite tendencies of directors but it also says a lot about the state of our technology. (Extracted from Computer Weekly, 5 September 1991)

VII. COUNTRY REPORTS

China

Joining the elite

When the Chinese take on responsibility for Hong Kong in 1997, they could find one of the world's elite electronics industries on their doorstep.

In the last five years the Hong Kong electronics industry has been undergoing a major sea-change to transform itself from nothing more than an assembly area for multinationals to a top-class electronics design centre.

A massive infusion of money and faith has just been made by Motorola. It has opened a wafer fabrication facility in Hong Kong, and built a brand new design centre right alongside. Already known as Silicon Harbour the company will make application specific ICs, bipolar and MOS memory devices.

More importantly the project puts top-flight designers on the doorstep of the burgeoning South-East Asia electronics equipment market.

C. D. Tam, corporate vice-president and general manager of Motorola's Asia/Pacific division estimates the region will be buying upwards of $15 billion worth of semiconductors by 1995.

Tam is also heading a commission which has recommended the Hong Kong Government to create a Science Park whose aim will be to raise the level of technology. The aim is to get the project under way before the handover to the Chinese. Given the go-ahead Tam reckons that the park could be started by 1994.

A $25 million technology centre in Kowloon has already gone ahead, and last April a Museum of Science and Technology was opened also in Kowloon.

Texas Instruments is another investor. In its Hong Kong headquarters it has established a design centre for custom chips.

International Quartz, a Kowloon-based company has just launched an IBM-compatible laptop which has a built-in cellular telephone, which can transmit data as well as voice. Statpack Systems

is claiming a materials breakthrough which, the company claims, virtually eliminates static. It is now supplying a number of plastic moulding and housing makers in Asia.

This energy has had a beneficial effect on the colony's electronics exports figures which rose 15 per cent in 1990 to about £14 million. The United States is the major customer, but China is catching up fast, and Germany is the third largest importer of Hong Kong's electronics goods. (Source: Electronics Weekly, 26 June 1991)

Brazil

Opening up to computers

Brazil is getting close to abolishing its "market reserve" on computers - the protectionist import ban that, critics say, has made local industries lag behind the rest of the world. A recently passed congressional bill will - if approved by the Senate and by President Fernando Collor de Mello - open up the Brazilian market after October 1992.

Collor has made it a priority to liberalize the country's economy, and nowhere has State control been more cumbersome than in the computer industry, where Brazilian microcomputers cost on average three times more than US or European equivalents.

The move to open Brazil to foreign competition has elicited very different reactions from the country's scientists. As might be expected, employees of Brazil's computer industry are among the most vocal defenders of the market reserve.

The Brazilian Society for the Progress of Science, for instance, argues that the import restrictions have created "local technologies" and provided jobs for thousands, including engineers and other electronics researchers.

But scientists who need computers and other electronic equipment for their work have other opinions. Biomedical researchers are particularly unhappy with the present situation. Not only do they not have access to good computers, but they must also struggle with the government bureaucracy whenever they need equipment that has electronic circuitry. The usual way to circumvent the informatics law is to resort to smuggling.

One option for survival for Brazilian companies is to create joint ventures with foreign concerns. IBM already plans one such venture with a Sao Paulo company, SID Informática. And the Brazilian legislature is now discussing other ways to help Brazilian companies, such as tax incentives.

Even if the final legislation does not open the market entirely, it will go far in improving things for consumers. (Extracted from Nature, Vol. 352, 15 August 1991)

Czechoslovakia

Joint venture for communications equipment

West European firms are continuing their drive into the potentially lush markets for communications equipment in East Europe. Among the latest moves is a joint venture between Standard Elektrik Lorenz AG (SEL), the German member of the French telecommunications group Alcatel NV, and Tesla Liptovsky Hradok of Czechoslovakia. In its first phase, the deal will involve production of SEL's System 12 digital switch in Czechoslovakia.

The aim is the annual production of System 12 switching equipment for 250,000 subscriber lines at a plant in Liptovsky Hradok. Production will start during the second half of this year. The venture calls for initial investments of about $11.5 million, and SEL has offered to fully finance it for 10 years.

The second phase envisions extending the cooperation to encompass the manufacture of private switching equipment and telephone sets. The German-Czech agreement provides for Stuttgart-based SEL to transfer manufacturing technology to its partner, train personnel, and set up a software centre. (Source: Electronics, July 1991)

Unix goes to Prague

AT&T, with the aid of SOKOL, the Czechoslovakian relief organization in New York City, donated 25 AT&T 3B2 Unix computers, 70 AT&T terminals, 12 AT&T Paradyne modems, and a full complement of Unix SVR3 software and applications to three Czechoslovakian educational institutions. The computers will be used by mathematics and computing departments at Charles University, Prague; Masaryk University, Brno; and Comenius University, Bratislava.

Karel Janac, Michael Potmesil, and Ralph Severini of AT&T Bell Laboratories began the project shortly after the Berlin Wall fell and the "velvet revolution" occurred in Czechoslovakia. The possibility of the computer transfer became a reality with the reduction in technological trade restrictions negotiated by the European Economic Community in June 1990.

Several university members are expected to attend Unix classes and seminars. One representative from Masaryk University already spent a month in the US getting hands-on Unix experience. (Source: Computer, June 1991)

India

India: a reservoir of trained specialists

Information technology, more than any other area of electrotechnology, will advance in India over the next decade and make major impacts on the country's economy. Among the industries that will grow are basic micro-electronics, computer hardware, computer software, telecommunications (including electronic switching, satellite communications, and optical-fibre communication), and the handling of large databases - both geographically distributed and concentrated ones. Such technology can radically transform most sectors of the the economy - including banking, insurance, industry, energy, and transportation - leading to much higher efficiencies.

Another area where information technology will advance is in television and radio broadcasting across the country, which will have a major impact in conveying messages concerning

education, health, sanitation, and the environment. Since India has most of its population in rural areas and a high percentage of illiteracy, visual images and voice communications are extremely important. Equally, non-voice data capabilities are critical for sectors that have to move forward rapidly, such as energy, transpor- tation, industry, and finance. Therefore, the development of databases with a wide geographical spread and the ability to interconnect is clearly needed.

One set of obstacles to realizing the full impact of information technology relates to administrative practices, which tend to result in significant delays. The more important obstacle, however, is a lack of awareness and appreciation of how information technology can truly transform the economy.

While optical electronics is expected to grow strongly, presently research, development, and production in this area are insignificant. Striking advances will also be made in serial and parallel processing and connectivity as well as in database management and national information systems.

India is currently attempting to shift its technological development processes from a serial approach (a step-by-step innovation chain from R&D through production) to a more concurrent methodology, both to compress the time-frame from start-up to production and to ensure that pricing and built-in quality in design, materials, and processing techniques lead to zero defects. (Source: IEEE Spectrum, June 1991)

Department of Electronics - LSI/VLSI Design Centres

Recognizing the importance of the area of micro-electronics and specially large-scale and very large-scale integration (LSI/VLSI), the Department of Electronics has set up the National Microelectronics Council (NMC) to oversee, coordinate and support programmes covering R&D, technology development and manufacture in the area of micro-electronics. The NMC is an inter-ministerial forum under the Chairmanship of the Secretary, Department of Electronics. Specialist working groups have been set up to assist the NMC in discharging its responsibilities. Currently, three working groups dealing with computer aids for micro-electronics, micro-electronics technology and discrete semiconductor devices have been set up, with 30 projects having been initiated at academic institutions, R&D laboratories and industry with a total outlay of Rs. 260 million.

A three-level framework has been evolved for CAD of LSI/VLSI. The framework consists of a level-I centre for VLSI design and prototyping being set up by the Department of Electronics, level-II design centres at universities and R&D laboratories, and level-III CAD awareness activity at engineering colleges. In the first phase, level-II centres have been set up at the IITs at Bombay, Madras, Delhi and Kharagpur; IISc-Bangalore; Jadavpur University; and CEERI-Pilani. The level-III activity is likely to be initiated at a few engineering colleges close to the level-II centres. The level-I centre of the Department of Electronics would act as a nodal resource centre to provide coordination and support to the level-II and level-III activities and would also carry out design and software activities. UNDP has approved part financial support for the level-I centre. Level-II centres have been provided with SUN workstations, PC-ATs and software tools developed indigenously by ITI, Bangalore and also the CAD tools of VLSI Technology Inc. (VTI), USA. The level-I centre also has the above hardware and software.

