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MICRO-ELECTRONICS MONITOR

The *Microelectronics Monitor* proposes to accept industry-related advertisements from companies interested in reaching planners and policy-makers as well as entrepreneurs and members of the scientific community in some sixty developing countries throughout the world and inform them about their products and services.

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I. NEWS AND EVENTS

International co-operation on superconductors

Japanese superconductor researchers are hoping for international co-operation and the US Administration sees the inevitability of nationalistic competition. That was the message from a panel discussion on "International co-operation" by speakers from the United States, Japan, Europe and India at a symposium on superconductivity held in Japan in September 1988.

The symposium was the first arranged by Japan's International Superconductivity and Technology Centre (ISTEC), an information centre and research consortium set up earlier this year with funding from the private sector and the Ministry of International Trade and Industry (MITI).

Professor Shoji Tanaka, vice-president of ISTEC, pointed out that each new project is longer than the one that went before and orientated towards more distant commercial goals. He expects the present superconductor project to last for about 10 years on a budget of around $150 million, and believes that commercial applications are distant enough to allow international collaboration on basic research.

Setting up collaborative research projects in Japan is not easy. M. Uenohara of NEC Corporation explained that Japanese electronics companies "compete furiously" in the market: at the start of the VLSI project, researchers from the different companies in the project were unwilling to communicate. After a year of negotiations it was agreed to limit research to "pre-competitive technology". From then on the researchers worked together like "family members", according to Uenohara. He thinks a similar style of co-operation on superconducters is possible at the international level.

Many experts feel that the strength of the VLSI project (and those that came after) was not in co-operative basic research, but in creating a consensus in giant electronic companies that the semiconductor race must be won. So the co-operative project stimulated competition. Foreign companies thus worry that joining in a "co-operative" project in Japan might simply provide basic research results to fuel the applications race.

Paul McLaughlin, director of the Council on Superconductivity for American Competitiveness (CSAC), said "nationalism" will be the driving force behind advance in superconductor research. But he did acknowledge the need for international exchange of information and says that CSAC's information services are open to everyone.

CSAC is proposing to form a research consortium, the Superchip Corporation, funded by private industry and possibly backed by US federal government bonds. The council is lobbying for legislation to exempt the corporation from US monopoly laws, and Superchip may also get special treatment over patents. But unlike Japan's superconductivity centre which is open to foreign companies, CSAC and Superchip are for US companies only.

The United States will spend $205 million on superconductor research in the fiscal year beginning 1 October 1988. Much will be spent on defence related research in government laboratories, which have a poor reputation for transferring technology to the commercial sector. CSAC's purpose is to ensure that the United States is competitive by organizing communication between government laboratories and industry.

India, on the other hand, has been hard pushed to scrape up $10 million for superconductor research, according to C. N. R. Rao of the Indian Institute of Science: developing countries "can never be equals" to the advanced nations, and he appealed for international co-operation.

The Governments of the United Kingdom, France and the Federal Republic of Germany are each spending a few tens of millions of dollars on superconductor research and new research centres have been set up in collaboration with industry. (Source: Nature, Vol. 335, 8 September 1988)

ESPRIT forced to prove its worth

A major review has been commissioned on the $300 million research programme ESPRIT, to check if the scheme is providing good value for money.

Seven top figures from European industry and scientific research, headed by Doctor A. E. Pannenborg, former vice chairman of Philips, will report back to the European Commission on the first phase of the four-year-old ESPRIT in spring 1989. The findings will be made public.

According to the Commission, over half the 226 projects involving 600 organizations have given results. Around 125 projects have resulted in commercial products and close to 30 international standards have been created.

Jean-Marie Cadiou, director of ESPRIT, drew special attention to the "Supernode" micro-supercomputer, built by a consortium including INMOS, Thorn EMI and Southampton University.

A total of 20 of the 25-400 million floating point operations per second machines have been installed since July, and orders have been placed for a similar number, with 200 expected to be sold next year.

Cadiou also remarked that 45,000 T800 floating-point Transputers, developed by INMOS under ESPRIT, had been sold mainly to Japan.

Other successes included Bipolar CMOS technology, partly developed at Trinity College, Dublin and robotic vision control, contributed to by the University of Newcastle. (Source: Computing, 1 December 1988)

Europe acts to remedy its shortage of chips

Three of Europe's biggest electronics companies have launched a joint programme of research aimed at ending Europe's dependence on foreign suppliers of microchips. SGS-Thomson, an Italian-French firm, has announced that it will join with Siemens of the Federal Republic of Germany and Philips of the Netherlands in the Joint European Submicron Silicon Initiative, or JESSI, to produce random access memory chips with a capacity of four megabits of information.

This is 10 times as much capacity as is now available. To achieve it, electronic components must be packed 0.3 millimetres apart on chips.

Philips plans to spend $250 million on JESSI, and will lobby the Dutch Government for funds to match this sum. The other companies hope for similar backing from their governments.

Officials at the EEC, which also sponsors pre-competitive research on microelectronics, say that they will not be able to fund a project as big as JESSI. The EUREKA programme may become involved. Europe now imports virtually all its general-purpose, or "commodity" chips, from Japan and the US, whose agreement in 1986 to set quotas for trade in chips has resulted in severe shortages of chips for computer manufacturers.

JESSI will require 20,000 worker-years divided among basic technology, applications, materials, and long-term, related research, such as work on the organization of neural networks. Scientists at the Frauenhofer Institute for Microstructural Technology in West Berlin, who are planning JESSI, will announce their detailed plans in December 1988. (This first appeared in New Scientist, London, 29 September 1988, the weekly review of science and technology.)

A new all-European computer network for research

The ever-increasing number of European scientists and other researchers who use computer systems has created a great need for international means of online communication facilities between the various computer systems. It was realized that existing networks must be harmonized, enlarged, combined and standardized, and that new services must be set up. This demand led to the formation of the COSINE (Co-operation for Open Systems Interconnection Networking) project.

COSINE is actually a EUREKA enterprise, in which all EUREKA partner States, the European Community organization and its Member States, as well as a number of other countries (including Austria, Switzerland, Sweden, Finland, Turkey, etc.) participate. Yugoslavia expressed an interest but no iron curtain countries are involved. Recently, negotiations were initiated to involve also the US, via trans Atlantic links.

The major idea is to supply data services and telecommunication facilities for the European community of academic and industrial researchers. The building of an effective infrastructure would also lead to economic advantages, because of the necessary new technologies that will go into the networking system. Finally, the effort to normalize several, so far independent, national networks within the frame of unified European standards is expected to improve political co-operation.

In order to avoid high costs and inefficient network-interfacing between incompatible networks, it has been decided to employ the international standards for open systems (OSI) for communication, to utilize existing postal teleservices, and to realize COSINE with commercially available products.

Common application services of COSINE, already available, are:

- Interactive data communications infrastructure;
- File transfer and access management;
- Message handling;
- Directory services;
- Accounting services.

Future planned services are:

- Screen-oriented dialogue;
- Remote job entry;
- Graphics;
- Virtual terminal support;
- Broadband communications.

The final implementation phase of COSINE has started, involving a shift of emphasis from international and centralized activities to national and decentralized activities.

Detailed information on COSINE can be obtained directly from Nicholas K. Newman or John Beale, Commission of the European Communities, Directorate-General XIII, Office A25-7/13, Rue de la Loi 200, B-1049 Brussels, Belgium. (Source: European Science News, June 1988)

Major new industrial consortium formed in Europe - superconductivity one of its first focuses

The recently formed European Institute of Technology (EIT) is a major new industrial consortium for scientific and engineering research and education. EIT was organized by leading European international corporations with the founding members being AT&T, EniChem, IBM Europe, Montedison, and Philips. Based in Paris, it was created to help European industry take full advantage of its own scientific and technological resources by forging a more effective industry-university partnership. EIT is funded by industrial contributions from its members, and its activities are focused on direct, precompetitive research in materials technology, information technology, and biotechnology. The address of EIT is Tour Franklin, Cedex 11, 92081, Paris.

One of EIT's first activities was to organize and sponsor a three-day conference, "European Symposium on Advanced Materials: Their Role in New Technologies", which was held in Madrid, Spain on 27-29 June 1988 and hosted by AT&T Microelectrónica de España. The symposium emphasized research related to functional materials and brought together speakers from industry, academia, and public research centres. Subjects covered were superconductors, semiconductors, composites, molecular electronics, optoelectronics, magnetic materials, surfaces and interfaces, and non-destructive evaluation.

Other activities of EIT include establishing networks of researchers and funding of projects selected from competitive requests. Announced at the meeting were the final six in this year's selection, and two of those were in superconductivity, with the winners each receiving 250,000 ECU (~ $350,000) per year for three years. One, from Professor Franco, University of Madrid, was a systematic search for new superconductors and the other, from Professor Lumley, Cambridge University, was a study of the weak links that cause low critical currents. Other winners were in composites, integrated circuits, laser processing, and non-destructive evaluation. (Source: European Science News, June 1988)

Hardware design verification

The Fusion of Hardware Design and Verification was the title of an international working conference held 4-6 July 1988 by IFIP's Working Group on Digital Systems Descriptions and Design Tools (WG10.2). Meeting in Glasgow, the 67 participants, including most of the leaders in this field, discussed 23 papers on applying formal techniques to the verification of VLSI circuits.

Dr. George Milne served as conference chairman. Proceedings of the Conference have been published by Elsevier/North-Holland.

A good summary of the state-of-the-art of hardware verification is found in the paper NODE: An Engineering Approach to Hardware Verification by Dr. Clive Pygott. Excerpts from the initial sections of that paper are quoted here:*

Hardware verification is a process by which a circuit designed to implement some specification is shown to be correct under all circumstances. Formal hardware verification involves the use of mathematical tools to manipulate the descriptions of the circuit and of the requirement, to show whether or not they agree under all circumstances. This is a far more complex process than that involved in normal circuit testing and is still the subject of much research. At present, formal verification has only been used on a handful of circuit designs. Currently, the justification for using such methods has been that the circuits being verified are to be used in safety critical applications, and so no design errors, however obscure, can be tolerated. However, as the complexity of integrated circuits increases, the use of formal methods is likely to become more relevant to all digital circuit designers.

Real-life practice

Verification methodology should be contrasted with what happens in practice during the fabrication of most circuits. Usually there is no formal statement of what the circuit is to do, the requirement being expressed in a natural language form (with its inherent ambiguities). A level of confidence in the correctness of the circuit is gained by simulating its response to a selected set of stimuli. This set of stimuli has to be designed to exercise as much of the circuit as possible, but all this method can ever show is that for those tests performed, the circuit behaves as expected. For example, a comparatively simple 8-bit microprocessor is capable of 2^{111} different state transitions. Even if a transition could be simulated every microsecond, it would take 10^{53} years to examine all the possible changes (this is far longer than the age of the universe).

The argument usually made to justify this approach is that it is known from the specification that there is no logical connection between different parts of the circuit. This leads to problems when rarely used parts of the processor interact in unanticipated ways. A number of microprocessors have come on the market which have later been shown to behave erroneously under unusual circumstances (such as an interrupt occurring in the middle of a block move instruction).

Research into hardware verification is typified by programs that lead to formal verification of an implementation. However, this proof of correctness involves a great deal of human interaction with the proving tools. Furthermore, the current state of the proving tools is such that a high degree of mathematical ability is required to use them. A secondary problem is that they have been developed within an academic environment, as stand-alone tools with little or no consideration given to the way they would interact with existing CAD systems.

In particular, the programs typically assume that the circuit will be described in the language used by the proving tool. In practice, the circuit is likely to be designed using a schematic capture process on a workstation, with the graphical representation being translated into a textual hardware description language. Whilst it would be possible to write a translator, this is not the whole solution to the problem. The steering of the tools by the person performing the proof is such that the person must have a good understanding of the structure of the information being manipulated. Automatic translation of a graphic representation of the circuit, followed by further translation into the proving language, is likely to lead to a poorly structured description that will be very difficult for the prover to interpret.

In addition to the translation problem, there is also a requirement to test the chips once they have been fabricated. This means that some quite detailed simulation of the device is still needed to provide test waveforms and expected results. This simulation cannot be performed at the top level of specification, as details of the circuit interface and timing may not be visible in the abstract high-level description.

Future trends

Given the above problems with formal verification, it may be wondered if it will ever replace testing for any but the most safety-critical circuits. Eventually, as improvements in the man machine interface of the proving tools are made, the human effort required to prove a circuit will be reduced until verification is as attractive as testing. More importantly, it would appear that the amount of effort required to perform verification rises only slightly faster than linearly with the complexity of the circuit under investigation. This should be contrasted with the effort required to test a circuit to the level of confidence required before it can be manufactured, which appears to increase as at least the cube of complexity, if not exponentially. This means that as circuits become more complex, there must come a time when it is cheaper to perform a verification than to test the circuit to the currently accepted level of confidence.

The author then proceeded to describe a system in which the method of proof was designed to alleviate some of the problems associated with the verification process. (Source: IFIP Newsletter, Vol. 5, No. 4, December 1988)

European telecomms suppliers unite

Twenty two national European telecomms suppliers have set up a joint company to sell pan European network services in competition with US multinationals like IBM, Geisco and Electronic Data Systems (EDS).

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The joint company (MDNS) will start operations next January, following an agreement which opens the way for the suppliers (also known as PTTs) to overcome national rivalries and offer the one-stop shopping and guaranteed service levels that have previously been the main selling point of the private suppliers.

At least 50 million ECUs (about $35 million) will be invested over the next three years in building the service, but a far larger investment will be needed.

The EEC is supporting the venture because it will allow European companies to build international networks without resorting to US companies.

A community directive on the liberalization of value added services is due at the end of this year which is certain to open the market and allow full competition in service provision while protecting the basic networks.

MDNS will offer a number of services that are currently either impossible to obtain, or costly and difficult to set up and run because they involve dealing with a number of national PTTs.

An "umbrella" network will offer gateway services, protocol conversion and translation between different national implementations of X.25 packet switching.

In the longer run MDNS will expand beyond offering network services and simple value added services such as network management into providing a fuller range of value added services. (Source: Computer Weekly, 6 October 1988)

State orchestrates its communications standards show

The UK Government's IT agency, the Central Computer and Telecommunications Agency (CCTA), has rounded up public sector IT advisers from eight countries to present a united front to international communications standards makers.

CCTA recently organized a meeting in Ottawa of fellow government advisors from Australia, the US, Canada, Sweden and the Federal Republic of Germany to harmonize communications standards around the UK Government Open Systems Interconnection Profile (GOSIP).

Launched in December 1988, GOSIP lays down selected Open Systems Interconnection (OSI) standards options which suppliers must conform to when bidding for open systems contracts.

There is also interest from the French and Federal Republic of Germany Governments to produce an open systems procurement handbook based on GOSIP.

In July, CCTA met US government representatives to discuss which parts of another open systems standard, POSIX, they should demand from suppliers.

CCTA aims to fall into line with US federal specifications for the POSIX interface standard.

The CCTA is also working with other European governments to form a standard software analysis and design methodology (SSADM). (Source: Computer Weekly, 27 October 1988)

Artificial intelligence and information systems

The Role of Artificial Intelligence (AI) in Databases and Information Systems was the title of a working conference held in Guangzhou, China, 4-6 July 1988. It was sponsored by IFIP's Working Groups on Database (WG8.3) and Design and Evaluation of Information Systems (WG8.1). Approximately 150 attended, some 90 from the People's Republic of China and the remainder from other parts of the world. Of the 35 papers presented, nearly one third were by Chinese authors.

Professor Dr. Arne Solvberg, WG8.1 chairman, was General Conference Chairperson. Chairpersons of the International Program Committee were Professor Dr. Robert Meersman and Professor Kung Chen-Ho. Xu Kongshi was chairperson of the Organizing Committee, assisted by Professor Shi Zongzhi, who also prepared the participants' edition of the proceedings.

The Conference had a twofold scientific goal: since information system design, implementation and operation is a complex problem-solving task, where expert knowledge is needed, papers concerning AI techniques for information system design were solicited. In addition, the Conference explored new database formalisms and technologies for use in (large) AI applications.

The proceedings of the Conference, to be published by Elsevier North-Holland in March 1989, are being edited by Meersman, Kung and Shi. (Source: IFIP Newsletter, Vol. 5, No. 4, December 1988)

1989 Canadian Microelectronics Corporation Workshop, 13-16 June 1989, Queen's University, Kingston, Ontario

The National Design Network, as envisaged several years ago when the Canadian Microelectronic Corporation (CMC) was planned, is a concept which depends on significant interaction among people active in the VLSI research community for successful implementation. Interaction can take many forms and while ability and capacity for electronic transactions is stronger now, it is vitally important to meet on occasion. The annual CMC workshop is intended for this purpose.

Each year the programme for the workshop reflects the advice solicited annually from university members of the corporation. In 1988 the programme extended from practical training to research innovation and the sessions moved progressively from topics in aid of IC design as supported directly by CMC to advances in university research and a special session about high-level design. The CMC business plan released in 1988 indicated many new aspects of support for VLSI research; some action has been taken, considerably more is planned and many details will be provided during the workshop week. Further information is available from Mrs. Nancy Peters, Canadian Microelectronics Corporation, Room 210A, Carruthers Hall, Queen's University, Kingston, Ontario K7L 3N6

Clearing house for third world news

The methods by which news stories on subjects concerning the third world at present reach the press are widely considered to be inefficient.

There is no one place in which journalists and other news-users can find sorted source materials from many agencies on a particular third world story. An alternative to the usual haphazard assortment of hard-to-locate press releases is promised, however, in the shape of the World Press Centre London (WPCL), a clearing-house of pre-publication source materials from the United Nations system and other agencies.

Based in London, UK and designed for and with press officers, journalists, publishers, editors, lobbyists and publicists, WPCL aims to provide, by subject, access to material issued by press offices, which the media might have difficulty in obtaining. Input is expected from the World Bank and other United Nations system organizations. Materials will be available in English and French.

The Centre is expected ultimately to become self-financing, although funding has been received from the UK Government. Its establishment has become feasible with the increasing use of information technology in news-gathering and reporting, in addition to falling costs and improving transmission quality in international telecommunications.

WPCL's services will cover three topics: international economics, Europe and the third world, and tropical forestry. The information is divided into three types of item: diary, today's news and background. Prototypes of all three of its services are expected to come online in the near future. A key component of the system is WPCL's terminal software, which allows any PC-compatible microcomputer equipped with a hard disk and modem to gain access to the system. News items can be consulted offline, to minimize communications costs. Users will pay a modest annual subscription fee for the use of a password giving them access to the WPCL clearing house. The fee will vary according to the type and location of user, with a reduction for third world media subscribers.

For further details, please contact: World Press Centre London, 3 Parolles Road, London N19 3RF, UK. (TP+44 1 263 03 31; TX 265871 MONREF G (Please quote box reference 72:MAG100707 at top of text.)) (Source: ARIS Newsletter, Vol. 6, No. 4, November 1988)

Microcomputers for developing countries

Africa, Asia and Latin America had just 5.7 per cent of the world's computers in 1985. Even so, there has been a considerable growth in the installation of microcomputers. And certain applications seem tailor-made for productive use in developing countries. So far, the main uses for computers in developing countries have been for the standard functions of inventory control, accounting and payroll. But there are opportunities in other areas, such as developing health care systems and promoting computing in education, the latter usually being a good way to stimulate local industry at the same time. The most promising technology tools for underdeveloped countries are PCs and networks. Both of these represent quite appropriate technology the PC in particular is cheap and easy to use, while networks provide considerable benefits in gathering and retrieving data and in spreading the geographical distribution of processing power. There are clearly practical difficulties in the establishment of computer networks. Wide area networks (WANS) depend on the existence of some national communications structure. The telephone system that could provide this is still often underdeveloped. Africa, in 1985, had one telephone to every 125 people, and many countries will not have X.25 switching systems to be able to log into international networks. Other problems associated with computing in underdeveloped countries have been eased by technological innovation. For example, an unreliable electricity supply can lead to voltage fluctuations or power failures. Small electricity generating sets have alleviated this problem, either running a computer full-time or cutting in when there is a mains failure. There are also resident systems that take automatic regular backups of the vulnerable memory. The major difficulty remains one of servicing. Although the number of computer installations has grown, there has been an increasing variety of suppliers, so that local servicing of hardware is no easier. But the world economy that brought the debt crisis, food mountains and food shortages can still strike with a perverse logic: that developing countries should concentrate not on technical development, but rather on areas where they currently do best: the production of commodities for export and the use of cheap labour. In this way, the fact of technical and economic disadvantage is made a reason for its perpetuation. (Source: Computer Guardian, 18 August 1988, p. 29)

Work starts on Alexandria library

Work on the reconstruction of the Ancient Library of Alexandria entered a new phase with the laying of the foundation stone in June 1989. The project is being undertaken by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in collaboration with the Egyptian Government. Preparation for the rebuilding of the library - founded by Alexander the Great in 332 B.C. - has taken two years and involved an international appeal and a symposium to review the project's feasibility study.

The Ancient Library was, in the six centuries following its creation, a unique repository of works in the scientific, philosophic and literary fields. Its 21th century successor - due to open its doors in 1995 - will be managed on an entirely computerized basis, and will offer all the services to be found in the most modern libraries. The initial collection of 200,000 volumes, it is hoped, will increase gradually to contain some eight million. The establishment on the library site of an international school of information science will ensure that staff are trained in all the relevant modern techniques.

A cost of US$160 million is foreseen for the project. Egypt has offered to provide four hectares of land, with an estimated value of US$60 million, together with an existing conference centre costing US$20 million, to form part of the library's future infrastructure. Egypt has also allocated 15 million Egyptian pounds to cover the costs of the Egyptian personnel and local project support services. This leaves an approximate sum of US$100 million still to be found for the completion of the library.

UNESCO, together with its co-promoters the United Nations Development Programme (UNDP) and the Egyptian Government, is launching an international architecture competition. The competition invites architects from all over the world to conceive a architectural design for the new library which should represent "the quintessence of tomorrow's cultural thought". Further details about the

contest, which costs US$150 to enter, should be requested from: The Director, Office of Information Programmes and Services (IPS), UNESCO, 7 place de Fontenoy, 75700 Paris, France. (Source: UNISIST Newsletter, No. 4, 1988)

CESI - helping aid to flow

The World Health Organization's Country External Support Information (CESI) System is a computerized data base on drinking water supply and sanitation projects in developing countries. Co-sponsored by the United Nations Development Programme (UNDP) and the Federal Republic of Germany, CESI was started in 1985 and now contains more than 3,000 records from 40 major donors. The system springs from an initiative of the Organisation for Economic Co-operation and Development (OECD) to improve the co-ordination of aid in support of the International Drinking Water Supply and Sanitation Decade. resent funding commitments will support CESI's operations until the end of 1988, after which long-term financing will be needed.

The data - collected from bilateral and multilateral funding institutions, United Nations system organizations, and non-governmental organizations - is analysed, standardized and coded by the CESI Co-ordination Secretariat, based at WHO's Geneva headquarters.

Participation is encouraged from funding agencies or government ministries working in the sector, which are willing to share their project information freely with others. Users of CESI can obtain regular updates in a variety of forms, such as country project listings. Output can be received as hard copy or on diskette. In future, it will be possible to transmit outputs electronically to the user's own microcomputer. Comprehensive keywording and sorting facilities allow reports to be tailored to the user's needs. The system offers the governments of Member States, and other users, a way to keep a continual check on requests for aid and the flow of aid in the drinking water supply and sanitation sector. For agencies wishing to develop compatible systems for their own use, CESI staff can provide advice on adaptations of the system's master program, with modifications to standard forms to deal with user-specific entries.

In future, it is hoped that users will be able to interrogate the CESI data base via electronic links. It is also hoped that CESI will be able to exchange information electronically with other microcomputer systems.

Further details and advice on participation in CESI can be obtained from the Community Water Supply and Sanitation (CSW) Unit, Environmental Health Division, WHO, 1211 Geneva 27, Switzerland. (Source: ACCIS Newsletter, Vol. 6, No. 4, November 1988)

II. NEW DEVELOPMENTS

The fifth generation programme

The search for the fifth generation has always been controversial. Electronic computers have passed through four generations over the past 4[illegible] years, from machines built out of vacuum tubes, through to transistors, integrated circuits and today's very large scale integration.

Unlike conventional computers, fifth-generation machines will process knowledge rather than numbers. They will be capable of inference: processing existing knowledge to infer information which was previously not known explicitly.

Japan's Ministry of International Trade and Industry (MITI) which set up ICOT (New Generation Computer Technology), believed that carving out a lead in such machines which would find applications in offices, factories and in hostile environments such as mines, would give Japan's electronics and computing industry a decisive lead in the 1990s.

Such computers would need breakthroughs in the electronic architecture and software of parallel processing. Icot said it could do the job in 10 years. Under pressure from MITI, Japan's 10 firms and two MITI laboratories loaned staff.

The companies involved are the computer giants Fujitsu and NEC, two companies best known for their consumer electronics, Matsushita and Sharp, and the engineering combines Hitachi, Mitsubishi, Toshiba and [illegible]. The other two participants are the telecommunications firms NTT and KDD. The Government provides all Icot's budget - Y5.7 billion this financial year. By 1992, the project will have cost very much more.

Fifth-generation machines will operate at least 100 times as fast as existing computers. The project's planners believed the only way to achieve this was to build massive arrays of processors, working in parallel.

The highlight of a conference in Tokyo came with the unveiling of a prototype parallel computer containing 64 processor elements. This will run programs written in a new language, Kernel Language 1 (KL1), based on Prolog. The technology for connecting up 128 elements is now ready, and the final goal, a 1,000-processor machine, is feasible. It will be capable of between 100 million and one giga LIPS (logical inference processes per second).

The design of the clusters of processors should not present any hardware problems. The tricky bit is developing the software to run applications programs on the 1,000 processor parallel inference machine.

MITI plans to launch a new project next year to investigate computers based on neural networks, laid out in similar ways to the human brain. Significantly, several major companies, including Fujitsu and Toshiba, have already decided to develop neural networks - with no prodding from MITI.

Although it is inconceivable that the Japanese Government might abandon the fifth-generation project, it may have to adopt a lower profile for its remaining three years. (Source: Electronics Weekly, 14 December 1988)

PALs get application specific

A new patent medicine for the engineering headaches suffered from matching the diversified interfacing protocols of asynchronous microprocessor peripherals is on the shelves from Advanced Micro Devices (AMD). The prescription is in the form of a new PAL device which AMD claims is a panacea for such infirmities. But the device is not only another PAL, it is also a first step for AMD in the direction of more application specific PALs.

The device is called IPAC, and numbered PAL22IP6. THe name stands for Interface Protocol Asynchronous Cell. The new design includes two new types of flip-flops not seen in PAL devices before, both edge-triggered. One is an SR flip-flop and the other a double-toggle flip-flop. The latter seems also to be a new type of flip-flop for the industry. AMD experts claim the 25 ns propagation delay time of the new unit will out-perform interfacing solutions made from 5 ns PALs, if there were such PALs available - and there are none.

The main reason for the speed advantage is architectural. Two clock cycles are saved compared to conventional interfacing schemes with generic PALs or standard logic devices.

The IPAC contains six of the edge triggered flip-flops. They eliminate the need for a separate clock, eliminating metastabilities with simple means. The device is a 24-pin PAL device with six outputs, each with a programmable macrocell and drive capability of 48 mA. It has 16 dedicated inputs and a fused PAL array of ANDs and ORs.

The flip-flops provide a convenient way of implementing asynchronous request grant-type handshake protocols, without requiring signal feedback for storing requests or grants. It also eliminates the data to-clock set-up time requirements of conventional flip-flops and latches, since the data signal is stored on its own rising or falling edge. The input itself acts as both data input and clock. Violations of the data set-up time in previous circuits can lead to unpredictable metastability effects. Eliminating the separate clock, the IPAC also eliminates the metastability in many instances. (Source: Electronics Weekly, 31 October 1984)

Fastest AlGaAs GaAs transistor developed

Researchers at Cornell University, Ithaca, N.Y., and the Siemens Research and Technology Laboratories in Princeton, N.J., jointly developed the fastest transistor using aluminium gallium arsenide (AlGaAs) and gallium arsenide (GaAs).

They manufactured the heterostructure field effect transistor (FET) by growing with Al, Ga and As using molecular beam epitaxy. They processed the conventional AlGaAs GaAs MODFET structure as a recessed gate FET using electron beam lithography. The researchers formed a 0.1μm gate with a T cross section that had low gate resistance. They demonstrated for the first time that a smaller gate size means an inherently faster device.

"The current gain cut-off frequency, which is the frequency at which current gain becomes one, is 113 GHz," says Allen Lepore of Siemens. "At the time of measurement, this was the record. In fact, it is still the record for AlGaAs GaAs structures. However, there are other material systems that can be grown by molecular beam epitaxy such as MODFETS where InGaAs replaces the GaAs in the channel which have greater potential for speed".

Microwave devices find applications in high speed satellite communication, spacecraft communications and radar systems. Transistor switching speeds in these devices are continuously inching upward as new materials are investigated and used.

The previous speed record was held by Hewlett-Packard at 80 GHz. The researchers at Cornell and Siemens believe that speeds above 200 GHz can be obtained using the AlGaAs InGaAs structure. (Reprinted with permission from Semiconductor International Magazine, September 1984. Copyright 1984 by Cahners Publishing Co., Des Plaines, IL USA)

New developments in GaAs

Gallium arsenide (GaAs) is the gifted child of electronics. Silicon, its rival, seems dutiful but dull by contrast. A GaAs chip is born with many advantages: it can work five times faster than silicon; it uses less power; it is less affected by radiation; and it can convert electronic signals to light. Unfortunately, GaAs is also expensive, ill-trusted and troublesome. It accounts for a meagre 0.5 per cnt of the semiconductor market. Silicon, cheaper and better understood, triumphantly takes almost all the rest. Now many companies claim they have overcome GaAs s problems.

Many of GaAs's strengths stem from one property: current-carrying electrons move more easily past arrays of GaAs atoms than they do past arrays of silicon atoms. So electronic signals can trigger and flow through a GaAs microchip faster, and waste less power. Also, the output of a GaAs chip is less distorted. Electronics engineers exploit these traits in circumstances where silicon does not come up to scratch.

Most of these are in defence and telecommunications. GaAs is useful for amplifying the weak signals received by radar and satellites. In space, its modest appetite for electrical power helps batteries last, and its resistance to radiation protects it. It also plays a part in telephony. In order to squeeze more traffic onto a line, telephone calls are often "multiplexed" - that is, cut up into little packages which are shuffled and then transmitted together. This job often gets too hectic for mere silicon.

Lucrative (and fast growing) as these niches are, GaAs needs to find its way into wider use in equipment like computers. Only then will it truly come of age. The makers of GaAs look hopefully to two trends: their improving ability to handle the material, and their customers' stringent demands for high performance. University research also promises to find new ways to bring gallium arsenide into the mainstream.

Because gallium arsenide is made from two ingredients (whereas silicon is a simple material), it can be a tricky job to produce GaAs which is pure and neatly enough arranged to hold microscopic electronic circuits. What is more, GaAs is brittle. Some 7 per cent of wafers (the discs of pure material on which circuits are imprinted) break during processing. Only 1 per cent of silicon wafers break. Silicon's oxide, which is easily formed with oxygen, can act as one of the structural components of the transistors that are built upon its surface. GaAs, on the other hand, has no such convenient compound. Its transistors have to be built in more subtle ways. Also, since GaAs does not conduct heat well, transistors will overheat if they are too closely packed on a chip.

These problems are reflected in the cost of a three-inch wafer of GaAs: about $160, compared with $30 40 for a six inch silicon wafer. A finished

chip might cost three to five times as much in small quantities. When companies produce more GaAs, costs will fall. In the mean time new technology can push prices lower.

They are also adapting processes from the silicon industry that sidestep the need for an oxide. Earlier Vitesse announced a process which it hopes will bring costs down to below 5 cents per logical step, or gate, on a chip's surface. Gates on high-speed silicon chips cost 2.5 to 5 cents.

Pushing down the cost of GaAs chips should help persuade computer makers to include them in their machines. But there are other reasons why GaAs might be used - at least in high-performance computers. Cray Research, a Minnesota company which builds some of the world's most powerful supercomputers, is using GaAs chips in the Cray-3, which will be launched next year. It wants the speed that GaAs can offer, whatever the cost. Other companies, including Sun Microsystems and Digital Equipment, have been sniffing around GaAs, partly because its low power consumption would give them more speed without liquid cooling.

A new fad in chip design, called reduced instruction set computing (RISC), works in GaAs's favour too. RISC computers build up complicated programs from a few, simple tasks etched into their chips. Although more steps are needed to run a given program than on a conventional chip, which has more complicated instructions etched beside the simple ones, RISC chips work fast enough to get through the job more quickly. Since RISC chips have fewer instructions, they also need fewer circuits built into them. This diminishes the advantage which silicon usually enjoys by being able to pack more circuits onto a chip.

The universities, too, are helping GaAs to grow up. One of the busiest areas of research is in semiconductor lasers. Lasers with GaAs chips inside are already used to convert the electronic signals of digital telephone calls into light, which is beamed down optical fibres. Adding impurities to tailor the optical behaviour of the material, and using some of GaAs's close relatives like indium phosphide, will help to make such lasers more versatile. Eventually they may be used to guide data between the computers in an office network or even through the insides of single computers.

Recent research at the University of Illinois suggests it might be possible to combine the qualities of GaAs and silicon in a single chip by placing a layer of gallium and arsenic atoms on a silicon base. At first sight this looks an unlikely prospect: the natural arrangements of atoms in silicon and in gallium and arsenic do not match. But the Illinois team, led by Dr. Hadis Morkoç, have found that tilting the silicon base by four degrees creates atomic steps on which gallium and arsenic atoms can nestle comfortably. Hybrid chips may soon find applications in solar cells and charge-coupled devices (which turn light into electronic signals).

With so many opportunities at the high end of technology, GaAs is likely to increase its world-wide sales on the open market from the paltry $150 million it will earn this year. But its share of the that market may not increase. Silicon will find ever more to do at the high-volume, low-tech end of the street. And silicon research, now in its thirtieth year, has far from dried up. Plenty of current work aims at building fast and dense chips that might compete with GaAs. (Source: The Economist, 3 December 1988)

Integrated circuits containing silicon and GaAs transistors

Texas Instruments is developing commercial monolithic integrated circuits containing silicon and gallium-arsenide transistors, using a process that could produce new high-performance electronic and optical devices. The co-integration process first puts silicon transistors on an ordinary silicon wafer, then selectively embeds thin islands of GaAs in the chip. The GaAs devices are fabricated, and all components are interconnected by metal. Currently, GaAs is grown atop the wafer in two to three micron thick layers. The combined chips may produce higher processing speeds, since GaAs components can be two to three times faster than similar silicon devices. GaAs can also be used to build light-emitting diodes and lasers that cannot be produced in silicon, according to co-developer H. Shichijo. (Extracted from Machine Design, 6 October 1988)

New compound for producing GaAs

Cornell University chemists (Ithaca, N.Y.) have developed a compound that can react at low temperature to yield gallium arsenide. This offers the possibility of a low-temperature, non toxic method of fabricating the material.

Normally, molecules with both gallium and arsenic atoms readily react to form pairs or chains. However, the Cornell chemists have synthesized a compound containing only one gallium and one arsenic atom, linked to each other and surrounded by small attached molecular groups that "cushion" the gallium arsenide pair from the effects of its neighbours. The cushioning groups attached to the gallium are two pentamethylcyclopentadienyl rings, and attached to the arsenic are two trimethylsilyl groups.

The new "arsinogallane" molecule was designed so that, when reacted with butanol at low temperature, the cushioning groups are stripped from the gallium arsenide core, yielding GaAs. The Cornell chemists also have produced a similar compound with a core of indium phosphide.

The chemists plan to continue development of new compounds that could be more useful as an alternative route to GaAs production. (Reprinted with permission from Semiconductor International Magazine, November 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, IL. USA)

Toshiba unveils IC w GaAs chip

Toshiba is sampling a gallium arsenide (GaAs) IC for microwave communications that features the world's largest output of 10 W. It applies the company's 0.5-micron fine-etching technology and mounts 200 elements on a single chip. The IC is available in six types working the frequency ranges of 8.5-14.5 GHz.

Microwave communications systems and radar systems have recently come to use GaAs field effect transistors (FETs) which enable system miniaturization and performance upgrading in place of the conventional type travelling wave tubes, but

the developments of FETs with larger outputs is needed to enable working in higher frequency bands.

The new GaAs IC chip arranges and operates 200 FET elements consisting of source, drain and gate electrodes in parallel to obtain a high output of 5 W, and by using two of these chips in combination provides the world's highest output of 10 W. Also, by incorporating an impedance matching circuit that regulates the input signal voltage and current ratio, it eliminates the need to provide a matching circuit externally.

With this IC chip, the layer thicknesses are made uniform by applying ion-implantation, and the direct etching by electron beam is adopted to form gate electrodes on the wafer at an accuracy of 0.5±0.06 micron. (Source: Electronics Weekly, 2 November 1988)

Fast chip brings power to digital processing

Adelaide-based company Austek Microsystems launched the digital processing industry's lowest-priced fast Fourier transform (FFT) device on world markets.

The company's A41102 frequency domain processor (FDP) microchip, developed as part of the Australia Telescope project, is designed to process large amounts of information at high speed. In the past, fast Fourier transforms have had to be performed on large, expensive mainframes.

The idea of producing a chip capable of performing fast Fourier transforms was conceived by Dr. John O'Sullivan of the CSIRO's Division of Radiophysics.

Dr. O'Sullvian was working at the Netherlands Foundation for Radioastronomy trying to observe very short pulses of radiation from small black holes when he realized that Fourier transforms would be the best method of processing the observations.

An algorithm specific configurable processor, the FDP chip, is able to perform 102 million arithmetic operations per second and can be incorporated into DSP systems without complex software development. It has wide applications in medicine, industry and defence.

The 8 mm x 9 mm chip contains 167,000 transistors and, operating at 40 MHz, uses about 1 W of power per second.

Unlike other FFT devices, it contairs its own memory, eliminating the need for costly external memory storage. (Source: Electronics Weekly, 14 December 1988)

Gate arrays can drive up to 96 mA

A family of CMOS gate arrays introduced by MHS will drive up to 96 mA from its output terminals. The chips can be designed by the user on a standard PC.

Designated MX, the process used is taken from the 2-micron, two metal MB family of arrays and has been developed to have a high I/O-to-gate ratio, producing ICs ranging in size from 90 gates with up to 32 I/Os to 3,060 gates with 120 I/Os. Normally, each I/O channel will drive or sink up to 24 mA, but this can be increased for high current loads by paralleling up to four channels on a single output.

The ASICs will operate at clock frequencies of up to 50 MHz. They are intended for use in bus drivers, motor controllers and serial data links, the high-current drive capability implementing these functions with a minimum of interface circuitry. The side transistor gate design gives one RAM cell per gate.

The design package, Gateaid Plus/PC, provides a complete set of PC-compatible ASIC design tools. It also supports MHS's 3-micron MA and 12-micron MB CMOS processes.