With a view to promoting and proliferating the use of ASICs by the indigenous electronics equipment industry, the Department of Electronics has set up 10 VLSI design centres at Bangalore, Baroda, Noida, Lucknow, Bhubaneshwar, Hyderabad, Madras, Calcutta, Pune and Trivandrum. The centres at Bangalore, Baroda, Lucknow, Noida and Bhubaneshwar have been set up and are being operated by Semiconductor Complex Ltd. (SCL), SAS Nagar. Indian Telephone Industries, Bangalore is similarly operating the centres at Hyderabad, Madras and Calcutta. Two centres are co-located with the Centre for Development of Advanced Computing (CDAC) at Pune and the Electronics R&D Centre (ER&DC) at Trivandrum. The Centres at Pune and Trivandrum are equipped with SUN workstations, VTI tools, ITI tools for standard cell-based chip design (VINYAS) along with their PCB software package (NIRMAN). The centres at Madras, Hyderabad and Calcutta have Nexus-3500 workstations and the same software tools as the centres at Pune and Trivandrum. The design centres operated by SCL are equipped with Nexus-3500 workstations, SCL CAD tool for VLSI design (BEACON), VLSI design and PCB software packages from Mentor Graphics, USA. Three ASIC testers have been provided at the Bangalore, Noida and Baroda centres for use by the five SCL centres. One LTX tester is available at the ITI centre at Bangalore for use by the design centres operated by ITI and those at CDAC and ER&DC.

A management board, under the chairmanship of the Secretary of the Department of Electronics, oversees the operation of the 10 VLSI design centres. An Advisory Committee has also been constituted for each centre with representatives drawn from the nearby industries and other experts to serve as a forum for identification of the needs of the industry. All the design centres, except those at Calcutta and Bhubaneshwar, are fully functional in terms of hardware and software commissioning, staffing and design activities. The Calcutta and Bhubaneshwar centres would be functional shortly. One of the successful chips designed by the Pune VLSI design centre is the Graphics Intelligence-based Script Technology (GIST-9000) for universal script processing. The chip, consisting of around 6,000 gates, was designed using VTI CAD tools and has been fabricated at VTI, USA. The potential applications for this chip cover data processing with d-BASE, word processing, library management, etc. Similarly, the Trivandrum VLSI design centre has also developed and fabricated a chip-set (Arjun and Krishna) for use in the low-cost PC. Efforts are under way to develop boards using the PC chip-set developed by the Trivandrum centre and the GIST chip developed by the Pune centre for use in the PC. The other design centres have also developed a variety of ASICs to cater to user needs. (Source: Electronics Information & Planning, April 1991)

Indonesia

Indonesian island provides home for new contract assembler

The island of Batam, 10 miles from Singapore's coast, is home to South-East Asia's

newest contract assembler. To start, the assembler will spend $73 million for the latest in automated production equipment, as well as bricks and mortar.

The subcontractor, PT Astra Microtronics Technology, is a wholly-owned subsidiary of Astra International. AI owns 108 different subsidiaries around the world. The multinational has sales in the billions.

The island, about 85 per cent of Singapore's size (which makes it fairly small), was opened to commercial development early last year. Although owned by Indonesia, Singapore joined its Asian neighbour to provide help with the infrastructure.

First of all Batam has been given freeport status, like Hong Kong and Singapore. There are no customs warehouses, no duties. The local Government has pledged to move goods through customs within four hours. From an on-again, off-again power supply, electricity has been upgraded. The same is true for the telephone service. Both are now on a par with Singapore, noted for high quality. Astra's market approach is to be "full-service, like ASE or Amkor". The assembler also plans to offer full parametric testing.

Astra decided to locate on Batam for several reasons. These include financial incentives offered by the Indonesian Government. The company also found a large and stable labour force. The island's residents have all been through high school and understand written English. Proximity to Singapore was another deciding factor.

Starting with 250 workers, Astra will have a capacity of 2 million units/week (14-16 pin equivalent). Packages handled will include 8-48 lead PDIPs, SOICs (both narrow and wide body), 44-208 lead POFPs, 18 lead PLCCs, PGAs and hermetics. New generations of equipment will produce products with a higher quality level and more UPH than formerly available. (Reprinted with permission from Semiconductor International Magazine, June 1991. Copyright 1991 by Cahners Publishing Co., Des Plaines, Illinois, USA)

Singapore

Disk drive makers race to adapt

Manufacturers of computer disk drives in Singapore - the world's largest exporter of the key memory units - are racing to develop smaller, more powerful products to meet growing international demand for portable computers.

Analysts say that the companies, nearly all of them US-based, are also preparing for a possible challenge if disk drive makers in Japan, South Korea and Taiwan - where most microcomputers are made - decide to become major exporters.

Reflecting an industry-wide trend towards automated output for the new disk drives, Western Digital Singapore Ltd. officially opened a $7.5 million manufacturing line in which industrial robots linked to computers run the entire assembly and quality-testing process.

Since 1988, the Singapore plant has been the sole disk drive production centre of Western Digital Corp. of Irvine, California.

Other leading US disk drive firms with manufacturing operations in Singapore include Seagate Technology Corp., Maxtor Corp. and Conner Peripherals Inc.

In 1990, Singapore exported disk drives worth 7.18 billion Singapore dollars ($4.1 billion), up 31 per cent from 5.47 billion dollars in 1989. The United States was the largest market for exports, followed by East Asia and Europe.

As market demand shifts from desktop computers to smaller, portable laptop, notebook and even palm-size computers, disk drive makers are having to manufacture increasingly compact units with greater memory capacity. (Extracted from International Herald Tribune, 16 July 1991)

European Community

European research

At last Europe's embattled electronics industry has found something to crow about. Or has it? On 18 June EUREKA, Europe's biggest technological-research programme, celebrated its fifth birthday in style at a jamboree in The Hague. Its supporters point out that more than 3,000 organizations from 19 European countries now take part in over 500 EUREKA projects worth a total of over 8 billion ECUs ($9 billion). But if EUREKA is so good, why is the state of Europe's electronics industry so bad?

Founded in 1985 as Europe's answer to America's Strategic Defence Initiative (star wars, remember), the EUREKA project now leans firmly towards civilian technologies like high-definition television and car electronics. Unlike EC research programmes, such as ESPRIT, which concentrate on basic research and consume large amounts of European taxpayers' money, EUREKA is paid for largely by the companies involved and is designed to promote technologies that can be quickly brought to market.

In theory, at least. A report notes that almost two thirds of EUREKA's participants expect marketable results within two to five years. Yet, astonishingly, some existing projects do not even have a business plan prepared for them. The report recommends that these be made obligatory and that EUREKA should withdraw its label promptly from projects that do not live up to expectations.

Among its other recommendations is one that would make the criteria for selecting and financing projects clearer, and another encouraging harmonized standards. Then there is the usual call for large-scale projects which, says the report, would give EUREKA the profile it needs to attract more political support.

Unsurprisingly, the report does not mention EUREKA's problem-child, the JESSI programme of semiconductor research. The cool response of Siemens and Philips to Thomson's recent suggestion of some kind of European alliance is proof that JESSI has done nothing to inspire European cooperation. The report also fudges the issue of

whether foreign firms should be allowed into European research projects. (Source: The Economist, 22 June 1991)

East Europe invited into EUREKA

East European countries have received an open invitation to participate in EUREKA, the European programme of high technology research.

The invitation came from representatives of participating countries at the IXth Ministerial Conference in The Hague.

In theory, the East Europeans could have participated before now, but with the exception of Yugoslavia, they have not been invited by potential West European partners.

East Europeans can also participate in the sub-micron chip initiative, which includes semiconductor equipment and materials. (Source: Electronics Weekly, 26 June 1991)

EC throws down the gauntlet

The European Commission has launched the third phase of its ESPRIT R&D programme with a rallying call for an attack on US and Japanese competition.

It wants R&D projects to be closer to the market with more user involvement.

Managers of the 1 billion ECU programme would demand to know the exploitation plans of consortia and get users to evaluate project efforts in the light of evaluation criteria. (Extracted from Computing, 11 July 1991)

Bull leads EC project to clamp down on copying

Most PCs and terminals in Europe could eventually be fitted with devices which police the illicit down-loading or copying of software and data.

Under a pan-European project funded by the European Commission, Bull and other companies are investigating ways of modifying central processing units so that any copying and downloading can be detected and recorded.

The idea is that the PC or terminal will ensure that copyright material is paid for, perhaps by electronic funds transfer, whenever it is downloaded or copied.

The project is known as Copyright in Transmitted Electronic Documents (CITED) and it follows concern among on-line data providers, including publishers, that digitally stored information can be rapidly and accurately copied.

Many potential sources of on-line data are reluctant to make their material available in digital form because of the risk of piracy. By producing a PC or terminal which detects copying and ensures that royalties for copyright material are paid, the EC believes that more companies will be encouraged to make information available on-line.

Potential sources include mailing list suppliers, publishers, specialist database providers, the British Library, and government departments.

Ultimately the CITED consortium hopes the EC will adopt a standard for new equipment that encourages manufacturers to fit CITED protection devices.

Participants in the project include the British Library, Spanish electronic publishing house AKG, and Telesystemes, subsidiary of France Telecom, and Norwich-based IT consultancy the Computer Industry Research Unit (CIRU). Bull is managing the project. The research is being funded under the EC's ESPRIT programme. (Source: Computer Weekly, 22 August 1991)

JESSI and ESPRIT get a new mission limited to CMOS technology

The Joint European Submicron Silicon Initiative, JESSI, which is Europe's only hope for cooperative research among various European Community nations and companies, is radically narrowing the range of its research projects.

The original purpose of JESSI was to gather funds for a European effort like that of Sematech in the US for semiconductor research. Now, JESSI and its partner program ESPRIT, which governs cooperative effort in every area of micro-electronics, will focus strictly on CMOS technology.

Some observers believe that the new effort comes because of political pressure for results. The EC semiconductor industry has come under heavy criticism recently for its failure to regain market share from the US and Japan. Many observers feel that JESSI and ESPRIT were not nearly enough to recoup. (Source: Electronics, July 1991)

EC computer firms making hay

European computer makers are pulling ahead of their US rivals in the race to dominate the East European market.

France's Paris-based Bull SA has concluded an important contract with the Czechoslovakian finance ministry, one that followed hard on the heels of a similar deal with the Polish Government. Germany's Siemens AG of Munich is dominating the former East German computer market, and ICL Ltd. of London has been successful in negotiating with the Hungarian Government. Of the US vendors, only IBM Corp. has been able to keep pace with the EC companies, boasting important deals in Poland and Hungary.

On the other hand, Ing. C. Olivetti & Co. SpA, which had great success in Eastern Europe, had to back off because of funding pressure. The Ivrea, Italy-based company shipped about $3 million worth of units to Czechoslovakia and Hungary last year. But the slow payment both there and in the USSR, where Olivetti is a traditional partner, has kept it from aggressively following up those sales. (Source: Electronics, July 1991)

Italy

Business practices

Italy has a sophisticated economy and one increasingly dependent on IT products and services. Italy's design-based industries are a major market for computer-aided design

workstations, and Italian automotive and engineering industries are at the forefront of developments in robotics, computer-integrated manufacturing and factory automation.

The combination of a large, enthusiastic market for IT in Italy - which the recent world recession has only partially suppressed - and a structurally weak Italian IT industry unable to meet domestic demand, has long proved irresistible to large foreign corporations such as IBM, Bull, Siemens and DEC which have long-established, successful subsidiaries in Italy.

The 1992 single European market legislation should allow more European suppliers to enter this potentially lucrative market, by removing the most obvious barriers to free trade between Italy and its fellow EC members. However, Italy's record to date on implementing this legislation is not good, and at the end of the day, no one will do much business in Italy by citing EC directives and complaining to Brussels. True commercial success will come to those non-Italians who can learn to do business here the Italian way.

The Italian IT industry seems the very model of propriety. Relatively free from major scandals, staffed by squeaky-clean graduates reading US business magazines, the industry, in appearance at least, resembles the IT industries of other industrialized economies, and the Italian IT market, fourth by size in Europe, is growing into one of the country's healthiest and most important economic sectors.

In 1990 the Italian IT market, broadly defined to encompass computer products and services, office automation products and telecommunications, grew 11 per cent to more than £27 billion, according to Milan-based research outfit Reseau. Put in perspective, the Italian IT market is larger than the turnover of the massive Fiat Group, roughly equivalent in size to the entire Italian chemicals industry and not much smaller than Italy's world-renowned textiles and fashion industries.

Francois De Brabant, managing director of Reseau, says the sectors driving Italian IT forward are software and services, which grew 18 per cent in 1990, and telecommunications, which grew by nearly 13 per cent. Unfortunately for interested foreign companies both these segments are also dominated by the Italian State, acting as both major customer and leading supplier.

In telecoms, the State still enjoys a wide-ranging monopoly and, despite investing heavily in infrastructure, the gap between Italy and other major industrialized economies remains embarrassingly wide. The national telephone density, that is the number of telephones per 100 inhabitants, averages just 37 throughout Italy - in France and Germany it is more than 47 - and in rural Calabria the figure drops to just 28.

Italy's long-suffering business telecoms users, who throughout the 1980s have had to subsidize residential subscribers, wait years for a simple analogue leased line and suffer appalling service, are finally going to get their own telecoms network, called Start. This massive project - worth more than £2 billion over the next three years - involves linking Italy's major business users with optical fibre and building an advanced business-only digital communication network. Start is just the sort of juicy public contract which, if the EC has its way, after 1992 will have to be put out to tender to European - not just Italian - supplies, and awarded according to EC rules.

When the details of Start were publicized by the Italian PTT Ministry, Dutch IT firm Philips was angered to learn that instead of getting its expected "historic quote" of 11 per cent of the total contract, it had been excluded from the consortium of nine, mainly Italian, telecoms companies which would split the lucrative contract.

Italian public-sector IT contracts are notorious for their vulnerability to political interference and reluctance to obey basic economics. Until 1986, SIP, the main State telecoms provider, contracted 150 separate companies just to install telephone cables. A contract to operate a second cellular radio network in Italy, competing with that of SIP, has been held up since 1990 because the PTT minister prefers not to upset the complex political alliances between SIP, the would-be private competitors and government ministers. To compound the issue, SIP also claims that it has a constitutional monopoly on cellular services until 2004.

The gradual demolition of the State monopoly on telecoms services is an inevitable consequence of single market legislation and in theory should encourage foreign companies to enter the Italian telecoms market.

BT has already started, with an office in Rome since 1988 and a staff of 20 people. As well as selling private telecoms equipment, such as dealer boards, BT Italia has established a niche market supporting multinational customers such as Coca-Cola and Nomura who, for a variety of reasons, are unwilling to deal directly with the Italian telecoms service providers.

BT Italia also has plans to offer satellite services to Italian business, and value-added network services on its global network - formerly the Tymnet network - but it can do little development in these areas until Italian telecoms are liberalized.

Turning to the software and services sector, another major IT contract waiting unsigned on a minister's desk: the project to computerize the State lottery, il Lotto. The value of the contract to install and operate the lottery system is huge; based on a percentage of the lottery's takings over 10 years the winner of the contract could gross more than £1 billion.

The three consortia bidding for the contract are all led by State-controlled IT companies - such as the Finsiel software and services concern - with major Italian private companies Olivetti and Fiat having to accept minority participation, and with similarly small stakes for foreign firms Unisys and NCR. Despite the protests of private industry, computerization contracts in the public sector, such as il Lotto, continue to explicitly specify or otherwise favour the State-owned IT companies.

As 1992 approaches, the invitations to tender for Italy's IT contracts will no doubt be

rewritten to accommodate the EC, but it remains to be seen if a simple rewriting of the rules is enough to change Italy's business practice. (Extracted from Computing, 19 September 1991)

United Kingdom

The Alvey programme

The Alvey programme of collaborative computer research backed with £200 million of Government money:

- Correctly focused on areas where Britain stood to benefit most;
- Was a success from a technical perspective; where there were failures, similar targets have not been attained elsewhere in the world;
- Considerably broadened and strengthened British research into computers;
- Nurtured successful and enduring links between academic and industrial researchers, and transferred important knowledge from the science base to industry;
- Fell short of expectations exploiting research results;
- Set an unrealistic target for a research programme in hoping to improve the competitiveness of the British computer industry.

Those are the conclusions of a report by the Science Policy Research Unit at Sussex University and the Programme of Policy Research in Engineering Science and Technology at Manchester University. The report concludes that the programme "met many of the targets it could reasonably be expected to attain", and that it compares well with the achievements of the Japanese Fifth Generation Programme and the United States Micro-electronics and Computer Technology Corporation. (Source: The Daily Telegraph, 28 May 1991)

United States of America

US firms invited to ESPRIT talks

US firms will launch a major assault to grab a slice of research grants worth £420 million.

A new category of research called the Open Microsystems Initiative (OMI) is aimed to make European industries more competitive in the design, manufacture and use of integrated circuit microsystems.

US companies have been talking to companies represented on the OMI's board and are expected to be involved in the research, which will be backed by £65 million of EC money.

Mips Computer Systems, Sun, Motorola, DEC and IBM have all been invited to preliminary OMI meetings. There had been no approaches from Japanese companies wanting to work in the OMI or the micro-electronics part of ESPRIT III.

The ESPRIT III work programme, which is backed by 600 million ECUs, is split into six sections. As well as the OMI and micro-electronics research, there will be information systems and advanced home systems projects. The EC's funding will be matched by participating firms and national governments, bringing the total to 1,800 million ECUs.

About two thirds of the funding will be spent on the first call projects, which will be invited next week. The rest will be allocated to a second round of projects in about 18 months' time. (Source: Electronics Weekly, 3 July 1991)

Union of Soviet Socialist Republics

USSR to work on digital radio

Soviet experts in radio broadcasting have joined their counterparts in Western Europe to develop and test a digital radio system. The Soviet partner is the Popov Institute in Leningrad, Russia's leading organization for developments in radio and TV. It will work with companies and similar institutes in France, Germany, the Netherlands and the United Kingdom.