The finished parts are available in DIL, SO, LCC, PLC, PGA or PPGA packages and any pin may be allocated to V_{DD}, V_{SS} or I/O functions. (Source: Electronics Weekly, 14 December 1988)

Chip makers reach for bigger memories

Japanese researchers have reported a breakthrough in producing memory chips which are capable of storing 64 megabits of dynamic random-access memory. Such a chip, known as a DRAM, would be able to store the equivalent of 256 newspaper pages of information. Today's most powerful mass-produced DRAMs store 1 megabit of information, although five Japanese companies this year started producing small quantities of 4-megabit DRAMs. Fujitsu, the computer manufacturer, said it had built a memory cell which would form the building block of a 64 megabit chip.

Today's 4 megabit chips have around nine million components in a piece of silicon 15 millimetres long and five millimetres wide. It is difficult to pack in more than this. DRAM chips store their bits of memory as electrical charges in tiny electrical stores, called capacitors. The smaller the components, the less reliable these charges become. Much of the effort which goes into building more powerful memory chips aims to pack more powerful capacitors into smaller spaces.

Fujitsu says it has developed a three-dimensional layout of fin-shaped capacitors which can do this. Creating this structure meant working with components with dimensions of 0.2 micrometres, one fifth of that needed for 1-megabit chips. The company said that the only big technological hurdle it needs to overcome, before putting the 64-megabit chips into production, is to find a way to improve the yield of the manufacturing process. (This first appeared in New Scientist, London, 24/31 December 1988, the weekly review of science and technology)

World's fastest 16-bit DSP chip

Texas Instruments and Microchip Technology have jointly disclosed development of the 320C14, a 16-bit digital signal processor (DSP) microcontroller that for the first time combines the high performance of a DSP with the on-chip peripherals of a microcontroller. Operating at 25.6 MHz the new device is said to be the world's fastest microcontroller. The 320C14 offers five to 10 times the speed of traditional 16 bit microcontrollers, yet will be comparably priced with those devices.

The companies say that the DSP engine of the 320C14 provides analogue designers with a digital solution, without sacrificing the precision and performance of their systems. In fact, system performance can be enhanced through the use of

advanced control algorithms such as adaptive control, Kalman filtering, and state controllers.

The chip's high-speed CPU allows the digital designer to process algorithms in real time, as opposed to approximating results via look-up tables. Its general-purpose instruction set, along with the extensive development support available for the TMS320 DSP family reduces development time and provides the same ease of use as traditional 16-bit microcontrollers.

The device is object-code compatible with the TMS320C10 DSP, and comes with 256 K words (512 Kbytes) of on-chip RAM and 4 K words (8 Kbytes) of an on-chip [illegible] can also address 4 K words of off-chip memory.

The high speed of operation is made possible by implementing functions like a 16 x 16 multiplier in hardware, and by the use of multiple internal buses. To allow greater precision for intermediate results, the 320C14 has a 32-bit ALU and 32-bit registers. (Source: Electronics Weekly, 19 October 1988)

Steerable chip array threatens gas lasers

Reseachers in the US have built an array of semiconductor lasers onto a chip which they claim is an important first step twoards a replacement for cumbersome gas lasers. The array gives out a narrow beam of coherent light from its surface, and the team from the Sarnoff research centre of SRI International, a company in New Jersey, claims that it can steer the beam electronically.

Semiconductor lasers convert electricity into light very efficiently, but the power of their output and the quality of their beams tends to be poor. In recent years, developers have increased the output power by placing strips of lasing material onto a single chip, but this has not helped to improve the quality of the beam, which is usually highly diverged.

The array is 10 lasers long and 10 wide. Each laser in the array is a strip a few micrometres wide and about 150 micrometres long. For the array to emit coherent light, there must be optical coupling between the laser strips along both the length and the width of the array. The easy part is coupling the lasers along the length of the array. Gratings made of gallium aluminium arsenide separate the laser strips and provide an optical connection between the lasers. These gratings also emit the light from the surface of the chip.

The difficult part is in coupling the lasers across the width of the array. The group at Sarnoff demonstrated two ways of doing this. In one, the laser strips are connected end-to-end, so that they look like a series of Vs. In the other, the lasers are coupled by light scattered between them.

Today's semiconductor lasers emit light from their edges, which means that the manufacturers must cut and polish the chip before it will emit the light. The array developed at Sarnoff does not have to go through this process.

Conventional semiconductor lasers and gas lasers emit beams in one fixed direction, but the engineers at Sarnoff say that they can steer their beams by applying slightly different electrical currents to electrodes attached to lasers in the array.

Neighbouring lasers then produce radiation with different amplitudes. When this radiation interferes, the result is light with a specific direction. As the engineers change the current applied to the electrodes, so the amplitudes change and shift the direction of the resulting beam.

The researchers say that the new array could find applications in optical data storage or in optical computing. (This first appeared in New Scientist, London, 17 December 1988, the weekly review of science and technology)

X-ray lithography to manufacture minute circuits

IBM's Research Division (Yorktown Heights, N.Y.) has developed X-ray lithography to make ultrasmall computer circuits, and thinks the process will replace ultraviolet and optical lithography processes. It has produced fully scaled NMOS circuits with 0.5 micron line widths. Key to the process is synchrotron radiation, which forms X-rays as a by-product of circulating electrons. X-ray wavelengths produce greater resolution compared to UV or optical lithography processes, and are less sensitive to surface contaminants. IBM hopes to produce 64 Mbit memory chips by the mid-1990s. (Extracted from Machine Design, 6 October 1988)

US start-up claims lead over Japan in RAMs

Inova Microelectronics, a four-year-old Californian start-up, is claiming to be leading the megabit static RAM market with a device that not even the Japanese can match for density.

Inova's megabit SRAM is being manufactured in Japan by Sharp because the US company does not have a factory of its own. Only Toshiba and Hitachi have announced megabit SRAMs and Inova reckons it is the only one to be shipping, in volume, for cash.

Inova has overcome the problems associated with getting to high-density SRAMs by making an enormous chip with redundancy. The die is so big that the I/O connections are all at the ends of the chip.

The chip has 5.5m transistors of which 4m are used to form the 1m cells that store 1m-bits of information. The other 1.5m are used as back-up redundancy for faulty cells.

Inova regards its single source of silicon for its SRAM as a limiting factor on its capability to expand. It says it is talking to a European house about a possible deal where foundry capacity is swapped for a second source. (Source: Electronics Weekly, 9 November 1988)

Fastest-ever DRAM set for world market

NMB Technologies, part of NMB Semiconductor of Japan, has begun sampling the industry's fastest 1 Mbit dynamic RAM.

The AAA1M200 series will come in 60 ns, 70 ns and 80 ns with cycle times as low as 100 ns. The best 1 Mbit dynamic RAM currently on the market is Toshiba's, which has access time of 70 ns.

NMB Semiconductor has been scrambling recently to respond to the strong demand for high-speed DRAMs. It converted a new fab meant for 1 Mbit DRAMs to expand production of its 256 Kbit line which includes the most difficult to get DRAM types - high-speed video DRAMs and high-speed by-four organizations.

Looking to the 4 Mbit generation, NMB has just started a strategic development programe with Ramtron based in Colorado Springs, which will use the latter's high-dielectric constant technology to make DRAMs simpler than the trench and stack cell techniques being pursued by everyone else.

NMB continues to focus on the higher-speed types of DRAMs, a strong trend being driven by emerging 32-bit microprocessors that have clock rates of 20 MHz and higher. Micron Technology, based in Boise, Idaho, recently reported its production of high-speed, video, and by-four types of 256 Kbit DRAMs is sold out for the next two years.

NMB reported it is making 3.5m high-speed 256 Kbit DRAMs each month, and will continue at this level through 1989. 1 Mbit chips are being ramped now in production, while a new module for 4 Mbit devices is scheduled to open in the early 1990s. (Source: Electronics Weekly, 9 November 1988)

Quantum physics theory in computer building

A computer built using quantum physics theories may represent the last generation in information processing technology, according to L. Gruenfeld of Touche Ross's Los Angeles, CA, office. Quantum theory states that quantum-state transitions occur instantaneously, so that the time between an electron going from one energy level to another is actually zero. The problem with using quantum theory for building computers is the inability to predict the behaviour of any given particle. Another problem is guarding against the erasure of data by sub-atomic particles in a quantum device. (Extracted from Computer World, 10 October 1988)

Josephson junction developed using microheater

Matsushita Electric Industrial (Japan) has developed a Josephson junction that uses a microheater to adjust its critical current. Josephson junctions, which are made by sandwiching a thin insulating film between superconductors, could be used in computers as high-speed switching devices. Until Matsushita's development, their lack of uniformity was a problem. The new device applies a small current to the heater, which produces an uneven temperature on the insulating film's surface. This causes the current to flow towards the film's coolest area - the area of superconductivity. This area becomes narrower as the heat is increased. Eventually, when the heat reaches a certain point, the Josephson effect is attained. (Extracted from Asian Wall Street Journal, 26 September 1988)

Word association ball game

In the US, the Defense Advanced Research Projects Agency is investing $30 million in neural computing. In Europe, the ESPRIT programme has funded an international research project in neural computing, known by the acronym ANNI. And, in Japan, the laboratories of Fujitsu, Hitachi and Toshiba have been busy building neural nets to control robots, recognize spoken words and read handwritten characters.

Neural nets are constructed from large numbers of simple units, which may initially be connected in haphazard ways. They are not programmed; instead they are trained. There are several kinds of network and various training procedures, but usually the effect of training is to strengthen some connections between units and weaken others. According to the most popular theory, this is how real nervous systems learn.

Such networks have the power of associative retrieval. A net trained to a particular pattern will recreate that pattern when exposed to an incomplete or distorted version of it. It can, therefore, recognize a new pattern as similar to one it has seen before. Each learned pattern becomes one of the network's stable states, into which it will settle if it is nudged in the right direction.

This makes neural networks promising as pattern recognizers, able to imitate some of the low-level signal processing that occurs in the early stages of human vision and hearing. They can recognize similar faces, or similar-sounding words, but it remains to be seen whether neural networks can progress to recognizing similar concepts, or similar social situations, without the spoon-feeding or predigested data that has characterized so much artificial intelligence research.

It is sometimes claimed that neural networks succeed by using fuzzy logic or something of the sort. But really what they do is neither fuzzy nor logic. "Fuzzy" suggests a technique which yields a less exact model of the world than regular logic, but if neural techniques are any good, they will build better models of the world. It is more helpful to point out that neural networks are good for solving problems which have no compact description, such as the recognition of an individual's face. Problems which can be exactly and succinctly described are usually better solved by programming.

Hypertext documents, too, are networks, with each chunk of information connected to other chunks by links which the user can follow at will. But one cannot equate hypertext nodes to units of neural storage. It is much more plausible to equate each node to a state of the whole brain. A path taken through the hyperdocument is associated with a sequence of brain states.

Hypertext, then, is a network model of mental behaviour, whereas neural nets are network models of brain structure. Systems analysts will be familiar with the difference between structural and behavioural descriptions. A data flow diagram charts a system's structure - its parts and their connections. A control flow chart or state transition or diagram records the system's behaviour - the possible sequences of states through which it may pass.

Structural and behavioural descriptions each have their uses. Usually it is easier to infer behaviour from structure than vice versa. Most machines and other artefacts - including good software - are built from separable parts with simple interactions, not because this is the only way to make them work, but because it is the only way to make them comprehensible. It also means we can devise a process for manufacturing the machine or program or whatever, by assembling it from smaller parts.

Translating the hypertext model directly into hardware would yield something rather like the semantic network machine proposed by Scott Fahlman in the 1970s. Each concept has its own little piece of silicon. Some neuroscientists have searched for this kind of organization in the brain, arguing that

somewhere there should be a "grandmother cell" - a cell which fires only when you see your grandmother.

The alternative theory is that there are no grandmother cells and concepts correspond to patterns of activation involving many cells. The difference between the theories is not as acute as it might seem. No one suggests that the grandmother cell can perform its recognition task unaided. Many other cells assist it. There must be some pattern of activation which causes the grandmmother cell to fire.

The main point at issue, therefore, is whether the firing of a grandmother cell is necessary before you can say "Hello, Gran" or engage in other appropriate behaviour. A slightly different version of this claim would be that the grandmother cell must fire before you can become consciously aware of your grandmother's presence.

In most of the experiments with electronic neural networks, there has been little evidence of these grandmother cells.

Instead, recognition is signalled when the whole network enters a particular pattern of activity. Storage is not on a one-cell, one concept basis. So hypertext ideas do not translate directly into neural network architectures.

What, then, do neural networks tell us about the way one mental state might lead to another, which is the idea guiding hypertext? The event which sparked the present wave of interest in neural computing was the publication in 1982 of a paper by John Hopfield of the California Institute of Technology.

Hopfield described a new kind of network with particularly amenable mathemetical properties.

One useful feature is that, for any state of a Hopfield net, there is a function analogous to energy in physics.

So that state space of a Hopfield net resembles a landscape, with hills representing high energy states and valleys representing stable states of low energy. The landscape is multidimensional, but no one seems to have come to much harm imagining it as an ordinary two-dimensional surface, with undulations in the third dimension.

To visualize how a Hopfield network seeks states of low energy, one can imagine a ball rolling over this landscape, in a generally downhill direction, until it comes to rest in a hollow. In such a landscape, low-lying basins might be identified with concepts, and long valleys as the associative paths that lead from one concept to another.

Branching valleys might be hierarchies of concepts, and mountain passes might represent remote associations which can only be made when the network is in a state of high energy.

Most of us know both the cool, disciplined, low-energy mode of thinking where only the most clearly-established links are pursued. We also know the high-energy brainstorming mode, where far-fetched, highly intuitive connections are explored; but if your intuitions are poor, you end up going nowhere. Both modes are part of the thinker's equipment. If the brain were a Hopfield network, it could move from brainstorming to disciplined thinking, simply by winding down its energy level.

The nodes-and-links model of hypertext, then, is perhaps only a simplified model of a much richer mental landscape. Maybe hypertext builders could capture more of that richness if they added an "energy" control: turn up the energy and more of the far-fetched links are offered to you. Turn it down and you tread the beaten paths: perhaps you abandon choice altogether and take the guided tour.

Constructing such a hyperdocument would be a challenge, if every link had to be created by hand - by programming, in other words.

Perhaps this is where neural networks will eventually serve the hypertext author. Instead of programming your hyperdocuments, you will train them. The far-fetched links will form automatically, if the author provides the basic ones.

Ultimately, hyperknowledge might be completely self-organizing, creating the entire nodes-and-links structure for itself, from input of some other kind. This would not necessarily be useful, since humans express themselves readily in the language of nodes and links. Nor would it be easy, for a self-organizing hypertext would be nothing more or less than a machine mind. Crack this one, and you have cracked artificial intelligence. (Source: Computing, 15 December 1988)

Specialized chip set for neural networks

Syntonic Systems (Portland, OR) has developed a specialized chip set for neural networks that can recognize patterns in real time. Unlike other companies that use computer software and digital hardware accelerators to simulate neural networks, Syntonic's approach is through chips that actually imitate the brain, even their need for "sleep". C. Tapang (Syntonic) designed the set using a modified version of the adaptive resonance theory (ART) and sleep-refreshed capacitive memories (SRCM), which store memory values on a capacitor as charges. Transconductance amplifiers make up the network's synapses, while a capacitor is linked to bias input. According to Tapang, after long periods of pattern recognition, the chips need sleep, which is achieved by disconnecting the environmental input. Tapang's design has been developed for a monolithic CMOS device that will be employed with 22 neurons known as clusters.

Meanwhile, Bell Communications Research (Bellcore) (Livingstone, NJ) is developing a computer chip that can be taught instead of programmed. While the "neural network" technology used in the chip is still in its infancy, the chip could yield "intelligent" computers that can be taught just as humans are taught. The chip, a VLSI (very large-scale integration) circuit, incorporates units that simulate structures that take place in the human brain. The chip "learned" an XOR function, a process which developers say may explain computer learning. (Extracted from Electrical Engineering Times, 10 October 1988 and Information World, 26 September 1988)

Prototype robots based on neural networks

Computer researchers have built prototype based on neural networks. A building block for

artificial intelligence, neural networks are a class of mathematical models that roughly mimic brain-like computing. For example, when used in a robot, the neural network is a computer system that is roughly modelled after the brain's web of neurons. M. Kuperstein of Neurogen is developing a robot driven by a neural network. According to Kuperstein, his robot will use a neural network analogous to memory maps that infants form in their brains as they learn hand eye co-ordination. Conventional robots move by processing large amounts of data to calculate distances and angles. Kuperstein is planning to match his robot in a game of ping-pong against a ping-pong playing robot built by American Telephone & Telegraph's Bell Laboratories in 1987. Conventional computer systems process precisely defined information at high speeds.

Neural networks can analyse "fuzzy" data, such as spoken words or fingerprints, and can learn by example. These abilities promise to further the research on artificial intelligence. Prototypes of systems to interpret radar signals, to determine credit ratings, diagnose diseases, compose music and to solve assembly line difficulties are already being tested. Neural networks can be implemented with programs that run in desktop computers. But many proposed applications of neural networks will need specialized neural network hardware because of the computing speed required. This hardware, which is related to the new parallel processors that use many small computers working in concert, may give birth to a multi-billion dollar market for new kinds of chips and computers. (Extracted from Wall Street Journal, 29 September 198[illegible])

Superconductivity theory

A comprehensive theory that accounts for all of the major aspects of superconductivity has been developed by scientists at the California Institute of Technology. The theory rules out the possibility that existing superconductors will ever be able to function at room temperature. However, researchers could eventually develop materials that would become superconductive at [illegible] F, higher than the temperature of dry ice ([illegible] F) and warmer than the [illegible] F required for the best known superconductors.

The researchers say that their magnon pairing mechanism theory calculates the superconducting temperatures for materials containing copper oxide, a compound found in all new superconductors. The theoretical results are in close agreement with actual experimental data. The theory predicts that compression in one direction would raise the temperature at which a substance becomes superconducting, while compression from another direction would lower it. Laboratory researchers are still far away from reaching the theoretical limiting temperature for copper oxide superconductors. The theory indicates that some form of a copper oxide compound would become superconductive at a temperature of 54.7°F. A superconductor that could be chilled by dry ice could be used in many applications and would be cheaper to operate than liquid nitrogen or liquid helium. However, it would still be more costly to operate than at room temperature which requires no refrigeration. (Extracted from New York Times News, 2[illegible] September 1988)

Superconductor layer theory builds up

Researchers studying superconductors based on either thallium or bismuth now better understand the relationship between the structures of the compounds and their superconducting transition temperatures (T_cs). Pradeep Haldar and his colleagues, at Northeastern University in Boston, predict that T_cs as high 180 K may eventually be obtained with these materials.

Thallium-based superconductors consist of compounds of thallium, calcium, barium, copper and oxygen. Their structures are like sandwiches with layers of copper and oxygen atoms separated by layers of thallium and oxygen atoms. The materials fall into two families in which one or two layers of thallium and oxygen separate the copper-oxygen layers. For a given number of copper-oxygen planes the T_c is higher when two thallium-oxygen layers separate the planes.

The scientists have made structures with only single thallium oxygen planes and up to four copper-oxygen planes and confirmed that, as the number of copper-oxygen planes increases, so does T_c, up to 122 K for the compound containing four copper-oxygen planes. They suggest that the variation of T_c depends on two things: the relative thickness of the thallium-oxygen and copper-oxygen layers, and the degree to which the thallium-oxygen layers contribute to the superconductivity, [illegible] thallium-oxygen planes [illegible] single plane.

[illegible] work by H. Ihara's group in Japan has shown that the addition of a fifth copper-oxygen plane leads to a slight drop in T_c, contradicting theories that suggested that T_c should simply increase with the number of copper-oxygen planes. According to Haldar, their new ideas are consistent with these measurements and predict a drop in T_c [illegible] of the effect of the thallium-oxygen planes. The researchers claim that by [illegible] the [illegible] copper-oxygen planes [illegible] thallium-bismuth [illegible] T_c [illegible] K [illegible] possible. (This [illegible] New Scientist [illegible] [illegible] 1988, the weekly review of science and technology)

[illegible]

Re[illegible] electrons in a superconductor [illegible] have undermined one of the [illegible] theories [illegible] high-temperature superconductivity occurs - the resonant valence bond theory. They found that the electrons involved in superconductivity in the compound $Bi_2CaSr_2Cu_2O_8$ are associated with oxygen atoms not copper as had previously been thought.

Ordinary electrical conduction in the high-temperature superconductors takes place when "holes" are able to move through the material. A hole is the absence of an electron and behaves just as an electron would if it had a positive, rather than a negative, electric charge.

Superconductivity takes place when the holes join together to form pairs, known as Cooper pairs. These Cooper pairs can move through the solid without any resistance. The pairing involves a subtle rearrangement of the most energetic electrons in the solid but there are many different theories which predict different mechanisms by which the pairing might occur.

According to Laura Greene, a physicist at Bellcore, in New Jersey, before scientists can fully understand what causes superconductivity they must

find out how many electrons are involved in the process, what energy they have and which atoms they come from.

Takashi Takahashi, of Tohoku University in Sendai, and his colleagues, claim that the most energetic electrons in the high temperature superconductor $Bi_2CaSr_2Cu_2O_8$ are associated with oxygen atoms. The energies of electrons in solids are restricted to limited ranges which physicists call bands. The electronic properties of solids depend on the highest energy band which contains electrons - in particular whether or not the band is full determines if the electrons or holes can move and therefore conduct electricity. The researchers have confirmed other work that indicates that the highest energy band in bismuth-based compound corresponds to one of the energy levels of oxygen, known as the 2p level.

Greene says that this discovery is "very bad" for the resonant valance bond theory which assumes that the electrons involved with superconductivity, are associated with the copper atoms. (This first appeared in New Scientist, London, 24 September 1988, the weekly review of science and technology)

Fujitsu develops 100 K critical temperature superconductor

Fujitsu Laboratories has developed a single crystal, bismuth type oxide compound thin-film superconductor that sports a 100 K critical temperature. Fujitsu researchers achieved the 100 K critical temperature by increasing the oxygen content ratio of an early, single-crystal thin film - a bismuth-strontium-calcium-copper ceramic compound fabricated via chemical vapour phase development. In a liquid helium environment (4.2 K), the critical current density was increased to 17,000 A cm^2. Meanwhile, Nippon Steel has developed a yttrium-type high-temperature superconductor ceramic plate that operates under a strong magnetic field. The yttrium type material features a 1,000 A cm^2 current flow without an applied electrical field. (Extracted from Electronic engineering Times, 19 September 1988)

New non-copper verified HTS

AT&T Bell Laboratories has announced the first [illegible] verified high temperature superconductor (HTSC). The new compound is barium potassium bismuth oxide. Like the copper-based compounds (cuprates), the new bismith based compounds (bismuthates) have a perovskite crystal structure. However, the bismuthate [illegible] electrical current efficiently in all directions, whereas the cuprates are efficient only in a specific direction. Still, the bismuthates retreat back to a 30 K T_c (the temperature at which zero electrical resistance is achieved). (Extracted from High Technology Business, October 1988)

Homogeneous [illegible]

Researchers at the Westinghouse [illegible] have developed a technique for producing superconducting yttrium barium copper oxide (YBCO) thin films that are uniformly superconducting throughout. This breakthrough is essential to the development of practical electronic devices using these new high temperature superconductors.

The researchers conducted a study to determine the cause of the tendency for oxide superconductors to degrade at the surface. They initially believed that this was due to the reaction of moisture and carbon dioxide with the exposed surface. However, they found from in situ electron spectroscopy for chemical analysis (ESCA) of surfaces and Auger electron spectroscopy (AES) compositional depth profiles, that there was an additional cause of non-superconducting film surface layers. They found that in amorphous as-deposited nearly stoichiometric films, the in situ thermal oxidation at 400-500°C prior to crystallization caused the barium (Ba) and, to a lesser extent, yttrium (Y) atoms to migrate to the surface: thus these elements became depleted of copper (Cu) atoms.

The researchers believe that this is due to an oxygen surface-charge-driven nonlinear diffusion process analogous to that observed in A15-structure intermetallics: atoms having a stronger affinity to oxygen migrate preferentially to the film surface to form oxides. They counteracted this diffusion process by depositing the films at the highest possible oxygen pressure, and increasing the annealing temperature relatively quickly to the maximum crystallization temperature. This process is referred to as the rapid ramp thermal process (RRTP). The researchers obtained nearly stoichiometric surfaces using this technique.

They coated these films with gold evaporated at room temperature without exposing them to atmosphere. They saw no significant surface segregation in the YBCO layer near the interface with Au. They then determined whether the YBCO surface was superconducting or highly resistive by measuring contact resistance and I-V characteristics of cross-strip junctions formed by depositing niobium (Nb) counterelectrodes. They measured the contact resistance at 4.2K to be $< 4 \times 10^{-6}$ Ωcm^2, lower than the limit of the apparatus sensitivity. Finally, they determined that the surface contact resistance was low enough for microelectronic applications, even if not necessarily zero.

In the past, superconducting films containing metals have required an anneal step. The team - as well as many others - are working on methods of depositing these films that do not require the anneal process. But at this time, the best films need this additional thermal treatment. (Reprinted with permission from Semiconductor International Magazine, September 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, IL. USA)

Sintered thallium based superconducting oxide

Sumitomo Metal Industries (Japan) has made a sample of sintered thallium-based superconducting oxide with 1,200+ A sq. cm critical current density at 77 K, the temperature of liquid nitrogen. Sumitomo said this is the highest level of current density for sintered thallic oxides, compared to the 500 A/sq. cm that formerly was considered the limit. Sumitomo developed a multi-step sintering technique in which a mixture of thallium, calcium, barium-copper oxygen and copper oxides is heated quickly and cooled gradually in the furnace in an environment of oxygen currents. Precision controlled sintering in which the material was sintered in four steps at 860° C, against the customary 880-900° C, allowed uniform organization of the mixture. More research will be carried out to make superconducting wire from the new material. (Extracted from Metalworking News, 10 October 1988)

Not-so-high temperature superconductors open up new avenues

American researchers have found two new families of high-temperature ceramic superconductors which, like previously known materials, contain planes of copper and oxygen atoms. The highest transition temperatures are close to 80 kelvin. This is well below the record of 125 K for thallium-based materials, so the practical application of the superconductors may be limited. However, both new families are superconducting for a range of compositions, and their discovery could help broaden scientists' understanding of high-temperature superconductivity.

One of the new families comes from the Lawrence Berkeley Laboratory in California. Donald Morris and his colleagues made the discovery when they worked on a compound found a year ago. This compound existed as a minor component of yttrium barium copper oxide containing one atom of yttrium, two of barium, three of copper, and about seven of oxygen - otherwise known as "1-2-3", after the ratios of yttrium, barium and copper. The scientists have called the new phase "1-2-4", after its composition, $YBa_2Cu_4O_8$.

Morris says that synthesis in high pressure oxygen makes the 1-2-4 phase more thermodynamically stable than the 1-2-3 phase. His group took advantage of this stability to make new superconductors by replacing yttrium with eight rare earths - neodymium, samarium, europium, gadolinium, dysprosium, holmium, erbium and thulium. Unlike materials with the 1-2-3 composition, the critical temperatures of those with a 1-2-4 structure increase as the size of the ion decreases.

The materials discovered by the group at Berkeley are unusual in containing uniform amounts of oxygen. In other ceramic superconductors, the amount can vary. Morris says the most important development may be the way in which the team made the new family of compounds because "the idea of 'highly oxygenated oxides' may provide a new avenue to discovering many new high temperature superconductors". The method also yields superconductors "in bulk". (This first appeard in New Scientist, London, 24-31 December 1988, the weekly review of science and technology.)

New superconductor class discovered

A new class of layered copper oxides that superconduct near 70 K has been discovered independently by two research teams at AT&T Bell Laboratories and Du Pont. The new materials have the general formula $Pb_2Sr_2LnCu_3O_{8-x}$, where Ln is either yttrium, a lanthanide, or a mixture of one of these with strontium or calcium. The unusual structural feature of this new class is a layer of copper atoms sandwiched between two lead oxide layers. The copper atoms, which are monovalent, lower the average oxidation state of copper in these compounds to below 2. In other superconducting copper oxides, the average oxidation state of copper is between 2 and 3. The lead oxide layers electronically screen the monovalent coppers from the conventional copper oxygen planes that probably carry the current in these new superconductors. Robert J. Cava, Bertram Batlogg, and colleagues at Bell Laboratories published their findings, while Mas Subramanian and colleagues at Du Pont have submitted their manuscript for publication. (Source: Chemical & Engineering News, 21 November 1988)

Safer superconductors

Scientists in the US have made new, high-temperature superconductors that could lead to the development of materials much less toxic than the best superconductors developed to date. The new materials have superconducting transition temperatures up to 122 kelvin (-151°C), almost as high as any reached so far.

The materials are similar to those discoverd in the US last year. They are made from mixtures of thallium, barium, calcium, copper and oxygen. In the new compounds, lead replaces part of the thallium and strontium replaces all of the barium.

Although the original thallium-based materials had record transition temperatures, their main drawback was that thallium is extremely toxic. The original thallium based superconductors have structures like sandwiches, with layers of copper and oxygen atoms separated by layers of thallium and oxygen atoms, interwoven with calcium and barium, or strontium.

Scientists believe that as the layers of copper and oxygen are squeezed closer together, the superconducting transition temperature will increase, possibly to as high as 180 kelvin. (This first appeard in New Scientist, London, 29 October 1988, the weekly review of science and technology)

Faster switching with slimmed-down transistors

Two teams of American researchers have set fresh records in the world of electronics with transistors that switch on and off very fast. Scientists at the Hughes Research Laboratories in Malibu, California, have made a field effect transistor (FET) that can switch on and off 200 times a second. Four researchers at AT&T's Bell Laboratories in New Jersey have made bipolar transistors that switch on and off 140 billion times per second. Both records are many times higher than the best commercial devices.

The two groups presented their work at the International Electron Devices Meeting in San Francisco. Both worked with indium gallium arsenide. Electrons travel about five times faster in InGaAs than in silicon, which forms the basis of today's integrated circuits.

The speed of a transistor depends on the time it takes for electrons to cross between its terminals. In FETs, the electrons travel parallel to the surface of the transistor. The new FET from the Hughes Laboratories is only 100 nanometres wide, which the scientists claim is the smallest width that has ever been achieved for this type of transistor.

In all types of transistor the speeds are reduced as soon as the device is used in a commercial product. This is because of difficulties in transferring signals between the devices, which limits the best integrated circuits to between 10 and 20 per cent of the speed of isolated devices.

The speed record for silicon is 75 billion switches a second. The fastest commercial circuits can switch at only a little over 10 billion times a second. (This first appeard in New Scientist, London, 24-31 December 1988, the weekly review of science and technology.)

Polyacetylene-based transistor

Researchers at Cambridge University have developed the first practical transistor using an organic compound. This development could mark the beginning of the end for electronic components made from inorganic compounds such as silicon and germanium, and lead to the development of components hundreds of times smaller than those components presently used on integrated circuits.

Richard Friend and colleagues used some cunning chemical techniques, recently developed at Durham University, to make a metal on silicon field effect transistor (MISFET) and diodes whose active element is the polymer polyactylene. Friend believes that polyacetylene is the most promising material to date as a replacement for inorganic semiconductors. His devices perform 1,000 times better than previous attempts to make components from organic compounds, but they are still some way off replacing conventional semiconductor devices.

Although the polyacetylene devices behave in the same way as existing electronic components, the physics that goes on inside the material is different. In particular, the optical properties of polyacetylene change once it starts operating in an electronic device. This feature of the new material may mean that it could eventually be used in optical systems and lead to the development of devices that form the heart of computers and telephone switching systems that work entirely on light.

Friend believes that the link between polyacetylene's optical and electronic properties will enable him to gain a much greater insight into how the material works and so develop even more efficient devices. (Extracted from New Scientist, London, 15 September 1988, the weekly review of science and technology.)

New type of solar cell developed

A new type of solar cell shows promise for generating electricity and producing chemicals, according to H. Ti Tien and colleagues of Michigan State University. Solid-state solar cells are expensive because they use highly purified single crystals. Semiconducting polycrystallites in photoelectrochemical cells (PECs) offer a less expensive alternative. A conventional PEC consists of a photoelectrode made of semiconducting material, a counterelectrode and electrolyte in a single compartment. Tien's approach, modelled on photosynthesis, overcomes the single-compartment's drawback of precluding the separation of light-generated products.

The new design, which mimics the natural process, uses artificial pigmented bilayer lipid membranes. It consists of a semiconductor septum electrode (e.g. an n-type polycrystalline cadmium selenide deposited on nickel) to separate two aqueous solutions in separate compartments. Electrical contact is provided by metal electrodes immersed in the two electrolytes. Illumination of the septum induces electron and hole separation within the semiconductor depletion layer. Electrons migrate through the bulk of the semiconductor to the metal, where they are available for reduction at the unilluminated metal/electrolyte interface. The electric field in the space charge region (depletion layer) allows the holes to move to the opposite side for oxidation at the illuminated septum/electrolyte interface. The contacting electrodes complete the circuit. (Extracted from Chemical & Engineering News, 3 October 1988)

The British build world's tiniest hybrids

Scientists at the Royal Signals and Radar Establishment in the United Kingdom have built a tiny hybrid integrated circuit measuring just 15 mm by 20 mm. "We believe it is the smallest (hybrid circuit) in the world," says John Bailey, project director for Research Initiative into Silicon Hybrids (RISH).

The miniature hybrid circuit consists of a silicon substrate containing aluminium interconnects, flip-chip transistors and polyimide dielectric. It functions as a military bus interface.

RISH is investigating the technologies required to produce multichip molecules using silicon as a substrate. Metalizations for these chips use aluminium and copper. Multiple layers of polyimide provide thick dielectric layers between levels of metalization. Project engineers use reactive ion etching to form via holes.

A main advantage of the silicon hybrid substrate is its compatibility of thermal expansion with the flip-chip silicon circuits and transistors that are applied to it. One thrust of the RISH project is to develop low inductance interconnections between the chip and its substrate. The flip-chip process uses controlled collapse solder bumps and thermocompression bonding, but project engineers are also exploring tape automated bonding for attaching chips to the silicon substrate.

A potential drawback of the flip-chips on a silicon substrate is that reworking the hybrids will probably be difficult. So pretesting both chip and substrate is considered essential. (Reprinted with permission from Semiconductor International Magazine, August 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, IL, USA)

VLSI manufacturing: the basic steps

VLSI chips are made by a complex series of perhaps 100 or more steps, several of them repeated many times. The steps build transistor parts (sources, drains and channels for CMOS circuits; emitters, bases and collectors for bipolar circuits) and other circuit elements into the silicon substrate. They also create insulating layers and metallized paths atop the silicon substrate. Simulation helps "tune" these steps.

Thermal oxidation: usually the first step, in which a layer of silicon dioxide grows on the silicon substrate as hot gas (at about 1,000° C) flows over it; later, the silicon dioxide will shield selected areas of the silicon surface from penetration by dopants. Critical parameters: temperature, time, gas flow rate. Simulation output: oxide thickness and topography.

Lithography: open areas are established in the silicon dioxide so that dopants can enter the silicon substrate to form n-type and p-type regions for transistor parts; the silicon dioxide layer is coated with a photoresist, a material that resists chemical attack after it has been exposed to light;

light is projected onto the photoresist through a mask containing the pattern of open areas; the exposed areas of the photoresist form an etch-resistant layer on the substrate. Critical parameters: thickness and composition of photoresist, distance between mask and photoresist, intensity of light. Simulation output: photoresist pattern and cross section.

Etching: a plasma of reactive gas removes exposed photoresist and the oxide below it, opening portions of the silicon surface. Critical parameters: plasma composition, voltage (plasma energy), temperature, time. Simulation output: patterns and cross section of layers.

Ion implantation: high-energy ions of dopant elements (impurities) fired at the silicon substrate penetrate the open areas on the silicon surface: the boron ions form n-type regions and phosphorus ions p-type regions; where the oxide and photoresist layers remain, the ions are absorbed before they enter the silicon. Critical parameters: current (ion dose) and voltage (ion energy). Simulation output: impurity concentration profile.

Thermal redistribution: heating the substrate in a furnace drives the ion-implanted dopants further into the silicon. Critical parameters: temperature, time. Simulation output: impurity concentration profiles, displayed as two orthoganal cross-sections that produce in effect a three-dimensional view.

Insulation: silicon dioxide deposited on the substrate insulates the underlying structure electrically; unlike the oxide grown just before lithography, the insulating oxide forms at a relatively low temperature to minimize further redistribution of dopants. Critical parameters: flow rate of gas, temperature, time. Simulation output: cross-section of oxide.

Metallization: a thin film of metal is sputtered on the oxide insulation and etched photolithographically into a pattern of electrical connections among the components, contacting them through windows in the oxide layer. Critical parameters: concentrations of metals in sputtering source, geometrical relationship between source and wafer. Simulation output: metal topography.

These steps are repeated in various combinations until all components are deposited in the silicon substrate and all insulating and connecting layers are built up on it. For example, oxidation, lithography, ion implantation and thermal redistribution may be repeated in sequence three times to create an n region in a p region in an n region (a vertical npn transistor). An insulation and metallization may be repeated two or more times to build up multilayer connections. (Source: IEEE Spectrum, October 1988)

Electroconductive ink developed

PrinTron (Mountainside, NJ) has developed an electroconductive ink for use in circuit boards. According to the company, the ink can be laid down in lines on the board, which is then irradiated and cured, producing the electricity-conducting capacity now obtained by using copper wires. According to PrinTron, a commercial product is about 18 months away. The technology is reportedly less expensive and quicker than the current technology. The copper wire process requires the use of toxic chemicals, which then creates toxic waste. Preliminary applications for the process will be simple, such as creating boards used for automobiles or appliances. (Extracted from Wall Stret Journal, 28 September 1988)

Feeling the heat with gallium arsenide

Physicists at AT&T's Bell Laboratories in the US have produced the world's first infrared detector made from gallium arsenide. Their breakthrough should lead to a range of new imaging devices.

The new detector, which will pick up radiation with wavelengths of around 10 micrometres (millionths of a metre) in the infrared spectrum, could benefit medicine and exploration in space, and could have applications on production lines in factories, says Barry Levine, one of its inventors.

Most infrared detectors now in use are made of mercury cadmium telluride, a material that is hard to work with and which performs best at short wavelengths.

"The 10-micrometre region is where objects at room temperature emit the most radiation," says Levine, "and that makes it perfect for medical uses such as blood-flow monitors and whole-body imagers. It will also be useful in electronics factories, for testing integrated circuits. If a single chip in a circuit is running particularly hot, it could be caught, and pulled off the board, rather than waiting until it causes the circuit to fail."

Radiation at this wavelength can also travel many kilometres through the atmosphere, Levine points out, which makes the new detector ideal for use in spy satellites, infrared mapping from space, and for scanning houses or factories that waste heat.

The process that the laboratories have developed builds "quantum wells", less than 50 angstroms (about 25 layers of atoms) deep, with a layering technique known as molecular beam epitaxy. The wells, made of gallium arsenide, are built up on substrates of the same material and are 40 angstroms wide.