Soviet participation should strengthen Europe's position to push for a world-wide standard for digital audio broadcasting (DAB), a promising candidate to replace FM radio. Its quality not only equals that of a compact-disk system, but it provides interference-free reception in vehicles riding through areas where reflections are common. Also, both text and pictures can be transmitted, and DAB accommodates more programs in a given frequency range than does FM radio. (Source: Electronics, July 1991)

Telecommunications joint venture

The lighting and telecommunications group, GTE (US), has formed a joint venture with the Soviet authorities and San Francisco Moscow Teleport (SFMT), an entrepreneurial US telecommunications group, to construct a modern digital network in Moscow, bypassing the Soviet Union's antiquated system. The venture will make it much easier to communicate between Moscow and the rest of the world. Called Sovintel, it will focus on foreigners and business customers and will be ready for service in November 1991. Lack of effective communications is seen as a deterrent to foreign companies wishing to do business in the Soviet Union. Sovintel is installing its own international switch with 240 dedicated circuits. Initially, Sovintel will serve four top international hotels, which will have a modern touch-tone phone in every room, and Expocenter, the main international business centre.

Customers will also have to pay in hard currency. There are plans to expand the network to more hotels and when the rouble becomes convertible, to the rest of the city. SFMT, which is backed by George Soros, a Hungarian American financier, has signed joint ventures for similar projects in other parts of the Soviet Union but is not making these public at present. (Extracted from Financial Times, 10 July 1991)

The IT revolution

IT trade with the Soviet Union has never been easier. The difficulties are more mundane, and relate more to prosaic problems of the Soviet economy than a vanished cold war. In June 1990, the Paris-based Co-ordinating Committee for Multilateral Export controls, commonly known as Cocom, undertook a massive overhaul of its restrictions, resulting in a host of previously restricted IT technologies being cleared for export to the East.

The potential of this newly-opened market is enormous: there are 180 million Soviets living in an economy now going through the same upsurge of computerization that the UK experienced in the last decade.

The sheer size of the demand for IT in the Soviet Union is difficult to grasp. The Soviets have either produced or imported about two million PCs so far, and estimated demand is expected to be up to 30 million small systems over the next decade.

IBM has been quick to move in, signing a contract to supply 130,000 PCs to the Soviet school system.

DEC is also active, but because of vast amounts of reverse engineering and cloning of its products behind the so-called Iron Curtain of the last 20 years, the company is in the curious position of having an extensive installed user base in the USSR that is illegal.

DEC has therefore taken the bold move of promising clone users a sympathetic hearing for those who want to own up to their guilt.

Apart from IBM and ICL, other firms have had somewhat variable success in penetrating the Soviet market.

ICL has maintained a sales office in Moscow for more than 20 years, but is only now engaged in large-scale ventures there. It has set up a joint company with the Soviet firm Morflot, to sell PCs and minicomputers. Further projects are rumoured to be in the pipeline.

In a country of some 180 million people, the total number of IT workers is about 360,000. The size of the computer literate population in the USSR is some seven million, compared to Japan's one million.

All this has essentially been achieved in the last 10 years, starting with tiny pools of talent in the institutes and universities.

The ordinary information worker on a factory DP site earns about 500 roubles a month, worth the equivalent of ten Big Macs at the Moscow branch of McDonalds. The average programmer salary is about 800 roubles a month - or £16 at tourist exchange rates. The dream of the average Soviet programmer is to work in the West, with Germany being a popular choice. Others have to be satisfied with working for UK computing service companies for just £50 a day through a London contract agency owned by the Soviet Government. This compares with daily rates charged by UK contractors of between £100 and £500.

In hardware and software technology terms, the Soviets have just about reached the stage the West was a decade ago, but with the occasional advantage of modern kit and the benefit of learning from the development experiences of more advanced technological countries.

With hindsight of our Western development curve, they are leapfrogging straight over our earlier beginnings and are already enjoying a higher percentage of networked, integrated systems used instead of centralized minis, usually tied to a database.

Evolution involves a natural extension into networking, hypertext and group-ware, where the theories of work practices and linguistics are applied to software design. It is a logical progression.

The standard departmental machine in the Soviet Union is the PC. The official IT policy seems to be one of licensing Western hardware and software wherever possible - Cocom permitting - in spite of some impressive successes with indigenous IT. The Soviet space shuttle Buran performed flawlessly when launched under the completely automatic control of the Baikonor space centre computers.

The software run on these machines is familiar: Supercalc III, Framework II, and most Microsoft, Ashton-Tate, Autodesk and Borland products are there. Most have been cunningly reverse engineered and translated into Cyrillic text and Soviet environments. This has all been done with native talent with a bent towards hacking.

The vogue at the moment is object-oriented programming.

Other advanced work is in progress by computer people rich in fundamental technical capabilities and scientific intelligence but frustrated by lack of access to advanced Western hardware. Most of these people are unknown in the West. Soviet society places much emphasis on education with the result that it is top-heavy with people who do jobs way beneath their abilities. This educated younger generation forms a frustrated intelligentsia, from which many are desperate to move into computing. Evening classes and training ciasses in any kind of computing are massively oversubscribed.

If something positive emerges from the present political, economic and social upheavals in the Soviet Union which embraces a technological revolution, a talented nation containing the world's best chess players and logicians may surprise the West yet. (Extracted from Computer Weekly, 6 June 1991)

VIII. AUTOMATION

Robots totter towards home-help status

Robots which help elderly and handicapped people will be in widespread use in the homes of industrialized nations in the next century, a Japanese robotics expert has predicted. Such "welfare robots" will be required to assist elderly people to live in comfort and to take part

in a society characterized by increased longevity and an inability to provide institutional care except for the most needy.

Ichiro Kato, a professor of robotics at Waseda University in Japan, made these claims in his keynote speech at the Fifth International Conference on Advanced Robotics held last June in Pisa, Italy.

Welfare robots will, he said, have the general shape and dimension of a human body. They will move about the house quietly and gently, be easy and safe to use, and be capable of performing many functions.

Today's industrial robots use so-called "mechatronic" technology, a combination of mechanical and electronic techniques. Future robots will require what Kato calls biomechatronics, mechatronic systems that emulate the shape of human beings.

Kato told the conference that a future biomechatronic robot can have such complexity of organization that it will be capable of expressing some forms of emotion. Not that the robot will be able to feel emotion but it will appear to express some forms of feeling that are appropriate to a context. This would make it a more congenial companion than one that does not.

These plans for advanced robotics research were not welcomed by many researchers at the conference. They would prefer a future in which robots are able to carry out many useful specific tasks but are not so capable as to appear to have human qualities.

"Special-purpose" robots announced at the conference included a mechatronic leg that can assess soil condition by stepping gingerly onto the soil, a device that automatically presents trousers for pressing, and novel systems for use in such hazardous environments as nuclear power plants, space and underwater. (Extracted from "New Scientist", London, 6 July 1991, the weekly review of science and technology)

IX. STANDARDIZATION AND LEGISLATION

Standardization

ISO book launched

ISO 9000 is the new standard for quality systems management which has become an essential prerequisite for all companies. Now the first book on the subject has been published by Gower, UK. Written by Irish journalist Brian Rothery, "ISO 9000" is a well-timed publication as companies prepare for the conditions of the EC market after 1 January 1993. The book is a timely entry and should make mandatory reading for the bookshelves throughout Irish industry. It tells managers how to go about preparing for and installing a quality management system to meet the requirements of the ISO standard. (Source: AMT, June 1991)

IEEE Standards Press debuts

The IEEE Standards Press has been established to respond to an industry demand for more standards information and to foster the positive influence that standards have in industry. Because essential standards-related information that would benefit industry often fails outside the scope of an IEEE Standard, Recommended Practice, or Guide, it is the charter of the new group to fill this information void and support the dissemination of standards information world-wide. For additional information, contact Deborah Czyz, managing editor, IEEE Standards Press, 445 Hoes Lane, Piscataway, New Jersey, USA. (Source: IEEE Spectrum, August 1991)

Information processing

Another International Standard has been published as part of the set of International Standards developed to facilitate the interconnection of information processing systems.

ISO/IEC 9506-1, Industrial automation systems - Manufacturing Message Specification - Part 1: Service definition, is positioned within the application layer of the Open Systems Interconnection Environment as an Application Service Element (ASE) with respect to other related standards by the Basic Reference Model for OSI.

The aim of OSI is to allow the interconnection of information processing systems from different manufacturers, under different managements, of different levels of complexity, and of different ages.

This part of the standard defines the service provided by the Manufacturing Message Specification and is concerned in particular with the communication and interworking of programmable manufacturing devices. By using this standard together with other standards positioned within the OSI Reference Model, otherwise incompatible systems may work together in any combination.

The scope of the standard is the Manufacturing Message Specification as an application layer standard designed to support messaging communications to and from programmable devices in a Computer Integrated Manufacturing (CIM) environment.

ISO/IEC 9506-2 specifies the protocol that supports the Manufacturing Message Specification. (Source: ISO Bulletin, April 1991)

Open Document Architecture (ODA) standard

A consortium to standardize the elctronic transfer of documents has been jointly set up by IBM (Aiwonk, New York), Digital Equipment (Maynard, Massachusetts), ICL (UK), Siemens Nixdorf (Munich, Germany), Groupe Bull (Paris, France) and Unisys (Blue Bell, Pennsylvania). The consortium by 1993 intends to develop a software tool kit that will permit utilizers of its members' own document processing systems to comply with the new Open Document Architecture (ODA) standard. DEC will supply a good part of the ODA tool kit, IBM will manage the project and coordinate testing work, ICL will develop programming interfaces to other uses, Siemens Nixdorf will make diagnostic tools, Bull will develop formatting code, and Unisys will supply various conversion routines. The consortium seeks to set up a document processing standard that has the degree of acceptance that the Initial Graphics Exchange Specification has for engineering drawings and data. (Extracted from Mechanical Engineering, July 1991)

EC grants funds for professional standards

An international project led by the BCS to establish common professional standards for computing people across Europe has been awarded £55,000 funding by the European Commission.

The work is being carried out by one of four task groups set up by the Council of European Professional Informatics Societies (CEPIS).

CEPIS was formed in September 1989 to represent European computing professionals' views on major issues to the European Commission and other organizations. It has since grown to 18 member organizations from 15 countries in West and East Europe.

CEPIS set up the professional development and qualifications task group, led by the BCS, because both CEPIS and the European Commission see these two related topics as priority areas.

At the same time the task group is working on ensuring recognition of suitable professional qualifications across Europe.

This is in line with a European Commission directive demanding such recognition of higher education and professional qualifications.

In addition the task group in drawing up a CEPIS professional code of conduct.

All this work is already well under way and the European Commission funding, agreed late last month, will help push it forward. The BCS will act as the agent, receiving and distributing the money.

The task group now has professional organizations from 11 countries taking part, including Poland from Eastern Europe.

The other CEPIS task groups are on social issues, such as how information technology can help disabled people; computer misuse; and technical cooperation, in particular between CEPIS members' specialist groups. (Extracted from Computer Weekly, 13 June 1991)

PC traders set up benchmark body

PC hardware and software suppliers have set up a standards body to provide users with benchmarks to help them when buying systems.

The Business Applications Performance Group aims to develop a set of performance benchmarks based on popular software applications and industry standard operating systems.

These should help PC users evaluate and compare system performance by producing a set of results based on realistic applications, rather than laboratory benchmarks.

The group has already attracted the support of IBM, Microsoft, NCR, Hewlett Packard, Dell and Novell.

The group, a non-profit-making association, will define standards for stand-alone, single tasking and multitasking environments as well as for PC networks. (Extracted from Computing, 11 July 1991)

Standards bodies pool efforts

The search for industry standards in object-oriented technology took a step forward in July when five leading standards bodies met to pool their efforts.

The meeting in Boston was instigated by Chris Stone, president of the Object Management Group (OMG). The other attendees represented Unix International, the Open Software Foundation, the Network Management Forum (NMF) and X/Open.

Stone said the idea behind the meeting was to agree on a standard object model. This describes what an object is, what it can do and how it interacts with other objects. Such a standard is seen as essential if object oriented databases are to be exploited commercially.

The OMG, the NMF and X/Open are already working on their own versions of the model.

Members of an OMG task group are working towards producing a recommendation on what constitutes an object model.

Research is also under way to produce a joint design specification for the group's key object, request broker technology. Two short-listed consortia, led by DEC and Hewlett Packard, were given 90 days from the start of June to combine the best elements of their submissions. (Source: Computing 3, 11 July 1991)

Cordless standard

Europe will have two competing digital cordless telephone standards by the end of the year if the European Telecommunications Standards Institute (ETSI) meets its deadlines for finalizing the DECT and UK pioneered CT-2 standards.

Europe's CT-2 standard, based on the UK's common air interface, will now be finalized in the autumn, only three months before the full DECT standard is rubber-stamped in December. (Source: Electronics Weekly, 10 July 1991)

TV standard protects chip makers

The European Commission is using patents for the new MAC transmission standard to shield microchip manufacturers from cheap imports from the Far East.

In June, the Commission unveiled a draft directive which requires all European satellite broadcasters to change over to the new transmission standard within the next few years. It says that European microchip manufacturers will then be able to move on to the high-definition HD-MAC standard. But the Commission is less keen to discuss its use of the MAC patents to protect European manufacturers.

Until the late 1980s, the European electronics industry relied on patents of the present PAL TV system to fend off cheap imports. But these patents have now expired, leaving the door open to far Eastern manufacturers. The issue has been complicated because satellite broadcasters, such as Sky, have adopted the PAL standard.

The Independent Broadcasting Authority came up with the idea for the MAC standard in the early 1980s. France-Telecom, Telediffusion de France, Phiips and Thomson then developed ways of interleaving digital data and sound with the picture. The MAC patents were pooled in April 1987. The main companies involved then set up a consortium known as GIE MAC Packet, now based in Paris. It offers a one-off licence to use MAC technology. The licence agreement (renewable every five years) has been carefully structured to encourage local European manufacture. Companies pay much reduce royalties if the MAC chip is European and if the equipment to carry it is also made locally.

To encourage microchip manufacture, the consortium asks for no royalty on MAC chips. Also, the consortium pledges not to sue a chip maker for patent infringement, provided that it sells its chips only to manufacturers which have a MAC licence. (This first appeared in "New Scientist", London, 29 June 1991, the weekly review of science and technology.)

LAN makers press for ANSI standard

Pressure is mounting for a high-speed local area networking standard, which accommodates newly developed copper cable technology as well as optical fibre systems. One US company plans to launch a copper-based 100 Mbit/s system this year with or without an agreed standard.

The US standards body, ANSI, has spent the last six months considering proposals to incorporate a twisted-pair cable interface into its fibre distributed data interface (FDDI) standard.

Without a final agreement a group of five manufacturers have published a specification for a 100 Mbit/s system using shielded twisted-pair (STP) which it presented to ANSI last December.

The companies, DEC, Motorola, Synoptics, AMD and Chipcom, hope to force the issue by encouraging other manufacturers to adopt the design. Synoptics says it will launch its STP/FDDI product this summer with or without a decision by ANSI. (Source: Electronics Weekly, 19 June 1991)

Euro group promotes world expert standard

A pan-European consortium is working on a £2 million venture to promote its design methodology as a world-wide standard for building knowledge-based systems.

Members of the consortium include management consultants Touche Ross, Lloyd's Register, systems house Cap Gemini Sogeti, Siemens and various European universities.

The three-and-a-half year project will build on one of the earliest ESPRIT projects, knowledge acquisition and design support. ESPRIT will provide half the funding for the new project, Kads-II.

Kads resulted in an iterative process of development based on models describing aspects of a knowledge-based system.

Kads-II aims to add a set of computer-based tools to allow users to make effective use of the methodology. It will also give participants and potential users advice on how to manage a Kads project using a risk-driven approach. All results will be put to practical test.

It is hoped that the diverse nature of the consortium will mean that any results from the project are quickly assimilated into business and industry.

There are already practical examples of knowledge-based systems in action. In the UK, Barclays Bank is currently using a system, developed using the Kads methodology, to detect Barclaycard fraud. (Source: Computing, 4 July 1991)

IBM adopts Posix standard

IBM has responded to user pressure with plans to incorporate the Posix operating system interface standard into its proprietary AS400 mid-range systems.

While not giving any dates for a shippable Posix compliant AS400, the company says that user demands, rather than technical considerations, have forced its hand.

Posix is a set of interfaces allowing different suppliers' machines to communicate at the operating system level, and its adoption is seen as a necessity towards providing open systems, by Unix and proprietary operating system vendors.

Mid-range rival DEC has already shipped its proprietary VMS with Posix compliance, while IBM's other main mid-range competitor, Hewlett-Packard, says it will launch the Posix-compliant MPE operating system before the year end.

IBM made its Posix announcement as it unveiled a low-end AS400, the D02, aimed at small businesses and sold in a pre-packaged configuration dubbed Plug'n'Go.

The Plug'n'Go packages include a D02 plus the OS400 operating system and one application geared specifically to the user's needs. After the configuration is chosen with an IBM reseller, the package is put together at IBM plants and then shipped.

The D02 will start shipping here on 20 September and prices will start at £8,879. (Extracted from Computer Weekly, 5 September 1991)

IBM grabs the optical lead

IBM Corporation is making a strong bid to set a new data-storage standard with a 3.5 in. optical drive that operates in both the read-only and read/write modes.

The PS/2 Rewritable Optical Drive is the first to fit into the 3.5 in. form factor. It accepts 128-Mbyte removable disc cartridges that conform to physical standards already adopted by the International Standards Organization. IBM is promoting its file format as an ISO standard as well.