Each well is surrounded by a barrier of aluminium gallium arsenide that measures 300 angstroms across. Silicon, added to the wells, creates an excess of electrons in the material.

When a photon with a wavelength of 10 micrometres enters one of the wells, it excites an electron at the bottom, so that the electron is kicked out of the well. Once free, the electron is pulled by an electric field towards a counter, which registers it. By varying the precise dimensions of the wells, as well as the amount of silicon in the gallium arsenide, the detector can be made sensitive to photons with precise energies, within the range of wavelengths between 8 and 12 micrometres. (This first appeard in New Scientist, London, 29 September 1988, the weekly review of science and technology)

Portable computers go on the tube

Owners of portable computers struggling to see what is displayed on a liquid-crystal screen can now connect their computer to a domestic television. Lindy Electronics of Cleveland, in Britain, charges pounds sterling 60 for an interface with a plug at

one end to fit the monitor socket on the computer, and a plug at the other end that connects with the television socket, known as Euroconnector, Peritel or Scart. This socket is now standard on most new television sets sold in Europe.

There is much more to connecting a portable computer to a television set than physically wiring the plugs to match. The electronic signal from the computer must match the circuitry in the television set.

European televisions display 50 pictures a second, with the horizontal picture lines scanned at a frequency of 15.625 kilohertz. The standard used on computers, however, was set by IBM in the US, and is based on the North American standard for televisions, which displays 60 pictures every second, and scans at 15.75 kilohertz.

The output to the screen from a portable computer is made up of six separate signals: red; green; blue; overall intensity; pulses for synchronizing each picture and pulses for synchronizing each line. All of these signals are in digital code at a level of 5 volts. A television set uses four signals: red, green and blue and a composite of synchronization pulses. All of these are analogue and emerge at 1 volt. The interface changes the signal voltage. It also fools the television into thinking it is getting a line synchronizaton signal at 15.625 kilohertz. (This first appeard in New Scientist, London, 29 September 1988, the weekly review of science and technology)

Optical floppy packs more data

An American developer of magnetic discs for computers has found a way to use optical technology to increase the storage capacity on conventional magnetic discs. Jim Adkisson, president of Insite Peripherals in Santa Clara, California, has built tracks onto a standard 3.5-inch magnetic floppy disc which let an optical reading device find its place on the disc.

It has always been possible, in theory, to cram more information onto a magnetic disc, but it has proved difficult to read it correctly. By combining magnetic and optical technology, the new "floptical" disc allows the capacity to be increased to 20 million bytes from the standard 0.8 to 2 million bytes.

The ability to store large amounts of data has become increasingly important with the rapid growth in the size of computer programs and the amount as stored data on personal computers. Hard discs, which store 20 million bytes or more, are virtually standard on new models, but such discs cannot be removed from their drives. Standard floppy discs, which can be swopped between machines, hold much less data.

Adkisson, who is one of several inventors around the world who claim to have helped to develop the original 5.25-inch floppy disc more than 10 years ago, chose the hybrid optical-magnetic approach to produce the cheapest possible discs. His system uses lasers to modify standard 2-megabyte discs by cutting a hole in the metal "slider" on the outside of the disc. The laser etches concentric grooves, 20 micrometres apart, on one side of the disc. These grooves act as reference points for the optical system which guides the magnetic read/write head.

The optical tracking system uses cheap components, including an infrared light-emitting diode; mass-produced plastic optical components and the same type of detector as that used in compact disc players. (This first appeard in New Scientist, London, 22 September 1988, the weekly review of science and technology)

Optical memory effect seen in fast ion conductor

Researchers have discovered that single crystals of sodium β''-alumina that have been doped with copper(I) ions display a type of optical memory. Doped crystals of this fast ion conductor luminesce with a green light. When a spot on the crystal is irradiated with an argon ion laser as the crystal is cooled to 10 K, the intensity of the green emission from the spot increases. The spot can be detected later by its brighter emission, indicating that the sample "remembers" where the laser was focused. This constitutes the write read operation, observes Gary J. Hollingsworth, a graduate student working with chemistry professor Jeffrey I. Zink and two other co-workers at the University of California, Los Angeles. Warming the sample to room temperature and cooling it again in the dark causes the spot's emission to be erased. The UCLA workers attribute the green emission and its dependence on irradiation to pairs of Cu^{+} ions. At room temperature, the copper ions hop around frenetically from site to site in the host lattice, sometimes binding to form dimers. "If the sample is irradiated while it is cooled, the dimers that form remain together and are trapped as the temperature is lowered," the researchers explain. "This results in a higher concentration of dimers within the irradiated area," and hence a stronger emission. (Source: Chemical & Engineering News, 10 October 1988)

Memories are made of molecules

A Californian physicist has challenged organic chemists to synthesize new types of polymers for constructing electronic memory circuits. The memories will use chemical and biological processes to store and transmit information. John Hopfield, of the California Institute of Technology in Pasadena, and AT&T Bell Laboratories in New Jersey, has drawn up a blueprint for a chemical memory which he says organic chemists can design.

The idea of a chemical computer using such a memory was first put forward by Forrest Carter, of the Naval Research Laboratories in Washington. He suggests that a computer which used chemical and biological processes - a "super molecular information processor" as he called it - was not only possible but would be smaller and faster than electronic computers.

Chemical reactions involve the transfer of electrons at a molecular level, so a "molecular chip" could conceivably hold thousands more transistors than is currently possible.

Molecular electronic components could eventually be more versatile and powerful than present-day integrated circuits. Some of the fastest and most difficult problems of recognition are solved, for example, by antibodies, which can distinguish between friendly and malign molecules. However, no one has put forward specific plans for molecular electronic components, so some people doubt whether such components are possible.

Hopfield and his colleagues have proposed a design for a molecular "shift register" memory made from a polymer.

A shift register is a type of memory used in a computer. The memory can be thought of as a series of boxes connected in a line. Each box stores one bit of information. During each cycle of the calculations in an integrated circuit, each bit is moved to the next box in the line. The first box receives a new bit of information and the information in the last box goes to another circuit.

Hopfield suggests that this process can be duplicated by electrons hopping along a polymer. Under Hopfield's scheme, the polymer would be connected at each end to electrodes which would introduce and remove electrons from the polymer. If the "in-electrode" is at a high voltage, an electron is introduced, corresponding to a "1" in the first box. If it is at a low voltage, then no electron is introduced, corresponding to a "0". A series of 1s and 0s could be sent into the polymer memory by rapidly changing the potential of the electrode.

A pulse of light shifts electrons along the polymer. The light corresponds to a clock cycle in an electronic circuit. During each pulse, electrons in each box are promoted to higher energy levels. Once the pulse is over, the electrons decay to their original energy levels and end up in the next box.

Existing polymers cannot be used in shift registers because electrons cannot be guaranteed to decay into the next box. Instead they decay back into their original box or even hop to the box behind them in the line. If a polymer were to behave like this in a shift register, information sent through it would become garbled.

Hopfield has set down the requirements for a "designer polymer" that reliably sends information in one direction. Under certain conditions electrons jump to lower energy levels in many short jumps rather than all in one go. Electrons can, therefore, be made to jump towards the end of the line by introducing groups with steadily lower energy states. The effect is almost like a stepladder which leads the electron gently down into the next repeat unit in the line. Hopfield suggests three molecular units which he calls, a, , y. He suggests a system consisting of 5,000 parallel chains, each having the same stored information. Information will therefore be transmitted even if some of the chains are faulty. The total current from 5,000 electrons emerging at the other end of the chain should be sufficient to power an electronic transistor so the signal will not need to be amplified.

He has calculated that the energy to transmit one bit of information using this technique could be as little as 2×10^{-19} joules one millionth of the energy used to transmit one bit of information in electronic shift registers. A computer using chemical components would use much less electricity than an electronic computer. Hopfield does not imagine that this component will eventually be used in a computer. He sees it as a step towards molecular components. (This first appeard in New Scientist, London, 25 August 1988, the weekly review of science and technology.)

Polymers for optical computers

University of California (Santa Barbara) researchers have been provided with $1.2 million by the US National Science Foundation to develop polymers with "interesting electrical and optical properties". Those materials will be "chain-aligned" versions of other polymers in which the polymer chains twist and tangle together. One goal is to find polymers with optical properties that change upon exposure to light, making them useful for optical computers. The university is also trying to increase electrical conductivity in polymers. (Source: Chemical Week, 9 November 1988)

Optical chips emerge

The arrival of a whole new era of technology, the optical microchip, "has the traditions of British industry was so low key that even most of the technical press missed it. Pilkington Electro-Optic Materials, Scotland, announced "the availability of a new lithium niobate waveguide substrate in the form of a three-inch diameter crystal in 'X' orientation, adding almost as an afterthought, that it is the only European supplier. Lithium niobate - or LiNbO, to give its chemical nomenclature - is a glass-like and highly transparent crystal that by the year 2000 will form the basis of an international industry as important as today's silicon chip business. Lithium niobate can be engineered to provide minute paths along which laser light beams can be guided and made to interact much faster, and in the long term, much more cheaply, than silicon. One of the first integrated optical switches to become commercially available illustrates the potential importance of the material. Pressey has an optical switch which will connect any one of eight circuits to any of eight others. It is made by implanting in subminiature optical waveguides into a small piece of lithium niobate measuring 4 mm by 9 mm by 1 mm thick. Each path through the switch is able to carry the equivalent of 565,000 simultaneous telephone conversations and the paths can be switched in less than 1 billionth of a second (Source: Sunday Times, 11 July 1988)

Germanium chip processes data better than silicon chip

Hughes Aircraft has discovered that a germanium chip can process data collected by infrared sensors better than its silicon counterparts. Hughes' chip has the first field effect transistor built from germanium junctions, according to officials from Hughes' Electro-Optical & Data Systems Group (El Segundo, CA). The radiation-tolerent germanium chips will be used in space based signal processing applications like the infrared focal plane arrays that the Strategic Defense Initiative will use to monitor in-flight ballistic missiles outside the Earth's atmosphere. (Extracted from Electronics, September 1988)

Electronic etching makes an entire encyclopaedia dance on a pinhead

Researchers at the University of Liverpool have shown that it is possible to write the entire contents of the Encyclopedia Britannica on the head of a pin. They have already copied one page at the necessary scale with a scanning transmission electron microscope. The instrument writes with an electron beam that has a diameter of 0.5 nanometres about twice the diameter of an atom.

Colin Humphreys professor of materials science at the university, says that the microscope can also analyse superconducting materials. It causes the emission of X rays at the boundaries between layers

of crystals in the superconductor. These X-rays indicate the purity of the boundary and whether there is a build-up of elements that disrupt the uniformity of the superconductor.

Humphreys is working closely with ICI on a ceramic superconductor composed of yttrium-barium-copper oxide. The company has already developed a superconducting wire several metres long with the help of the microscope's analytical techniques. As a result, the company has increased the amount of current its superconducting wire can carry to about 1,500 amperes per square centimetre.

Two British companies, VG Microscopes and Link Analytical, built the instrument which they delivered in March 1988. Humphreys said that the secret of the machine is in its computer technology, which allows precise control over the electron beam.

The annual report of the Science and Engineering Research Council says: "Using this instrument, it is possible to write one million lines side by side in the width of a pencil line, or to drill one million million holes on the head of a pin. The precision would be comparable to sitting in a geostationary satellite 100 miles above the Earth's surface and trying to paint the window frame of a doll's house on the surface of the Earth using a single-bristle paint brush with a handle one hundred miles long."

Researchers do not yet fully understand how the electron beam can drill holes in certain materials. It seems that in some compounds the beam causes a hole to form from the centre of the material out. In others, the hole forms on both surfaces and meets in the middle. (This first appeared in New Scientist, London, 17 December 1988, the weekly review of science and technology.)

Packing the pits to store more data

Nimbus Records, of Monmouth, has succeeded in doubling the storage capacity of a 12-centimetre compact disc. It has packed the pits on the disc, which contain information, more closely together. The company is confident that it can double the disc's capacity again - to let one CD store four times as much data as is possible at the moment. This means that an ordinary CD could store 2.4 gigabytes of information.

Nimbus stresses that the new disc format, to be called CD4X, is not intended as a replacement for conventional music CDs. It will store computer data and a mixture of pictures and sound. Commercial exploitation of the quadruple-density disc will also have to wait for cheap, solid-state lasers which emit blue light, at a shorter wavelength than that used in today's CD players. These will be necessary to read the more closely-packed pits.

The disclosure by Nimbus comes shortly after an announcement by Philips and Sony, co-inventors of the CD system, and Microsoft, the computer software company, that they have agreed on an extended format for CD-ROM, called XA. This format, says Philips, will eventually let a 12-centimetre CD store moving video pictures in compressed digital code.

Taken together, the two announcements suggest that the new CD video format, CDV, has only a limited life. CDV stores at most six minutes of video on a 12-centimetre disc. The sound is digital, but the pictures are analogue. The announcements by Philips and Nimbus mean that the electronics industry's dream of an hour of video on a 12-centimetre disc now looks feasible. An all-digital video disc would also offer a major advantage over the analogue CDV. One type of digital video disc would work in any country. When analogue signals are recorded, two types of video disc must be made, to cope with the different TV standards used in different countries. (This first appeard in New Scientist, London, 8 October 198-, the weekly review of science and technology.)

III. MARKET TRENDS AND COMPANY NEWS

Market trends

Electronics industry forecast

The electronics industry will see a downturn in semiconductors beginning in 1989 and becoming apparent in 1990, according to Dataquest (San Jose, CA), a market research firm. But strong demand in telecommunications, computing and possibly consumer electronics will ensure that the effect will not be as devastating as the 1985 downturn. Dataquest analyst G. Madden notes that venture capitalists should seek opportunities in promising fields such as telecommunications, where Integrated Services Digital Network, fibre optics and network management services are expected to grow steadily. In semiconductors, digital signal processing, new packaging technologies, IC manufacturing equipment and integrated data processing will grow.

Meanwhile, the high-definition TV market should grow to $26 billion/year by the year 2000, according to Dataquest's Japan analyst S. Tatsuno. Likewise analyst M. Boss predicts that the world-wide smart power IC market will grow to $1.13 billion by 1992, as against $480 million in 1989. The US market for programmable logic devices will hit $1.4 billion in 1992, as against $700 million in 1988, due to customer demand for enhanced speed. Digital signal processing will grow to $1.9 billion by 1992, as against $450 million in 1988, with demand for new communications equipment driving the market. Although semiconductors are susceptible to four-year cycles, marked by recurring market collapses, the 1989-1990 downturn will not be catastrophic, but will be comparable to the $49 billion semiconductor market in 1988. (Extracted from Electronic Engineering Times, 12 September 1988)

Uses for superconducting materials

Superconducting materials will likely find highly specialized electronics applications, not the wide range of uses ranging from power transmission to magnetic levitation trains once touted for the materials. The more modest predictions that superconductors will be used in microelectronics are based partly on the success at making superconducting films and the difficulty in making superconducting wire. Within the next three to five years superconductors might be used in sensors to monitor the Earth's magnetic field or brain waves. They might be used in sensitive antennas and in wiring for computers. (Extracted from New York Times News, 25 October 1988)

Development of reversible optical media

Chemists and chemical engineers may be most likely to develop erasable (reversible) optical media for data storage and retrieval. Although

read only and write once optical disks are available, disks with read write erase rewrite capabilities are needed. S. I. Abbott of ICI Electronics (UK) claims that optical media are capable of high storage capacity, since lasers can inscribe one micrometre data tracks separated by one micrometre distances. Unlike magnetic hard disks, optical media can be protected from the environment without becoming a permanent part of the drive device. Abbott said that "digital paper" or flexible sheet forms can be used to store large amounts of data in medical imaging, satellite data processing and geological surveying applications. The data could be stored on media such as tape, disks, cylinder or tags. ICI's digital paper consists of a polyester film backing coated with a light-reflecting, metallic film, a laser-imageable plastic film and a protective top layer.

Researchers at the University of California (Berkeley) have developed an alternative to magnetizable films of rare earth transition metal alloys. The new polymeric films are made of liquid crystalline 4-ethoxybenzylidene-4'-butylaniline mixed with poly(methyl methacrylate). The two materials are normally immiscible, but become miscible above a critical temperature. Recording and erasure of data depend on the light-scattering properties of glassy and phase separated domains. Photochromic changes in polystyrene resins containing dithienylethylene units could be used to store and read data, according to M. Irie of Osaka University (Japan). (Extracted from Chemical and Engineering News, 17 October 1988)

Forecast for small office home equipment

Annual sales of image products to small business/home offices are expected to continue steady growth through the end of the decade, with an exploding market for facsimile equipment overshadowing minimal or no growth in copiers and electronic typewriters.

A study by CAP International pegs 1987 total small office equipment sales at $3.7 billion and projects 13 per cent annual growth to $5.3 billion in 1990. Without small business' insatiable appetite for FAX, overall growth would be nearly flat.

A combination of factors - declining prices, despite the strong yen; aggressive promotion by manufacturers; and effective product distribution - will fuel 78.4 per cent annual growth in facsimile shipments to $1.6 billion in 1990 from $280 million last year. CAP predicts that home offices over the next 12 months will develop the same hearty appetite for FAXes. Comprising only 7.6 per cent of the total market last year, FAX equipment will account for nearly 30 per cent of sales in 1990.

Copiers should grow at 2.9 per cent annually through 1990, to $2.3 billion, from $2.1 billion last year. As a percentage of total volume, copiers will decline to 43.5 per cent from 57.5 per cent. Heavy competition at the low end, with Panasonic, Ricoh and Xerox challenging the long time domain of Canon, could spur sales in home offices, where copier penetration to date is light.

Electronic typewriter shipments are seen falling 10.9 per cent annually, but personal word processors will pick up the slack with 26.7 per cent annual growth. Overall, this segment will decline 3.2 per cent annually over the three years, according to CAP. Personal word processor sales are strong among small offices that require advanced capabilities such as mail merge, but are not ready for pcs or printers.

Finally, pc printer sales are predicted to grow at a 6.3 per cent annual clip through 1990, driven largely by the requirement to produce documents in lieu of data printouts. The introduction of high-quality 24-pin printers and advances in ink-jet technology should offset the impact of recent price hikes, says CAP. (Reprinted with permission of DATAMATION ® magazine ©, 1 October 1988, copyright by Technical Publishing Company, A Dun and Bradstreet Company - all rights reserved.)

CASE prospects

The case for CASE is evidently getting stronger. The latest distributed systems industry research report from Boston's Yankee Group estimates that by the end of 1987 4 per cent of 580,000 MIS professionals and 6 per cent of the professionals in the integrator, engineering and defense fields were using computer-aided software design. Usage is forecast to hit 26 per cent across the board by 1992.

According to CASE Consulting Group, Portland, Ore., there are over 150 companies competing in the broadly defined CASE market. Of these, 70 are "classic" front end CASE vendors, representing $120 million in sales in 1987. The exponential growth predicted by analysts translates to a market turnover of $500 million by 1992.

The drive for higher software quality and productivity has been a boost to the CASE market, and the outlines of a distinct CASE industry are now appearing. CASE Consulting, in its newsletter CASE Outlook, has itemized what it sees as the signposts of the transition from fledgling product to established niche (not in order of importance):

- Increased attention in the trade and business press;
- Industry fragmentation;
- Market boundary expansion;
- Greater presence of major computer manufacturers;
- Entry of traditional software tool and DBMS vendors;
- Entry of major application software original equipment manufacturers;
- Entry of established design automation vendors;
- Acquisitions of, and by, CASE companies;
- The first IPO by a CASE vendor (Index Technology);
- Increased CASE related standards activity;
- Strategic alliances; and
- Greater emphasis on product differentiation and support.

Of these factors, perhaps the most convincing would be the presence of major computer makers. The heavy tread of IBM tends to legitimize any market it steps into, and CASE will be no exception. IBM's

new Workstation Aided Software Engineering product customizes Professional Work Manager version 2.0, allowing programmers to access a variety of tools to support the applications development process. WASE (as it is called), which runs on the IBM AT, PS/2 Models 30, 40, 60 and 80, and the IBM 3270 AT, costs $350. (Reprinted with permission of DATAMATION [r] magazine [c], 1 October 1988, copyright by Technical Publishing Company, A Dunn and Bradstreet Company - all rights reserved.)

PC growth cooling off

US users are putting the brakes on pc purchases. The latest DATAMATION Cower & Co. survey of mini and micro users forecasts a 5 per cent drop in pc shipments and a modest 10 per cent rise in pc revenues in 1989, versus 21 per cent unit and 23 per cent revenue growth last year. A west coast brokerage firm also has just scaled back its pc projections for 1989 to 5 per cent growth, from a reported double-digit growth rate. Analysts speculate that users are holding off new pc purchases until they get their existing pcs networked and until they see whether there are enough OS/2 applications to justify new hardware investments. (Reprinted with permission of DATAMATION [r] magazine [c], 15 October 1988, copyright by Technical Publishing Company, A Dunn and Bradstreet Company - all rights reserved.)

'88 Top Ten: Intel up, National out

In 1988, the top five semiconductor manufacturers are expected to be the same as the top five for 1987. This is according to a top 10 forecast (Table 1) issued by Integrated Circuit Engineering Corp. (ICE), Scottsdale, Arizona.

For 1988, ICE forecasts that Intel will continue its ascent up to the top 10 chart, with a growth rate better than all other top 10 manufacturers. But National Semiconductor will not make the 1988 top 10 rankings, dropping to eleventh.

In 1987, both National Semiconductor and Intel were added to the listing after being absent from the top 10 in 1986, explains Bill McClean of ICE. National's acquisition of Fairchild in 1987 vaulted it into the seventh spot in the 1987 listing. Intel, spurred by a tremendous increase in microprocessor sales, rose from being ranked twelfth in 1986 to eighth in 1987.

ICE's 1988 top 10 list has six Japanese, three US and one European semiconductor manufacturer.

Table 1. ICE 1988 forecast of worldwide top ten merchant semiconductor manufacturers

Forecasted 1988 rank	1987 rank	Company	Forecasted 1988 sales ($M)	1988/1987 percent change
1	1	NEC	4 175	30
2	2	Toshiba	3 675	23
3	3	Hitachi	3 325	32
4	4	Motorola	2 950	24
5	5	TI	2 675	24
6	8	Intel	2 375	50
7	10	Fujitsu	2 025	47
8	6	Philips	2 010	25
9	11	Mitsubishi	1 900	44
10	9	Matsushita	1 875	26

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European market forecast

Europe's IT industry has about as long to prepare for the single European market as the world's athletes have to prepare for the next Olympic Games. For both, 1992 will be a once in a lifetime opportunity, but for Europe's IT industry there are no medals at stake - just survival.

By then, Europe's politicians will be putting the finishing touches to a raft of legislation designed to unite Europeans in what will be the world's largest single trading block.

Market researchers say that when they ask firms what they think 1992 will mean for business, the answer is always increased business outside the domestic market, without losing market share at home. When this is the stock answer throughout Europe, things do not quite add up. But it does point to the fundamental assumption about life after 1992: that the European Community will be a market of 320 million consumers all buying standardized products under similar conditions throughout the 12 member States.

That expanded market may not be realized on 1 January 1993 - agreeing standards will probably take a little longer - but it does mean casting aside national preferences and opening up public procurement, especially in telecommunications.

This will be achieved to a large extent through economies of scale. Ian MacIntosh, founder of IT consulting group MacIntosh International, points out that throughout the IT industry, "it is almost always economies of scale which dominate the costs of products and services - from chips to packaged software to electronic messaging".

The European Commission estimates that failure to harmonize standards and technical regulations on many products cost firms and consumers 40,000 million to 50,000 million ECUs a year.

The costs arise because technical barriers mean products cannot be sold without expensive modifications, which means production runs are smaller than they could be, so production costs are higher.

1992 looks set to serve as the catalyst for changes that have already begun. The IT standards-making process is under way, and the trend towards globalization is already well marked for IT suppliers and users alike.

The European market itself is growing. In 1985 Europe accounted for about 27 per cent of the world IT market; it now accounts for 32 per cent. That growth has been accompanied by a growth in the market share held by European suppliers, up from around 30 per cent in 1982 to 50 per cent today.

There are hurdles to be overcome with language and the workforce. English may be the language of the IT industry, but it is not the users' language. (Source: Computer Weekly, 6 October 1988)

There is big money in mergers

The outlook seems to be encouraging if you control either a large on line data base or a software house.

That is the view from a new set of research by US matchmaker Broadview Associates, 1988 Information

Services - Industry Trends in the UK and US; UK Information Services Industry 6-Month Merger Report for 1988; Information Technology Industry Overview from Broadview Associates, Fort Lee, New Jersey, US.

The raw figures on activity in the UK and US show that in the first six months of this year the number of mergers and acquisitions was up by a half in the UK since the same period last year (from 34 to 53), with the value of the transactions up by almost 80 per cent to 530 million pounds sterling. For the US they were 39 per cent more (up from 137 to 190) at a value of $5.4 billion (a 150 per cent increase).

Nearly half the buyers of the UK IT services companies were buying into the sector: 11 per cent from entirely non-IT firms, 18 per cent from hardware and "diversifieds", and 15 per cent from investor or venture capital groups.

Clearly the computing services industry is becoming more popular - a recognition both inside and outside the sector that this is where future growth is going to be built.

The predicted popularity of on-line data bases is almost an accident, unrelated to the merger activity. But Bernard Goldstein, a partner at Broadview who is a past president of Adapso, believes a lot of attention will be focused there in the short term.

Being a software house also makes a firm an attractive target, according to the analysis. US firms especially are not strong in the non-packaged software market; the prediction is that as a sector, UK software houses will have an annual compound growth rate of 23 per cent for systems software in the years to 1992, against a 21 per cent compound rate for applications software. Recent figures from UK firms such as Logica and Microfocus bear this out.

Broadview predicts that the systems software market will grow from 605 million pounds sterling in 1987 to 1,675 million pounds sterling in 1992; applications software sales will go from 325 million to 855 million pounds sterling.

Those improvements also make UK firms attractive as buyers of US firms.

One particular species of company which Goldstein singles out for comment is the aircraft manufacturers. The message is downbeat: they are not going to take over the information services world.

"They are on 20-year planning cycles for selling and designing planes. They have all got a position in the information services market. Well, I predict that all of them are going to fail in it, because the dynamics are different. In this industry you can barely plan five to 10 years ahead."

But where is an unlisted, small firm eager to grow large enough to come to the notice of a potential buyer, or to take over someone else, going to find the money?

Venture capital is not as easy to come by as some think. The only certainty seems to be that joint ventures (where two firms create and run a jointly-owned firm) are bad bets. Ninety per cent of them do not even reach the formal agreement stage despite the companies' common aims.

Of those which do get under way, $7\frac{1}{2}$ per cent flop in "the short term" (i.e. a few years), which leaves only $2\frac{1}{2}$ per cent to succeed in the short term - and even they face a shifting future.

On the whole, it looks a better bet to get into software. Or else start building your data base, starting this afternoon. (Source: Computer Weekly, 29 September 1988)

Drop in semiconductor market predicted

For the first time, the world-wide semiconductor forecast promulgated by the SIA (Semiconductor Industry Association) has anticipated a downturn - in 1990. Seeing rapidly slowing growth rates in national economies and key systems markets, this composite of forecasts by semiconductor companies themselves shows a roller coaster ride over the next three years, from a high growth of 38.2 per cent this year to a low of minus 3 per cent in 1990 and bounding back by 14.4 per cent in 1991.

The segments supporting this second-highest growth year in semiconductor history were fuelled by extraordinary strength in CMOS microprocessors and CMOS memory devices.

This is the first time that this forecast has stated negative growth. Its most glaring misforecast, for which it has been continually criticized, was in the early 1980s when it anticipated growth just before the drastic downturn of 1984.

The forecast is made up of the individual forecasts of each semiconductor company, including every significant company in every part of the world. Forecasting the downturn of 1990 is a sign that the companies are trying to be more accurate and state what objective analysis shows rather than their more optimistic hopes.

However, the forecast shows the US dropping 6.6 per cent in 1990, while Japan only drops 0.5 per cent and Europe by 2 per cent. These area forecasts are composed from the companies' headquarters in those areas, showing Japan is more optimistic about its business than the others.

The semiconductor industry is more volatile in the US than anywhere else. One reason for this is that some 30 per cent of production is transferred to other divisions at each semiconductor company in Japan, 50 per cent in Europe, but only about 5 per cent in America.

However, the 1990 recession is expected to be due to falling selling prices more than slumping until production. A large part of the drop in average selling prices is expected to be due to supply of DRAMs catching up with demand in 1989 and a sharp decline in prices following. However, if that is true it should affect the Japanese the most, but their own forecast is for only a 0.5 per cent drop. Either the Japanese do not expect DRAM prices to soften much or they expect other products to grow rapidly and take the place of lost DRAM revenues.

The Japanese are expecting such new systems as ISDN telecom and digital TVs to take up the slack. There is not the same expectation for new product

areas to buoy up sales in the US and the mainstays for the US semiconductor makers are slowing down - personal computers and workstations.

As for the international struggle, the Japanese have pushed their share of the American market up to about 20 per cent, but if the high DRAM prices settle down that should fall back to the more traditional 15 or 16 per cent. The growth of Japanese share in the US is due to prices and not units. (Source: Electronics weekly, 12 September 1988)

Shifts in global IS trade

(This article is based on the results of a recent study called "International Informatics Policy - From Participation to Regulation", which was compiled by a team of researchers headed by managing consultant Roman Krawec at Logica Consultancy Ltd., London.)

The balance of power in the informatics industry is continuing to move East, despite attempts by IS corporations and governments in the US and Europe to maintain a competitive dominance. That industry shift, combined with fundamental changes in technology, has led to new international trading patterns and new pressures on western IS companies.

Equally important is the way the shift is forcing governments around the world to adapt their industrial policies and strategies to cope with the new informatics environment. The consequences for government policy-makers have been threefold: a move away from direct intervention and toward regulation; a focus on the demand side of the industry rather than the supply side; and less protectionism of local markets in favour of moves to attract international vendors and multinational users. The technology changes underlying this trend have become obvious to many observers.

The convergence of computing and telecommunications, together with the increasing internationalization of the informatics industry, means that information handling demands new solutions from users and suppliers alike. The informatics environment is extremely dynamic, with technological change driving rapid changes in industry structure and usage.

Alongside these changes has come a shift in the technological balance of power. Many of the developments that formed the basis of the early informatics industry such as telex, television and the first generation of thermionic valve computers, have their origins in Europe. The development of the transistor and integrated circuits resulted in a shift in dominance to the US, typified during the post-war period by the successes of AT&T and IBM.

Today, however, it is the Japanese electronics giants such as NEC, Toshiba, Fujitsu and Hitachi that appear best positioned to exploit the developments of a new information age. Their corporate structure is typically vertically integrated, with interests ranging from component manufacture through computers and communications to consumer electronics and broadcasting.

Governments have played a major role at each stage in the development of the informatics industry. The direction and aims of government intervention vary between countries that have chosen a complete espousal of free market forces - such as the US - to those that have traditionally taken a more conservative or structured approach, such as France, the Federal Republic of Germany, or Sweden. Nevertheless, some common trends are evident.

The telephone authorities (PTTs) in Europe, typically State monopolies, provided both a pool of technical expertise and a protected market for the developing national suppliers in the past. The so-called military-industrial complex in the US, meanwhile, has funded successive generations of research and development initiatives through the nuclear weapons programme, the space programme, and, most recently, the Strategic Defense Initiative (SDI). The Ministry of International Trade and Industry in Japan (MIT), provided the vision and research direction that has enabled Japanese companies to leap ahead of their American and European counterparts.

This type of direct participatory intervention in the supply side of the informatics industry - where the State holds direct control of telecommunications, invests directly in R&I programmes, and supports national champions such as ICL in the UK and Siemens in the Federal Republic of Germany - is becoming less relevant as the supply-side pressures become more internationalized.

An examination of the global sales of the top 10 suppliers in informatics (which includes a broad range of technologies, from telephones to data processing systems) holds some surprises. Only two of the top 10 in 1987 were US-owned, compared with four Japanese suppliers. Of comparable interest is the fact that five of the top 10 are telecommunications operators. They are: NTT in Japan, AT&T; the Deutsche Bundepost (the German PTT); British Telecom; and the French PTT, known as the DGT.

In addition to these shifting patterns of industrial dominance, the supply side of the informatics industry as a whole is becoming increasingly internationalized as R&D costs soar and suppliers reposition to take advantage of newly liberalized markets. These changes are especially evident in the telecommunications equipment market.

Consequently, the focus of government intervention has begun to shift towards demand-side issues. The demand side of the informatics environment is still closely linked to the fortunes of national economies. Now, it is well accepted that the successful use of IS can give a competitive advantage to individual firms and national economies alike. Moreover, governments have realized that information is a valuable resource and the jobs of millions of people are dependent on collecting, storing, retrieving, processing and communicating it.

In the developing climate of convergence between computing and telecommunications, the PTT occupies a pivotal position between supply and demand, and telecommunications deregulation plays a central part in the policy changes taking place.

Telecom policies are now being directed towards obtaining a higher quality of service and wider choice for users through the liberalization of services and terminal markets. Greater emphasis is being given to the development and promotion of open standards in telecommunications and computing, and to training and awareness schemes. The boundaries

of regulation and competition are progressively being relaxed, allowing the creation of new services that cross the old frontiers between computing, telecommunications and broadcasting. Around the world, the newly liberalized PTTs are diversifying their operations into areas outside pure telecommunications and are increasing the international scope of their business.

In this environment, the role of government is changing from that of a player to a referee, arbitrating between different interest groups and ensuring fair play according to the new rules of the game. The US led the way with deregulatory policies directed towards telecommunications services, coupled with the divestiture of AT&T in 1982. Meanwhile, much of the present impetus for policy initiatives - such as the US Japan semiconductor agreement or the co-operative research of Sematech - is coming from associations within the private sector. The US Government continues to play a major role as a buyer of informatics products, especially in the defence sector, but its main policy thrust recently has been in extra-territorial issues. These include control over high-tech exports to Eastern Bloc countries, deregulation of international leased circuits and satellite services, and pressure on major trading nations to grant reciprocal access to protected markets.

In Japan, too, the policy-making role of MITI has been progressively reduced as the companies it has assisted are now able to direct their own research and trading policies. MITI pressure is now being applied to the traditionally conservative Ministry of Posts and Telecommunications to force a shake-up in the structure of the telecommunications industry so that the new generation of value added network services (VANS) can prosper. The first stage of deregulation has been achieved remarkably rapidly with the privatization of NTT, the introduction of network and service competition, and the growth of a Japanese VANS industry. Japan is now preparing for a second stage, which will include the introduction of more competition and the possible divestiture of NTT.

In Europe, similar trends are occurring as governments are moving away from direct participation and the fostering of national champions and towards regulations and the creation of a single European market. The UK Government has progressed furthest towards telecommunications deregulation through the privatization of British Telecom and the creation of a network duopoly. The UK Department of Trade and Industry has withdrawn from near market support and retains support only for basic research and for pre-competitive collaboration between firms.

In France, the nationalization of leading electronics firms is being reversed through privatization and sell-offs. Direct funding for R&D programmes of national champions is being reduced and selected aspects of telecommunications provision, such as VANS and mobile communications, are being opened to competition.

In the Federal Republic of Germany, which has traditionally had one of the most restrictive telecommunications regimes, wide ranging changes have been proposed by the Government's Witte Commission and have been adopted as draft legislation, expected to come into force in 1989. Although the Deutsche Bundespost will retain its network monopoly and control over basic telephony, a regression from the more liberal interim position adopted by the Witte Commission, a route has been opened for increased competition in Federal Republic of Germany telecommunications.

In Sweden, the close relationship between the socialist Government, the PTT (Televerket), and the leading supplier (Ericsson) is increasingly coming under threat as pressures for the liberalization of telecommunications grow. Swedish informatics policies show a high degree of co-ordination and integration, with programmes ranging from basic research through industrial applications to education, training, and user awareness, an approach more akin to that of Japan than other European countries.

This new integrated and international policy environment demands more of policy-making organizations if policies are to keep up with technological change, the needs of the informatics industry, and the requirements for effective informatics use. Regulation is more demanding than intervention and calls for a greater understanding of market dynamics and structure.

For example, the global informatics suppliers can now afford to locate their operations where the policy environment offers new business opportunities or the most conducive conditions for profitable investment. Multinational users can also shift their data centres or network hubs to wherever regulations are least restrictive or the package of service availability is most attractive. Consequently, rather than directing the informatics industry in this new international phase of its development, governments are increasingly having to compete with each other to attract it.

While a deregulatory climate provides many benefits for users in terms of greater choice in services and equipment and generally lower prices, there are also costs involved. A competitive environment can lead to a deterioration in telecommunications service in peripheral regions or within disadvantaged groups in society. Deregulation can lead to the proliferation of incompatible proprietary standards and may deter investment in services or products that cannot guarantee short term profitability.

The most evident problem arising from the liberalization of the informatics market-place, though, is the emergence of a growing trade imbalance in high-technology goods. "Balance of Trade in Computing and Communications" shows how Japan's trade surplus in computing and communications goods has risen from $3.3 billion in 1980 to $15.6 billion in 1986 at the expense of trade deficits in the US and Europe. The Japanese trade surplus will continue to rise to an estimated $25 billion by 1990, leading to protectionist pressures and a possible reversal of market-opening moves. The US Government has begun to put pressure on the Japanese Government to ease trade pressures, resulting in:

- The US-Japan semiconductor agreement;
- A bilateral treaty on the deregulation of international VANS; and
- The opening of Japanese telecommunications services to US investment in new common carriers.

The agreements reached between the US and Japan have eased considerably the tensions in informatics trade, but have resulted in criticism from several sources, such as the General Agreement on Tariffs and Trade (GATT), on the grounds of unfair trading practices.

By contrast, European governments have been largely preoccupied with national issues or the problems surrounding the creation of a single European market by 1992 which, while laudable, is in danger of blinding the European players to the global context of the informatics industry. Unless Europe can present a united front, it may be too late to prevent a US/Japanese hegemony of the international informatics industry.

The message for policy makers is that the informatics environment is becoming ever more complex. Simple direct intervention in supporting national champions or maintaining monopoly controls of PTTs is no longer necessary or desirable.

There is, however, a key demand-side role for governments to play in removing obstacles to the use of informatics in the economy as a whole. These obstacles may be financial or psychological, or they may be due to restrictive regulations, lack of choice, or lack of awareness.

One example of reducing financial and psychological obstacles is the way the French Government has supported and promoted the use of videotex systems throughout French society as a replacement for the telephone directory. The result is already close to 4 million users of the Teletel service and one of the busiest and most varied national information networks in the world.

In the new liberal environment, governments must also take positive action to counteract the negative effects of this increased competition. This involves the promotion of open standards, enforcing reciprocal access to overseas markets, and encouraging collaboration on high-risk projects or long-term basic research. It will also involve arbitrating between different interest groups in society and protecting the weaker groups, such as residential subscribers, small firms and disadvantaged regions.

The major conclusion, however, is that governments must address international issues with greater vigour. Japan's MITI, for example, has now identified two major trends that will shape its future policy. First, the use of informatics will pervade all sectors of the economy - public, private industry and consumer - and second, the trend towards global informatics operations will increase.