Although IBM appears to have a time-to-market as well as technology lead on other systems houses, it is not alone in the small-format optical-drive race. Sony Corporation has a similar technology that utilizes a file format fairly close to IBM's. It appears likey that IBM, Sony, and ISO can reach agreement on a single file-format standard.

O-ROM applications include the distribution of application software, databases, and reference works. The erasable disks, on the other hand, can be thought of as 128-Mbyte floppy disks that can store data, sound, graphics, animation, and video.

Priced at £1,795, IBM's drives are available on mid- and high-end PS/2 models that use the MicroChannel bus architecture. (Source: Electronics, July 1991)

Legislation

Is compatible legal?

The European Council of Ministers passed the most important piece of legislation to affect the computer industry for a decade. The directive introduces a uniform system of copyright protection for computer programs throughout the Community. It is the first piece of legislation in the world to address the vexed issue of how far a manufacturer may use copyright to prevent competitors developing a compatible product. Because this sets such an important international precedent, US and Japanese companies have not sat idly watching from the sidelines, but have all joined in the fray. Interest grew in protecting computer programs by copyright rather than patents. The "first generation" of cases, ruled that a program could be copyrighted. The recent "second generation" of cases have grappled with the more difficult issue of what forms of copying constitute infringement. The European directive requires all member States to introduce legislation in a common form by the end of 1992. The directive adopts the now widely accepted approach of treating computer programs as "literary works" for copyright purposes. But its attempts to deal with infringement of copyright proved extremely contentious. Most of the debate concerned how far it should be permissible to analyse and copy parts of a program to create a competing program that is "interoperable" (functionally compatible) with the first. This involves two issues: whether an "interface" is protected by copyright, and whether "reverse engineering" is an infringement.

The big hardware manufacturers - IBM, Apple and DEC - and the major software houses - Microsoft, Lotus and Ashton-Tate - wanted copyright protection for interfaces and wished to see reverse engineering treated as an infringement. Other manufacturers - Bull, Olivetti, Amstrad, NCR and Fujitsu - opposed this approach, as did, not surprisingly, the smaller software houses. More than 350 big IT users throughout Europe favoured the development of interoperable systems, thus supporting the second approach.

The directive as adopted represents an uneasy compromise between the two positions within the industry. In relation to the protection of interfaces, it maintains the classic copyright distinction between an "idea" and the "expression of that idea" - the expression of an interface is protected, but the idea behind it is not. The problem with this approach is that no one can easily determine what is "idea" and what is "expression" in a computer interface. The general test for copyright infringement is "substantial similarity" between two works. The European directive gives no guidance as to what constitutes substantial similarity in the case of computer programs. If such a broad interpretation of substantial similarity is adopted in Europe, creation of a substitutable program will infringe copyright, notwithstanding the reverse engineering exceptions. The directive leaves important questions open. The long skirmish about the wording of the directive may be over but the real battle about the matters on which it is silent has yet to begin. (Source: Microcomputers and Microprocessors, October 1991)

Superconductors caught up in court challenges

All the major innovations in high-temperature superconductivity are now bogged down in patents disputes in the US. The situation is a "complete mess", according to Chris Vear of the British Technology Group. BTG, which started tracking patent applications on superconductors in 1986, now has one of the world's most extensive databases on this technology.

Superconductors carry electric current with no resistance, but only at very low temperatures. In 1986, superconducting ceramics were discovered which worked at warmer temperatures up to -150°C. Patents were filed on many of the new materials but researchers are still working to find practical applications for them.

The US Patent Office in Washington DC has now declared an "interference" action between the American companies AT&T and IBM, the Naval Research Laboratory and the University of Houston. The dispute centres on superconducting ceramics made from yttrium, barium and copper oxide.

Interference is a procedure peculiar to US patent law. The US Patent Office looks at pending applications while they are still secret, decides if they are in conflict and challenges applicants to prove who came up with the idea first.

An interference between two applications is bad enough. But interference between four cases where a monopoly on superconducting materials is at stake is a legal nightmare which could take at least a decade to resolve. The last four-way dispute, on who invented the laser, took 20 years.

The US Patent Office has also declared a four-way interference on superconducting materials based on bismuth, this time between the University of Houston, the New Zealand Department of Scientific and Industrial Research, Hoechst of Germany and the Japanese National Research Institute for Metals.

There is a further dispute between the University of Arkansas and IBM on thallium materials. This case is especially complex because Arkansas filed first with a broad, generic claim on thallium compositions with superconductive properties. But IBM took advantage of a special favour, granted by President Reagan, allowing inventors of

superconducting materials to apply for "fast track" examinations and grants. IBM applied and secured a patent ahead of Arkansas, which is now objecting.

In Europe no patents have been granted on any superconducting material. The University of Aberdeen has applied for patents on a titanium-based material and the University of Cambridge is developing superconducting wire for electronic circuitry. (This first appeared in "New Scientist", London, 31 August 1991, the weekly review of science and technology)

Software protection

Seeking to spur computer research collaboration between US Government and industrial researchers, Senator John Rockefeller (Democrat, West Virgina) wants to keep Government software from automatically falling into the hands of the public. He has introduced a bill that would make an exception to current copyright law (which now makes government-developed software freely available to all) for the products of cooperative research and development agreements between Federal laboratory and industrial partners. Rockefeller hopes that this will reassure companies that their intellectual property will be protected. But his bill has run into opposition from the American Civil Liberties Union (ACLU). Joined by such mainstream computer groups as the Information Industry Association and the Institute of Electrical and Electronics Engineers, the ACLU testified last week that copyrighting Federal software would violate the public right of access to Government information. (Source: Nature, Vol. 353, 19 September 1991)

X. RECENT PUBLICATIONS

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XI. SPECIAL ARTICLE

COOPERATION BETWEEN SCIENCE, STATE & INDUSTRY: THE RESEARCH INSTITUTE FOR APPLICATION-ORIENTED KNOWLEDGE PROCESSING (FAW - Ulm)*

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ABSTRACT

The "Forschungsinstitut für Anwendungs-orientierte Wissensverarbeitung - FAW" was founded at the end of 1987 in Ulm, Baden-Württemberg, as part of an evolving scientific centre. The institute is co-sponsored by the State of Baden-Württemberg and a number of large industrial enterprises. For the FAW these partners are the industrial companies Daimler-Benz AG, Robert Bosch GmbH, and five computer industry companies: namely IBM Deutschland GmbH, Hewlett-Packard GmbH, Mannesmann Kienzle GmbH, Siemens Nixdorf Informationssysteme GmbH, and the Siemens AG.

Its research focuses on application-oriented knowledge processing, which ranges from basic research to precompetitive research and projects in industrial applications. The institute was formulated and implemented to do high-quality research and to achieve an intimate relationship between basic research and applications and it depends on the right integration of inputs from State, industry, and science, solid funding with emphasis on deficit funding mechanisms, interchange of staff with the State and industry, close ties with the University of Ulm and other universities and the right kind of legal arrangements, for example working contracts for fixed periods of time.

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* A detailed description of FAW's activities and projects can be also obtained by e-mail: karagian dulfawla.bitnet.

This paper gives some general information about the cooperation between industry and research in the AI field in Germany, where the main emphasis is on FAW as a particularly innovative example. The paper is oriented primarily towards professionals from the computer science, data processing and information technology audience.

1. Research opportunities and industry interest in AI: a collaboration approach

AI presently carries a big potential for application in industry and administration and therefore induces interest in new types of interaction between science, State and industry. A major reason for the contribution of AI is the many new modelling possibilities that are offered by AI methods (9). Any survey of this AI potential should start with applications characterized by a shallow type of knowledge, that is, with flat hierarchical systems that involve the management of very large rule bases and integrate hereditary processes. Such systems are already used in a variety of demanding and sometimes labour-intensive applications. Examples are applications in which process specifications, management directives, compatibilities, or classification requirements (diagnosis, configuration, planning) must be adhered to, where complex procedures must be followed (e.g., in granting credits or compiling actuarial insurance tables), or where support for administrative tasks is required (e.g., distribution and processing of documents). It is increasingly clear that AI can contribute considerably to accomplishing these tasks by providing bridging functions, which are cognitively relatively simple but extremely important for the operation of systems. Examples are intelligent networks and intelligent technical aids in offices, greatly simplified for the user. Intelligent networks will play an important future role in telecommunication and in computer-integrated telephoning, for example. In the use of knowledge processing methods for comprehensive tasks in robotics and language understanding, however, we face a fundamental problem in the need to always build or update the appropriate knowledge bases. Efforts to find universally applicable solutions are under way world-wide.

The other major task to be tackled is the integration of classical methods of applied mathematics, from such areas as optimization, statistics, decision theory, and differential equations, into knowledge-processing systems. To the present, developments in this area have been very specific; examples are statistical expert systems and, increasingly, work towards integrated method and model banks. Adequate problem-specific use of methods and models is one of the major challenges that could provide the motivating force for the cooperation and ultimate fusion of AI and classical modelling initiatives. At the same time AI will continue to improve interfaces to make classical modelling techniques available to an always wider circle of users. Better interfaces will also make it possible to manage and record modelling techniques in a way that far exceeds present limitations. Resulting new forms of knowledge transfer ultimately will facilitate access and use of the great wealth of modelling and methodological knowledge acquired by generations of researchers, which as yet is largely consigned to journals on shelves.

In addition to the potential of technical innovations, the theoretical and philosophical implications of developments in AI and modelling theory are of particular importance. This aspect is especially relevant to gaining a proper understanding of research into problems of technology assessment. There are sound reasons for assuming that AI will generate significant insight into such central human concerns as the nature of knowledge, learning, intelligence, consciousness, and freedom. The systems created may reshape our understanding of these concepts. We may learn more about the nature of being human and the forces that shape our lives. The influence of global political and environmental forces on individual lives will become more clearly comprehensible, perhaps making it easier for individuals to accept limits to their individual options. Such steps are probably unavoidable to preserve the human race and achieve global fairness. AI has a key role to play in this process of understanding and decision- making. Beyond this, it can also contribute significantly to social and economic advances through systems of automatic knowledge processing used, for example, to automate work processes, to help in our daily duties, or in the transfer of knowledge to developing countries.

This AI potential is always stronger identified by industry. However, much knowledge about this new technology is available at universities and State institutions (2). This situation as well as a need for always more powerful methods for handling different applications make it reasonable for industry and state administration as well to orientate themselves towards a close collaboration with university researchers in new organizational platforms (7). Such platforms extend the existing R&D infrastructure with new types of research institutes. Their work is to bridge the gap between the traditional university research which is often oriented towards basic aims and the research which is done by the industrial research laboratories which is often done with emphasis on a particular application and thus is domain specific. Such new types of research institutes can also contribute to a transfer of know-how and to the acceleration of technical innovations. A very good overview of how the European nations work to build a unified marketplace in information technology is given in (3). In Germany, research institutes may be categorized in four categories, depending on the legal and founding structure:

(a) Industrial laboratories;

(b) State institutions;

(c) Laboratories sponsored by an industrial consortium; and

(d) Laboratories sponsored both by an industrial consortium and by the State.

Representative research institutes of type (a) in the field of AI in Germany are:

- IBM/IWBS

Name: International Business Machines
Location: Stuttgart

- Siemens/ZFI

Name: Siemens
Location: München

Representative research institutes of type (b) in the field of AI in Germany are:

- Universities

- GMD

Name: Gesellschaft für Mathematik und Datenverarbeitung
National Research Center for Computer Science

A representative research institute of type (c) in the field of AI in Germany is:

- ECRC

Name: European Computer-Industry Research Centre GmbH
Location: München

Representative research institutes of type (d) in the field of AI in Germany are:

- DFKI

Name: Deutsches Forschungszentrum für Künstliche Intelligenz
German National Centre for AI Research
Locations: Kaiserslautern and Saarbrücken

- FAW

Name: Forschungsinstitut für anwendungsorientierte Wissensverarbeitung
Research Institute for Application-Oriented Knowledge Processing
Location: Ulm/Donau

- FORWISS

Name: Bayerische Forschungszentrum für Wissensbasierte Systeme
Barvarian Research Centre
Locations: Erlangen, München and Passau

- KI-NRW

Name: Forschungverbund "Anwendungen der Künstlichen Intelligenz"
Knowledge-based Software Technology in North-Rhine Westphalia
Location: NordRhein-Westfalen

- LKI

Name: Labor für Künstliche Intelligenz
Hamburg AI Group
Location: Hamburg

A good example for international collaboration not only between different institutions but also involving several countries is the International Computer Science Institute (ICSI) at Berkeley which was primarily funded by the German Government but after its founding gained Switzerland and Italy as new sponsors (6). Similar institutes are MCC in Austin, Texas, USA, and ICOT in Tokyo, Japan (5).

In the following, we describe the FAW as a particularly innovative example of an institute which has been established by the industry as well as the local government and closely collaborates with the University of Ulm (4).

2. FAW-Ulm: partners, aims and basic ideas

By the summer of 1987, building on a solid consensus among the partners, the institute was founded on the basis of very detailed formal contracts, carefully describing the complex arrangements regarding legal status, taxation, staffing, financial obligations, and the State involvement. These agreements and the institute structure are quite sophisticated and make this institute unique in Europe, if not in the world.

Since its founding, the FAW has, in cooperation with its sponsors, defined and established projects in different application areas, being of principle interest to the institute and its partners. Particular problems in the field of knowledge processing, that motivated the cooperation of the different sponsors in founding FAW, have been its rapid development, its very diverse and expensive tools, the unsolved and rapidly evolving questions at the foundation level, such as in evidence theory, and the need to transform all these elements into applications. Knowledge-intensive applications usually require a great deal of insight into the application domain and thus the coordinated work of interdisciplinary scientific groups. At present, the institute has an academic staff of approximately 50 full-time scientists and 70 students from eight different academic fields, and several project or cooperation partners who contribute expertise, e.g., from application areas or from still other academic disciplines. Research in knowledge processing needs to bring in scientific insight of different kinds, to accommodate different scientific orientations, and to enlarge application knowledge. Also, all this input must be integrated by means of a variety of information system technologies ranging from data bases to decision support systems, simulation and optimization.

All this means that high-quality research and good application-oriented work in knowledge processing at present involves huge investments, a very qualified staff, and a great deal of specific knowledge that is very difficult to organize, especially within a single industrial firm. Moreover, the danger of error, either organizational or scientific, is always present, and the chance of avoiding mistakes is much higher if several companies share research capacities at an early precompetitive stage. Such cooperation also affords the partners an opportunity to integrate their interests, to transfer needed information, and even to coordinate their efforts towards pre-standarization or use of particular tools. All this can be done more easily by joint activity within an organization like the FAW institute. In addition, the participation of the State ensures coordination and communication of information with respect to users' needs in the State bureaucracy; provides considerable financial support that covers part of the cost of interaction; and it can provide the kind of national and international political and scientific involvement and freedom of research that opens doors, brings in new information, and allows for unexpected breakthroughs in science. It also provides a form

and degree of independence that could otherwise not be achieved. In particular, it fosters the close coordination with a university that provides career opportunities in academia for the scientists involved. This helps in recruiting the very brightest young people for this research. It also creates new ways to transfer knowledge directly via people. For its student assistants, FAW makes knowledge transfer part of their scientific education and opens doors to interesting career opportunities.

The FAW is the only institute founded by the state of Baden-Württemberg particularly for the AI field and it is responsible for collecting information in this field, testing tools, establishing contacts, and keeping track of successful new applications accomplished elsewhere. It is also required to carry out technology-transfer activities (education, consulting, joint project activities) with industrial companies in the area, especially with small and medium-sized enterprises initiating this new technology. The institute makes a huge contribution to education. Experience with projects, tools, and software packages (some of which are expensive) gives young scientists opportunities not often available at universities. The many groups working in the institute address many different topics, and these topics are mutually fruitful (1).

Basically the FAW tries to encourage young scientists by giving them an encouraging research environment. Generally, the following "Commandments" given in (10) seem to be very promising in such an environment:

- Be revolutionary in ideas.
- Have long-range goals.
- Build a durable good image.
- Try to be evenly funded.
- Invest in infrastructure.
- Support your people emotionally.
- Help young researchers.
- Do not be unnecessarily aggressive.
- Avoid gimmicks and surface quality.
- Do not lock yourself in a clique, or position.

Based on principles as mentioned and involving three years of very intensive work and aggregation of experiences, the essential elements of the FAW foundation were laid, the general aims were designated, and some very decisive organizational and financial steps were planned and implemented. Several early steps required and were built on a number of consensus and confidence-building supporting actions that brought the partners from State, town, industry, and university together. Confidence and fairness remained essential elements of the FAW, where the following principles are identified as important:

- Organize the institute in close cooperation with but not within the university with the aim to do high-quality research.
- In cooperation with the university, find a scientific director of the institute, who should, at the same time, become a professor at the University of Ulm.
- Obtain clear and considerable financial commitments from the sponsors for an initial phase of five years, with the idea of extending after these five years; make all contracts with scientists in the set-up phase for this five-year period only.
- Provide the scientific director enough authority to allow integrated work in the institute towards general aims.
- Appoint a co-director of the institute who is an expert in industrial finance, organization, and personnel.
- Provide the institute with high-level oversight by the sponsors on the board-of-directors level.
- Provide the institute with constant support by a team of high-ranking experts within the sponsoring institutions and companies (so-called Stiftergremium) and organize further task-specific monitoring groups from the sponsoring.
- Provide the institute with considerable freedom for national and international interaction.
- Provide the institute with a new building, and ensure that the scientific director is involved at a very early stage in all design and equipment decisions.