This is the first evidence of a cohesive response to the new challenges for the IS industry in the future. It is now up to policy makers elsewhere to realize that they can no longer afford an insular perspective. The future for the informatics industry is global. (Reprinted with permission of DATAMATION ® magazine ©, 1 October 1988, copyright by Technical Publishing Company, A Dunn and Bradstreet Company - all rights reserved.)

When is an ASIC not an ASIC?

Until recently, ASIC devices have only been partially ASIC. True ASICs have been hidden from view and publicity. The true ASICs at the leading edge of systems performance have only just begun to emerge.

Semiconductor device definers and designers have concentrated on the logical functions and electrical parameters of custom devices, cell-based devices and gate arrays. And that, of course, is where the real action is in systems - in the chips. But the speed performance of that action is not being realized in leading-edge systems because the speed of devices has risen to outstrip the packages and interconnects, which now dominate the system speed performance.

When, or if, the package and interconnect deficiencies are solved, they will continue for ever to be as much of the system design problem as chips will be. Their solutions must be integrated with the chip design, making them truly ASIC.

As we push on towards the goal of "a system on a chip" we have hopefully come to realize that one chip systems, though important, are not nearly as important as multi-chip systems, no matter how complex the chip. The data processing monster will continue to demand more processing power no matter how well we feed it. We need advancements in multi-chip technology no matter how far we go on the die. Whatever can be done in a single chip, much more can be done with several.

But the success of systems using groups of chips will depend on each chip fitting its place in the system perfectly, that is in each and every way that affects function, performance, size and cost. The system architectures, die, packages and interconnects must be optimized for total system performance.

True ASICs have existed as full custom designs in high volume consumer items where device technology, die size and special packaging were needed to get the low-power and low-cost requirements. Small consumer items like watches, calculators, etc. are good examples. But there the optimizing trade-offs among die, package and system factors are not publicized and are hidden from view in the final product. The design and engineering secrets behind them are kept secret.

There have been examples of true gate array ASICs, in IBM, Amdahl, Cray computers and a few others. But the special packaging, heat dissipation, and interconnect systems never made it into the merchant markets. The technologies were too specialized and expensive.

But recently three critical elements have become available to the merchant market - the forces that are combined to make ASICs the basic technology driver for the industry. First, CAE brought us the ability to configure vast arrays of gates rapidly and predictably. Also, gate array technology has pushed speed performance to where many, not just a few large companies can work on the edge of the art in processing speeds. In addition, interconnect technologies have made strides not only in performance, but also into broad availability.

This sets the stage for system designers to optimize by tailoring each die in the system to the needs of that particular spot in the system. If only the design automation tools were there. If one die design is used in several places in a system, it

probably needs to be altered to function optimally in each position. Pinout patterns need to be changed so PC interconnects line up perfectly with their destinations.

Packages will have to be different at different positions to satisfy size, power and cost needs, even if the die inside stays the same. The interconnects within the die may also have to change from position to position, even if the same die function is used, to support these packages and PC interconnection needs.

When the device is designed for a particular spot in the system, considering all the requirements of that spot, then we will have true ASICs. And that day is coming. It must, because the competition among producers of high-performance computing systems is fierce and getting more so. After all, squeezing the last drop of capability out of the system must involve tailoring every element of the system.

When custom devices are made with the logical, electrical and mechanical combination of characteristics so that they each support the best possible system performance, then they can be called true ASICs. And that is a lot more than ASICs are today. It cannot be done yet because the tools are not there. It is the CAE tools that will bring this capability into general practice. The pursuit of true ASICs will become the top-level driving factor of systems design. (Source: Electronics weekly, 21 September 1988)

Company news

Future orientation of Data General

Data General (Westboro, MA) is basing its future growth on systems built around products like AT&T's Unix operating system. According to founder E. de Castro, the computer industry is about to undergo its fourth wave of change. The first was dominated by mainframe computers, the second by minicomputers, the third by the spread of PCs and workstations. The fourth involves open architecture and interchangeable parts. During the minicomputer phase, the company's reported earnings rose 12,500 per cent in 1970-1980. Since then, the company has stumbled repeatedly. Since July 1987, four plant closures have been announced, the work-force was reduced by 6 per cent, management was shuffled twice. The company's success had come from its ability to produce cheap, reliable minicomputers that can handle the tasks of more expensive mainframes.

During its peak years, 70 per cent of the company's sales had been to other manufacturers, who bought the machines and added enhancements and often their own nameplates. Then Data General decided to sell its equipment directly to the large corporations. In the end, the company lost sales people and alienated many of its traditional customers. Moreover, Data General was unable to compete with the large companies, such as DEC and IBM, and had missed opportunities at the lower end of the compute. spectrum, which were taken over by companies such as Sun Microsystems and Compaq Computer. Determined not to miss the fourth wave, Data General, which will not abandon its installed base, has decided to base its future products on "open" systems, which use products such as AT & T's Unix operating system and Motorola's newest 32 bit microprocessor. (Extracted from Forbes, 19 September 1988)

Olivetti restructures

Ing. C. Olivetti (Italy) has restructured into three separate operating companies as of 1 January 1989. The Olivetti Office Division will be responsible for consumer products for text, data and image management; products in that category include calculators, typewriters, text processors and facsimiles. Olivetti Systems & Networks will target the distributed data processing market, using systems of MS-DOS, OS 2, and Unix. It will market personal computers, minicomputers, LANs, terminals, workstations, and other related systems. Olivetti Information Services will provide business computer services, e.g. VAN services, voice/data services, and electronic publishing. Another group, Technological Activities, will consist of Teknecomp, Conner Peripheral Europe, and Laserdrive; it will manage Olivetti's equity investments in special technologies. Sales in the office and systems unit and the network division will total $2.1 billion each in 1989; the information services division's sales will total $285 million. Olivetti's total sales will reach $5.7 billion in 1988, as against $5.26 billion in 1987. (Extracted from MIS week, 3 October 1988)

UNIX spawns unusual unison

A few months ago seven computer manufacturers (Apollo Computer, Groupe Bull, Digital Equipment, Hewlett Packard, IBM, Nixdorf and Siemens) established the "Open Software Foundation" (OSF). The foundation was created in response to a co-operative agreement between AT&T and Sun Microsystems to jointly develop a new version of UNIX, a highly successful operating system. OSF aims to develop its own version of UNIX, and is sponsoring research and development in open systems and their compatibility. (Source: Siemens Review, April 1988)

Fujitsu sets fast pace in the supercomputer stakes

Fujitsu of Japan claims to have developed the world's fastest supercomputer and has set itself aggressive sales targets in an already crowded market.

Its Facom VP2000 top-end system offers a processing power of four Gflops (floating point operations per second), with a maximum main memory of two Gbytes, and systems storage of up to eight Gbytes.

On the given figures this tops Control Data Corporation's (CDC) four-processor ETA-10 system, which claims a rating of 3.4 Gflops and was released last year.

Fujitsu says it has been able to improve greatly the overall performance compared to its earlier supercomputers through its development of the dual scalar processor - a new type of multiprocessor.

The VP2000 series launched by Fujitsu consists of eight systems with single processor and dual scalar processors, starting at the low-end at a processing power of 0.5 Gflops.

The company expects to sell 200 systems in the next four years. The target is doubly ambitious: it roughly equals the number of installations that Cray has at present worldwide, and comes as the market is crowded almost to saturation. Cray

recently reported losses, and CDC reabsorbed Cyber (which makes the ETA systems) while loosening financial performance targets for return to overall profitability.

Fujitsu expects the new supercomputers will increasingly be used in commercial applications as well as the traditional ones in scientific and engineering applications.

However, the top-end VP2600 10 and VP2600 20 models will not be available from Fujitsu until 1990.

Competition then may be swollen by the arrival of another supercomputer company, Supercomputer Systems (SSI), with 64-processor systems. Cray's former design genius, Stephen Chen, has found backing for his ambitious plans at SSI from IBM. Chen plans to develop gallium arsenide-based systems and have them on the market in the early 1990s. (Source: Computer Weekly, 15-22 December 1988)

Motorola applies automated assembly operation

Motorola has successfully applied a totally automated assembly operation based on "stolen" output technologies at its communications sector plant in Boynton Beach, FL. The plant formed "Team Bandit" in 1986 to study a new approach to manufacturing that used present techniques and mature and available machines and systems. Engineers were given the task of designing a new product and producing it with an innovative approach, and they decided to pick Motorola's Bravo pager. Operation of the system with prototype products for shipment to customers for testing was begun in December 1987, with high-volume output beginning in February 1988. The operation is centred around a 450 ft.-long, C-shaped conveyor system with 34 work cells, 2 robots, high speed surface mount machines and five computers. Half the pager is assembled by surface mount devices and the rest by the robots. The ideas from the Boynton Beach plant are being examined by other company divisions from which special technologies were taken. (Extracted from Metalworking News, 10 October 1988)

IBM provides new image workstation

IBM is entering the growing multimillion-dollar document image processing market with a new image workstation. Built around the Personal System 2 Micro Channel architecture, the new ImagePlus system will not be released until the first quarter of 1989. It will be restricted to a Controlled Systems Installation Program (CSIP) over the next six months or more. System/36- and MVS/ESA-based systems are currently installed at pilot sites. The company plans to install System 36 ImagePlus systems in the fourth quarter of 1988, followed by AS/400 and MVS/ESA systems in the first quarter of 1989 and second quarter of 1989, respectively. Users of the mid-range System/36- or AS/400-based systems will not be able to migrate to the MVS/ESA environment. (Extracted from Datamation, 1 October 1988)

Reports takes some terror out of start-up efforts

Starting a company? It has been called "the most terrifying experience of a lifetime". Now, there is expert help in the form of a $395 report and Lotus 1-2-3 based software "Start-up: Founding a High Tech Company and Securing Multi-Round Financing" from Electronic Trends Publications, Saratoga, California.

This report analyses case studies of successful high technology start-ups, including Chips and Technologies, Cypress Semiconductor, Silicon Graphics and Sun Microsystems. It is an analysis of techniques used to establish, finance, value and guide a new high technology business from seed financing through the initial public offering.

Some of the phenomena facts revealed in the research behind this report show that:

- Chances are 6 in 1,000,000 that an idea for a high technology business will eventually become a successful company that goes public;
- A founding CEO can expect his stock to be worth about $6,500,000 and all employees about $100,000 if the company succeeds in going public;
- Of those that succeed, the median company takes 3.5 years to get to the public offering stage;
- Over $24 billion was committed to pools of venture capital in 1986, managed by over 500 firms and more than 2,000 venture capitalist;
- A typical venture capital firm reviews 7,000 start-up business plans in a seven-year period, funds 42 and sees four funded companies reach initial public offering;

  "Internal start ups" a company's own effort to fund internally developed ideas - are emerging phenomena and have been very successful for growth companies seeking to combine retention of a high spirit of entrepreneurial drive and an uninterrupted focus on the parent company's bread-and-butter business; and
- "Unfair advantage" and "sustainable competitive advantage" are missing in most business plans, but are considered by investors as critical if the high technology start-up is to have an acceptable chance of succeeding.

Report author, John Neshiem, president of Saratoga Venture Finance, states, "The most commonly asked questions by entrepreneurs and corporate acquisition specialists are: 'What are the insider strategies and principles of the winners? And how can I create the best strategic plan for successfully financing a company from start-up to public offering or acquisition?'"

According to Neshiem, the secrets include driving start up company managers to answer a series of crucial questions. For example: How can we assemble a founder's team that will see us through both the good and the unavoidable, tough times? What will be the personal cost to us and our families? And what are the key steps to doing the planning and implementation?

"Successful start ups resolved these questions, thereby improving by millions of dollars the eventual worth of the founders and investors. Conversely, failure to address even one of the key questions often becomes the critical difference in reaching success or failure at initial public offering time," says Neshiem. (Reprinted with

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IBM plans for GaAs

According to a recent report by International Technology Group, Los Altos, Calif., IBM is expected - by 1995 - to switch to GaAs-based ICs for high performance processors in its new mainframe line of computers. This step is necessary to realize the performance demands of multiple 64-bit processors operating in a simultaneous environment.

IBM presently has access to advanced GaAs IC technology and production methods through an agreement with Rockwell International. Rockwell has been a leading developer of GaAs IC technology since the mid-1970s, primarily under DARPA sponsorship, and now has a GaAs IC production line in Newbury Park, Calif., near their Science Centre in Thousand Oaks, Calif. The agreement gives IBM access to both the GaAs IC production MESFET process, as well as the heterojunction bipolar transistor (HBT) technology being developed at the Science Centre.

The report says that IBM will make increasing use of GaAs ICs during the next few years, culminating with the introduction of a new mainframe line by the 1995 timeframe, based on a high-performance GaAs-based processor. During the interim period, other uses of GaAs ICs include communication channels, cache memory and cache controllers. (Reprinted with permission from Semiconductor International Magazine, November 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, Il., USA

Philips plans move to save West's DRAMs

Philips, Europe's biggest semiconductor company, wants to get into the dynamic RAM business. Worries about the dangers of the Japanese owning nearly 50 per cent of the world semiconductor market are believed to have prompted the move.

Philips is in the unique position of having two sources of leading edge DRAM technology. One is Siemens which is currently sampling 4 Mbit DRAMs and which will hand over the technology to Philips under the terms of their joint Megaproject.

The other source is Matsushita Electrical Components in which Philips has held a 35 per cent share for 35 years and with whom Philips has a technological exchange arrangement. Matsushita is tipped by market research firm Instat to become the world market leader in the 4 Mbit generation and will also hand over the technology to Philips if it wants it.

Although Philips is the seventh largest semiconductor company in the world it has not made memory chips until recently. This year it started to sell EPROM memories and sold $50 million worth. Next year it will start to sell SRAMs. In 1990 it may be gearing up for DRAMs.

One reason for Philips' increasing involvement in memory manufacturing is its closeness to Japan. (Source: Electronics Weekly, 12 October 1988)

What is ahead for IBM's on line systems

Today, the IBM world of on line systems primarily consists of CICS and IMS/DC. Once, both CICS and IMS DC tried to do everything for everybody, but a new picture of the once-competitive systems now seems to be emerging. According to various IBM presentations, the products are evolving in different, yet converging, directions.

While IBM will probably further clarify its directions during the 1990s, currently available information and the evolution of the software to date indicates that CICS, IMS and DB2 will converge into an on-line system:

- CICS will be the IBM on-line system of the 1990s as it becomes responsible for data communications and terminal and applications handling;
- IMS/DC apparently will be positioned for the foreseeable future as the agent responsible for disk logging, recovery, data sharing and other back-end operational functions; and
- DB2 will be the primary data base component, supplemented with IMS, DL/1, and Fastpath as special requirement data base components.

Part of the evidence for these conclusions can be found in the work done at IBM's Santa Teresa, Calif., laboratory, which is responsible for IMS and DB2. Both IMS and DB2 have evolved rapidly with respect to back-up recovery, disk logging, and data sharing, particularly the latter two. Today, however, terminal handling, networking, and other transaction processing (TP) facilities of IMS/DC are almost as primitive as they were in the 1960s.

CICS, on the other hand, even if still greatly troubled with its macro-level applications support, has evolved strongly in the TP area. Examples of this are LUC, as it was originally called (now LU 6.2), auto install of terminals, and on line definition of (so far only selected) resources.

This restructuring, with the on-line applications executing under CICS in the data communications part of DB DC systems, can easily be misinterpreted as CICS winning a battle with IMS/DC. More precisely, however, it seems to be an example of IBM finally bringing together its hardware and software into a more uniform architecture. Its push in this direction is shown also in its announcements in support of Systems Application Architecture (SAA).

Unfortunately, to date, the impact of the CICS changes on IS organizations has not been addressed by IBM and is compounded by today's shortage of systems programmers. CICS, which once was a simple to install, single-region operations system, has grown into a complex, multi-region system that is difficult to install and maintain.

The systems programmer must assume full responsibility for the region set-up and usage, as opposed to IMS DC, where all regions are generated from a single system generation. Having yet another responsibility can be problematic for systems programmers today, who often have to fill many roles simultaneously: applications support, end user support, and, in smaller installations, sometimes technical support, trouble-shooting, firefighting, and software strategy planning.

Consequently, installations should try to utilize scarce systems programming resources as efficiently as possible. Certain organizational changes, accompanied by the acquisition of

appropriate software tools, can provide great relief for systems programmers and make it easy to perfect the on-line environment when tools do become available. Try to standardize the environment as much as possible, and let junior systems programmers or trainees perform the necessary generations and region set-up.

Set up the production environment so that errors are avoided as much as possible:

- Control all resource definitions centrally;
- Make sure fallback possibilities to the previous resource definitions and program versions used are always available;
- Run storage protection tools in quiesced mode, ready to be turned on in case of problems, or use stabilizing software for the production regions;
- Protect all systems transactions, such as CICS master terminal transactions and de-bugging transactions; and
- Automate general error handling and file/data base close and re-open for batch processing.

Make applications programmers independent of the need for systems programmers' assistance by providing tools in the applications testing environment for storage control for all user applications, de-bugging, on-line dump handling, on-line performance monitoring and reporting, on-line definition of needed resources, access to necessary CICS master transactions, consolidated message and alarm message handling, and transaction and resource status and action capabilities.

If it has not already been organized, set up a special help desk to handle end-user problems, and provide the necessary tools for them to be able to diagnose problem situations without systems programmer assistance.

Such tools should provide access to necessary CICS master transactions, consolidated message and alarm message handling, transaction and resource status and action capabilities, on-line performance monitoring and reporting, and broadcast and log-on message possibilities.

Some of the tools listed above are already available from a number of vendors, while others are yet to be marketed, and it is not possible to achieve a full systems programmer offload immediately.

The effects of technical changes in the DB [illegible] environment, the suggested organizational changes, and use of software tools are difficult to estimate in terms of measurable economic savings. Even without exact numbers, however, there is no question that the poten ial direct and indirect savings through increased productivity are large.

Nevertheless, the restructuring of IBM on line systems, as described here, should provide the following benefits:

- For installations running both IMS [illegible] and CICS and requiring access to the same data, the costly duplication of data and overheads with LU 6.1 ISC solutions and or data sharing can be eliminated when all DL I and Fastpath data is gathered in separate sub-systems;
- CICS recovery restart capabilities will improve, reducing the number of outages and amount of downtime, if outages do occur;
- CICS DL I function shipping, with its gross overhead, will be eliminated;
- DL I and Fastpath database recovery will be more manageable, with the sub-system in charge of the recovery process;
- Resulting simpler applications solutions will require fewer cpu cycles and be less error prone.
- As DB2 usage becomes even more common, its ease of use will continue to provide programmer productivity increases.

The beneficial effects that can be realized from organizational changes and the use of appropriate software tools include the following:

- Fewer systems programmer disturbances for minor problems in large installations, which can save as much as a man year or even more;
- More independent applications programmers who do not have to wait for systems programming assistance; this can give the individual CICS applications programmer an efficiency increase of anywhere from 5 to 10 per cent, depending upon the installation - for large installations, this can save many man-years; and
- By handling all the time-consuming end-user assistance, more independent help desk operations can - in large installations - save many man-years in other parts of the organization.

Overall, the most important benefit of the expected, and suggested, changes in these systems will be higher-quality end-user services and increased responsiveness to end-user problems. For today's highly competitive businesses, this could be an important element in achieving a competitive edge over less well organized companies.

An emerging niche market for the CICS environment

IBM would seem to have its hands full in catering to the growth in CICS systems by adapting the CICS structure to the new software and hardware components becoming available. It seems unlikely that IBM will have the resources necessary both to restructure the basic system and to provide adequate tools needed by applications programmers, systems programmers and operators/supervisors. Some vendors already have recognized this and provide excellent tools for selected areas, such as storage control (CICS only), de-bugging tools, dump handling and performance monitoring.

A new niche that will increase in importance, and from which new systems and software will emerge, is operations control and monitoring. Some examples of the needs outstanding in this area include:

- Consolidated message handling for all regions in a CICS complex;
- Consolidated operator and systems programmer interface to all regions in the complex from a single transaction in a single CICS region;
- On-line definition not only for transactions, programs, and terminals, but also for files and data base resources, among other items;
- Broadcast and message services across all regions in a CICS complex, with appropriate applications interfaces;
- Automated actions on the various error messages, automated time-initiated services for triggering CIS internal or external activities, such as closing down data bases, submitting batch jobs, and re-opening the data bases automatically upon batch job completion; and
- Consolidated performance monitoring, as some vendors are beginning to offer.

Bell's bid for superconductor sales

Long a key player in research on superconductors, AT&T Bell Laboratories (Murray Hill, NJ) says it has developed a novel chemical process to prepare the oxide powders used in making high-temperature superconductors. The company initially plans to use the technology to commercially produce kilogram quantities of yttrium, barium and copper oxide powders at its subsidiary, Nassau Metals. Such powders can be heated and further processed to make the so-called 1-2-3 high-temperature superconductors.

In the standard method of making oxide superconductors, the precursor powders are mechanically ground together to mix them before they are heated to form the superconducting phase of the material. Researchers - hoping to avoid the physical grinding and achieve a more homogeneous mix - also have developed a number of techniques in which the components are dissolved and then precipitated out before they are heated to form the superconducting phase. The solution techniques tend to more easily produce intimately mixed powders than the grinding methods.

Bell Laboratories' method takes advantage of the solution approach but attempts to avoid some potential problems associated with precipitating out the compounds from solution.

In the technique the appropriate nitrate and organic ligand salts are combined and dissolved in water. The resulting solution is sprayed in small droplets through hot air, evaporating the water and leaving the finely mixed salts. Because the nitrate salts are potent oxidizers, an oxidation-reduction reaction occurs, converting the salts into their corresponding mixed oxides. As in other processes, the mixed oxides can then be heated to about 900°C to produce the high-temperature superconducting phase.

Nassau Metals intends to sell the powders for about $1,000 kg. Making the powders available on a commercial basis is considered by AT&T to be a realistic and appropriate starting point in the company's strategic plan to eventually supply an array of superconductor products.

Indeed, a handful of other companies, including several large chemical firms, have already started selling oxide powders that can be used to make high-temperature superconductors. W. R. Grace's Davison Chemical Division began using a proprietary aqueous process to make kilogram quantities of the powders almost a year ago. A research project in market development, the effort is aimed at building closer relationships with research laboratories working on high-temperature superconductors.

Likewise, Rhône-Poulenc sells oxide powders for superconductors and plans to expand its capacity. (Source: Chemical Week, 30 November 1988)

IV. APPLICATIONS

Uses for GaAs integrated circuits

GaAs ICs are now viable for use in high-performance electronic equipment, according to R. Milano of Vitess Semiconductor (Camarillo, CA). GaAs digital ICs are used for metal-semiconductor field-effect transistors (MESFETs), p-n junction FETs (JFETs), and various heterostructure devices. Commercial efforts are focusing on depletion mode and enhancement depletion mode MESFET devices. When process control capabilities are improved, direct-coupled FET logic (DFCL) gates will be used. They will have the smallest number of active devices per gate, thus achieving power dissipation of 0.2 mw/gate. GaAs firms are working on epitaxial growth of GaAs layers on silicon to counter the problems of high cost and low ruggedness of substrates. Also, various heterojunction transistor structures are being considered as alternatives to MESFET devices. Techniques for improving epitaxially grown heterostructure devices are being sought. These efforts are leading to creation of devices that integrate transistors and optical devices such as lasers and LEDs on a single wafer. (Extracted from Defense Electronics, October 1988)

Potential applications for high temperature superconducting ceramics

A variety of applications for the magnetic properties of high-temperature superconducting ceramics are being explored, including frictionless bearings, optical computer memory disks, high-speed gyroscopes, motors that could run indefinitely with no energy in space and delicate probes. The new materials become superconductive at temperatures as high as liquid nitrogen's 77° Kelvin. In 1987, AT&T Bell Laboratories researchers found that a magnet's field penetrated a superconducting material enough to hold it in a stable position over the magnet; the company applied for a patent on superconducting bearings as a result. When P. N. Peters, a physicist at NASA's Space Science Laboratory (Huntsville, AL), added silver oxide to

the most common superconducting compound, a combination of copper oxides and rare earths, the superconductor stayed suspended beneath a magnet by reversing its electric field and going from repulsion to attraction. Silver-oxide-doped ceramics may be able to carry currents up to 100,000 amps/cm^2, 100 times more than undoped materials, according to tentative findings by Chao-Yuan Huang, Lockheed Missiles and Space. Existing superconducting ceramics do not carry nearly enough current to be feasible in applications such as power transmission lines. (Extracted from Business Week, 24 October 1988)

New small laptop PC announced

Sharp Electronics will introduce a new pocket-size laptop personal computer in late 1988. The new 8 oz Wizard features 32 Kbytes of memory, an 8-line x 16 line display, and seven built-in functions, including calculator, calendar, and memo. It also offers innovative techniques that let users add communications and expansion capabilities. A small slot allows the Wizard to accept integrated circuit (IC) software cards such as Time Elapse Manager, 8-Language Translator for Travelers, and Thesaurus Dictionary. These three cards will be available when the new hand held portable begins shipping. (Extracted from PC week, 12 September 1988)

Seiko laptop in full colour

In the final big technological breakthrough needed to bring laptop PCs up to the capability level of desktop PCs, Seiko-Epson has developed a laptop with a full 16-colour liquid crystal display.

Until now, laptops have only been able to have two-colour displays. That has been a restriction on their market acceptance among business and professional users who need the full-colour displays which they get from desktop PCs.

When the Seiko-Epson laptop comes on the market - scheduled for the second half of 1989 - the sole remaining advantage which the desktop has over the laptop will be removed.

Chip-sets capable of handling the graphics on full-colour LCDs have been developed by the high-flying Californian start-up company Chips and Technologies, which specializes in providing chip-sets for PCs.

C&T's marketing vice-president, Steve Shanks, said that they developed the chip set for full-colour LCD PCs to a timetable which coincides with a 1989 market availability of laptops using these displays.

The Seiko-Epson laptop has a 10 in. full colour LCD screen which has a resolution as good as a CRT. At the moment the machine is a fully tested prototype. No price has yet been fixed for its introduction next year. (Extracted from Electronics Weekly, 26 October 1988)

New chip for laptops

Chips & Technologies (San José, CA) has introduced a new chip set that extends the length of time that laptop computers can operate on battery power. The chips, which could boost operating time by two or three times, shut down the parts of the machine that are not being used. The technology has already been used for some high-end machines. Another product that will contribute to laptop popularity is Prairietek's (Longmont, CO) hard disk drive which is only 2.5 inches in diameter, in comparison to 3.5 inches for other products. The Prairietek drive also weighs less than currently available products and uses less power. The laptop computer market is expanding by some 50 per cent a year, according to the market research industry, so many new products are geared to laptops, such as "page-white" screens that resemble white paper with black characters and have better contrast than most screens. (Extracted from the Wall Street Journal, 28 September 1988)

Two new chips developed

Texas Instruments (Dallas, TX) has announced two chips that will lessen the need for costly cache memory in upcoming high speed computers. Currently available to hardware developers, the ALS631C and ALS632I chips house memory addresses of current row and previous row memory and liberate the processor from the task of searching for the memory that must be accessed. Acceleration takes place when a program makes repeated calls to specific or sequential areas of system memory. By offering the address of the last used and current memory, the system does not have to waste time searching for the location of the required memory. (Extracted from Information World, 3 October 1988)

Potential applications of minute motors

Tiny motors only as wide as a human hair have been designed and built by engineers at the University of California (Berkeley). Although at least six laboratories are working on the micromotors, the University of California's group claims that their motors are the most advanced. The micromotors are 70 microns in diameter and are powered by electrostatic energy. Their minuscule notched teeth are the size of a red blood cell. Materials and processes similar to those used in semiconductor production were employed when designing the new micromotors, which might be combined with powerful integrated circuits. According to the US National Science Foundation, which is funding the research, these micromotors could be used in many medical and industrial applications. In patients with heart disorders, tiny devices powered by the motors could remove fatty deposits from arteries. Miniature scissors and chainsaws could be used to remove scar tissue from the retina in microsurgery. Microscopic pumps powered with the micromotors could administer controlled quantities of drugs or could cool the surface of computer chips. Micromotors could also be used to align lasers and optical fibres for telecommunications applications. The motors are made of polycrystalline silicon sandwiched between silicon dioxide layers. The silicon dioxide acts as a framework or matrix that holds the assembly together as it is built up. After enough layers have been deposited to produce moving parts, the matrix is chemically dissolved.

The University of California researchers have also developed a tiny silicon microphone sensitive to noise and air pressure. The microphone contains the thinnest diaphragm ever made and might be useful in miniature robotic systems, hearing aids and speech recognition. (Extracted from New Scientist, 1 September 1988)

Unisys introduces XTPA

Unisys has introduced its Extended Transaction Processing Architecture (XTPA), which is made up of hardware and software. With XTPA, the firm's new 2200/600 mainframes and its high-end 1100/90 computers can achieve up to 6,500 transactions/second, against the 1,000 transactions/second industry standard benchmark. Unisys' on-line transactions-processing efforts will be focused initially on its current installed base of 1,100 customers in the airline and banking industries, as well as in government and manufacturing. The XPTA architecture will be included in the firm's new OS 1100 SB3 - System Base 3 (SB3) - operating system, which will provide a single growth path for customers; in contrast, IBM offers a variety of operating systems, e.g., VM/SP, VSE, and MVS/XA, for its various computing platforms. (Extracted from MIS week, 26 September 1988)

Early warnings prevent false alarms from electronic tags

The Home Office in Britain is evaluating electronic "tagging", which allows a court to sentence an offender to a curfew at home, instead of sending them to prison. Marconi and Racal Chubb are both offering radio technology which does the job. The Home Office now has to decide whether to go for a cheap system, which sounds the alarm as soon as signals from the offender's tag stop, or a more expensive system which gives offenders an audible warning before it will activate the formal alarm which could send them to prison.

Marconi has been supplying its Hawk system to the US for six months. The offender wears an anklet or bracelet which contains a battery powered transmitter. A receiver connected to a telephone line in the offender's home continually monitors the transmitted pulses and sends an alarm signal down the line to a central computer, for instance at the local police station, if the pulses stop. The transmitter has a maximum range of only around 100 metres, so the alarm warns the police that the criminal has probably left home and broken curfew.

Racal Chubb has offered the Home Office a different system which is designed to prevent false alarms if the offender inadvertently shields the transmitter from the receiver. This could happen if the offender walks behind metal filing cabinets, lies on a metal bed frame or gets into a metal bath.

The Chubb receiver expects to pick up a signal from the transmitter every minute. As soon as two minutes have passed without a signal it sounds an audible alarm, for instance a bell or siren. This warns the offender that the receiver is about to send a formal alarm signal down the telephone line to the central computer. If the offender is in the house, but shielded, he or she has two minutes to move so that signals from the transmitter can again reach the receiver. If after two minutes the receiver has still not picked up a signal, it sends off its alarm.

Racal-Chubb believes that the cost of its system can be brought down to around £1,000 for a transmitter and receiver. Marconi acknowledges that the Hawk does not sound an alarm, but says it could build one in if the Home Office is willing to pay the inevitable price premium this will involve.

(This first appeared in "New Scientist", London, 5 November 1988, the weekly review of science and technology.)

Workstations are being increasingly used for electronic publishing

Workstations are being increasingly used for electronic publishing applications. For example, Sun Microsystems gained 5 per cent of its $1 billion workstation business in 1987 from electronic publishing. Among the firms using workstations for electronic publishing, Minnesota Mutual Life (St. Paul, MN) is using Sun-350 workstations and Intran's publishing software to produce insurance documents, e.g., forms, policies and certificates. Compared to mainframes, which have a turnaround time of weeks, workstation-based systems handle the same work in only a day or two. Republic National Bank (New York, NY) is using a DEC VAX station and Apple Macintosh IIs with Interleaf software to produce manuals, internal forms, and signature books, among other publications. Workstations are a good match with electronic publishing, because the machines offer 32-bit power, virtual memory, and strong multitasking capabilities for an application that has its complexities, e.g., laying out and sizing documents, formatting, moving and resizing graphics, and cutting and pasting documents, according to D. Weinberger, manager of executive communication, Interleaf. (Extracted from MIS week, 24 October 1988)

Motorola claims first for power MOSFETs

Motorola has introduced the logic compatible, high-avalanche energy-rated TMOS power MOSFETs, called TMOS logic level EFETs. These devices are designed with low threshold voltage (full "on" with 5V drive) enabling the design of power control circuits that can be driven directly from 5 V logic ICs or microprocessors, or any other low-voltage source.

These devices are available in a Motorola surface mountable package called the DPAK for small, high component density circuit boards. They are also available in the industry standard TO-220AB package for conventional mounting techniques.

Both devices have a breakdown voltage rating of 60 V, a drain current rating of 12 A at 25° C and a maximum on resistance of 0.18 Ω at a drain current of 6 A.

Applications of these TMOS logic level E FETs include switching power supplies, lamps, motor controls, solenoid drivers and a variety of general purpose applications where the drive signal is limited.

The specified avalanche energy capability, commutating safe operating area specification and critical parameters specified at 150° C eliminate the guesswork in designing power control circuits. These devices are particularly well suited for under-the-bonnet automotive applications where low battery voltage and high operating temperatures may be encountered.

Prototype quantities are available from stock and lead time for production quantities will vary from four to eight weeks, depending on the quantity. (Source: Electronics Weekly, 12 October 1988)

Vision on ...

Reading written matter - something sighted people take for granted - is now a reality for the blind. Sight and Sound Technology has launched the Kurtzweil personal reader into a portable system, the first of its kind in the world.

The system works by using a scanner to read written or printed material and then feeds the messages to a voice synthesiser. The system provides the option of an interface with a computer and the user can also use headphones.

Sight and Sound says the system will allow visually impaired people to compete on an equal footing with their sighted colleagues and make use of material the sighted take for granted. (Source: Electronics Weekly, 12 October 1988)

Prototype reading machine for the blind

A prototype of a machine that can read books to blind people has been developed by the Agency of Industrial Science and Technology of Japan. It scans words and stores up to 3,000 characters in its memory. Then it begins reading out loud. While reading, it scans the next page so it will not have to pause. To make sure it pronounces characters correctly it stores the previous page and compares it to the text being read as a guide to context. The device can also store graphic images. According to the Agency of Industrial Science and Technology it will cost about Y15 million. (Extracted from Asian Wall Street Journal, 19 September 1988)

Memory added modularly on Intel processor

In a bid to improve the usefulness of parallel processors, Intel Corp.'s scientific computing division has made it possible to add hard-disk memory to individual processors in the Intel Personal Computer System 2 parallel processing machine.

The capability of tying a Winchester hard disk drive to an individual Intel 80386 CPU, with I/O between CPU and memory governed by additional 386s, enlarges the capacity of a parallel processing machine to deal with massive amounts of data, Intel spokesmen said.

A modular design was chosen, which adds a twin 80386 processor for each channel to memory. According to Steve Cannon, I/O and graphic subsystem product manager, the pair of 386s can handle up to seven 700 Mbyte disk drives, although the norm is two.

Intel claimed the setup is faster than shared memory because each processor can submit a request for data separately, without having to wait for other requests.

Intel's storage system, in a basic configuration of one processor and two disks, costs $60,800. The nodes can be added as needed. The storage subsystem is slated for March delivery. A similar subsystem for tape storage will be available in the first half of 1989, the company said.

At the high end, Intel claims the system runs at more than 500 million instructions per second. It is Unix-based. (Source: Computerworld, 31 October 1988)

ASICs and hybrids complement each other

In the increasing customization of circuits, the use of ASICs and hybrids are playing complementary roles.

Hybrid circuits allow the designer to mix technologies on the same printed circuit board or ceramic substrate, as well as incorporating passive components and standard parts. Power sources too can be incorporated into the same package.

When considering high pin-count, large size VLSI devices that do not lend themselves to through-hole PCB assembly, surface mounting and consequently hybridization offer a particularly suitable solution.

Another critical factor when deciding whether to go for a silicon or hybrid solution is one of production volumes. While the cost of production favours hybrids in low to medium quantities, gate arrays are cost effective in quantities up to 20,000 parts, and standard cell in volumes up to 100,000 units.

An area in which hybrids are finding applications in increasing numbers is the automotive business. As the number of features offered increases, these features require a mixture of technologies, operating on the same substrate.

In order to operate in such a critical environment, under the car bonnet, where temperatures can rise dramatically, ceramic substrates lend themselves to acting as the circuit base, compared with PCB laminate. This is because laminate is more likely to buckle with heat.

The use of ASICs will increase the speed of a system. One-micron technology may be employed to reduce the physical size of the die. There are also other advantages of going for a silicon solution.

On most ASIC circuits there are some areas of unused silicon which can be used for redundant functions should the first function fail. It is also possible to design-in diagnostic or self-test functions.

Taking the hybrid solution, a certain amount of test can be undertaken before the circuit is built. By using the CAD netlist, it is possible to check for circuit "shorts" and "open circuits".

The choice of testing hybrids is a function of the product mix and the volume produced. Most hybrid manufacturers produce circuits in low volume at present, with a high mix of circuit types. So the choice favours programmable testers rather than systems requiring dedicated fixturing. (Source: Electronics Weekly, 12 October 1988)

A flexible aim for linears

The main thrust of ASIC design has been firmly in the digital realm. Gate arrays and digital cell based designs comprise the lion's share of today's ASIC business. Producing linear circuitry on silicon, where performance rather than just functionality is vitally important, has generally proved far more difficult using semi custom techniques.

Yet the trend towards systems on a chip has made combining analogue functions on silicon

increasingly popular, and the choices available to meet this growing demand have been considerably widened by ASIC vendors over recent years. There is now a broad spectrum of options to cater for those who simply wish to add a few basic analogue functions to their digital devices through to those with almost wholly linear designs.

Most of the major digital ASIC vendors have responded to the rising demand for linear functions by adding increasingly sophisticated analogue cells to their libraries. Though the fabrication processes are generally CMOS and optimized for digital circuitry, it is still possible to create such functions as A/D converters, op-amps and comparators of an adequate performance for many applications.

At the other end of the scale, designers looking to create primarily analogue devices of higher performance also have a widening choice as several semiconductor companies explore ways of simplifying the design of linear ASIC devices and overcoming the inflexibility of earlier methods.

Arrays aimed at the analogue designer have been available for almost as long as gate arrays. These consist of a matrix of predefined components such as transistors, capacitors and resistors awaiting connection by a final metal mask to create customized circuitry.

As an early attempt to bring the fast development time and low-cost advantages of semi-custom to the linear fraternity, such arrays have achieved only limited success. The predefined nature of the on-chip devices inevitably makes them inflexible to use and often demands significant design compromises. (Extracted from Electronics Weekly, 21 September 1988)

Latest news from Compaq

Compaq Computer has introduced an 80386-based computer with a smaller form factor and better performance than the Deskpro 386 20. The new Deskpro 386 20e offers VGA compatibility and supports 5.25 and 3.5 in. floppy drives, in addition to a tape backup drive and a 220 Mbyte hard disk drive. The 6 in. high, 15 in. deep, 16 in. wide computer comes in three models: the Model 110, with a 110 Mbyte hard disk, the Model 40, with a 40 Mbyte drive, and the Model 1, which lacks a hard disk drive. Meanwhile, production of the Deskpro 386 and Deskpro 386/20 has ceased. (Extracted from Information World, 26 September 1988)

IBM brings out faster Token-Ring products

IBM has announced high speed versions of its Token-Ring networking products to support data hungry applications and for backbone bridging of networks.

The new Token-Ring local area network (LAN) operates at 16 Mbits per second, compared with four Mbits for the current version. It will support applications such as advanced graphics, image and scientific functions. The 16 Mbit LAN also uses a new token passing architecture, called "early token release", and a larger frame size, 18,000 bytes compared to 2,000 bytes which is the current frame maximum at four Mbits.

Among the products released is a bridge that links LANs operating at different speeds making it suitable for backbone bridging of distant LANs.

IBM has applied to the international standards bodies to adopt its new developments as additional 802.5 Token-Ring standards. (Source: Computer Weekly, 24 November 1988)

And NeXT ...

The launch of a new computer boasting an array of technological innovations and using an erasable optical disk has aroused controversy as to whether the next generation of computers has been born. Significantly named NeXT, the machine is produced by NeXT Inc., a USA-based company run by Steven Jobs, one of the co-founders of Apple Computers, the firm responsible for the Macintosh.

Inside the matt black magnesium box unveiled in October 1988 is a computer which is claimed by its makers to encompass the best attributes of PCs and workstations, and to incorporate features previously found only on mainframe computers. One of its biggest selling points will be its use of a "magneto-laser" disk offering massive storage capacity in harness with full read-write capability.

The NeXT computer's 256-megabyte disk comes equipped with a library containing a dictionary, a thesaurus, a dictionary of quotations and the complete works of William Shakespeare - and still has room for 100 copies of Moby Dick. It even has a Digital Librarian, a powerful indexing and searching tool.

With this impressive storage capacity comes two VLSI (Very Large-Scale Integration) chips, claimed to endow the one-foot-square cube (containing NeXT's computing power) with mainframe-like qualities.

The NeXT machine is also claimed to produce compact-disc quality audio output. Furthermore, its use of Display PostScript - ensuring WYSIWYG (What You See Is What You Get) between screen and printer - allows it to be used as a desktop publisher. The package includes a mouse. Other software packages are included, such as a word processor, a mathematics program, a database server, a database manager, and a graphical electronic mail application with integrated voice-mail capability.

The powerful desktop computer features a speech system that will enable programmers to develop software that talks. The computer might eventually be able to recognize speech. It will have stereo sound and will be able to produce special sound effects, such as echoes and reverberation. Its video display will enable images to be enlarged or shrunk on the screen without distortion, while a laser printer will print the same image shown on the screen. The laser printer will be capable of higher resolution than existing printers.

The computer will use a version of the Unix operating system and a user interface from International Business Machines should make the computer more simple to operate. The NeXT application kit will enable software developers to write programs faster by combining prefabricated building blocks called "objects". Some of the technology is based on Objective C, a computer language developed by Stepstone. The computer will have a program that solves mathematical equations, a word-processing program and some reference works. Other software might include a statistical analysis program.

Merits of user programmable devices

The gate array market is changing. In many applications conventional mask-programmed arrays are being challenged by gate arrays which are user-programmable. These new devices offer the advantages of mass-produced standard products while overcoming the density limitations of previous generations of programmable logic.

Programmable logic devices (PLDs) based on AND-OR plane architectures have been widely used for some time. Although this architecture is effective for devices with up to a few hundred usable gates, utilization begins to fall off dramatically as more gates are added. The primary reason for this is the limitation of interconnect in this architecture. Custom ICs, most notably mask-programmed gate arrays, have offered the only path to logic integration levels comparable with memory and microprocessor devices.

Architectural innovation and advanced CMOS processes have resulted in user programmable gate arrays with thousands of usable gates.

The supporting manufacturing process is CMOS, with minimum geometries of 1.2 micron, and two metal layers for interconnection. These minimum geometries are needed to meet the density and speed requirements for the majority of gate array applications. Two metal layers are required for interconnect to implement the same kind of horizontal and vertical interconnect structure used in conventional gate arrays.

Choices among logic technologies are typically based on three factors: performance, density and cost. In most gate array applications, these factors are considered in that order.

Based on recent advances in architectures and processes, programmable gate arrays are challenging custom gate arrays in many applications. The eventual market split between programmable and custom gate arrays can be estimated by combining the market fractions addressed by programmable gate arrays for speed, density and cost. If these fractions are combined as independent variables, the conclusion is that programmable gate arrays address about 30 per cent of the production requirements forecast for conventional gate arrays, and should reach that market share as programmable arrays become more widely known and used.

Historical trends in the non-volatile memory market appear to be a relevant precedent for the evolution of the gate array market. EPROMs offer the same functions as mask-programmed ROMs, with the added benefit of flexibility. About 40 per cent of the non-volatile memories shipped over the last five years have been EPROMs. Over this same period, the price per bit ratio between the two solutions has been about 2.5. This is an interesting quantitative measure of the value of flexibility. As the cost per gate for programmable gate arrays approaches this same ratio compared with conventional gate arrays, a similar market share should result.

Another measure of market acceptance is based on the number of designs. The fraction of gate array designs done with programmable devices will reach 40 per cent in 1988, and is still growing rapidly. Just as EPROMs were a significant factor in increasing the use of microprocessors, programmable gate arrays are broadening the use of ASICs. (Source: Electronics Weekly, 21 September 1988)

Computers offer new horizons

Delays in the overcrowded civil air lanes at peak seasons can be much reduced, but not until the vast majority of aircraft in the air, and the air traffic controllers on the ground, are provided with more computer assistance and ground-air-ground data-link facilities, according to scientists at the Royal Aerospace Establishment, Bedford, UK.

The crucial item is the data link. Because an air traffic control system is only effective if it is accepted and used by all aircraft, there will have to be data-link equipment in virtually all aircraft.

However this is not likely before the late 1990s. A data link is one of the facilities in the new generation of secondary radar interrogators and transponders, and it will be 10 years before this equipment is universal.

The work at RAE is being done for the Civil Aviation Authority. Broadly, it adds close control of the time component of an aircraft's flight path to the current technique of control of the aircraft's position in three dimensional space.

Full four dimensional control, say RAE scientists, will raise the reliability of the planning of aircraft movements so that more aircraft at closer spacings can be allowed through a given air space. In the RAE scheme, once an aircraft enters ground radar range its plan for its flight path will be transmitted to ground control over the data link. A computer on the ground will compare this plan with the plans from other aircraft, similarly filed. It will correlate the timings and, if necessary, alter the plans so that there is no conflict of aircraft in time and space. The revised plan will be sent over the data links to the flight management computers of all aircraft.

RAE says that aircraft moving in air space can be thought of as moving bubbles. The dimensions of the bubbles depend on the time and space tolerances that have to be allowed around the indicated times and positions in space. The flight paths can be thought of as tubes through which the bubbles move, with the bends in the tubes liable to change to avoid conflicts in time and space.

The flight management computer of the 1990s should be suitable for the airborne job, with relatively small software supplements. The ground computing will be more extensive and complex and much work has to be done. A major part will be ensuring that potential computing errors cannot initiate a disaster.

The fourth element of the system is the airborne display. The best method of conveying to the air crew what is happening has to be worked out.

Beyond the range of ground radar, GPS (global positioning system) satellites will enable aircraft to fix position in three dimensions automatically, probably to within 100 m accuracy. They will transmit the position information to the ground regularly and automatically through communication satellites, probably in response to polling from the ground.

Hence the ground computer will be able to take into account aircraft approaching over the oceans long before they are in radar range. (Source: Electronics Weekly, 28 September 1988)

Cheap parallel power for overloaded scientists

Previously expensive parallel computing may now be within the grasp of researchers for applications that need very powerful processors, such as DNA and protein sequencing. Active Memory Technology, an 18-month-old company spun-off from ICL, the British computer company, has just launched a system called the distributed array processor (DAP) 610 which is far more powerful, yet cheaper, than most parallel systems.

Massively parallel computers such as the DAP, are the key to searching large amounts of data very quickly. Scientists at Edinburgh University's Biocomputing Research Unit have already developed software for protein sequencing which will run on the DAP. The software searches the huge database of existing proteins, to find sequences of amino acids which might help researchers to identify new proteins. The new DAP 610 could cut the time it takes to search the database by up to four times. This is because, in less than a year, AMT has improved the DAP's performance four times. The 610 costs £250,000, just over twice the price of the 510.

The key to these improvements is in linking more and more processors together. The 610 has 4096 processors, versus 1024 for the DAP 510, linked in a 64-by-64 array which can handle 4 billion operations per second. The DAP runs as a processor attached to Sun and Vax workstations. Its architecture is designed such that every instruction fed into the machine is acted upon many times.

Each processor in the array has its own memory, so data is available at exactly the point where the computing is carried out. This makes the machine much faster.

A wealth of software covering applications such as speech recognition, hydraulics and molecular modelling has already been developed for the processor. The first customer in Britain for the DAP 610 is the Hydraulic Research Station in Oxfordshire. It is using the system to model wave motions in the North Sea.

Plessey also plans to integrate the DAP into a radar system it is developing. This calls for "real-time" processing of data. Previously computers which can both gather information and process that information as it arrives have proved difficult to build. The DAP cuts through this because it can transfer data from processor to memory very rapidly, at 4.8 gigabytes per second. (This first appeared in New Scientist, London, 15 September 1988, the weekly review of science and technology.)

Computer advances keep waste in check

In the wake of Title III requirements of the Superfund Amendments and Reorganization Act of 1986 (SARA), interest in computer software and data bases used in hazardous waste applications has soared.

Following the implementation of regulations that require producers of hazardous materials to provide surrounding communities and emergency response groups with information concerning the toxic materials that may be located within or emitted from their plants, the need for technological advances to handle mounds of paperwork is stronger than ever.

A number of data bases and software is available to waste generators that will also allow them to comply with government regulations. And without the use of computers, most hazardous waste experts say, companies and government agencies would not be able to accommodate the 70,000 to 80,000 reports that are being filed annually.

Primary areas of interest to hazardous waste watchers also include daily housekeeping chores leading to waste minimization and emergency response systems.

Installation of such technology, sources say, can cost from $3,000 to $10,000 per system. And more sophisticated systems that link software with data bases can cost about $30,000 to $40,000, with some going for as much as a half million dollars.

A significant development in the computer industry itself is the evolution of smaller, more powerful computers that have eased the burden for chemical companies who use them. Computer modelling can help chemical companies and other users identify potentially risky situations, demonstrate ways to avoid them and provide vital chemical data should an emergency occur. Early systems were simple air conversion systems, but they have started to become more sophisticated each year. And while they can only predict the effects of one gas at a time, more recent models can track both dense and light gases.

Vapour cloud modelling is an important application for computer models. This involves calculating the path and concentration of a volatile cloud resulting from the accidental release of a toxic material. One model uses a system called "Systematic Approach for Emergency Response", or "SAFER", which was originally developed in the early 1980s by SAFER Emergency Systems Inc., a California-based research firm that is now a contractor with the company developing, designing and engineering systems for specific plants. The system is able to predict within a minute or two the path, concentrations and arrival and dispersal times of a vapour as it moves downwind.

Earlier models of air emissions also assumed that the ground was flat. But a topographical map of the terrain of the company's plant and surrounding community is fed into the system to help simulate the area over which a vapour cloud might be floating. Since the system can only track one gas at a time, other models can be combined by qualified personnel to estimate the combined effects.

Modelling systems are semi-quantitative. While no one can predict their accuracy because of site-specific scenarios, most cases can be predicted within about 10 to 20 per cent of the actual situation. However, modelling cannot handle the complexity of every situation; therefore it requires qualified individuals to interpret and modify information that is entered into the system.

These individuals feed weather data into the computer about every five minutes. Constant information, such as what chemicals are in inventory and where they are located within a plant, is also

updated to help the system keep an up to the minute watch on potential new modeling situations.

A larger, more sophisticated system is ENSR's "Distributed Dispersion Modeling System" ("DIDMS") installed at Union Carbide Corporation's North American plants. "DIDMS" was developed to provide companies like Union Carbide with state-of-the-art technology in air dispersion modelling. "DIDMS", said to be the only system of its kind, co-ordinates models used at different plants at one central location. Through dial-up telephone connections, six plants across the US are linked to a central technical centre in South Charleston, W. Va. The system has a capacity of 12 linkups, and four to six divisions of Union Carbide are expected to join by 1989. There is a possibility that the system might go worldwide, but only after modifications to the present system to allow it to accommodate more information.

"DIDMS" is capable of storing about one year of weather data on a computer and any number of years on a magnetic tape at its central location compared with the five-week capacity most systems offer. This extra storage allows companies to keep weather data on file that may apply to potential incidents.

Currently, "DIDMS" is being used to monitor model air emissions. But other applications may be included later. Next in line would probably be a system that works with surface water.

Special systems are also available for users who need to determine toxicity levels of certain chemicals.

CompuDrug USA Inc., Austin, Tex., has developed a system called "Hazard Expert" that will predict the level of toxicities for any given organic chemical compound on several levels of living organisms from amoeba to humans.

While the system is not yet commercially available, the artificial intelligence base will originate from a separate modeling of toxicokinetic and toxicodynamic behaviour of compounds and predictions produced by partial models that can be integrated into a single overall estimation of toxicity. The company was recently awarded a contract to develop a system for toxicity prediction for the US Environmental Protection Agency (EPA) based on "Hazard Expert" and EPA's own data base.

To help contact local authorities and citizens in an emergency situation, Digital Communications Research and Applications (DI/COM) of Lexington, Ky., has developed an automated notification system and crisis notification system (ANS/CNS) that it says allows a single operator at an ANS/CNS console, or at a remote computer linked by modum to an ANS/CNS, to pinpoint the geographic centre or path of an emergency.

The system then can record a special message or select an appropriate prerecorded message and deliver it to more than 3,800 individual telephone numbers in 15 minutes. (Source: Chemical Marketing Reporter, 21 November 1988)

Rewritable optical-disc drives

The first commercial rewritable optical-disc drives, complete with controllers and media, went on the market in October 1988, in a pioneering move by Sony Corp. of America, New York City.

The 5 1/4 inch SMO S501 drive is self-contained, incorporating a power supply and an interface for easy integration into a workstation. The SMO D501 consists of just the drive subsystem and is aimed at original-equipment manufacturers. In single quantities, each sells for $4,650, a price that eventually should decline enough to make the drives attractive for personal computers, said a Sony spokesman.

The double-sided disc cartridges are removable, to allow the user to transport and distribute stored programs. The EDM-1DA1 and EDM-1DA0 discs have 512- and 1024-byte sectors, respectively. When formatted, each individual disk has a usable capacity of 600 Mbytes, about the same as on the highest-capacity Winchester hard-disk drives.

The drives employ Sony's magneto-optic rewritable technology which provides users with a data-transfer rate of 7.4 megabits per second - about the same as the average Winchester drive. (Source: IEEE Spectrum, December 1988)

Pen and paper - the latest way to talk to a computer

An electronic tablet which lets a computer recognize and act on hand written instructions, has just gone on sale in the UK. The Penpad tablet, made by Pencept of Waltham, Massachusetts, produces perfect typewritten text on screen from rough text written onto the tablet.

The system is available from a small firm of British computer graphics consultants, Bergman and Company of London. Whitbread is already using it for telesales. Sales staff put a blank paper form over the graphics tablet and write orders onto it with an electronic pen as they are dictated by telephone. The pen writes on the paper, to give a hard copy, while generating signals which instruct the computer to register the order.

The computer industry has for many years struggled with character recognition. The pitfall is that different people write in different ways. A computer can be programmed to read text entered in a predetermined style, but Pencept found that it is impractical to force users to write in any particular style for very long. Pencept also found that it is difficult to train a machine to recognize a user's handwriting, because handwriting changes with time and circumstance.

The Penpad tablet has a conventional matrix of wires which register the position of the pen, and software loaded into the computer recognizes characters by decoding the pen strokes used to write them. An "I" is distinguished from a "l", by the imprint of one long vertical stroke, and two short horizontal strokes, at the top and bottom. This is far more simple than trying to register the overall shape of a character of text.

Penpad's software can be taught to recognize up to 37 letters and numbers and treat them as full words or instructions, for instance a scrawled Z is interpreted as the keyboard control word Zoom, D for Delete and so on.

Pencept acknowledges that many people can type as fast as they can write, and thus may not immediately see the advantage of "talking to" a computer by pen. Character recognition comes into its own when the user is performing a task which

involves switching between a keyboard for entering text, a tablet to enter graphic designs, or a pointing device such as a mouse to move a screen cursor. Because the graphics tablet can recognize handwriting and direction, there is no need to switch to the keyboard to enter a text instruction or use a mouse to point. (This first appeared in New Scientist, London, 15 September 1988, the weekly review of science and technology)

Voice-driven, hand-held computer

Advanced Products & Technologies (Redmond, WA) is getting set to unveil a new voice-driven, hand-held computer. The new 3 lb Voice computer will have the capability of recognizing natural-language speech input regardless of user dialect. It has six times the memory capacity and 100,000 times the file-access speed of an IMB PC. The computer also contains more 8- and 16-bit microprocessors than the PC. Additional features include a 16-line screen, custom chips and its own operating system. A cable that will permit communication with MS-DOS-based machines will be developed. Voice will also come with specially designed software, including voice-driven calculation packages, a voice pulled appointment calendar, and instant language-translation programs. Shipment is expected to be in late 1988. (Extracted from Computer Reseller News, 19 September 1988)

New translation system

Sharp's (Japan) new Duet-E J system translates English text into Japanese. The English language documents are placed onto a surface that resembles that of a photocopier, and a built-in dot-matrix printer produces a Japanese translation. A one-page document takes approximately 2 minutes. It takes one hour to translate 25 pages totalling 10,000 words. The Duet E J system consists of a CRT, a central processor unit box, a printer, a keyboard and an optical character reader. The optical character reader can read 100 characters sec., but cannot handle handwritten text or printed Japanese. Once read, the text is displayed on a screen for checking. The system asks about any words not in its 60,000-word basic dictionary, and the user can indicate which parts of the document are to be translated. The user can add 40,000 words to the system, and there are optional dictionaries available containing words related to economics, information processing, electronics and mechanical engineering. Sharp will begin producing the Duet-E J in September 1988 at a rate of 1,000 units a year. The system will sell for ¥7.71 million. (Extracted from Asian Wall Street Journal, 12 September 1988)

New digital audio tape

New digital audio tape (DAT) drives that are designed to store data rather than music will be released in late 1988. Sample quantities of the new DATA/DAT drives will be delivered by several manufacturers, including Hewlett-Packard, Sony, Hitachi America, and Gigatape. Production quantities are expected by early 1989. DATA DAT, which permits unattended backup of large disks, can store over 1 Gbyte on the same low cost, 44 mm tape cartridges targeted at the music industry. On the other hand, less than 200 Mbytes can be stored on 0.25 and 0.5 in. reel to reel tape drives. In order to perform a read-after-write function, DATA/DAT needs a second set of heads and accompanying electronics. Selecting the right error correction code (ECC) to make up for poor tracks is the primary difficulty associated with DATA/DAT. An industry group has been formed to help manufacturers develop a common formatting standard for the new device. (Extracted from Mini-Micro, September 1988)

Olivetti markets voice computer

Olivetti's "Speech and Language" Laboratory in Turin has developed a new device to translate text into voice. Called VOXPC (Voice Option for Personal Computer), the cost as an optional add-on for personal computers is 1.3 million lire (about $1,000). VOXPC can synthesize voice in three different languages (Italian, English, Spanish), and will be used in language teaching, proof-reading of texts dictated in the office, electronic mail, and as an aid for the blind. The Olivetti laboratory is also working on a computer voice recognition system with a 10,000 word dictionary in seven different languages. (Source: European Science News, August 1988)

A new consumer area

A new type of technology packs the power of a personal computer (PC) into your wallet. Smart cards, the size of credit cards, that to all intents and purposes behave like small PCs, are being considered to tackle the growing problem of football hooliganism. Although the UK has yet to capitalize on the wide range of applications that the smart card offers, banks, car manufacturers, health and education authorities are now piloting the technology in earnest. Suppliers of the cards believe that in 10 years' time, smart cards will be as commonplace as the cheque card is today, but far more of a flexible friend. They are the next generation PC. Semiconductor manufacturers expect smart cards to be their biggest market in the 1990s. The benefits are their size, their convenience and their price. In a GEC pilot scheme the Department of Health and Social Security has issued smart cards to 6,500 diabetics who take them when visiting their general practitioner, hospital, pharmacist or dentist. Because diabetes can cause a number of problems - in the eyes, the feet or the kidneys - different specialists treat each patient, and each gives a different diagnosis. Smart cards hold all the patient's data, which can then be read by each of the different specialists. The smart card cuts down on waste and frees money to be spent elsewhere. Other industries are ripe for the smart card. There are so many potential applications, and the more power, the wider the possibilities. As a rule of thumb, GEC expects to double the cards' memory capacity every two years - by 1990, Card Technology's intelligence contactless card will have a memory of 64 K - equivalent to a small personal computer. Three types of use for the technology are predicted: as a simple data carrier, as a means to control access or in the financial arena. The Midland Bank is already experimenting with the cards. Smart cards could help car manufacturers tailor their production lines. The cards could even replace tax discs and be read from outside vehicles by police or traffic wardens with a portable reader no bigger than the card itself: paperwork would be cut down and errors eliminated. Smart cards are one of the most secure forms of computing available. Cards can be individualized by a personal identification number, a digitized photo of the holder or even fingerprints. They could be the passports of the future. (Source: The Independent, 18 July 1988)

Lasers out-think the smart credit cards

Optical techniques that can store and protect data as well as prevent counterfeiting, are becoming big business. They may also supercede chip cards which are only just at the trial stage, because they have memories that are many hundreds of times bigger than the so-called "smart cards".

A "laser card" was demonstrated at an optical security conference in Zurich. The card, which is manufactured by Drexler Technology of California, holds 2 megabytes of data. This compares with the smart cards that are being used by the Department of Health in Devon to hold medical records in just 16 K of memory.

The optical memory card also has advantages over the smart card in terms of security. Because of its limited memory, the integrated circuit card can only protect data if it is encrypted before being recorded on the card. A laser card, however, can store more security measures, such as hidden serial numbers, which would make the cards almost impossible to duplicate.

With such a huge memory, there should be little chance of a card being used by the wrong person, either. If necessary, a card could hold a fingerprint, photo, voice print and signature and still have room for hundreds of pages of financial, medical, educational and other information. The manufacturers claim that it can keep all this information in different sections so that each requires a separate access code. This could mean that the same card could pay for meals in the company canteen and hold personal files.

Information is stored on the card by using a light source to make holes micrometres wide in a photosensitive recording medium. The recording device is covered in plastic and the card can last five years even in the most severe climates.

Trials have already started in Japan where the Sumitomo Bank issued laser cards to its customers. They can record all deposits and withdrawals and use the cards in shops. So far only one mistransaction has taken place out of the tens of thousands that have been made.

As well as keeping information secure, optical devices can keep money safe from counterfeiters. The Reserve Bank of Australia will be issuing 2.5 million banknotes containing diffraction gratings after the success of its revamped commemorative $10 note.

Shortly after it was launched, the manufacturers found that the reflective rainbow picture would crumble if rubbed repeatedly.

The bill had been tested for rubbing along with the many other tests which are standard in the banknote industry, and it had passed. The bank claims that the reason for this discrepancy was that the public in Australia, who can get new bills for damaged ones, decided to experiment and subjected them to extreme conditions.

Nevertheless, the bank decided to improve the durability of the grating by improving its coating and found a new test to check the results. They improved the wear of the grating by a factor of five. (This first appeared in New Scientist, London, 29 October 1988, the weekly review of science and technology)

Miniature chips track swarm of killer bees

The swarm of African "killer" bees, which is now in southern Mexico but is travelling north towards the US, has prompted American engineers to produce a microprocessor small enought to sit on a bee's back to track its movements. The device may not stop the swarm, but it could help to monitor its progress and warn populations in its path.

Engineers at Oak Ridge National Laboratory, in Tennessee, have produced a microprocessor which broadcasts infrared signals. The miniature transmitter, says one of its inventors, will enable entomologists to track the bees in the same way that miniature radio transmitters let biologists track wolves, whales and other large animals.

The chip contains solar cells, diodes which emit infrared radiation, a capacitor and circuitry to control the unit. The solar cells gather energy, the capacitor stores it to build up an effective charge and the diodes convert the power into infrared light, with a wavelength of about 800 nanometres. Entomologists will be able to monitor a bee's movements from a distance of one to two kilometres with a scanning receiver built by the team.

Kelly Palter, one of the three engineers who developed the chip, says it is the result of a talk given by Orley Taylor, a bee specialist from the University of Kansas.

Taylor is also interested in tracking bees as they gather pollen, and he hopes to discover how many flowers a bee visits per flight. The final version of the chip, Taylor estimates, will weigh about 35 milligrammes, about half the load that a typical 88 mg honeybee worker can carry. "We would like to know how far insects can move, and how they migrate. Such a small tracer ought also to find applications in manufacturing, in tracing components as they move through a factory," he says.

Although Oak Ridge is best known as a nuclear engineering laboratory, specializing in reactor controls, the chip is the second device the laboratory has developed to fight the bees. Last year Palter worked on a hand-held microphone that can measure the frequency at which the wings of bees beat. It flashes a red light for the fast beats of African bees, and a green light for the slower, European bees. (This first appeared in New Scientist, London, 22 September 1988, the weekly review of science and technology)

Mitsubishi pioneers the first 2 Mbyte ROM card

The 2 Mbyte mark for memory cards has been reached by Mitsubishi Electric, with the development of a one time programmable (OTP) read only memory (ROM) card.

Mitsubishi said that the card is similar to a floppy disk in capacity, quadrupling the previous high for ROM cards of 512 Kbytes.

A very thin integrated circuit (IC) with a thickness of 1 mm containing 1 Mbit OTP is behind the capacity increase. There are 16 such chips on the card. The card can store up to one million characters, equivalent to 1,000 pages of A4 text.

Applications for the card will range from computer controlled machines to portable PCs. Word processors which use ROM cards to store fonts can

like use of this card for higher definition characters, as well as for the creation of higher speed PC operation.

Marketing of the card will start in Japan in November with an intended production run of 150,000 units per month.

In the new year, Mitsubishi expects to announce the availability of a RAM card with 2 Mbyte capacity to complement the ROM card and the family of memory cards manufactured by the company. (Source: Electronics Weekly, 12 October 1988)

V. COMPUTER EDUCATION

The computers in teaching initiative

Developments in technology have made it now rare to find an academic, in any discipline, who does not aspire to have a terminal or microcomputer of some kind on their desk. Lecturers in all subjects are increasingly aware of the benefits of working in a rich computing environment - one where users profit from access to a high-band with campus communications networks, with links to national and international networks, and where there is a hierarchical arrangement of computing power. Ideally such an environment will benefit from user interfaces which are in some measure intuitive, emulating the way we think, and from computers which give at least the illusion of total control. Many university campuses are now moving towards such richer computing infrastructures, where with pervasive networking, access to IT will become an everyday reality for thousands of academics and their students. One area which stands to gain particularly from more computers is teaching. It is in teaching that the most promising market for future expansion lies. That does not mean that the day will come when philosophy students, linguists, historians or future medics will be forced to learn the nuts and bolts of computing for its own sake. Using computers in teaching does not mean teaching about computers, but rather exploiting IT to represent and communicate ideas within substantive academic disciplines. One model for work of this kind has been demonstrated in the Computers in Teaching Initiative (CTI). This joint programme of the UK University Grants Council and the Computer Board for Universities and Research Councils has sought over the past three years to encourage the development of computer-mediated teaching and learning throughout the whole of the UK's university community. There are 139 projects participating in this programme, covering almost all university institutions, and including at least one project in most disciplines taught at undergraduate level in the UK. The aims of the CTI are to promote the development of computer-assisted teaching and learning in universities, to evaluate the educational potential of the new technology, and to enhance awareness of IT among lecturers and students in all disciplines. (Source: The Times Higher Education Supplement, 17 June 1988, p. 6)

Better training urged on fourth generation users

Although training in fourth generation languages is urgently needed in the UK software industry, the job is largely left to suppliers, who do it inadequately.

This assertion comes from Patrick Raymont, chairman of the British Computer Society's (BCS) education and training committee, who believes that such training is now creating a bottleneck.

In a recent member survey carried out by the National Computing Centre, the lack of staff trained in fourth generation languages emerges as a key personnel problem among IT users.

The suppliers who provide full-scale training for their products often find that entrenched language attitudes of programmers, used to previous language generations, are forming an obstacle.

Others have found former third generation language programmers often want to skip learning the necessary manual functions and come unstuck in fourth generation language courses, having not learnt, for example, how file structures operate.

Jacqueline Kathirasoo, head of the Computing Services Association's training group, reckons development staff need improved training in how to decide on which applications are suitable for fourth generation languages and which are not. (Source: Computer weekly, 8 December 1988)

VI. SOFTWARE

Pioneering software and hardware marry

Two pioneering UK products are to be brought together with the development of the Generis knowledge-base management system on the Inmos transputer parallel processor.

Generis was launched in June by the new firm Deductive Systems for DEC, Sun and Hewlett-Packard machines running under Unix. It is claimed to be the first product of its kind in the world.

The transputer version will be offered as a circuit board for standard personal computers. After that Deductive Systems aims to put Generis on supercomputers from UK firm Meiko, which are made up of transputers running in parallel.

The work is being partly funded by a Department of Trade and Industry Smart award - Small Firms Merit Award for Research and Technology - which Deductive Systems received last week.

The award gives the company pounds sterling 37,500 this year and pounds sterling 50,000 after that.

Generis is described as combining the most advanced work on expert systems, artificial intelligence and relational data bases to provide a development system for knowledge-based applications.

The problems of marketing such a different idea mean the company aims to be profitable from month to month only by the end of 1989. But it is still pressing ahead. (Source: Computer Weekly, 1 December 1988)

Reusable software: passage to productivity?

What does reusability mean in software development? According to T. Capers Jones, president of Software Productivity Research,

Cambridge, Mass., it includes reusable data, designs, systems, programs, and modules or subroutines. Data, while appearing to be obvious candidates for reusability, are often isolated due to a lack of standard data interchange formats. The emergence of data interchange formats in spreadsheet programs and an awareness of the problems caused by dissimilar formats indicates that the future will be better than the past.

Not even the most ardent supporters of reusability are predicting that the legendary achievements made in hardware will soon be duplicated in software, but a growing number of software pundits see carefully designed and documented reusable software as a way of breaking the bottleneck in programming productivity. Several companies are reaping significant increases in productivity through concerted reusability efforts. Toshiba Corp. realized annual productivity rates in excess of 20,000 lines of source code per person-year as a result of utilizing reusable designs.

Other reusability advocates point to studies that show software productivity languishing at an increase of only 3 per cent to 8 per cent per year during the 1960s and 1970s. The processing capability of installed hardware, on the other hand, increased at a rate of 40 per cent or better per year.

Studies also found that likely 15 per cent of all programming code written in 1983 was unique, novel, and specific to individual applications. The remaining 85 per cent was common and generic and theoretically could have been developed from reusable components. Typical examples include Gregorian date edit routines, Gregorian to Julian date conversions, and edits and validation of part, employee, and account numbers.

The higher forms of reuse, namely designs and systems, show the most promise among researchers for future quantum leaps in productivity, but, by and large, these types of reuse have yet to have a signficant impact on the average programmer.

Since any program used by two or more users qualifies as reusable software, virtually all programming shops participate at this level through vendor-supplied and commercially purchased software. A large company's budget for off-the-shelf software, however, is typically dwarfed by spending for development of its own systems.

Commercial software can be disappointing in the reusability benefits it provides. One industry veteran gives the example of a client that bought a payroll package for $600,000 that was supposed to have been loaded with reusable, generic code. "Well, it took them one-and-a-half years and 20 people to make enough modifications just to install it. Why did it take 30 man-years to modify if you can just drop it in? Because you can't. And that was commercial code designed to be 'reusable'".

In trying to control software development costs, some MIS managers are exploiting - with notable success their existing software bases. (Extracted with permission of DATAMATION[r] magazine[c], 15 September 1988, copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

Compact analyser software

Electric Power Research Institute has sponsored an R&D project that has introduced software for a CRT-based power plant simulator. The Compact Analyzer software is easily configurable to a user's specific needs, it allows interactive simulations, and is adequate for engineering and training purposes. The training configuration involves a DEC VT100- or Televideo-compatible terminal as an instructor console. The engineering configuration includes one workstation with two monitors. Compact Analyzer uses an IBM PC with high-resolution graphics and a separate instructor console. The simulation software operates on a DEC Vax. EPRI in 1988 intends to integrate the system with a PC-based simulation code that uses special modelling methods to supply real-time performance for full-plant dynamic simulations. The resulting compact simulator will supply a generic software platform for interactive simulations, handle full-plant models for different kinds of coal-fired units, support real-time simulations using PC-based codes, operate on a PC AT or PC 386 with a multitasking operating subsystem, supply software facilities for adaptation to special uses by utilities engineers, and be capable of meeting single engineering and or training needs. (Extracted from Mechanical Engineering, August 1988)

Drug venture to use Eastern bloc software

A joint venture between a US technology transfer firm and a Hungarian co-operative has resulted in a new corporation that is trying to bring technology developed in the Eastern bloc to the West. The new firm, CompuDrug USA of Austin, Tex., specializes in expert systems software for pharmaceutical researchers and toxicologists.

The US company is the progeny of Kiser Research - a Washington, D.C., company that seeks to identify Eastern bloc technology that promises to prove useful in the west - and CompuDrug Ltd. of Budapest. The Hungarian co-operative is a group of more than 60 medicinal chemists, pharmacologists, computer scientists and other researchers. Headed by Ferenc Darvas, the Budapest firm is concentrating on software that uses artificial intelligence as a predictive tool.

CompuDrug also sells conventional software for molecular modelling, computational chemistry, statistical analysis and the like. But what sets the firm apart, according to CompuDrug USA's president and chief executive officer John P. Anerousis, are its expert systems programs.

For example, the firm's Metabolexpert program predicts what metabolic pathways a chemical compound will follow and the specific metabolites that will be formed from it.

Anerousis believes the software can be useful in designing and screening drugs, predicting toxicology and improving analysis of metabolites. Several US firms, including UpJohn and Marion Laboratories, have purchased Metabolexpert.

Another expert system program offered by CompuDrug is Prologp, which estimates the hydrophobicity of a compound from its structure. A third artificial intelligence based program, Hazardexpert, is due out before the end of 1988. Hazardexpert shares a starting point with

Metabolexpert but goes beyond that program to estimate the toxicity of a given compound towards seven different living organisms.

CompuDrug's software runs on IBM personal computer XT or AT models or fully compatible units. Metabolexpert and Hazardexpert versions that will run on Digital Equipment's VAX computers are under development. (Source: Chemical and Engineering News, 19 September 1988)

Expert tool offered to predict performance

That needling problem of how you predict the performance of a new application when it is up and running gets the expert system treatment in a software tool.

Taunton-based capacity planning specialist Metron is claiming its Perseus estimator will be able to tell at the design phase, to within plus or minus 15 per cent, how much machine resource an application will require.

At present, the question of how much processing power future applications will need is generally swept under the carpet by software engineers, who instead focus on applications' functionality.

Typically an IT department's annual capacity planning meeting is about all the attention that is paid to predicting the performance of future applications. Perseus attempts to make performance forecasts by using a knowledge base compiled by consultants at Metron which compares the application with past experience.

It will estimate for example how much disc space a file will occupy, and will warn if it foresees an overload on the CPU that could cause a drop in response time and throughput.

To begin with Perseus will be available for ICL VME systems, and will later move to DEC VAX as well as IBM, Unisys and Tandem equipment. (Source: Computer Weekly, 8 December 1988)

IBM supports the automated dream

The dream of a completely automated applications factory is behind IBM's commitment to an eight-year computer-aided software engineering (CASE) development programme.

Morris Taradalsky, IBM's general manager of the Santa Teresa laboratory in California, underlined his company's commitment to integrated CASE tools for the automation of applications development.

In time, IBM would deliver a full set of life-cycle tools. Some already existed as IBM products, some existed in IBM's development laboratories and some would be bought in from other vendors.

As for methodologies, it was not clear that IBM would support one directly. Instead, it would include a generic process manager within the repository which could enforce chosen design methods.

The repository manager is vital to IBM's vision of applications development in the future. Built upon the data base platform relevant to the operating system being used, the repository will include a common data model specifying how tools will store data objects.

Instead of the current arrangement whereby each mainframe software tool has its own data dictionary, the repository would hold the data definitions, only populating the relevant local dictionary at run-time. In this way, consistency across applications and systems products can be maintained.

An interface would be provided to the repository. This would allow third parties and customers to integrate their own tools into it.

IBM sees three main "threads" to future applications development. These were third-generation languages, such as Cobol and RPG III, fourth-generation languages, such as CSP and knowledge-based tools.

All three would take advantage of the facilities provided by the repository.

The repository is intended to meet the international repository standard, IRDS. It will eventually allow CASE and fourth-generation language users to store all their data definition and modelling information in one place, rather than attached to each program as at present. (Source: Computer Weekly, 17 November 1988)

See SPOX run

Digital signal processing (DSP) is busting out all over. Hot on the heels of the NeXT Computer System - the first workstation with a DSP chip built in - comes SPOX, the first operating system for real-time DSP.

SPOX was written by Spectron Micro-Systems Inc., a small software company in Santa Barbara, Calif. The goal is to give developers a quicker way to write more robust real-time DSP software, by providing a set of high-level software commands that each stand in for one or more assembly language instructions, making up a "virtual DSP machine".

Thus programmers need not know the assembly language of the DSP chip for which they write. Instead, they can simply code with SPOX's generic system calls to produce a final program that is easily recompiled for other or newer DSP chips.

The first chip to which SPOX has been adapted is the TMS320C30 from Texas Instruments Inc., Dallas, Texas. The 'C30 is TI's third generation of DSP chips, and it has many features - general-purpose registers and on-chip peripherals, for instance - that suit it to real-time control applications that formerly demanded general-purpose microprocessors.

Four components make up SPOX: a set of DSP mathematical functions that manipulate vectors, matrices and filters; memory management functions that put the programmer's application in control of data storage; stream I/O functions for data input and output independent of the specific peripheral device; and a real time kernel containing primitives for scheduling and synchronizing multiple prioritized tasks.

Using SPOX, a DSP application program can view elements of an I/O stream not as individual bytes, but as arrays of data blocks instead. These arrays can then be viewed as vectors, matrices or filters, each with attributes such as length and location that can be dynamically altered by the application.

As well as using the system calls for built-in math functions, application engineers are also free to write their own math functions in C30 assembly language and integrate them into SPOX, along with their own I/O device drivers.

While the extra processing by such an operating system increases execution time and code size, Spectron says the added overhead is marginal against the savings in development and maintenance. Each math function, for instance, requires 800 words of memory in addition to 2.5 K words for the generic portion. Spectron says, though, that the math functions are 5-25 times as fast as corresponding C code, with 2-8 microseconds of overhead time added for run-time checking (which can be disabled by the user).