To establish an institute like the FAW and to build a stimulating research environment as mentioned above, the following elements seem for us to be essential:

- First, there must be a clear will to accomplish specific goals and enough funding to reach them. In a partnership between a State and private enterprises, making small investments in several places to do the same thing accomplishes litte. Instead, considerable investment must be made in organizations that genuinely emphasize the particular topic, and not in those that exhibit "me too" activity. Support should be made available quickly enough so that the organization or institute can react on short notice. It should be largely independent of outside bureaucracies. Deficit-funding instruments can be used to provide shelter against legal or bureaucratic problems.
- An institute of this type must be monitored by a high-ranking, qualified controlling board. Good people from the companies involved should monitor and coordinate particular projects.
- The aim of such an institute must be high-quality research. To attract good scientists and good staff, it is essential to have good working conditions and good equipment and to provide travelling funds, cooperative arrangements, scientific opportunities, and opportunities for

academic promotion. The involvement of the State and of universities brings in the extra funding that allows for more basic research and strengthens the willingness of companies to cooperate together.

- Reasonable arrangements for publication rights are important.

- Decision-making is made by a committee consisting of an equal number of State representatives, sponsoring company staff, and independent scientists.

- It is important to have young people involved with contracts for fixed periods - and after a short period most of them should carry their knowledge outside. This form of transfer of knowledge is one reason for the existence of such an institute.

These elements are neccessary for good work. The quality of the scientific and non-scientific staff is really crucial. Also essential is a genuine scientific basis, to which the scientific director, the leading scientists of the institute, the scientists on the governing board, and the monitoring experts have their most important obligation. At the FAW, the right kind of model-oriented integration of classical approaches from decision theory, optimization theory, statistics, applied mathematics, and computer science with modern approaches in artificial intelligence has been the underlying scientific basis of the successful work done up to now.

3. Research Projects at FAW Ulm

Based on insights such as those described above, the Research Institute for Applied Knowledge Processing is presently engaged in a wide variety of application-oriented problem-solving tasks (8). At present, the FAW works in five major areas of research. These are computer-integrated manufacturing, office and business systems, environmental information systems, assistance systems, and distributed resource management.

On top of the mentioned activities, FAW does a lot of smaller projects in different areas dealing with logic programming, preference elicitation, autonomous robot systems, medical applications, and so forth. An additional emphasis in the next years will be on connectionist systems and on the integration of subsymbolic and symbolic forms of information processing. The following is a short overview of current or completed projects in these fields:

3.1 Computer-Integrated Manufacturing

The FAW project CAD-KI supported by all sponsors deals with knowledge-based add-on components to commercially available CAD systems. In Genoa, the FAW cooperates with an industrial company on the topic of the generation of optimal work plans. Methodological bases are, among other things, optimization algorithms for travelling salesman problems. The original set-up of that project was done with Nixdorf Computer AG, and the project builds on an earlier successfully finished project on computer-aid planning (CAP) with that company.

In the KWEST project, FAW cooperates with the IPA Institute in Stuttgart and a number of industrial partners in building up modern factory control systems.

Finally, in the AIDA project sponsored by Daimler-Benz AG and Hewlett Packard GmbH, FAW addresses the problem of diagnosis for a cold-mill press used for a very sophisticated technical process within Daimler-Benz.

3.2 Office and Business Systems

In the field of office automation and business systems, FAW follows the general idea of flexible office systems (FOS). Particular use of those ideas is made in the project OSSY, sponsored by all partners of FAW, that deals with the distributed processing and management of office tasks that regularly have to be redone.

Another project, CESAR, deals with the building up of a semi-customized expert system shell for the field of banking applications. This project is sponsored by Siemens Nixdorf Informationssysteme GmbH. Also in this area, FAW addresses the topic of mediator systems, partially based on methods of game theory.

Finally the FAW finished the IBM Deutschland GmbH contracted project MHS (material handling system). During this project a prototype was developed that provided guidance for the engineer throughout the entire MHS planning cycle. This project was to clarify in the "technical office" environment area.

Currently this area is extending its activities into the field of interoperability in the office/production application area. The approach of flexible office systems is also used for the development of methods which facilitate the integration of common tasks in an office/production environment.

3.3 Environmental Information Systems

In this area, the character of the FAW as a foundation of "public law" bcomes particularly vivid. The institute cooperates closely with the State of Baden-Württemberg and tries with its projects to contribute to the much advanced Baden-Württemberg environmental information system.

In the project ZEUS, sponsored by all partners of the institute, the question of the integration of models, methods, and data and particularly the aspect of the use of metaknowledge is followed. The RESEDA project deals with the automated processing of satellite images and is sponsored by the State of Baden-Württemberg and Siemens AG.

Finally, the WANDA project, sponsored by the State of Baden-Württemberg, IBM Deutschland GmbH, and Hewlett Packard GmbH, deals with water analysis problems. Here, FAW closely cooperates with scientists in the field of chemical analysis from the University of Ulm. In all of the

environmental information systems work, FAW strongly builds on geo-information systems. Also, the processing of uncertain information has a particular importance in that area.

3.4 Assistance Systems

In the area of assistance systems, FAW deals with the interesting topic of the car of the future in the project IKARUS, sponsored jointly by Daimler-Benz AG and Mannesmann Kienzle GmbH. The main topic of the project is the integration of information exchange between drivers and autonomous activities in the car of the future.

In the project CAE/KI, which is part of the recently started ESPRIT project PRINCE, FAW deals with questions of modelling and quality insurance in design processes, particularly with respect to systems FMEA. The project builds on a successfully finished earlier ESPRIT project, in which FAW had also been involved, and that dealt with the evaluation of the new computer language PROLOG III.

Finally, the project NAUDA jointly sponsored by the State of Baden-Württemberg and IBM Deutschland GmbH deals with natural language access to databases.

3.5 Distributed Resource Management

The projects in this field deal with questions of integration of heterogeneous soft- and hardware components based on an intelligent network. The question of how to distribute scarce resources is addressed in a quite basic research project SESAM that deals with sophisticated decision support for scheduling.

In the project WINHEDA, access to heterogeneous distributed data bases, which will probably be one of the major areas of data base research over the next decade, is addressed. This is done by analysing the heterogeneous environment of FAW and with emphasis on some applications within the Baden-Württemberg environmental information system. Another topic addressed in this field is computer-integrated telephoning and telefaxing based on the particular technical installations of the institute.

Finally in this area, questions of connectionism and neural networks are addressed. The FAW finished the quite advanced system development ALIAS, which constitutes a subsymbolic way of classifying images, in a joint cooperation with the University of Ulm, Robert Bosch GmbH, and a research group from George Washington University. The subsequent project ALANN, that extends the cooperation with the partners from George Washington University, aims at the extension and the transfer of the results obtained to industrial processes and is sponsored by Robert Bosch GmbH.

4. Summary

The FAW is an example of a kind of institute that might be established in other places in the world to create favourable conditions for partnership among universities, the State, and industry that may give the competitive edge needed in the next decades. The FAW has profited greatly from the special attention in Ulm and from particular aspects of the topic of knowledge processing, but what ultimately counts is the right kind of structure and approach. Comments on the scientific approach, which is of critical importance, have been given in the paper. The right structure includes cooperation between the partners; high-level monitoring; ambitious research goals; solid funding with basic research projects, precompetitive projects, and considerable contract work and consulting; legal independence; a substantial amount of freedom; the coupling of scientists from industrial firms and from the institute; a close association with a university and funding for consultants, for subcontractors, for visiting scientists, and for conferences. These ingredients, used in the right way, help to make such institutions work. At least for the moment, they seem to have worked well at the FAW with its particular scientific and methodological approach. We would like to think that our experience may be used by other similar foundations elsewhere in the world. In fact, in Austria, another FAW is being founded.

5. Acknowledgements

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Abbreviations

AIDA:	Automatic Maintenance and Diagnosis in the Automotive Industry
ALANN:	Adaptive Learning and Neural Networks
CAD-KI:	Knowledge-based Computer-aided Design
CAE-KI:	Knowledge-based Computer-aided Engineering
CESAR:	Customized Expert System Applications and Requirements for Banking and Insurance
FMEA:	Failure Mode & Effect Analysis
FOS:	Flexible Office Systems
GENOA:	Generation and Optimization of Working Plans
ICOT:	Institute of New Generation Computer Technology (JAPAN)
ICSI:	International Computer Science Institute (Berkeley, USA)
IKARUS:	Borderline between Driver-Vehicle Communication and Autonomous System Intervention
KWEST:	Knowledge-based Shopfloor Control
MCC:	Microelectronics and Computer Technology Co-operation (Austin, USA)
NAUDA:	Natural Language Access to Relational Databases
OSSY:	Organizational Support Systems
RESEDA:	Remote Sensor Data Analysis
SESAM:	Decision Support System for Scheduling Application
WANDA:	Knowledge-based Data Interpretation in Environmental Chemical Analysis
WINHEDA:	Knowledge-based Access to Distributed Heterogeneous Database Systems
ZEUS:	Integrated Environmental Information System