An alternative for DSP applications has been the C language, but many C compilers for DSP chips are incomplete. Some omit PRINT or argument-passing functions, and most cannot work with the data objects - vectors, filters and streams - used for real-time DSP. SPOX, says Spectron, alleviates all these problems.

SPOX may be just the first in a flood of high-level software for DSP chips. In mid-October, TI also announced that it and Tartan Laboratories Inc., Pittsburgh, would jointly develop the first ADA compiler for a DSP chip. The chip is TI's SMJ320C30, a military variant of the TMS320C30: it is aimed at missile guidance and tracking, radar, sonar, image processing, and communication applications, among others. (Source: IEEE Spectrum, December 1986)

Software saves chips from the rubbish tip

Philips, the Dutch electronics company, has started to use a sophisticated collection of software, developed under the ESPRIT programme, to design the chips that will control its next generation of compact disc players and video recorders. This should mean fewer chips will have to be thrown away because they do not work or because they are too difficult to test.

At present, software engineers carry out about two thirds of the process for designing microelectronic chips by hand. This can take several months. Even then, there is no guarantee that a chip will work when it is made. About 70 per cent of chips have to be rejected because they are faulty.

A team that includes Philips and two other European electronics groups, Siemens and Alcatel, has developed a collection of software tools that drastically cut the time required to design and test chips. Applications such as audio, video systems, speech-processing and image processing, consumer electronics and telecommunications, which demand dedicated chips, could benefit.

The collection of computer programs, called Cathedral, contains knowledge about the consequences of any design decision which might change the speed of a chip, its size or how easy or difficult it will be to test. The designer tells the computer what functions the chip will have to perform. The program works out how the components should be arranged. It is possible to design a chip that contains 100,000 transistors in a few hours.

One of the Cathedral programs forces the designer to think about how the chip should be tested, and what functions should be tested. The verification programs then check whether the chip will adhere to accepted standards of good design practice. The program compares the chip against a collection of design rules held in a knowledge base. The system can point out the origin of problems and the researchers claim that it can find every error during a single run of the program. They say the system cuts verification from a week or more to about one hour.

Designers have already used Cathedral to produce an error-correction chip for compact-disc players which can "hide" any scratches on a disc, and a chip, known as a vocoder, for speech-processing. (This first appeared in New Scientist, London, 3 December 1986, the weekly review of science and technology)

Software teaches computer the art of the balancing act

Two research students at Bristol Polytechnic have designed software for a transputer - the computer on a chip - which allows the processor to teach itself to perform a balancing trick that only experienced jugglers can carry out with ease. The trick is to balance a pole on the end of a finger - a difficult feat of control that a computer has managed to solve theoretically, but which no physical system has ever demonstrated.

This type of self-taught control system could replace manual switches and valves in the manufacturing of chemical industries. For example, a transputer functioning as a controller could learn how to handle the flow of industrial slurries, which have very inconsistent densities and so behave in an unpredictable fashion. At the moment, complex problems like this, where a plant may need to mix precise volumes of different slurries, are usually monitored and controlled by hand.

The Bristol system is based on the skeleton of an ordinary printer, and uses the backward and forward motion of the print head to wiggle the pole. It takes advantage of the fact that the printer can identify the linear position of its cartridge.

The students have fitted optical sensors to the print head, which monitor the angle of the pole and the rate at which this angle is changing. The aim is to minimise the rate of change in the angle and keep the pole as close to a vertical position as possible.

The "learning" software, written in the transputer's own development language, Occam, requires a very large amount of computing power. The transputer can easily provide this, because it uses parallel processing, handling several pieces of data at once.

The algorithm uses a form of logic known as Michie's boxes to learn how to balance the pole. This process was invented by Donald Michie, a pioneer in the field of artificial intelligence. The software quantises four parameters of the movement of the pole and cart system. These are the angle of the pole and its angular velocity, the velocity of the cart and the length of the track.

There are hundreds of combinations of these parameters, each of which is called a software "box".

Inside each box is a switch which can move the pole to the left or right. The software has no concept of the length or mass of the pole, but simply learns which boxes are "good" or "bad". Good boxes are those which result in the pole balancing for a significant length of time. The software takes notes of bad boxes which cause it to fail, and tries to move only into good boxes. At first the system fails frequently, but after about 70 attempts it can balance the pole for up to three minutes. (This first appeared in New Scientist, London, 12 November 1988, the weekly review of science and technology)

Disaster recovery

Flood. Fire. Lightning. Terrorist Attack. Armageddon. There is no predicting what form a disaster will take. But when it does, you have got to be prepared. Traditionally, disaster recovery plans centred on the dp centre - after all, that is where the computers were. But with the pc revolution, the advent of departmental computing, and the addition of newer and more widespread applications to IS's workload, a corporate-wide disaster recovery system makes sense.

One company has developed just such a system. RecoveryPac, from Profile Analysis Corp., Ridgefield, Conn., takes a data base approach to disaster recovery planning, allowing the development in one place of any number of disaster recovery plans, utilizing a central set of corporate data. This facilitates co-ordination of the plans, says the company. Further, any change in the corporate data would be distributed to the various plans, guarding against human oversight.

The pc-based RecoveryPac, which runs under Paradox data base software, requires 640 KB. It includes guidebooks, forms for data collection, project management capabilities, and documentation. RiskPac, Profile Analysis' data collection product, can be included in a package with RecoveryPac.

Profile Analysis claims that the data base approach it uses in RecoveryPac is unique. It is evidently popular, too: the company reports 30 sales since March. (Reprinted with permission of DATAMATION® magazine©, 15 October 1988, copyright by Technical Publishing Company. A Dunn and Bradstreet Company - all rights reserved)

Software viruses: Pc-health enemy number one

A few days before Thanksgiving last year, a student at Lehigh University checked out a software disk from the microcomputer laboratory. Within minutes, he returned what he believed to be a faulty disk and asked for another. Before the day was over, this scenario was repeated dozens of times with students checking our floppy disks at the 15 microcomputer laboratories across campus and returning them immediately as inoperable. Officials at the Bethlehem, Pa., university knew something was dreadfully wrong, but they could not explain what had caused disks to go haywire.

Unbeknownst to students and staff at the time, the university's computers were afflicted by a software virus - a small, mischievous program written by a hacker as a practical joke or as an act of vandalism. Viruses, like their biological counterparts, are programmed to reproduce rapidly, debilitate hosts and spread like wildfire through a variety of carriers. Fortunately for Lehigh's computer users, the school's software analysts quickly identified the errant software and devised a "vaccine" program. Within days of the initial complaints, they had apparently eliminated the virus from software libraries in the microcomputer laboratories. Still, the virus had infected several hundred disks and probably disrupted the work of just as many students.

Although Lehigh University recovered relatively unscathed from its first bout with a computer virus, the well-publicized case augured the newest - and perhaps the most frustrating - problem in pc maintenance: diseased software.

More and more information systems managers are appreciating the destructive potential of this problem after watching viruses spread through their installations faster than the common cold. The pernicious attacks have affected personal computers for the most part, although mainframes can function as carriers and transfer virulent code to other pcs. In the past six months, virus reports have been growing with alarming frequency, and the virulent software shows no deference to business, government or academic computers.

Even commercially sold, shrink-wrapped software has been infected with viral contagion. Seattle-based Aldus Corp. discovered a virus last March in copies of its FreeHand product, a Macintosh design program. The virus, which displayed a harmless "message of peace", was inadvertently passed to Aldus by another company that prepares training disks for Aldus. Contaminated copies of the software were distributed to retail outlets for a few days before the problem was discovered.

While users are puzzling over the anatomy and biology of viruses, software vendors are rushing to the market with vaccine programs designed to detect or quash virulent code. John McAfee, president of Interpath Corp., Santa Clara, a firm that sells several antiviral products, knows of more than 25 different viral programs and he says the list is growing. Working closely with the National Bulletin Board Society, a Santa Clara-based, non-profit organization dedicated to certifying communications experts, McAfee's firm routinely analyses viruses and catalogues their behaviour patterns.

Most viruses known today were originally implanted by the hacker-author in existing systems software or applications software on a pc disk. These viral hosts include systems boot blocks and operating system utilities. The virus may be appended to an existing program or cleverly embedded in the program's code.

When the program is executed, the virus seizes control of the computer and tries to replicate itself by copying the viral code to a non-infected program on the same or another disk. After reproduction or attempted reproduction, which is carried out relatively quickly so as not to draw the attention of the user, the virus transfers control to the host program.

Following a period of reproduction, which varies from virus to virus, the disease usually will

surface by making some powerful and deliberate demonstration of its presence. This demonstration ranges from a benign - if annoying - display of a screen message, to the erasing of a hard disk without warning. While inflicting damage, viruses have been known to taunt users with messages.

Never, better-designed viruses, however, tend to mimic their organic-life counterparts, making self-preservation and global infection top priorities. They discreetly clone themselves and place copies on all available disk media, especially floppy disks - the conventional path for transferring programs and data between pcs. Their destructive behaviour is tied to an incubation period, so the virus will have ample opportunity to reproduce and the user will be less likely to associate subsequent problems with the acquisition of the infected software.

Some viruses are programmed to do no harmful actions for a set period. Depending on how they were designed, they could be programmed to reproduce or lie dormant. Others are triggered by a specific date. Still others link activation to random intervals or a predefined cycle. For example, a spread-sheet virus may slightly alter the results of a recalculate operation every hundredth time it is executed.

Once a virus is identified and removed from a system, one of the major challenges is to prevent reinfection.

The medicine a user can buy off the shelf for fighting viruses falls into two general categories: programs that help prevent viruses and programs that help determine whether a system has been infected.

Programs that prevent viruses are typically terminate-and-stay resident programs that monitor systems activity and watch for characteristic viral replication activities. They check all disk reads and writes and generate a warning message when potential viral activities are attempted. Such activities include writes to executable programs, systems device drivers, and boot blocks. This type of protection has the advantage of stopping viruses before they enter a system; however, viruses can be written to circumvent it.

The second category of viral protection software, programs that help identify an infected system, must first be installed on a known clean system. These programs work by periodically checking key information on the system disks (such as file date stamps, sizes, and check-sums, among other items), looking for changes that would indicate a virus has infected the system.

Vendors of vaccine software admit that their products are effective only against known contagion and will likely lag one step behind the latest mutant strains. Not only will new generations of mutants be more resistant, they probably will be much more difficult to detect because of increased complexity.

Some new viruses operate subtly with random and intermittent behaviour to ensure survival.

How to maximize the safety of your disks

Computer viruses range from crude, simplistic software to extremely sophisticated programming that may well be the work of several people. While it is impossible to eliminate totally the possibility of infection from these viruses, there are practical, commonsense ways to minimize the risks. The following material summarizes recommendation from virus victims and the vendors of antiviral products.

- If you are booting a pc from a floppy disk, always use a single write-protected copy of the original system disk. Booting from borrowed, unknown or multiple disks greatly increases the chances of infection.

- If your pc has a hard disk, use it for booting if possible.

- Treat all public domain software and shareware as if it were infected. There is at least one virus that masquerades as software that gives instructions for a populare shareware vaccine program; while displaying instructions on how to combat viruses, the virulent software erases the hard disk. If you must use software obtained from a public source, execute it on a standalone pc without a hard disk, so that it has no chance of infecting other disks. In the case of shareware, obtain a copy from a secure source, such as the original author, rather than from a bulletin board or a friend. Friends or acquaintances might in all good faith recommend a program that they do not realize is infected.

- Write-protect all floppy disks that you do not expect to be writing to. Remove floppy disks from drive slots when they are not being referenced. As yet, there is no evidence of a virus jumping from a pc's memory to a floppy disk that is not inserted in a drive.

- Watch for changes in the behaviour of your pc. Do programs take longer than usual to execute? Does a device light turn on when there should be no activity on the device? Is there a sudden reduction in available memory or disk space? Any of these signs could be symptoms of viral activity.

- When using resources on another person's pc (a laser printer, for example), transfer the necessary data on a disk that contains no executable code. Exposing executable programs to foreign pcs increases the chances of viral infections.

- When using a publicly accessible pc, turn the machine off to clear its memory from viruses possibly left behind by the previous user, and then turn it back on to begin work. Rebooting in itself will not necessarily clear a virus. The machine must be powered off.

- If you must work with high risk software, namely, public domain software or shareware or in an environment known to have viral infections, consider the use of antiviral agents.

Viral invader spreads havoc in American computers

Thousands of computers across the US were brought to a halt for up to 36 hours when one of the largest computer networks in the world was invaded by a highly sophisticated software virus. The virus destroyed no files but spread rapidly and clogged computers with useless information. Internet, the network it attacked, links computers at about 600 sites in the US including universities, NASA institutes and the Department of Defense. As many as 20,000 computers were infected with the virus.

Delays while the computers lay idle during purging will cost an estimated $100 million. A spokesman at the Defense Department denied that the virus had breached national security. Classified files were not involved.

As word spread that the virus was jumping from computer to computer across the network, some institutions were reluctant to act because authority could not be obtained to close down computers or to shut gateways to other computers. The problem was compounded because the virus was first detected in California at night.

The version of UNIX invaded by the virus was developed by the University of California at Berkeley. The software, known as Berkeley 4.3, runs on VAX computers made by Digital Equipment Corporation of Massachusetts and on workstations made by Sun Microsystems of California. Both computer systems are widely used by Internet and its subsidiary networks, Arpanet and Milnet. These networks typically transfer unclassified material between universities, research laboratories and contractors for the Defense Department. They are also linked to overseas networks - the virus is believed to have spread to Australia and to the Federal Republic of Germany.

The Berkeley software contained a "de-bug" feature designed to track down problems in the exchange of electronic mail. The feature was meant to prefix connections with other computers before being removed.

The virus, which contained about 50,000 bytes of program and 5,000 lines of code, would have taken several months to write. The virus - which some people refer to as a "worm" because it replicated itself without damaging files - used electronic mail to send a 100-line "trigger" program to a target computer.

The program was able to bypass the "de-bug" feature and reconnect with the parent computer. Once reconnected, the trigger program copied the rest of the virus into the computer "victim".

But, according to people who have analysed the program, the virus rampaged through each computer quickly filling up entire memories. The instructions told the virus how long to wait before copying itself and how many copies were to run on each machine. (This first appeared in New Scientist, London, 12 November 1988, the weekly review of science and technology)

CSA responds to threat of hackers and viruses

The UK Computing Services Association (CSA) has finally responded to the growing threat to computer security posed by hackers and so-called software viruses.

The group has issued guidance on how to prevent, detect and recover from security risks to heighten awareness of the need for data security, now a legal requirement of the Data Protection Act. The CSA hopes the advice will help guard against a repeat of the network chaos caused in the US when a rogue software program jammed thousands of computers.

The American incident occurred when a student prankster inserted a programme in a defence network, intending it to live there, undetected and harmless. But a one-digit slip-up in the code caused the program to multiply itself across the Arpanet system, the US Department of Defense research network.

It also crippled thousands of computers through Internet (an international computer network) at US universities and government research laboratories.

The CSA note offers only general advice on data security as it says each organization's security needs are different.

The CSA note briefly defines some of the terminology used to describe the more common software risks, like attacks from logic time-bombs, Trojan horses and viruses. It also defines upstream, in-house and downstream risks.

These include risks to the computer service supplier who buys packages; staff introducing problems by accident or design; and the risk of those with access to products either failing to comply with security requirements, returning corrupted products to customers or pirating software and modifying it. (Source: Computer weekly, 17 November 1988)

'Desktop' much more than words

Like any craftsman's tool, desktop publishing does not give good results in the wrong hands. Desktop publishing equipment puts many of the graphic designer's tools into lay hands, but does not give its user the skill or visual flair the designer has gleaned from his training. DTP software makes the technical elements of design accessible to everyone, but there is more to successful document production than being able to line up text with pin-point accuracy. Early efforts often resemble typesetter's sample sheets as typefaces, column widths, font sizes and line rules litter the page with merry abandon. The result is invariably a mess, despite its technical virtuosity. The design of a document should be the servant of the information it contains, not the master. If it attracts attention away from the text, it has failed. A good starting point is to switch the computer off and spend some time gathering a number of documents aimed at the same sort of readership as yours. Look for common design features and make a few fundamental decisions about how a document will look. The majority of books, magazines and newspapers select their body copy typefaces from variations on no more than a dozen

old favourites, many of which are almost indistinguishable from each other at a casual glance. This is purely on the grounds of legibility. Once this basic criteria has been established, it should be followed consistently throughout the document. Disciplined editing can improve the impact and readability of the message, as a careful rereading can reveal redundant words or phrases which would be better eliminated. Further detailed editing may also be needed to eliminate the piquantly named "widows and orphans" - the first or last line of a paragraph which spills over the bottom of a column or page. In human terms, one of the dangers of the desktop publishing process is that too much can be done by one man. If the whole document, from the initial copywriting to the design, proof-reading and printing, is handled by the same individual, silly mistakes often survive right through to the finished product. (Source: The Times, 19 September 1988)

Two new desktop publishing programs

Desktop Publishing has recently received a couple of shots in the arm. The two leading pc-based programs have both been improved in the last few months. Earlier this month, Xerox Corp., San Diego, brought out a new release of Xerox Ventura Publisher, as well as a souped-up version aimed at professional publishing applications, and a version for use over a network. In May, Aldus Corp., Seattle, began shipping its new version of PageMaker.

According to Dataquest Inc., San Jose, Xerox Ventura Publisher 1.1 holds 62 per cent of the MS/DOS-based desktop publishing market. Xerox is advertising increased ease of use and ease of training with release 2.0 of Ventura Publisher. Arthur E. Coles Jr., vice-president and general manager of the Xerox desktop software unit, says that the new version also has the ability to do colour separations.

The new version is priced at $895. The upgrade price is $85, but discounts are available to users that subscribe to the support program. The Professional Extension module, which provides advanced desktop publishing features and support for larger documents, is priced at $595.

According to Coles, the Ventura product is the first pc-based desktop publishing program to come out in a networked version. The networked version is targeted at work group applications, such as newsletters and annual reports. Pricing for the Network Server has not been finalized.

Aldus Corp.'s spring release of PageMaker, which Dataquest estimates to hold 34 per cent of the MS/DOS-based desktop publishing market, was garnished with the following features: user-defined style sheets; support for long documents; enhanced graphics capabilities, such as the ability to wrap text automatically around rectangular graphics and customize wraps for irregularly shaped graphics; and user interface improvements, including built in templates.

PageMaker 3.0 is $795. The upgrade price is $95. For subscribers to Aldus' Extended Technical Support Service, the upgrade price is $47.50. (Reprinted with permission of DATAMATION[r] magazine[c], 15 September 1988, copyright by Technical Publishing Company, A Dunn and Bradstreet Company - all rights reserved)

Take a copy

Computers chew up data, lose programs and ruin discs: users delete wanted files, mess up software and mislay information. Chaos lurks perpetually, ready to pounce the moment you relax. The causes are many and often mysterious. One cause is that microcomputers are seldom protected against fluctuations in mains voltage. A sudden sharp change in the electricity supply can upset the delicate constitution of a chip and cause such indigestion that work is wiped off or the program being used is degraded. Switching on an electric typewriter plugged into the same circuit can send down the mains cable an electrical spike on which precious work is impaled. Clumsiness, ignorance, or the innate viciousness of inanimate objects causes a foul-up. After the first time an expensive program vanishes, another convert is made to methodical procedures for keeping copies of everything: the back up. People who have been at it some time have strict rules for frequent and regular copies: Make a copy of every program as soon as received and work only from copies. In addition, at regular intervals you make a routine copy of all working data files. But in many businesses the volume of data to be backed up would require a long series of floppy discs and that would be an inconvenient bore. One alternative is an external hard disc drive plugged into the back of the machine, onto which back-ups from an internal hard disc can be made. But the copy remains next to the original on the same desk. For real security they need to be separated. Recently we have seen the arrival of drives with removable hard discs but probably a cheaper option is the tape streamer. It has the disadvantage of being slow to record and access, and the cassettes are grossly overpriced, but on the whole it is a simple and straightforward system. To save time at the copying time you can put relatively stable and fixed files onto one tape which need not be updated every time and record regularly only those that change. The major health hazard in computing is not from the much-discussed VDU radiation but high blood pressure from the fury and frustration of the notorious aaaaargh factor. Systematic backing up may help you live longer. (Source: The Daily Telegraph, 22 August 1988)

Computer logic

If the computer were asked, "Can you tell me the time?" it would answer logically and correctly, "Yes". Of course, this would not be a satisfactory reply. Scientists in Munich are trying to teach the computer to understand what is actually meant by such questions. Their computer "Spicos" in Munich has already made some progress in this direction. Using its vocabulary of 1,000 words it is estimated that it can form 1.5 million sentences. However, they are extremely simple sentences. The computer does not understand subordinate clauses, dialect throws it into utter confusion, and it also has to make a pause between each word that is speaks. When talking to people the computer has to process huge masses of information, which would even be a problem for the largest supercomputers. All the same, the scientists believe that "Spicos" will, in the not too distant future, be capable of giving satisfactory information in reply to spoken questions on certain special subjects, for example

medicine, literature, share prices or coming events. (Source: Scala, 6 November 1986)

Databases

TEKTRAN (Technology Transfer Automated Retrieval System) contains summaries of 6,000 brief, easy to read summaries of the latest research on genetic engineering, safeguarding crops and animals from diseases, biological control of pests, human nutrition and other fields. Write: James T. Hall, National Technology Transfer Co-ordinator, USDA-ARS, Room 403, Building 005, BARC-west, Beltsville, MD 20705, USA. Tel: (301) 344-4045.

SEPASAT - Survey of Economic Plants for Arid and Semi-Arid Tropics - is a databank which aims to collect and preserve knowledge about the local uses of plants in their native areas which are being lost as traditional custom collapse. It collates information on some 6,000 plants from the dry regions which have been reported useful but have not been commercially exploited. Write: SEPASAT, Royal Botanic Gardens, Kew, UK. (Source: Development Forum, Vol. XVI, No. 6, November December 1988)

Adaptation of data processing technology for Arabic

As a Moroccan, an Egyptian, or a Saudi, one can use data processing today without resorting to English or French. But most of the systems being offered come from abroad.

The pressure currently being generated to adapt data processing technology to the Arabic language appears intended to safeguard the economic and cultural interests of the Arabic world. From Morocco to the Emirates, the enactment of legislation requiring the incorporation of Arabic in data processing applications is becoming widespread. Thus, the use of this language in data processing has now left the domain of theoretical research and entered that of industry.

According to the Pierre Audinet Conseil (PAC) consulting firm, the Arabic market absorbed some 10,000 workstations during 1987-1988. This provides a measure of its importance. Moreover, all the producers of data processing ware have understood that, to be able to penetrate this market, they must offer systems (terminals, personal computers, printers and Arabization software) capable of word processing in both the Arabic and Latin alphabets.

What basic concepts must go into these "bilingual" systems? The first is "contextual analysis". The letters of the Arabic alphabet are very closely linked to one another and can assume four different forms depending on their position within the word. The same letter is written with slight modifications depending on whether it is located at the beginning, within, or at the end of a word; and depending on whether it is isolated or not from the rest of the text. They also differ as to their calligraphic aspect. The Alif is narrow, whereas the Sin is broad. Unlike text written in the Latin alphabet, Arabic text therefore cannot be displayed by a mere juxtaposition of characters. For every character, an algorithm (the contextual analysis algorithm) must select the correct form to be displayed.

The second essential point is "offsetting". Apart from the fact that the form of the letters differ, Arabic is written from right to left. A bilingual terminal therefore must be able to display words from left to right (English or French, for example) as well as from right to left (Arabic). "Offsetting" consists of totally masking the direction of the display from the standpoint of the applicational software, and of considering a bilingual text as if it were a normal text. The software involved must thus function as an interface between the image on the screen and the screen itself.

The third important point for the realization of a bilingual word processing system is a standard for the coding of Arabic characters. Some 10 years ago or so, most designers of bilingual systems used different coding techniques. The result was a proliferation of customized facilities, adapted to specific configurations of hardware and software, and decidedly incompatible with one another. "This incompatibility," according to Adel Chalouhi, president of Integre (producer of bilingual data processing hardware), "is found among products of the same producer and even among different versions of the same product. This has all led to numberous inconsistencies, severely handicapping Arab users." It was specifically to remedy this situation that the ASMO (Arabic Standardization and Metrology Organization) in 1982 adopted a set of Arabic characters with a 7-bit code for the exchange of data. This code, known as ASMO 449, has still not won universal approval, but it has opened the way to data processing transparency between the Latin and Arabic alphabets, enabling portability of foreign programs and systems without the need for any design or physical modifications whatever.

The Europeans and the Americans are today the most active in the Arabization of data processing. On the other hand, the co-operation and investments in this sector by Arabic countries are negligible. Mohamed Azzedine, manager of CIMOS, states, "A few years ago, the representatives of the Arabic countries at the United Nations and UNESCO worked together to gain acceptance of Arabic as an official working language in these two international bodies. Today, the Arabic data processing specialists need to co-ordinate their efforts to ensure that Arabic is taken into account from the very start by the designers of operating systems (MS-DOS, UNIX, etc. ...) and by the designers of compilers (Basic, Pascal, C, L4G, etc. ...) and application software (Word, DBase III, etc. ...), with designs based on transparency."

Arabs must also not lose sight of the fact that, if foreigners Arabize their products they do so with the sole aim of accessing the Arabic market. Some projects, like that of the Aliph Institute (France), nevertheless, do have cultural aims. Notably, this Institute, headed by the young "beur" engineer Rachid Kechidi, has developed a Universal Islamic Data Bank (BUDI) (see J.E. No. 1306 and J.A.E. No. 98), which, to date, makes available over 22 million characters of data and over 514 programs. This data bank contains the entire Islamic heritage (Koran, tradition, law, dogma, history) and can be accessed by way of the Teletel network and by any personal computer. (Source: Jeune Afrique, 4 May 1988)

Arabization: Who does what

(This list is not exhaustive. Large-scale manufacturers, such as IBM, Bull, Unisys, NCR, ... etc., who also offer Arabized products, have not been included.)

Firm or institution	Country of origin	Principal products
ACTIFS	France	Software on Arabic morphology and grammar drills, designed for secondary school pupils and undergraduate students, for Thomson and IBM computers.
ALIPH	France	Universal Islamic Data Bank (BUDI): trilingual: Arabic, French, English. Software on Koran, Hadith, Muslim law, Muslim history, prayers, Arabic language ... etc.
ALIS	Canada	Bilingual terminals. Arabization software. Arabic-Latin languages printers.
ALT	France	Bilingual data processing systems.
APTEC	United Kingdom	Educational games, strategy, simulation.
Arab League Documentation Center	Tunisia	Aliph Bibliographic Data Bank on HP 3000 and Falcon Arabized Minisis microcomputers.
Arabic and Pedagogy Association	France	Computer-aided instruction software for both secondary school levels.
Association of Arabic World Data Processing Specialists	France	Unification of data processing terminologies. Publication of bilingual data processing dictionaries and of data processing educational books for children.
AVERROES	France	Islamic data banks.
B.B.S. S.A.	France	Office automation and multilingual communication softwares for microcomputers.
CASH	Saudi Arabia	Computerized English-to-Arabic translation system.
Lebanon University Juridical Data Processing Center	Lebanon	Islamic law data bank.
CIMOS	France	Arabic-Latin languages terminals, bilingual word processing, PC Arabization software, bilingual plotter.
CNRS/University of Lyon I	France	Software for MOS in nano-network and compatible IBM PC. Publication of bilingual texts in Turbo Pascal.
CREL International	France	Arabic-Latin languages terminals, Arabic-Latin languages dot and laser printers, Arabic-Latin languages data processing.
DIWAN	United Kingdom	Multilingual software, word processing, educational programs.
Falcon	United Kingdom	Bilingual office automation, multiple-user bilingual network systems.
Gachot	France	Computerized translation system: English to Arabic, French to Arabic.
Ganymede	France	Arabization software.
IDS [International Data Soft]	Tunisia	Software for Macintosh computers
IERA [Institute of Studies and Research for Arabization]	Morocco	Coding and Arabic script standardization problems. Bi-alphabetic terminals.
Arab World Institute	France	Documentary data bases (monographs, films, audio visual documents) for HP3000 and CIMOS terminals.

Firm or institution	Country of origin	Principal products
INTEGRO	France	Data processing engineering, multilingual (Arabic, Greek, Cyrillic) office automation and data processing systems, satellite data and image processing.
Language and Data Processing	France	Software using Arabic and Latin language fonts.
Micro Hexa	France	Arabic Macintosh Plus.
Microgenie	France	Arabic word processing, Arabic, French, English Koran software.
Sakhr	Kuwait	Arabic-Latin languages Sakhr microcomputers, bilingual peripherals, educational, Koran, word processing, ... etc. softwares.
Spectra	France	Multilingual softwares.
Nejma System	France	Trilingual (French-Arabic-English) syntaxic and probabilistic system of indexing and searching for textual data.
University of Lyon II	France	Expert system for computer-aided instruction.
Wang	United States	Arabic version of PACE [Professional Creation and Creation Environment] and of Wang Office. Wang word processing (Collis Polyglot) is to be added to these two products.

Different forms of Arabic characters and their Latin alphabet equivalents

Start of Word	Within a Word	End of Word	Alone	Latin Alphabet Equivalent	Start of Word	Within a Word	End of Word	Alone	Latin Alphabet Equivalent
ا	ـا	ـا	ا	a	ظا	ـظا	ـظا	ظا	dhā
ب	ـبـ	ـب	ب	b	ط	ـطـ	ـط	ط	tā
ت	ـتـ	ـت	ت	t	ظ	ـظـ	ـظ	ظ	dhā
ث	ـثـ	ـث	ث	th	ع	ـعـ	ـع	ع	ʿa
ج	ـجـ	ـج	ج	j	غ	ـغـ	ـغ	غ	gh
ح	ـحـ	ـح	ح	ḥ	ف	ـفـ	ـف	ف	f
خ	ـخـ	ـخ	خ	kh	ق	ـقـ	ـق	ق	quā
د	ـد	ـد	د	d	ك	ـكـ	ـك	ك	k
ذ	ـذ	ـذ	ذ	dh	ل	ـلـ	ـل	ل	l
ر	ـر	ـر	ر	r	م	ـمـ	ـم	م	m
ز	ـز	ـز	ز	z	ن	ـنـ	ـن	ن	n
س	ـسـ	ـس	س	s	ه	ـهـ	ـه	ه	h
ش	ـشـ	ـش	ش	ch	و	ـو	ـو	و	ou
ص	ـصـ	ـص	ص	sā	ي	ـيـ	ـي	ي	ī

Look and learn computers

One of the core areas of research on the fifth-generation computer aims to produce a machine that can talk to humans in their own "natural" language. Icot has spent much of its time over the past seven years developing systems to make this possible. The result so far is a system which can read and understand sentences in Japanese, then answer questions on the text.

The system, known as Duals (Discourse Understanding Aimed at Logic-based Systems) works with one particular piece of text, taken from a book used by 11-year-olds in Japanese schools. It contains 2,000 different words in 200 sentences. In order to understand any other piece of text the system would have to "learn".

At first Duals would be fairly slow, and sometimes wrong, when answering questions on an unfamiliar piece of text. For example, it would have to learn that an animal can be a four-legged beast or a football hooligan, depending on the context.

Two researchers from Icot showed that Duals has to make inferences and solve problems in order to reply to questions. It does not simply compare phrases in the question and match them with similar phrases in the text. The first sentence of the text is: "Man's continued existence on Earth is inseparably dependent on the blessings of nature." Duals takes 10 seconds to work out the answer to the question: "What does man depend on to continue to be able to live on Earth?" First, one module of the system must work out that man lives on Earth, because that is not stated directly in the text. Then another module finds the subject attached to the word "dependent", and another constructs an answer. (This first appeared in New Scientist, London, 15 December 1988, the weekly review of science and technology.)

Expert software teaches air traffic controllers a lesson

The UK Civil Aviation Authority has awarded Logica, one of Britain's leading software houses, a two-year contract to develop "intelligent" software to train young air traffic controllers. At the heart of the software will be a series of "knowledge-based systems", software that relies on a data base of rules of thumb gathered from experienced controllers.

The training system, which should be ready by next summer, will be known as Aviation. The College of Air Traffic Control at Bournemouth will help to design the system, which will guide cadets through the course according to their knowledge and experience, judging the pace of each student as the program runs.

Logica claims that the level of intelligence that will be built into the software is what makes the system unique. It will adapt to each cadet, and store a profile of that person and his level of skill. The subject material, which will appear as computer graphics, as text or as video, will take the students through flight theory, aircraft performance and aircraft recognition.

The air traffic training college commissioned the system when it found that even its brightest students, who perform well in tests of theory, often come unstuck when they face a real situation. The system aims to bridge the gap between the classroom and real life by simulating an airfield.

This prototype has three knowledge-based systems behind it, each with a set of rules which experienced controllers use to make their decisions. Every instruction that the student sends out to an aircraft or to other vehicles, such as fire trucks, is displayed on the screen. At the moment, fully trained controllers still rely on strips of paper, on which they jot down the last instruction they issued to each aeroplane, such as details of wind speed or atmospheric pressure.

The clever part of the system is that it notes the student's mistakes continuously. It has its own knowledge of what each of the vehicles on the airfield wants to do, and whether each is satisfied with the commands it receives. The system builds up a profile of the cadet's performance, and a picture of the strengths and weaknesses of each student. It can then create scenarios where the students have to practise their individual weak points. Some of Britain's most advanced air traffic controllers have used the system, and even they found that it is uncanny in its ability to pick out their weaknesses. (This first appeared in New Scientist, London, 29 September 1988, the weekly review of science and technology.)

VII. COUNTRY REPORTS

Australia

Software opportunities down under

Despite its relatively small size in world terms the Australian computer market is a fiercely contested one, with new players continuing to enter the fray. It is dominated by the Americans and the British, on the one hand, who see it as another market in which products can be released with little change. The Japanese also have a considerable input, since they tend to view it as a nearby Western market in which to test products before selling them further afield.

Trade figures for 1986-87 for the two main categories classified by the Department of Foreign Affairs and Trade, "ADP machinery" (computers) and "equipment and spare parts" (including software) give a good indication of where Australia stands vis-à-vis other major world technology centres. The figures show a massive differential of nearly six to one, with Australia importing $2,263.1 million worth of computers and software and exporting a mere $390 million. The demand for computers and software, the second biggest commodity item in the past two years, makes up 6.1 per cent of Australia's total import bill.

It is not too surprising to find that the two biggest exporters of computing equipment to Australia in 1986/87 were the United States ($696.9 million for computers $339.7 million for equipment including software) and Japan ($439.9 million/$165.6 million). In third place comes Taiwan, that massive exporter of IBM-type clones ($91.9 million $19.6 million) and in fourth place is the UK ($69.1 million/$26.4 million). A big surprise for many Australians, however, is to find Ireland in fifth place ($66.5 million/ $7.7 million) and ranked in sixth place is neighbouring Singapore ($52.8 million/ $6.0 million).

Further down the ranking in overall terms, but with a healthy ratio of equipment and software products, are Canada ($8.0 million/ $14.2 million) and the Federal Republic of Germany ($32.4 million/ $19.7 million). With no Australian-owned computer industry, export figures for computers are unimpressive, but the export of equipment and software is clearly growing, particularly to the United States ($00.0/ $55.6 million), and to neighbouring countries in the Pacific region, such as New Zealand ($30.8 million/ $57.4 million), India ($9.8 million/$16.0 million) and Singapore ($7.5 million/$14.2 million).

The massive dependence of Australia's information industry on foreign technology is partly a reflection of the failure of successive governments to recognize adequately the current impact of this industry and its potential for growth. The recent budget statement, however, did bring some relief to the software sector with the decision to have no sales tax on customized software, while retaining the 20 per cent level on packaged products. The recent government decision to promote partnership agreements with multinational computer companies is also an attempt to change Australia's poor record in research and development.

In the market for large mainframes, IBM dominates and only IBM "compatible supplies" are making inroads. Government departments, major purchasers of computers, have bought some non-IBM machines such as UNIVAC, Honeywell, Burroughs, and both ICL and Central Data have been particularly successful with government contracts. Yet in the first half of the 1980s, Honeywell and Burroughs both dropped in market share from 10 to 5 per cent, while Fujitsu, Japan's largest computer company grew from 5.4 to 13.7 per cent.

In 1986 IBM's Australia subsidiary broke the $1 billion mark for the first time. In 1987 it built further on that performance, announcing revenues of $...12 billion and an operating profit after tax of $49.6 million. Data in late 1988, however, reveals that while IBM still dominates the mainframe market, DEC will control almost one quarter of the market for mid-sized computers.

From 1985 onwards personal computers in the price range $1,000-$8,000 accounted for 32.5 per cent of the total market in value terms, and thus had taken over from medium-scale systems which were 31.5 per cent of the market in 1984. The PC's share of the market further increased to 36.1 per cent in 1986. In 1985 the three frontrunners in the $1,000-$8,000 PC market were Apple (18.7 per cent), Commodore (9.1 per cent) and IBM (9.2. per cent).

Computer research organizations in Australia have recently come in for severe criticism because of their widely differing methodologies for devising market share. Apple's representatives have been particularly critical of the "fudging of figures behind a smokescreen of direct sales, mainframes and photocopierr". This criticism, however, reveals a nervousness among the traditional suppliers with the successes of newcomers such as Amstrad and Commodore. Apart from the recent arrivals to the scene, a longer-term threat in the PC market is from the Taiwanese IBM-style PCs. In the past year Taiwan conquered more than 25 per cent of the world market with their IBM clones, exporting three million machines, worth $US 1.3 billion. While the makers of cheap clones might be seen as making contemporary technology more available, they are also pillagers of the technology industry, exploiting the efforts of the committed developers.

There are three main sections in Australia's software industry: packaged software, professional and processing services (includes system design and integration consultancy), and training and facilities management. Professional services is the highest growth segment because of the increasing importance of consultancy and after-sales support services. A large variety of companies make up the software industry but they can be classified into two main groups: those who conduct in-house software development, e.g. banks, mining companies and hardware companies, and independent software houses. Among the latter group there is a substantial number of small companies producing specialized software, or modifying overseas software to meet Australian requirements. There is a small number of relatively large enterprises producing software products, but with a major emphasis on importing software and providing software services.

In 1986 there were 1,100 software companies in Australia, with a turnover of $1,176 million and having about 13,000 employees. The projected turnover for 1991 is $3,245 million. Despite the large number of companies only about 20 are reasonably big with the remainder being small players. The top 16 companies with yearly turnovers up to $100 million accounted for 50 per cent of the turnover in the independent segment (about $588 million in 1986). More than 7 per cent of companies in 1986 had turnovers of less than $5 million. Many of the smaller companies either developed products or had agencies for overseas authors. Many other enterprises, such as computer hardware companies and large accounting firms, who were not ostensibly in the software business, have significant software capability.

Packaged software makes up about 49 per cent of the market and it is dominated by applications solutions (53 per cent), which is projected to remain the major segment with a growth rate of more than 18 per cent per annum. The second major segment is applications tools and systems utilities. The largest vertical market is the financial, banking, accountancy and administrative sectors, which combined with the business and professional sectors, accounts for more than 58 per cent of the total packaged market. In 1986 the government sector grew by 76 per cent, finance, banking and insurance by 42 per cent and engineering/scientific by 47 per cent. The Australian PC software market was worth $34 million in 1984/1985 and $40 million in 1995/1986. About 20 companies carve up the market, with three or four majors, and the remainder being small players. In first place is Imagineering with more than half the market, then Microsoft and Arcam Pacific, each having about 15 per cent. Sourceware and SCA both have about 5 per cent each and the remaining 10 per cent is shared by smaller companies.

Leading Australian companies

Computer Power Group Ltd., based in Melbourne is the largest Australian-owned software and services company. With more than 400 employees it has offices in the major Australian cities and in Singapore, Hong Kong and New York.

Computations is the leading supplier of software packages to the Financial Services Industry

in Australia, supplying products for insurance, finance, banking, merchant banking, investment, trading and property management. It is one of Australia's largest software companies and it has offices in the US, Canada, New Zealand and the UK. Recently the company has been negotiating with major Australian banks to develop financial software packages for export, which have an estimated potential of $800 million. The Australian banking and financial industry is large and sophisticated by world standards and many banks need to upgrade their systems which in some cases are 10 to 12 years old. Recently the Commonwealth Bank signed a contract with IBM, worth $50 million for their new site in Sydney.

Infofink Computer Services which was formed in 1987 claims to be among the top software and services companies in Australia and it now has a total staffing of 200. In August this year Infolink formed an international division based in the UK which is expected to reap $12 million in revenues this year. It also bought the Perth-based educational software company "Listen a.d Learn". Among the areas for which Infolink provides software applications are securities management, share registry, stock control and asset management. The company has its eyes fixed firmly on the European market post-1992, where it hopes to dominate certain key sectors.

Among the other larger Australian companies two others might be mentioned, PAXUS Financial Systems Pty Ltd, and Mincom Pty Ltd. PAXUS employs 300 and specializes in supplying computer systems for IBM mainframes to the insurance industry. Its extensive network includes New Zealand, Hong Kong, the UK and Canada. Mincom, employing 110, develops software systems for the mining industry and it has outlets in the United States. (Source: Technology Ireland, November/December 1988)

Brazil

Semiconductor physics in Brazil

Until the beginning of the 1970s, the semiconductor physics activity in the country was virtually non-existent, with only a few isolated researchers in a few universities. The activity received a good impetus upon the creation of research groups in that field at UNICAMP, consisting of Brazilians recently arrived from abroad, and foreigners. Resulting from this effort, in addition to the training of a large number of professionals in the field, was the project on lasers and other optoelectronic devices at TELEBRAS' [Brazilian Telecommunications Inc.] CPqD in Campinas, with the generation of its own technology and the transfer thereof to the industry.

Semiconductor physics expanded and assumed greater dimensions during the 1980s, with the consolidation of a theoretical research group at IFUSP [Sao Paulo University Institute of Physics] and the creation of various groups in the country: in Sao Carlos (USP and Federal), INPE [National Institute of Space Research], PUC/RJ [Pontifical Catholic University/Rio de Janeiro], COPPE [Co-ordination Board of Postgraduate Engineering Programs], UFRS [Federal University of Rio Grande so Sul], UFMG [Federal University of Minas Gerais], UFF [Rio de Janeiro State Federal University], UnB [Bahia University], and other locations, some engaged in exclusively theoretical activity, others in basically experimental work, and still others in both activities. In the engineering and industrial sectors, there was major expansion of the LME-POLI and LSI-POLI laboratories, and the advent of some industries with laboratories engaged in research on devices, such as SID-Microelectronics, Elebra, Iatucom and others.

However, the expansion of basic research in semiconductor physics in the country occurred mainly in the direction of theoretical research, creating a distortion in this field, which should be predominantly experimental. This resulted from the fact that after the initial investment during the 1970s, there was a cutback on funds for maintenance and for new investments in laboratories. This situation was exacerbated by the rapid changes occurring in this field at the international level, resulting in the need for sizeable funds to modernize the laboratories.

While, on the one hand, the country stopped investing in laboratory maintenance and modernization, it continued to invest in the training of human resources. This resulted in the current situation, wherein there are many physicists trained in the country and abroad in semiconductor physics, without suitable laboratories in which to work.

The national superconductor project is aimed at consolidating already established groups through the recovery and modernization of existing laboratories, guaranteeing continued support for financing and establishing new laboratories with recent techniques. It is also aimed at backing new groups with a good potential for semiconductor physics research. During the execution of the programme, interaction among the various groups will be encouraged. The programme calls for the presence of external monitoring commissions and an efficient flow of information through circulation of reports and the holding of meetings. In this way, it will be possible to promote scientific co-operation and to render mutual services. The National Commission on Semiconductor Physics, which will be the top-ranking manager of the programme, will also have the function of identifying and promoting incipient areas of acknowledged importance to the mastery of semiconductor materials S&T in Brazil. So that it will be possible to correct shortcomings in the programme it is planned to request a technical reserve, equivalent to 20 per cent of the value of the project, which is to be administered by the National Commission on Semiconductor Physics. The commission will assign those funds to the various groups, seeking improved harmonization of the programme, and keeping the attainment of its objectives in mind.

The management of funds will be carried out by local co-ordinators, proposed by the groups affiliated with the programme for the National Commission on Semiconductor Physics. Two types of funds have been called for: funds previously allocated to the groups affiliated with the programme, as specified in this project, and a technical reserve (20 per cent of the project) managed by the national commission to meet unanticipated requirements.

The monitoring of the programme's establishment and execution will be done by commissions ouside each group, by means of weekly visits. The monitoring commissions will be proposed by the national commission and will

produce annual reports on the group's performance. A National Meeting on Semiconductor Physics will be held annually, for scientific exchange and evaluation of the programme's execution. (Source: Boletim Informativo da Sociedade Brasileira de Fisica, March 1988)

Electronic devices: 'Current stage in Brazil'

In the field of Si integrated circuits, there are at least three companies that are active: Itaucom, SID and Elebra Microelectronics. All have development plans and targets for producing integrated circuits in the country by 1991, mastering all the technological phases required for this.

Among the firms, SID appears to have the greatest mastery of the technology at present, because it inherited an already prepared line from the former RCA.

Among the research centres operating in the field there are the Technological Computer Science Center, and TELEBRAS' Research and Development Center, both in Campinas SP.

As for optoelectronic devices using GaAs and InP as substrata, Elebra Microelectronics signed a contract with CpqD for the transfer of technology for the manufacture of semiconductor lasers from GaAs, and intends to establish this technology in the country industrially within two years. (Source: Boletim Informativo da Sociedade Brasileira de Fisica, March 1988)

Superconductivity R&D at UNICAMP

UNICAMP [Campinas State University] has seven new research projects in the field of superconductivity for 1988. Last year, the university achieved new superconductor materials at higher temperatures.

According to Professor Sergio Gama, the main study is for the purpose of procuring films used in microelectronics with good superconductor qualities. In addition to this, there is research on orientation and substitution of particles, to make the substance purer, and on the procurement of materials through acqueous precipitation, as well as studies on the effect of the atom's location on the properties of those materials. (Source: C&T Noticias, January 1988

Canada

Descriptions of integrated circuit designs received by the Canadian Microelectronics Corporation

Design descriptions were requested from universities for each integrated circuit design submitted to the Canadian Microelectronics Corporation. These descriptions (maximum length of approximately 10 lines) are intended to provide information regarding the IC design activites within the university community. The following pages contain descriptions of three-micron CMOS designs received by CMC in July 1988. Further information about specific designs or the integrated circuit technology interests of the universities sponsoring the design activities can be obtained by contacting the universities concerned.

Member Organization	Representative	Telephone Number
University of Alberta	Dr. K. Stromsmoe	(403) 432-5148
The University of British Columbia	Dr. D. Camporese	(604) 228-4623
University of Calgary	Dr. J. Haslett	(403) 220-5808
Carleton University	Prof. C. H. Chan	(613) 564-7415
Concordia University	Dr. A. Al-Khalili	(514) 848-3119
Lakehead University	Prof. J. Coolen	(807) 343-8597
Université Laval	Dr. U. Ganguly	(418) 656-7943
University of Manitoba	Dr. R. D. McLeod	(204) 474-8896
McGill University	Dr. N. Rumin	(514) 398-7120
McMaster University	Dr. J. P. Reilly	(416) 525-9140 ex. 2895
Memorial University of Newfoundland	Mr. M. Bruce-Lockhart	(709) 737-8937
Ecole Polytechnique de Montréal	Dr. J.-L. Houle	(514) 340-4753
Université de Montréal	Dr. E. Cerny	(514) 343-7472
The University of New Brunswick	Prof. D. Luke	(506) 453-4561
Technical University of Nova Scotia	Dr. D. Pincock	(902) 421-1250
University of Ottawa	Dr. D. Gibbons	(613) 564-3446
Queen's University	Dr. A. R. Eastham	(613) 545-6081
University of Regina	Dr. W. J. Misskey	(306) 584-4161
Royal Military College	Dr. D. Al-Khalili	(613) 541-6401
University of Saskatchewan	Dr. R. Muir	(306) 966-8576
Université de Sherbrooke	Dr. S. Richard	(819) 821-7141
Simon Fraser University	Dr. R. Hobson	(604) 291-3128
University of Toronto	Dr. A. Salama	(416) 978-8658
University of Victoria	Dr. E. G. Manning	(604) 721-8612
University of Waterloo	Dr. J. A. Barby	(519) 885-1211 ex. 3995
University of Western Ontario	Dr. Z. Kucerovsky	(519) 679-2111 ex. 8309
University of Windsor	Dr. G. Jullien	(519) 253-4232 ex. 2574

Concordia University

A systolic VLSI matrix for fundamental searching problems. Marco Zelada and Warren Berman

This chip has been designed to solve basic searching problems. In particular, it is capable of reporting intersecting pairs in large sets of rectangles, a crucial step in checking the design rules for VLSI circuitry. It can also be used to perform general range queries. It is estimated that the IC will work at around 5 MHz although it could possibly run at around 6-7 MHz, but this could only be determined after testing. Two input clocks are required, clock 1 and clock 2. Clock 2 must be 180 degrees behind clock 1. The chip matrix is composed of 20 rows. Each row contains four identical cells composing the columns. Attached to each row there is a multiplexer which will receive the added row result and shift it down between the word begin (WG) and word end (WE) signals. Each cell itself contains two 6 bit shift registers (SR) and one boolean operator which performs the operation. Computations are carried out in parallel and outputs are generated in a bit serial manner.

McGill University

A self-reconfigurable massively parallel processor. Babu Mandava

This chip contains 24 processing elements arranged as a six by four array. The chip incorporates the concept of self-reconfiguration and on chip diagnosis of Processing Element failures. It is fully scanable with parallel scan paths. The chip contains 33,000 transistors and is designed using two-phase clocking scheme and testable flip-flops and multiplexers.

Convolution processor for a robot vision system in image processing. Damian Hawke

This is a design of a VLSI system convolution circuit, implemented using CMOS/SOS technology. The circuit will be used in a robot vision system for image processing. It uses multi-processor techniques such as pipelining to divide the computational task among a number of identical processors; an N point convolution can be realized using N of the processors operating in pipeline mode. The processors may be used to compute any linear, shift-invariant filters. It may also be used to compute correlation. Bit-serial communication techniques were used throughout the design to reduce the number of I/O pins required for each chip. A total of 30 chips were used for this design. The use of shift-registers to hold the coefficients and their availability as outputs makes it possible to chain them and reduce the board's I/O pin requirements. Bit-serial processing was also adopted in this design.

Université de Sherbrooke

External control unit of a cochlear prosthesis. Soheyl Pourmehdi.

This chip is a part of the external board of a cochlear prosthesis. It processes the input signal and with the help of a TMS320 microprocessor it generates a control signal which will then be transmitted through the skin to a cochlear implant for electrical stimulation of the auditory nerve.

An implantable urinary prosthesis. Mohamad Sawan.

This chip is an eight-channel implantable neural prosthesis. It is composed of manchester decoder, timer, command decoder, four pulse generators, four digital to analog converters and a finite-state machine implemented by a PLA. The present submission corrects errors in the previous submission of the same name and many test cells have been added.

An improved 16-channel cochlear implant. Marc-Andre Talbot

This neural stimulator recovers serially transmitted manchester coded data via an inductive link through the skin. The numerical data are translated into analog signals by means of an array of 16 totally independent 8 bits D/A converters. The configuration also permits monopolar and bipolar type of stimulation. The system's operation is regulated via an elaborately testable PLA. The chip is an improved version of IC3SHTNP and 1988 design review recommendations were taken into consideration for performance improvement. (Reprinted with permission from the supplement to VLSI in Canada, October 1988, Vol. 6, No. 3)

China

New chip-making agreements

The Government's effort to attract foreign computer-chip manufacturing investments is beginning to pay off. Currently, all of China produces about as many chips as a lone US factory. In addition, barely 3 per cent of these are large-scale integrated (LSI) circuits, i.e. devices with up to 100,000 transistors. No very LSI (VLSI) - up to one million transistors - or ultra-LSI chips are made at all. However, Philips (Netherlands) has agreed to make chips in China, and an agreement with Motorola is being negotiated. Philips and Shanghai Factory No. 7 will form a joint venture called Philips Semiconductor of Shanghai. It will make 70 million chips per year, boosting China's output by 70 per cent. Industry experts expect Motorola's agreement will give China its first VLSI factory. (Extracted from Business week, 10 October 1988)

Hi-tech street

Electronics Street, an enterprise-packed thoroughfare in Zhongguancun, is Beijing's version of California's Silicon Valley. The high-tech industrial zone in the vegetable fields of Haidian, northwest of the capital, is home to applied-science units of Peking and Qinghua universities and the Chinese Academy of Sciences. But a more active presence is some 170 non-governmental enterprises. One of Electronic Street's star performers is Jinghai Industrial, which has developed world class products including a digital sonic depth-sounder and a sonic alarm system. Last year industrial production from Electronics Street was worth more than $160 million. (Source: Asia Pacific Tech Monitor, November/December 1988)

European Economic Community

Europe lays down basic research plans

From January 1989, the ESPRIT programme will include basic research. This is the first time that

the programme's directors have included basic research in the plans. However, only 62 projects from more than 300 proposals will receive funds.

All Europe's leading researchers in information technology were hoping for money, which has made the European Commission concerned about the funding available for research in each member State. The Commission has only 55 million European Curiency Units ($36.3 million) to spend on basic research; to fund all the projects would have cost more than one billion ECUs ($660 million).

The Commission intends to spend its small resources on topics in microelectronics, computer science, artificial intelligence and cognitive research. To win funds, the projects had to show that they were likely to produce advances useful to the mainstream development programme of ESPRIT.

Research in microelectronics will focus on high-temperature superconductivity, semiconductors, systems for designing complicated computer software, and optical and organic computing.

In computer science, researchers will tackle the problems of drawing up specifications for complex computer systems, to make sure that they do the job they are supposed to do. The universities of Edinburgh, Rome, Pisa, Leuven, Lisbon and Bristol will work on logic and problem-solving. Other universities will study robotics. (This first appeared in New Scientist, London, 3 December 1988, the weekly review of science and technology)

Documentation

Eleven European organizations are collaborating on PODA-2 (Piloting of Office Document Architecture) under the ESPRIT II research programme. Running for two years, the project seeks advances in the application of open systems standards for the handling and transmission of documents containing a mixture of text, image, graphics and data (Source: Computer Weekly, 17 November 1988)

JESSI likes BESSY's X-rays

JESSI - the Joint European Submicron Silicon Initiative - Europe's emerging consortium appears ready to concentrate on X-ray lithography.

This consortium of Siemens, Philips, SGS-Thomson and possibly other European semiconductor manufacturers is being formed to keep West European semiconductor manufacturers competitive well beyond the year 2000. The goals of JESSI members include developing flexible semiconductor manufacturing equipment and materials.

In the area of lithography, consortium organizers expect to draw on the European synchrotron X-ray research effort - BESSY or the Berlin Electron-Storage Ring Society for Synchrotron Radiation - already in place at the Fraunhofer Institute (Reprinted with permission from Semiconductor International Magazine, November 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, Il. USA)

Project contraction cuts cash

Two EEC research programmes on industrial systems and materials are being merged with a reduced budget - and UK firms are being urged by the Government to get in early.

The new $300 million programme brings together BRITE, the Basic Research in Industrial Technologies for Europe scheme, and EURAM, European Research in Advanced Materials.

BRITE has had $125 million in its first four years and the next stage was to get $230 million. EURAM was to get $110 million.

The $40 million cut in the proposed combined budget is due to the introduction of an extra EEC research programme, for the aeronautical industry.

The new combined BRITE and EURAM programme will cover new technology for manufacturing; the application of that technology in systems; the use of technology in product design and quality assurance; and advanced materials.

BRITE projects so far have included work on image processing for classifying defects in fabrics, computer-aided design in shipbuilding and an automatic knitting plant. (Source: Computer Weekly, 29 September 1988)

INSIS - integrated information services

The European Community has undertaken a project aimed at promoting the development of high-speed information services. INSIS, the Inter-Institutional Integrated Services Information System, is an attempt to improve communication between the Community's institutions and its Member States by exploiting, in a co-ordinated and harmonized way, new techniques combining data and text processing and the use of telecommunications systems. A User Advisory Committee (UAC), composed of representatives of EC institutions and member States, has defined the following priorities for INSIS, which was launched in 1988:

- Electronic document transmission and electronic messaging;
- Facilities to give easier and more coherent access to information of interest to the Community, most of which is held in computerized data bases.
- Videoconferencing, to reduce travel costs and save time.
- Facilitating access to informatics services and facilities for non-computer professionals.

INSIS is being implemented in the form of programmes aimed at preparing the technical and industrial environment and at promoting political consensus, and pilot projects aimed at creating experimental systems to assess the technical problems and the impact on working procedures of introducing new technology into administrative environments.

Three pilot projects are at an advanced stage of development: INSEM (Inter-Institutional Electronic Mail System), designed to facilitate the exchange of documents between member State administrations and Community institutions; Videoconferencing; and OVIDE (Organisation de Videotexte pour les Deputes Europeens), designed to provide high-speed access to up-to-date information for members and officials of the European Parliament.

Particular emphasis is being placed on the promotion of European standards; INSIS provides a

structure for member States to co-ordinate their views and convey them to the standardization bodies. The system is also concerned with promoting early product development and stimulating the development of coherent, Community-wide public communications services by the European PTTs.

For further information, contact: Commission of the European Communities, 200 rue de la Loi, 1049 Brussels, Belgium. (Source: ACCIS Newsletter, Vol. 6, No. 4, November 1988)

Workers rule in the EC

Employers who believe they can easily move their operations out of Europe, should the need arise, to a low-cost part of the world after 1992, are in for a shock.

In a draft document, entitled Statute for the European Company, worker participation is thought desirable, and the rules governing worker participation are considered. This participation will not be organized at the day-to-day management level, but rather at the supervisory level, and at the level of development of the company's strategy.

As if to emphasize the fact that worker participation is already part and parcel of the European scene, the White Paper states that worker participation already plays an important part in industrial relations in a growing number of member States.

The European Commission is worried about the Community's competitive position, and in an almost frenzied bid to weld industries together, it appears to have already decided that worker participation is an essential ingredient.

"Only through Community-level industrial co-operation will it be possible to bring together the large amounts of capital and technical know-how required to ensure competitiveness on world markets" says the paper.

The Commission's view is that worker participation is essential, not just as a matter of social rights, but as an instrument for promoting the smooth running and success of a business, through promoting stable relationships between managers and employees in the workplace.

The approach to company law harmonization is going to be a long-term affair. The move towards the harmonization of VAT is just the tip of the iceberg. The next step is aimed at unifying the method in which accounts are undertaken.

When it comes to company taxation, the benefits appear to be slightly better. This is because the Commission favours a policy of transferring losses incurred by a company's foreign subsidiaries to offset these against profits made within the EEC. (Source: Electronics Weekly, 26 October 1988)

When in Europe, think alike

European computer societies are to work together to help prepare the IT community for 1992 and the single European market.

Representatives from Belgium, France, Federal Republic of Germany, Greece, Ireland, Italy, the Netherlands, Spain and the UK met recently at British Computer Society's headquarters to iron out ways of letting kindred societies co-operate.

There is a common belief that establishing professional standards is crucial to all countries, but at present there is no agreement between European countries on qualifications.

Societies at the meeting were unanimous in their stand against hacking, but different European countries have different approaches to the problem.

The copyright, hacking and privacy issues are important because legal systems are completely different.

Plans for the future could include getting legal experts from the various societies to attend workshops on hacking and copyright law, and collaborating on publications, meetings and conferences and special interest groups. Reciprocal membership is another possibility and will be discussed at the next meeting, scheduled for 27 May in Paris. (Source: Computer Weekly, 17 November 1988)

Federal Republic of Germany

Huge co-operative research centre for artificial intelligence launched

On 4 July 1988, the carefully planned and vigorously pursued goal of a multifaceted, nationwide research centre for predominantly basic research in artificial intelligence (AI) came into being with the official incorporation of the Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI), GmbH. This enterprise, DFKI, with the unusual structure of a "Ltd" or "Inc" institution, has its central administration and its new laboratory building in Kaiserslauten. The executive director of the "company" is Professor Barth. DFKI comprises segments of nine industrial firms (Siemens and Philips are the largest), two national laboratories for computer science, two universities (Kaiserslauten and Saarbrucken), and contributing representatives from the two "Länder" (States) of Rheinland-Pfalz and Saarland, as well as delegates from the Federal Ministry of Research and Technology. The present staff includes about 100 scientists. The budget (for personnel costs alone) is DM 50 million (about $29 million), to be spent within the next 10 years. After that date, the DFKI may or may not be dissolved, or reoriented, if need be. (This fixed-term lifetime of new German research centres is quite typical, and serves to avoid "petrification" of institutions in the face of changing national goals or opportunities.)

In addition to this national (federal) AI centre, the Freestate of Bavaria and the Land of Baden-Wurtenberg are also setting up a joint centre for AI. This will comprise several university departments and industrial laboratories. (Source: European Science News, August 1988)

Computer-integrated manufacturing (CIM) technology

For its programme "production technologies", the BMFT has earmarked DM 502 million (about $270 million) for the period 1988 to 1992. Under this programme, support measures concentrate on two priorities: computer-integrated manufacturing (CIM) and new production technologies (NPT). The major objective of the programme is the promotion of CIM technology transfer, standardization in the field, and its applications for small- and medium-sized enterprises. Leading work is being done at the

University of Stuttgart, where a special Institute for Computer Screen Technology (Bildschirmtechnik) has been established, and by the Fraunhofer Institute for Production Technology and Automation (Institut für Produktionstechnik und Automatisierung [IPA]), also at Stuttgart. (Source: European Science News, August 1988)

The Research Institute of the Deutsche Bundespost

Traditionally, the telephonic and telegraphic communications in most central European countries were handled by the governmental postal services. For this reason, it was only natural that most national post offices organized systematic in-house research activities in these areas which, in more recent times, have become high-level research institutes in all modern aspects of telecommunication. One of these on the European continent is the research institute (FI, for Forschungsinstitut) of the Federal Republic of Germany's Federal Postal Services (Bundespost). This establishment has a long and respectable history. Its origin can be traced back to the 1920s, and from 1937 to 1945 research has been concentrated in a branch of the Central German Post Office in Berlin.

In 1947, the British Occupation Forces found it expedient to revive the research groups, and after a number of structural changes the FI, housed in a modern skyscraper at Darmstadt, now operates as an independent unit of the administrative entity called Telecommunications Central Office (FTZ, for Fernmeldetechnisches Zentralamt). The FI is headed by a scientific director, who operates through a research council and is monitored by a supervisory board. (The latter also acts as an advisory board for the FTZ management.) The FI has 350 employees (some 60 of them are not in Darmstadt but in a West Berlin branch office). Out of these, 130 have a higher university degree. The FI also has strong working ties with many German (and even some foreign) universities - in fact, about 10 M.S. theses per year (and occasionally a Ph.D. thesis) arise from this partnership. In addition, the FI participates in a large number of European international projects (including EUREKA and RACE). Not counting salaries, the annual research expenditures have now reached the level of DM 30 million (about $18 million).

FI's research is organized into five areas:

A1. Information processing
A2. Transmission technology (in material media)
A3. Antennae and wave propagation
A4. Solid-state electronics
A5. Switching and networks

The breakdown of these broad areas into research-group projects is as follows:

A1. Mathematics for communication technology, acoustics, cryptology, information processing of voice and video signals, information processing of speech transmission, high-resolution television, computer-aided network design.

A2. Digital transmission methodology, channel quality in digital transmission, optical switching and optical networks, transmission technology through fibre-links.

A3. Antennae, wave propagation for point-to-area radio services, wave propagation in ground-station/satellite links, wave propagation in directed high-frequency-range transmissions.

A4. Semiconductor technologies, microelectronic circuits, optoelectronic components, optical devices for telecommunication, materials research and testing.

A5. Digital networks, digital multiplexing methods, broadband switching, optimization of communications networks, consumer-premises networks.

Further information may be obtained from the Director (currently Dr. Udo Mlecek), Forschungsinstitut der Deutschen Bundespost, Postfach 5000, Am Kavalleriesand 3, D-61 Darmstedt, Federal Republic of Germany. Telephone: (011-49-6151) 831. (Source: European Science News, August 1988)

Summary of high-temperature superconductivity research in selected laboratories

Some research groups in Germany, such as KfK, Darmstadt, and Giessen, have a long history of research and development of superconductivity and not surprisingly, these groups have developed quickly in high-temperature superconductivity research. Government support of superconductivity research from the BMFT had been tapering off, from DM 4 million/year to 1-2 million/year. In Financial Year 87 the level was stepped back up to DM4 million with some additional new funds and re-programmed funds. This included DM 0.8 million made available very early in 1987 for equipment purchases by existing groups. The expected level in Financial Year 88 is DM 16 million that will be mostly new funds provided by separate legislative action. Planned support for Financial Year 89 is anticipated to be DM 35 million with a further increase hoped for in Financial Year 91 to DM 46 million.

The BMFT programme consisted of four major thrusts: (1) development of superconducting magnets, (2) cryogenics, (3) development of practical superconductors including new materials, and (4) new applications of superconductors. While BMFT support of university industrial collaboration is normally 50 per cent, support for high T_c materials will be provided at 50 per cent to industry and 75 per cent to university, thus reducing the industry support and product-oriented influence on the initial university studies. Such a plan would remain in effect for four to five years.

In addition to the research and development funds in superconductivity there is specific support in medical applications and for an electric generator construction at DM 25 million/year each. Applications in accelerator physics are funded by other mechanisms also.

University of Giessen. The group at Giessen has been developing superconducting electronics with classical superconductors for some years and is producing some of the best and quickest results as part of the development of new superconductor circuit elements.

Technical University at Darmstadt. Based on a long history in low-temperature superconductivity

research, the Darmstadt group has developed a number of experimental techniques for determining the fundamental properties of the new superconductors.

Hoechst AG. The Hoechst company's recently acquired businesses in ceramics have produced a substantial and long-range commitment to the development of the new superconductors, including the recent BiCaSrCuO compound.

Siemens AG. Extensive experience in conventional superconductors, which are being marketed and further developed, has placed Siemens in a very strong position with expertise and commitment to develop the new superconductors, including the BiCaSrCuO materials.

Kernforschungsanlage Julich. The current research in high temperature superconductors extends over the 10 KFA institutes, with reorientation and strengthening planned in the area of thin films of both superconductor and semiconductor materials.

Kernforschungszentrum, Karlsruhe. The long-term commitment to superconductivity research at KfK has produced recent significant advances in the conventional superconducting materials, NbN and $PbMoS_8$. The wide range of expertise and planned long-term future effort seems certain to yield substantial gains in fundamental understanding and in technological developments in the new materials that will keep KfK at the forefront.

Walther Meissner Institute, Garching. This institute's contributions to fundamental physical properties of the new materials have been carefully accomplished with limited resources combined with capable expertise.

Max Planck Institute (MPI), Stuttgart. At MPI Stuttgart excellent optical measurements and advanced materials preparation has produced seminal work in understanding the lattice vibrational properties and chemistry of the new high-temperature superconducting materials, including prompt work with BiCaSrCuO.

The eight university, federal and industrial laboratories represent a small, but high-quality, set of laboratories in Germany doing research in high-temperature superconducting materials. Long-term, steady support of superconductivity in each setting has provided both significant expertise in individuals and marketable products. The fast pace of developments stresses the existing mechanisms of communication. This situation is not dissimilar from that in the US. The future prospects are being nurtured with increased federal funding and corporate commitment on a time scale that appears to be consistent with the expectations for improved fundamental understanding closely followed by the development of applications. This also has a positive effect on the careers of young scientists where this commitment will provide opportunities to establish their professional stature in this field. (Source: European Science News, June 1988)

The machine-learning project of Siemens

The Foundations of Information technology Division of the central research laboratories of Siemens (Neuperlach, near Munich) is in the midst of a major five-year artificial intelligence (AI) project called "Machine Learning" (Maschinelles Lernen, [ML]). This project has two different approaches:

1. Learning within the framework of traditional AI, as a means for improving and extending already existing knowledge bases by adding to it new knowledge learned from its own applications to concrete problems.

2. Learning in connectionist systems which function as interfaces between the natural environment and a computer.

Correspondingly, current research deals partly with traditionally oriented symbolic learning paradigms; and also with connectionist schemes, massively parallel architectures and neural networks. The second line of research is strongly emphasized.

Not surprisingly, the huge programme originated in the US, due to a long-standing co-operation of Siemens AG, Princeton, on the one hand and the Research and Technology Laboratories, also in Princeton, on the other. This co-operation utilized, in addition, well-known academic centres in the US. There are now new co-operative efforts under way, especially with MIT. However, since the end of 1986, the centre of gravity of the Siemens AI research moved to Munich. The work in these central research laboratories also involves joint projects and contracting with a number of German universities and industrial firms in electronics. Moreover, the project is co-ordinated with the all-European ESPRIT-effort aimed at building, within the next few years a prototype workstation for neural networks.

The most interesting parts of Siemens in-house ML research are concerned precisely with neural networks. There are four major efforts in this field, to be briefly described below.

Basic research in neural networks: better understanding and improvement of already known learning mechanisms and learning methodology, as well as discovery of the new network structure is the primary goal here. In the historically proven Germanic approach, the project leaders emphasize that neural networks may become relevant to practical applications only if one gains a really deep understanding of how neural networks function.

Interfacing of neural networks with other architectures: the scientists responsible for the ML project believe that neural networks will not be able to solve all possible problems of interest. Thus, it will be necessary to continue relying on von-Neumann architectures, traditional software technology, and classic AI. Hence, to utilize neural networks in such an environment, it is imperative to develop interfaces with these techniques. A synergetic development approach of ML and other technologies is a serious research topic.

Development tools for neural networks: it becomes more and more necessary to develop training environments for neural networks which not only facilitate good ML, but also allow for optimizing the networks in relation to specific requirements. The Siemens ML project plans to build within the next two to four years several versions of developing environments and training environments. To begin with, these will be relatively simple systems permitting the choice of a suitable structure, of layers and of learning algorithms. The more sophisticated versions, to be developed later on, will also provide testing environments in addition to synthetic functions and to generating task activities.

Validation of procedures: it is necessary to ensure that the insights gained in the course of basic explorations be truly relevant for later non-trivial applications. The Siemens researchers decided to make use of the world renowned SPICOS project (Siemens-Philips-IPO Continuous Speech Understanding System) for the purpose of objectively validating partial results in the neural network research. (SPICOS is an integrated system which takes natural language input, processes it as needed, uses the result to query data bases or knowledge bases, and then synthesizes the answer in natural language.) Now, in the validation procedure, selected parts or components of SPICOS are replaced by alternative neural networks. Thus, comparison of the conventional and neural-net solution inside a sophisticated environment can objectively be achieved and judged. Other validation procedures will use problems in image-processing.

At this point, the attentive reader may ask: "What about hardware?" In this area, the Siemens project directors also adopted a cautious approach. First they note that, for the foreseeable future, existing, well-proven and selected task-specific hardware is fully adequate for performing the high-level research tasks. Second, the scientists do not want to commit themselves to any specific hardware design or architecture before a fully optimized arrangement emerges from long, broad-based, basic research. Once understanding of neural net functioning and of ML is really well accomplished, the ideal chips can no doubt be quickly produced. The scientists proudly add that this confidence is based on recent Siemens successes in the use of CAE for VLSI tasks.

The areas in which Siemens' AI research in general, and ML studies in particular, has so far proved most successful are speech recognition and pattern recognition machine vision. (A third area, not within the scope of this article, is industrial expert systems. With their offering of over 40 systems, Siemens appears to be the largest European - possibly worldwide - producer of expert systems.)

In the field of speech recognition, issues related to real-time recognition and to recognition under non-ideal circumstances are central endeavours. Effective use of perceptual knowledge and of knowledge-based and learning techniques leads to good progress at the acoustic-phonetic level. Neural networks appear to be particularly promising. Expertise has been achieved in speaker-verification, speaker-independence, speaker-adaptivity and connected word recognition for small vocabularies.

In the field of pattern recognition, one activity concerns sensor fusion tasks, primarily for improving machine vision and robotic applications. Another focal point is transmission of moving images. Using AI methods (and especially ML) for image processing and image recognition, substantial success was achieved in transmitting in almost-real-time the images of moderately fast moving scenes on the standard, simple, inexpensive 64 Kbit/sec ISDN lines.

Regarding more general plans in the area of ML, the researchers follow two major approaches:

- Symbolic concept formation,
- Connectionist models.

The first of these can be further divided into empirical learning and explanation-based learning (EBL). Currently, the focus is on the latter approach, which uses a theorem-prover and encoded knowledge about the world to interpret events; this approach has an unprecedented potential for autonomously increasing the system's store of knowledge. Siemens is now developing EBL systems that reason about several problems at once, and thus aim at a consensus. Another system under development analyses its mistakes as it attempts to solve a problem, so that it can avoid similar mistakes in the future.

Regarding work on connectionist models, nothing can be added at this time to what was already described in the earlier part of this article. Further information may be obtained from Werner Remmele, Siemens AG, ZTI INF3, Otto Hahn Ring 6, D-8 Munchen 83, Federal Republic of Germany. (Source: European Science News, October 1988)

France

New group for the development and application of superconductivity technology

France has recently announced the formation of a group responsible for both the development of superconductivity technology and its commercial application. The group is composed of four Centre Nationale de Recherche Scientifique (CNRS) laboratories and two large industrial conglomerates, Rhône-Poulenc and CGE.

The objective of the group is to develop superconductors for the transport of high current - approximately 1 kA cm^2 - without resistance and at the temperature of liquid nitrogen.

The participating CNRS laboratories are the Institute of Matter and Radiation (CRISMAT) in Caen, the Laboratory for Solid-State Chemistry in Bordeaux, the Laboratory for Very-Low Temperature Research in Grenoble, and the Laboratory of Crystallography, also in Grenoble.

In addition to funds provided by the two industrial participants, the group will have a budget of FF9 million (approximately $1.5 million) over the next four years provided by the French Government. This FF9 million budget is strictly for the procurement of equipment and does not include salaries or other laboratory costs.

The group hopes to develop superconductors with commercial applications in the areas of magnets, transformers and electric motors.

The participation of Rhône-Poulenc and CGE suggests that this is a serious effort. This group represents one of the few organized French efforts in material sciences to bring scientific development and industrial application together under the same programme. It is also reflective of the new approaches the Government and Minister of Research Curien are taking towards research and development. (Source: European Science News, August 1988)

A new neural research network

In addition to its already functioning scientific co-operation networks, the European Science Foundation (1 Qua. Lezay-Marnesia, F-67000 Strasbourg, France) recently launched a new network of an interdisciplinary nature. The purpose of this

enterprise is the furthering of research in learning and memory. The aim is to bring together key individuals and laboratories working on the experimental analysis of the neural mechanisms of the memory processes. This could ultimately feed into work on neural computing. Another goal is to attempt an understanding between experimentalists and model-builders.

A brochure and further information may be obtained directly from Professor S. Rose, Director, Brain Research Group, the Open University, Milton Keynes, MK7 6AA, United Kingdom. (Source: European Science News, August 1988)

French microcomputer industry receives a "mise en garde"

According to le Figaro, France has recently spent FF156 million (approximately $26 million) on 13,120 microcomputers for the public school system. Ironically, despite the new Rocard Government's push to support French industry, the Government has purchased the majority of this equipment from foreign companies, giving the French microcomputer industry a reason for concern.

According to the Union of Public Purchase Groups (UGAP), their principal criteria for microcomputer selection was an assessment of maximum performance for minimum price as well as an evaluation of the array of compatible accessories. That the UGAP made their decision to purchase an overwhelmingly high percentage of non-French microcomputers despite the "computers for all" plan (instituted by the Government in 1985 to favour the burgeoning French computer industry) underlines the current lack of competitiveness of the French microcomputer industry. In fact, the French microcomputer industry currently holds less than 5 per cent of the European market.

In this particular instance, Victor (an American firm acquired by the Swedish firm Datatronic) garnered nearly one half of the Government's orders with a contract worth FF72 million ($12 million) representing 5,906 units. In addition, Victor has won another contract for next year involving 800 machines and FF17 million (approximately $2.8 million). Olivetti-Logabax (an Italian firm) will deliver 2,371 microcomputers. The 1,056 printers ordered will be furnished by the Japanese firms NEC and Epson, and 696 digitalizers will be of American origin.

The only French firm "to save face" is SMT-Groupil, who received an order for 3,470 units. The other French brands, however, receeived remarkably low orders; Leonard will furnish 664 microcomputers, Bull will supply 525, and Forum will only provide 184.

Ranking after the failures of Matra and Excelvision in 1986, the current big loser is Thomson, who furnished the GOF with 100,000 machines in 1985 but was noticeably absent from this year's list of contract winners. Despite its ambitions, Thomson has never quite made its mark on the European microcomputer scene and had encountered a downward trend by meeting only about one third of its sales objectives in recent years. (In 1986 Thomson projected sales of 300,000 units but only sold 100,000. In 1987, Thomson projected sales of professional microcomputers to be in the 20,000 to 50,000 range but only sold 10,000. This year's sales were anticipated at 150,000 microcomputers based on 1986 estimates but Thomson will probably only sell 50,000 units.) Thomson's abandonment of microcomputer sales abroad as well as rumours that they have been curtailing projects in the planning stages indicated to some that Thomson may eventually phase-out microcomputer production, evidenced by a collapsing market share in France (12.5 per cent in 1986 as compared with 7.3 per cent in 1987). Moreover, Bull no longer considers the microcomputer industry a strategic priority and is currently assessing the possibility of having its machines manufactured by other companies.

The French microcomputer industry, despite being supported by numerous public purchases in recent years (education, policy, army, postal service) has not been competitive with the rest of the world as demonstrated in comparatively low sales figures (tens of thousands per year versus hundreds of thousands).

The Government's recent move to purchase the majority of microcomputers for the French school system from foreign sources has been read by many as an indictment of severe technological inadequacy in the French industry. While one cannot predict the response to this event it is likely that we will see many more of the type of arrangements that Matra has with Sun systems (US). Matra currently markets Sun products in France, simply replacing the "Sun" label with one of their own in a direct "pass through" process. (Source: European Science News, August 1988)

The Laboratory for Solid-State Chemistry at the University of Bordeaux

The Laboratory for Solid-State Chemistry at the University of Bordeaux (I) is considered by French and foreign scientists, including American, as one of the best in the world. Directed by Jean Etourneau, the laboratory, which is jointly supported by the university and the Centre Nationale de la Recherche Scientifique (CNRS), consists of 14 professors and 13 lecturers from the university, 11 directors of research and 9 research fellows from CNRS, 56 Ph.D students (22 of whom are foreign), 10 trainees, and 35 engineering, technical, and administrative staff (CNRS). The laboratory does both basic and applied research in solid-state chemistry, materials science and solid-state physics. The laboratory is a member of the CNRS-industry group on high-temperature superconductivity. It has significant expertise in the area of interfaces and in the preparation of new materials. Also, according to a senior American scientist from the General Electric Corporation, the US "simply cannot do what they are doing here" in research on the chemistry of oxygen at high pressures.

The most renowned laboratory in the Bordeaux complex (there are two other universities in the city, Bordeaux II [Medicine and Pharmacology] and Bordeaux III [Arts and Letters]) is the Laboratory for Solid-State Chemistry. It is jointly funded by CNRS and Bordeaux I. CNRS primarily funds salaries of CNRS researchers and specific projects. Etourneau, as well as being the Director, is an expert in the preparation of new materials, including ceramics. He is also the group leader of the high-temperature superconductivity effect.

The major foci of the laboratory in basic sciences are:

- Magnetism and magnetic properties of materials;
- Transport properties in materials;
- Ferroelectric and ferroelastic materials;
- Luminescent properties of materials;
- Inorganic noncrystalline solids;
- Interfaces in composite and ceramic materials;
- Crystallochemistry and chemical transitions in solids;
- Growth of crystalline materials.

In applied sciences the foci are:

- Materials applied to electronics (dielectrics, variable resistant materials, semiconductors, chemical detectors);
- Coatings for magnetic recording;
- Optical materials: image transmission, light transmission, colour dispersion;
- Materials for the conversion and storage of energy;
- Materials with high mechanical and thermal performance.

This strong emphasis on applied science with commercial applications is the wave of the future for CNRS-funded laboratories.

The laboratory has had, and continues to have, close ties to the US. In particular, it was the leading French laboratory in the US French experiment on the growth of germanium crystals which was carried out in November 1985 aboard the space shuttle Challenger. In June, the laboratory was hosting two post-doctorates and three senior scientists from the US. Ongoing collaborations exist with General Electric Corporation, AT&T, IBM Yorktown Heights, and Brown, UC Berkeley, Purdue, and Texas (Austin) Universities. (Source: European Science News, August 1988)

German Democratic Republic

Ion beam induced epitaxial crystallization

German Democratic Republic researchers have demonstrated the ion beam induced epitaxial crystallization (IBIEC) of amorphous silicon layers after preamorphization of the transition layer/substrate. They used conventional low pressure chemical vapour deposition (LPCVD) to deposit the silicon layers onto monocrystalline silicon substrates. IBIEC may meet the need for the lower process temperatures that are becoming increasingly important in the manufacture of ICs with higher speed, lower power consumption and smaller dimensions.

The workers at the Central Institute for Nuclear Research, Rossendorf, Academy of Sciences of the Federal Republic of Germany, Dresden, oxidized cleaned <100> orientated monocrystalline silicon wafers at 1,000°C and etched away the oxide layer (thickness about 100 nm) with buffered HF immediately before loading the wafers into a CVL reactor.

They deposited 400 nm of amorphous silicon by LPCVD at 1 Torr, 570°C, and implanted a part of each wafer with a dose of 2×10^{15} cm^{-2} arsenic ions of energy 660 keV at room temperature. This amorphized the transition regions between the layer and the substrate.

They found that a dose of 2×10^{17} cm^{-2} silicon ions did not produce recrystallization of the as-deposited layer, although this dose should have been adequate. The additional step of amorphizing the transition layer by arsenic implantation gave much better results. After implanting a dose of 6×10^{16} cm^{-2} silicon ions, about half of the layer was recrystallized, whereas a dose of 1×10^{17} cm^{-2} resulted in recrystallization of the full layer. An increased dose of 1.5×10^{17} cm^{-2} produced negligible further growth.

The group estimated the IBIEC rate as 60 nm/10^{16} silicon ions/cm^2. The current density of 8 μA cm^{-2} during ion irradiation accounted for a growth rate of 18 nm/min. Comparative results using thermally activated solid phase epitaxy show a rate of 0.6 nm min at 500° C. The IBIEC rate for deposited amorphous silicon was similar to that for the amorphized part. (Reprinted with permission from Semiconductor International Magazine, November 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, Il. USA)

Hong Kong

Hong Kong begins EDI study

Starting 1 November, a consortium of Hong Kong and Chinese corporations, supported by the Hong Kong Government, began a six-month study to determine the prospects for electronic data interchange (EDI) and how it may protect the territory's much envied trading status in South-East Asia.

The EDI study will determine whether EDI services are suitable to the territory, what type would be suitable, how they should be run, and how they can be made profitable for investors.

The hope is that the study will come up with some suggestions for relieving the numerous bureaucratic delays that hamper the Hong Kong trading community - a community that produced revenues of $55 billion in the first six months of this year. The results of the study may also clarify Hong Kong's fears that it is being left behind in the race towards electronic trading systems, which are emerging in other Asian trading centres.

It has taken a year of pressure from the private sector, and an internal review of its own paper processing procedures, to get the Hong Kong Government to agree to help fund and participate in the study. Now, at last, the study is under way, with the bulk of the financial backing and corporate clout coming from a consortium called Tradelink Electronic Document Services. Its members are China Resources Holdings, a Beijing-based trading firm; Hong Kong Air Cargo Terminals; two container terminals; the international Swire Group trading company; the Standard Chartered Bank;

Maersk (HK) Ltd.; Hongkong and Shanghai Banking Group; and Hong Kong Telecommunications.

Government bureaucracy accounts for a large portion of delays. A government work-force of 800 people handles the 5 million export licence applications processed each year. A computer matches redundant information typed from licences into terminals by local officers, a system that fosters mistakes and delays.

It would be particularly helpful if the system accommodated the Chinese language, since Hong Kong is emerging as a service economy and trading centre for China in the run up to its return to Chinese control in 1997. Deals with China now account for 30 per cent of the paper trade declarations generated in Hong Kong - most of which are handled by truck drivers and are written in Chinese.

The EDI network's topography will be relatively easy to design since Hong Kong is geographically small, with one seaport and one airport, and it would be possible to link all trading parties with a single network. This already happens in Singapore, one of Hong Kong's trading rivals, where an EDI service called Tradenet is scheduled to be operational by January 1989. This boosts concern that Hong Kong's service to overseas trading partners may deteriorate if it does not keep up.

Overseas links will be a major part of the study, as reliance on international trade has spurred EDI projects throughout the region. Australia leads the way with efforts to link its retail, banking and transportion communities to the US and Europe.

Since these countries are not in a position to defy international standards, Hong Kong's Tradelink will most likely follow Edifact standards. Singapore's Tradenet (being implemented by IBM) will also adhere to Edifact. (Reprinted with permission of DATAMATION[r] magazine[c], 1 November 1986 copyright by Technical Publishing Company. A Dunn and Bradstreet Company, all rights reserved.)

India

Computer software in India

Blessed with a vast brain pool and with an eye on the growing market, India has launched an aggressive programme for producing computer software for export. The Government has decided to set up four technology parks where engineers will write software for export via satellite.

The first software technology park at Pune, near Bombay should, by the end of 1986, have 20 Indian companies with shops in the park sharing the satellite terminal directly linking their customers in US cities. In five years, software export from the park is expected to reach $300 million. Three more parks are being established at Bubneswar, Bangalore and Chandigarh. Officials of the department of Electronics (DOE) say that India could become the world's major software producer by the end of 1990.

The United States is the first target for export, followed by Japan and Europe. Potential US customers are being identified by the State-owned company CMC Limited in preparation for the establishment of an Indo-US software trade network. As part of the export drive, the DOE has been organizing seminars abroad to project Indian software capabilities and has set up a software development agency within the department.

India wants to keep its brightest graduates at home rather than see them emigrate to the United States and elsewhere. Software parks can keep them gainfully employed while earning foreign currency for India.

The Government has also welcomed foreign computer companies that recruit Indian staff. Two years ago, Texas Instruments (TI) of Dallas set up a subsidiary in Bangalore with a staff of 30 software specialists. An Earth station on top of its office building now sends the program written by the Indians to TI's mainframes in Dallas via Bedford in England. With cheaper Indian labour, TI expects to recover its investment cost in another two years.

In another project, Indian engineers are generating financial software programs for the US company Citibank at its subsidiary in a free-trade zone near Bombay airport. Hinditron Services of Bombay has been developing programs for US companies Tetronix Inc., Digital Equipment Corporation and Hewlett-Packard. Japan has also spotted India's software potential, and PSI Systems in Bangalore develops software exclusively for Japanese computers.

India is also encouraging Indians living abroad to return home and invest their talent and savings in software parks. Two groups have so far responded and will invest $5 million in each of the three proposed parks at Pune, Hyderabad and Nilgris (in Tamil Nadu) where the Government will install Earth stations to link them with US computer companies. (Source: Nature, Vol. 335, 15 September 1988)

Matsusnita plans electronic city

Matsushita Electric of Japan is reportedly planning an electronic city in India with an investment that could run into Rs. 10,000 million (330 million pounds sterling).

A high-powered team from Matsushita is expected to visit India shortly with concrete proposals about the project. The team would be making detailed presentations before different State governments and holding discussions to assess the infrastructure facilities available.

Matsushita is reportedly keen to extend its manufacturing activity to India because labour costs are still relatively cheap. (Source: Electronics Weekly 30 November 1988)

Ireland

ESPRIT collaboration pounds sterling 500,000

The Community's ESPRIT programme has been an important - some would say crucial - source of research funding for Irish universities for some years now, and many researchers have formed important alliances with specialists overseas. This is true for the National Institute for Higher Education in Dublin, where its School of Computer Application has tied down a number of useful projects. It has won participation in ESPRIT Phases I and II, and has found the programme of particular importance to students who need advanced projects to keep them working at their full potential.

An ESPRIT I project, coming to its conclusion in February 1989 after a three-year run, involved the design and "building" of a software development manager's workbench, a software suite designed to streamline the development process. It involved four students in all, equivalent to three full-time positions, and brought between pounds sterling 100,000 and pounds sterling 150,000 into the NIHE, Dublin for each of the three years.

The workbench included the software tools necessary to estimate time and costs, carry out risk analysis, complete work breakdown, planning and quality assurance, amongst other headings.

Most of the tools are now at a demonstration stage and are being integrated with tools completed by other project partners. The finished prototype workbench should be ready by February 1989. The School of Computer Application is involved in another project, this time under ESPRIT II, called SCOPE, Software Certification Programme in Europe. SCOPE is an attempt to create a unified approach to the certification of software products written in Europe and made available for sale in Europe.

The SCOPE project is very new, and will not start until January 1989. The NIHE Dublin participation is now approved but its terms of reference and contract details are still under discussion and negotiation. It will probably employ the equivalent of two or three full-time students, and should be worth about pounds sterling 500,000 over its four-year run. There will be collaboration with France, Italy, Denmark, FRG, UK and Austria, making it "one of the biggest projects" to come out of ESPRIT. Austria will make its own contribution as a non-EC State.

NIHE, Dublin is involved in yet another ESPRIT II project called SIMPR, Structured Information Management and Processing. It will also begin in January 1989 and is a "spin-off from a project at University College, Dublin", called Minstrel.

The cross-fertilization will be formalized in that the NIHE and UCD are joint participants in SIMPR. They will join with researchers in Denmark, Scotland, Portugal, Holland and two Finnish partners. Finland will cover its own costs, and the EC will contribute six million ECU, which includes the contribution made by the participants.

The project will involve text retrieval using language processing techniques. This will allow a tree-structured index to be created, and the system will be driven using an expert system. It is a three to four-year project and will require up to 38 man-years from the Irish participants. (Source: Technology Ireland, September 1988)

Office tasks from abroad

An office may be spread around the world and linked by computer and telecommunications equipment. For example, New York Life Insurance has set up a claims processing office in Castleisland, Ireland, which is linked by computer to its offices in the US. The company has had trouble finding qualified office workers in the US, but Ireland has a large pool of well-educated young people who need jobs. The trend to performing office tasks abroad will likely accelerate. Ireland is actively seeking US office work, and has attracted New York Life, Travelers, McGraw-Hill, Boeing and Bechtel. In addition to being able to find qualified workers who will stay on the job longer, the firms opening offices abroad are able to pay lower wages. Some public and political opposition to such moves is likely as the trend grows. Some resistance already exists within firms that are opening the new offices.

Foreign office operations can range from simple data entry to software development. A computer scientist in Ireland might earn $14,000 per year, which is 50 per cent as much as a comparable person in the US. The labour cost savings more than offset the increased costs of telecommunications and shipments of forms. (Extracted from New York Times News, 18 October 1988)

Italy

Italian supercomputer for theoretical physics

A consortium of the Universities of Rome, Pisa, Bologna and Padua, in co-operation with CERN in Geneva, have completed development of two prototypes of the Array Processor Experiment (APE) supercomputer. APE, which can handle 250 million operations per second, has 16 co-processors and 16 memories. A 32-processor, 32-memory machine is expected to be tested by the end of the year. The objective of the consortium is to produce a computer more powerful and less expensive than the Cray. (Source: European Science News, August 1988)

Computation centre in Naples

A new computer centre is being established in Naples for research on parallel architectures and supercomputers. The centre, headed by Professor Carlo Savy of the Department of Informatics of the University of Naples, has initial financing of 16 billion lire (about $12 million) and will employ 22 scientists. (Source: European Science News, August 1988)

Digital Equipment opens world research centre in Varese

Digital Equipment Corporation (DEC) is opening a software research and development centre in Varese for the development of base software for DEC systems worldwide. The centre, which opened in October 1988 and employs 300 scientists, will focus on integration of standard operational systems (such as UNIX/POSIX and VAX/VMS), computer-aided software engineering (CASE), and computer-integrated manufacturing (CIM). (Source: European Science News, August 1988)

Japan

Ten-year project brings Japan to starting block

The final three-year stage of Japan's ambitious 217 million pounds sterling fifth-generation programme will take researchers to the starting point for building computers which can process knowledge - but will not produce immediate commercial results.

Today, seven years into the programme, many of the key target developments are still only in their infancy.

This emerged at a conference in Tokyo for over 1,000 computing specialists from across the world organized by ICOT, the research institute set up to run the programme.

ICOT director Kazuhiro Fuchi now refuses to reveal the programme's criteria for success. It has already been down-graded in Japanese eyes and he is still waiting for the Japanese parliament to approve the ¥8C million for the last phase.

The best progress has been made in logic programming languages and the development of a 64-processor shared memory machine. This consists of loosely coupled clusters of eight processors.

But the next stage, the development of a machine with 128 tightly coupled processors, is six months behind schedule.

Another key component of the programme, the Kappa knowledge base management software, appears to be only in its infancy. ICOT claims it has developed the basic software.

ICOT has spent five years developing a program analysis and verification tool but this proved rather simplistic when demonstrated.

There has been no work on human interfaces in ICOT: work on speech and graphics is going on outside the programme.

ICOT has demonstrated a discourse understanding system, Duals 3, which can read and answer questions on a piece of text 200 sentences long, taken from an 11-year-old's school book. It handled questions from the audience impressively - but ICOT says a lot of fine tuning had been done to enable the system to handle that particular piece of text. A new piece would pose severe problems.

However, the system does seem to show learning abilities and is working by inference.

Dual's project leader Kiochi Hashida expects to develop the system on the programme's parallel inference machine in the final stage of the programme.

Kinka Yamamoto has been appointed to promote ICOT's work for commercial exploitation. She is confident that the parallel inference machine will reach the market. (Source: Computer Weekly, 8 December 1988)

Tiny steps towards the thinking machine

The centrepiece of Japanese plans to build a fifth-generation computer is a network of processors known as the Parallel Inference Machine (PIM). Visitors at the ICOT conference were keen to see what progress the Japanese had made on PIM, and most were surprised to find that this part of the fifth-generation project has moved forward at a tremendous rate.

PIM is the array of processing elements that will form the hardware of the parallel computer and make it possible for the machine to handle many different problems at the same time. The Japanese aim to build an array of 1,000 processors with software that will allow it to deal with concepts and indefinite pieces of information, or knowledge, rather than a series of numbers.

Researchers at ICOT have conquered the technical problems associated with building the network. Progress on the operating system, which controls the way the processors will function together and on the language which programmers use to talk to the computer, was also enough to convince leading computer scientists that Japan's plans for a machine with 1,000 processors are not just pipe dreams. What is different about PIM is that it uses a mixture of the two most popular methods of making the processors talk to each other.

In these approaches, the processing elements sit at the nodes that make up the network. One method allows several processors to communicate with each other by writing to and reading from a shared memory. The other approach gives each processor its own memory and the processors send messages to each other over communication channels. PIM consists of clusters of processors which share one memory and the network of clusters sits underneath another separate array which holds the communication nodes. This allows every processor to talk to the others in the network and makes the machine faster because messages do not have to pass directly through the processors as they cross the array. At the same time this type of structure is more difficult to program and the communications channels can take up valuable processing time which could otherwise be used to solve problems.

Takashi Chikayama, a senior researcher at ICOT, says that another critical aspect of PIM is that it can handle eight bits of information at a time, as opposed to conventional parallel processors which take in one bit of serial information at a time.

When PIM is finished it should be able to handle millions of logical inferences every second. A logical inference is a parallel process equivalent to around 100 machine instructions on today's computers.

At the conference ICOT showed hardware which is a precursor to PIM. This is the Multi-PSI, a collection of 64 processors which ICOT originally developed as the heart of a computer called the Personal Sequential Inference machine. Multi-PSI has a different hardware structure to PIM, but the research team has been able to develop the operating software on Multi-PSI which will eventually run on PIM. (This first appeared in New Scientist, London, 10 December 1988, the weekly review of science and technology.)

Brainwave hits Japanese computers

Japan's computer manufacturers are turning to neural computers, consisting of electronic processors laid out in a similar way to the neurons in the human brain, to solve some of the trickiest problems in artificial intelligence. Recently two companies have announced progress in such systems, which they say will recognize handwriting and human speech by employing "fuzzy logic" - notoriously difficult with conventional computers.

Designers of neural computers try to recreate the connections in human brains by connecting simple electronic processors together in three-dimensional networks. Such networks have a layout similar to the neurons and synapses, or connections, of the brain. The idea is that, by fine-tuning the different connections between neurons, the whole network can be "trained" to carry out tasks, especially those that involve the use of imperfect data.

Enthusiasts say that these machines should be much better than ordinary computers at tasks such as identifying visual patterns or spoken words.

The concept dates from the early days of computing in the US. However, most researchers abandoned the idea because of the difficulty of constructing and programming neural networks. Japanese companies, driven by the huge potential markets for robotic vision and machines to cope with speech, have now revived the idea.

Researchers at Toshiba's systems and software engineering laboratory said that they had developed an experimental neural network for recognizing handwritten characters. The company claimed that the network had accurately recognized between 99.8 and 99.9 per cent of more than 12,600 samples in the test. Previous systems had an accuracy of between 90 and 96 per cent.

Engineers programmed one of the company's engineering workstations to create 200 processing units laid out in a neural network. The present model recognizes only handwritten numbers from one to nine. However, researchers plan to adapt the idea to recognize the thousands of Chinese characters which form the bulk of the written Japanese language.

Meanwhile, the giant engineering company Hitachi announced it had developed a system for speech-recognition that is based on neural architecture. It works in two stages. In the first, neural networks pick out consonants in spoken Japanese. These match the pattern of sounds against the known rules governing consonants. The company said this system recovers about four out of five errors that conventional systems of speech recognition commit.

The second part of the system recognizes words in the context of a sentence by following rules on semantic relationships. These are enshrined in a type of expert system.

Hitachi said the system can recognize 3,000 words from a particular speaker with an accuracy of about 95 per cent. A representative of the company said that computers based on the technology could be on the market within two or three years.

Neural computing is about to win a seal of approval from Japan's Ministry of International Trade and Industry, which wants to establish a national programme of research to lead the technology to the market. Many researchers believe, however, that it will be impossible to create large-scale neural networks with electronics because of the sheer complexity of wiring up tens of thousands of electrical nodes.

The answer to the problem may be to use pulses of light which would not interfere with each other in the way that electronic links tend to do. In theory, an optical computer of a practical size could contain millions of nodes. But even the most optimistic researchers do not expect such machines to become reality for several decades. (This first appeared in New Scientist, London, 26 November 1988, the weekly review of science and technology.)

Japan "opens" to foreign chip firms

The Electronics Industry Association of Japan (EIAJ) says it is improving Japanese market access to foreign semiconductor companies.

The move follows sustained pressure from US semiconductor companies complaining that Japan is failing to meet an agreement that opens up its domestic market.

The Users Committee of the EIJA has put together an Action Plan after two months' work by six sub-committees. The plan lists company-specific advice on how to create long-term relationships with potential Japanese customers of foreign-made semiconductors. It also advises companies on how to become involved in Japan's consumer electronics and automotive markets.

The Users Committee will also provide information on trends in the Japanese market, sponsor seminars for foreign companies and will monitor the Action Plan to ensure it fulfills its goals.

The EIAJ is asking the SIA to accept the Action Plan so that the two organizations can work together on improving Japanese market access to foreign companies. (Source: Electronics Weekly, 28 September 1988)

Republic of Korea

Overview, prospects of industry

Ask officials responsible for Korea's high-tech industries to name their most prized developments and one project appears on everyone's shortlist: the drive by Korea to become a leading semiconductor manufacturer.

Korea is third behind Japan and the US in making the new generation of memory chips, 1 megabit DRAMs, and is aiming to produce the next generation of memory chips, 4 megabit DRAMs, by 1990.

Yet a decade ago, Korea had virtually no capability in semiconductors, the building blocks of the entire electronics industry from computers to video recorders. Its position has been transformed by sustained investment in chip research and manufacturing and by government encouragement to regard semiconductors as a strategic industry.

The Korean electronics giants decided early on that concentrating on memory chips was the best way to build a rapid semiconductor presence. Large volumes and keen pricing are what matter for memories, the basis semiconductor workhorses for the data processing industry.

Ample funds were available to underpin Korea's ambitions. Samsung, the country's biggest chip manufacturer, has invested about $800 million in its semiconductor operations, a figure projected to rise steadily. It employs about 800 engineers at its semiconductor research and development centre in Korea and 100 engineers at a facility in California.

However, Korea launched its semiconductor initiative into choppy waters. Its build-up of investment coincided with the electronics slump of 1985-1986 when even established chip manufacturers were haemorrhaging cash.

Some of the country's biggest companies began to lose their way during the order famine. Hyundai, widely seen as having failed to appreciate the capital and expertise needed for this sector, closed

a plant in Santa Clara, California, though it is now firmly back in the business with a new plant in Ichon, west of Seoul.

Prospects are rosier now, however, thanks to the world-wide memory shortage, powered by the US-Japan chip pact and buoyant sales of personal computers.

While Korea undoubtedly has made dramatic progress in its chip operations, it remains unclear whether it will be able to close the yawning gap still separating it from the US and Japan, the two countries it relied on heavily for technology during its drive into the chip market.

Samsung insists it designed its 256 K by itself, but last year it had to pay Texas Instruments, the US chip maker, substantial sums for patent infringements. The issue of how dependent the 4 megabit work is on overseas technology is too sensitive for most Korean officials to discuss.

One of Korea's handicaps has been a lack of infrastructure - supplies of semiconductor materials and chip-making equipment such as wafers, photomasks, lead-frames and bonding wires.

The Korean industry has concentrated on a relatively narrow range of products. About half of Samsung's chip output falls outside the memory family, but they are mainly unsophisticated parts for Far East customers - such as watch and calculator chips. Moreover, Korean industry insiders accept that even their memory chips are available in more limited configurations than those of the Japanese and the Americans.

Manufacturers such as Samsung and Goldstar have some capability in Application Specific Integrated Circuits (ASICs), the semi-custom chips increasingly emphasized by advanced manufacturers in Japan, the US and Europe. But both acknowledge it will be some time before they sell many ASICs overseas, mainly because of the investment in marketing needed to underpin that sector of the business.

Yet the fact remains that Korea has been successful in reaching the goals it set when launching into chips. Korean manufacturers have been steadily increasing their chip yields - a key determinant of productivity and price in the semiconductor business. (Source: Financial Times, 9 May 1988)

Sweden

TERMDOK on CD-ROM

TERMDOK, the data base created by the Swedish Centre for Technical Terminology (TNC) is now available on Compact Disc, Read-Only Memory (CD-ROM). The data base contains approximately 25,000 single and multi-word terms related to various branches of science and technology, with corresponding terms and synonyms in Danish, English, Finnish, French, Norwegian, Russian and Spanish. TERMDOK is derived from 25 separate dictionaries published by TNC. The CD-ROM version is published by Walters Lexikon i Stockholm, Sweden. It was produced by UK-based Archetype Systems Ltd. using new multilingual CD-ROM retrieval software from Dataware 2000 GmbH, in Munich, Federal Republic of Germany. This software has rapidly achieved international recognition for its speed of retrieval, ease of use and facility for presenting the user with prompts and help messages appropriate to the language selected.

For further information, please contact: Keith Taylor, Director, Archetype Systems Ltd., Boundary House, 91-93 Charterhouse Street, London EC1M 6LN, UK. (Source: Program automated library and information systems, July 1988)

United Kingdom

NEDO forms study team to look at UK electronics

The National Economic Development Office has formed a committee to investigate the effectiveness of the British electronics industry in meeting the requirements of industry.

The committee, called the Electronics Applications Sector Group, will be chaired by Ivor Cohen, the former managing director of Mullard (now Philips Components). He will be joined by representatives of the Government, trade unions and major manufacturers such as IBM and GEC and users such as ICI and Marks and Spencer.

The group's first task will be to look at applications of electronics and information technology in four areas - health, education, leisure and security.

A pilot survey of each sector will be undertaken. When the results are known, the group will decide whether a research and development think-tank should be established to explore and exploit potential applications.

A specific problem the group will study is the sluggish response sometimes shown by British industry when applications of electronics and information technology are identified in the four sectors under review. (Source: Electronics Weekly, 7 December 1988)

Superconductors raise antenna's power

Engineers at the University of Birmingham claim to have made a miniature radio antenna from a high-temperature ceramic superconductor that can radiate virtually all the energy it receives.

Conventional antennas work best when they are about the same size as the wavelength of the radio waves they emit or receive. However, because radio wavelengths can be half a metre or more, engineers are forced to use smaller antennas in many practical applications such as communications on aircraft.

Unfortunately, efficiency drops with size such that a conventional antenna that is one-twentieth the size of the radio wavelength radiates only five to 10 per cent of energy. Resistance in the antenna wire causes the drop in efficiency.

The group at Birmingham has made a short dipole antenna of yttrium barium copper oxide, which the engineers cooled to about -183^{o}C. The 20-millimetre antenna operated at 550 megahertz, corresponding to a wavelength of 545 millimetres. Its gain was 16 times that of a copper antenna of equal length at room temperature. (This first appeared in New Scientist, London, 29 October 1988, the weekly review of science and technology.)

More UK backing for EUREKA's HDTV project

The UK's Department of Trade and Industry (DTI) announced that it will be providing $1.7 million financial support for participation by the UK's Quantel Ltd. and Philips Research Laboratories in a major EUREKA project to develop a high-definition television (HDTV) system. This takes the total DTI support to UK participants in the HDTV project to $4.8 million.

Quantel will develop a range of high-definition editing and image manipulation equipment and Philips will be making a major contribution to research into picture analysis and coding techniques associated with the transmission and display of high-definition signals.

The aim of the EUREKA HDTV project, which involves some 30 European industrial companies, broadcasters and research institutes, is to define a standard for HDTV which is compatible with the Multiplexed Analogue Components (MAC) transmission system being introduced for Direct Broadcasting by Satellite (DBS) services in Europe. The project will develop and demonstrate, by 1990, a complete prototype production and transmission system for MAC-compatible HDTV.

Demonstrations of the EUREKA system will take place in 1989, with the objective of having the system adopted as a world standard by the CCIR (the international radio standards body) in 1990.

Further information about the EUREKA HDTV project may be obtained from Mr. H. Wessels, EUREKA HDTV Directorate, Philips International BV, Building SF 7, Eindhoven, the Netherlands. (Source: European Science News, June 1988)

Computer hackers cleared of lawbreaking

Hackers in Britain can breathe a sigh of relief. The Law Commission of England and Wales has decided not to recommend that hacking, breaking into a computer system without authorization, becomes an offence. In a report on "computer misuse", published recently, the Commission has decided not to make a ruling on hackers and has appealed instead for comment from the public, before it makes a final recommendation.

Computer misuse covers a broad spectrum of activities including fraud, and the laying of "logic bombs" and computer "viruses" in computer systems.

The report concludes that most forms of computer misuse are embraced by existing law, and so recommends no changes. This is despite the case of Gold and Schifreen, two men who hacked into British Telecom's Prestel computers.

The pair were convicted of forgery, but their convictions were put aside when they appealed to the House of Lords, which decided that hacking could not amount to the crime of forgery.

Immediately after this decision, in May, the British Computer Society issued strong recommendations that hacking should become an offence in Britain.

Hacking, the Commission says, is the only category that is not covered by existing law, despite a recent conclusion from the Audit Commission which ranks hacking as "the single largest computer-related crime". The Law Commission has pulled together the case for and against its criminalization.

Arguments in favour include the fact that unauthorized access to certain information held on a computer, such as personal data covered by the Data Protection Act, could be "peculiarly damaging". It also notes that many other countries, including the US, Sweden and France have already made hacking a crime. (This first appeared in New Scientist, London, 22 September 1988, the weekly review of science and technology.)

British collaboration on soft errors

A "Soft Errors Club" will bring together Britain's leading semiconductor manufacturers, users, materials suppliers and scientists. This new collaborative research project, aimed at dramatically reducing the problem of soft errors in microelectronics, has recently been launched by the Microelectronics Materials Centre of the UK Atomic Energy Authority's Harwell Laboratory.

There is now a clear need to identify ultrapure materials to guarantee the quality of the integrated circuits fabricated from them. This will enable the number of single event upsets caused by alpha particles emitted by naturally occurring radioactive elements in these materials to be reduced.

This research program will extend the technique invented at Harwell, which can measure the presence of uranium atoms in concentrations as low as 1 ppb. This fission track autoradiography technique employs optical microscopy to count fission tracks in polyimide film coated onto semiconductor material previously irradiated in a nuclear reactor. The technique is also suitable for quality assurance at each stage of microchip manufacture, such as etching, evaporation, soldering, bonding, etc.

The two-year programme already has the support of MEDL, Inmos, Anamartic and the British Government's Department of Trade and Industry, with an initial budget of more than $250,000. The Club is open to UK organizations and to overseas companies that have a significant manufacturing presence in the UK. The members will review the program regularly and advise on the future direction of the research. (Reprinted with permission from Semiconductor International Magazine, October 1988. Copyright 1988 by Cahners Publishing Co., Des Plaines, IL. USA)

Rule change forces researchers' rethink

British firms may withdraw from the UK's new post-ALVEY information technology research programme due to start next year because the Government has changed the funding rules.

In a major shift from the ALVEY programme, the Government will fund only 50 per cent of the total research work carried out, under so-called LINK rules. This means industry must fund part of the work of its university partners. Under ALVEY, industry got 50 per cent government funding and universities 100 per cent.

Firms argue that to support a university partnership could reduce their funding to 25 per cent or less, so taking part would no longer be cost-effective. At best, firms could cut the level of university collaboration. But both courses

of action could destroy the relationship built up between the two communities under ALVEY. (Source: Computer Weekly, 6 October 1988)

Campus network gets green light

The first project in the Government's open standards network demonstration scheme finally got the go-ahead more than two years after the programme was announced.

Eric Forth, the new junior industry minister, announced that the Department of Trade and Industry (DTI) will contribute £900,000 to a £4.9 million scheme to install a broadband network at Aston University.

The campus network will have up to 2,500 nodes, with satellite links and connections into the academic Janet X.25 network. The cable can hold 100 data circuits including two Ethernet channels, a manufacturing automation protocol (MAP) channel, eight one-way television channels and four two-way video channels.

DTI failed to find any suitable takers for OSI demonstrator funds when the scheme was first announced in 1986. The scheme is similar to the software engineering demonstrators where commercial companies got grants to show off software engineering applications to would-be users.

The leading user standards body Itusa tried to get DTI backing to set up an X.400 electronic mail demonstration but was turned down because its proposal was not commercial enough.

The whole OSI demonstrator project then got held up by policy reviews at DTI.

The network will be used to support three major projects as well as allowing any of the university's 5,000 staff and students to access distributed processing power. The library and information service will give users access to internal and external library systems and there will be an X.400 mail service for campus users. (Source: Computer Weekly, 29 September 1988)

UK firms join in EUREKA project

The UK is set to play a full part in Europe's £300 million EUREKA software factory project.

Lord Young, Secretary of State for Trade and Industry, has approved backing for two UK participants, Sema Group and ICL, to join the project, which started in 1986.

The 10-year EUREKA project, involving 17 other information technology and electronics groups, aims to develop a computer-aided software production system which will tackle today's problems of software quality and reliability.

Recently UK ALVEY researchers published the results of a one-year £100,000 study into the impact and design of an information system (or software) factory.

While no money is available to support a UK research initiative, their ideas may yet be taken up by the EUREKA consortium or in the ESPRIT technology integration project, Atmosphere, currently undergoing evaluation for funding from the European Commission.

The authors of the report, Gavin Oddy of GEC Research and Colin Tully of Cranfield IT Institute, fear that the factory notion may be yet another good UK technology idea which others will exploit.

The report presents recommendations for the requirements and architecture for an information software factory and a means of realizing the concept.

Software developers and users who are interested in the factory concept hope to set up a workshop to tackle these research and development questions. (Source: Computer Weekly, 3 November 1988)

Superconductivity in UK suffers from apathy in industry

Superconductivity research in Britain is being held back because industry is unwilling to invest. Of £16 million available in public funds, only about £10 million has been spent. This is partly because superconductivity is officially classed as an advanced technology project and one of the funding criteria is that there must be three partners from industry or two from industry and one higher education institute. Sir Martin Wood, who chairs the national committee, said at a symposium on high-temperature superconductors at the University of Cambridge that industry has been "somewhat slow" in coming forward. The attitude of industry, he said, is that if something is being done in Japan and the United States, then Britain will not be able to keep up and that if those countries are not involved then it is not worth doing.

Funds in Britain for high-temperature superconductivity are not available on the scale of funding elsewhere, said Wood, and if industry is to benefit then it must target specific areas where applications are seen to be likely. This contrasts with the situation in Japan where the fact that commercial benefit may be distant does not discourage investment in basic research on a large scale.

But in Britain, the funding arrangements require that industry is involved and industry wants to see applications on the horizon. The present funding arrangements will probably change in 1989, possibly in an attempt to alert industry to market opportunities. Funds for high-temperature superconductivity will then be channelled through the Government's LINK scheme. Whether the move will have the desired effect is debatable, but it may unlock some of the funds available, because a project will be required to have only one industrial partner. There will also have to be one partner from the science base involved. The switch will mean that most of the projects might change quite dramatically.

Funds for research in high-temperature superconductivity also come through the Science and Engineering Research Council (SERC), which spends £2 million a year, and through a joint arrangement between the Council and the Ministry of Defence. Between £3 million and £5 million is available through this joint scheme but remains unspent.

After finding funds, researchers in Britain are faced with another problem: how to keep up with developments in the rest of the world. Because of the expense, there is no comprehensive data base in

this country. Both SERC and DTI have examined bids for a data base and rejected them on the grounds of cost. Now work is under way to establish links with existing data bases in Europe.

Another obstacle to advances in this field is a shortage of post-graduate researchers. Short-term posts are not always attracting the required workers. (Source: Nature, Vol. 335, 15 September 1988)

UK firms invited for research in superconductors

UK companies have been invited to take part in a research project to identify and fabricate high-temperature superconducting materials started at the UK Atomic Energy Authority's Harwell laboratory.

As part of the Department of Trade and Industry's national industrial high-temperature superconductivity programme, the £2 million project merits 50 per cent funding from the Government. The balance will be provided by industrial participants which already include Air Products, BICC, BOC and Johnson Matthey.

Companies will take part in research activities at Harwell and Oxford University aimed at producing usable components based on bulk materials, flexible thick films of a tenth of a millimetre and wires. High-temperature superconductors are usually the oxides of a "mix" of elements such as barium, yttrium, copper and bismuth that start to lose their electrical resistance at around 90° above absolute zero.

World-wide research is now producing superconducting ceramics that reach zero resistivity at temperatures above the boiling point of liquid nitrogen which is 77° above absolute zero. Current work at GEC and Plessey is producing ceramics based on oxides of bismuth, strontium and copper that have zero resistivity at 106 K. This is amost 30° above the boiling point of nitrogen.

The Harwell project, which at present does not include either GEC or Plessey, will draw on the laboratory's experience in the fabrication of complex ceramic components. When applied to superconducting materials work could lead to applications in computer memory stores and "magnetic levitation" transport. (Source: Electronics Weekly, 9 November 1988)

UK researchers get Japanese welcome

The UK is to be the first country to get industrial researchers inside Japan's fifth-generation computer programme - jsut as the project's pioneering parallel inference machine and knowledge-based software system enter a key phase of development.

An agreement on the exchange of researchers will be signed in Tokyo by Tim Walker, head of the UK's Information Engineering Directorate in the Department of Trade and Industry. The UK has been holding out for industrial exchange researchers rather than academic ones for four years. The first UK industrial researchers could go to Japan in 1989.

The agreement comes just as the 10-year programme reaches what director Kazuhiro Fuchi calls its genuine core after seven years of preparatory research. The project faces its biggest challenge in the next three years.

The idea of an exchange agreement with the UK has been discussed since the UK's ALVEY programme of advanced computing research began in 1984. The stumbling block until now has been the UK's insistence that the exchange reserachers should be from industry rather than the academic world. The Japanese have now agreed to these terms. (Source: Computer Weekly, 1 December 1988)

Ansa project wins ESPRIT funding and partners

The UK's ambitious Ansa project, which looks far beyond open systems to the distributed networks of the future, has three new European partners and a guarantee of funding under the next phase of Europe's IT programme, ESPRIT.

AEG and Siemens of West Germany, and Ellentel, Ericson's Swedish research subsidiary, join eight UK and US firms working to develop an architecture for open distributed processing, under ALVEY funding.

Some see the new European project (ISA) as "the strategic powerbase for IT in ESPRIT". ISA will co-operate with another ESPRIT project, Commandos, led by Bull of France, which is also working on distributed systems. The two will exchange information and have agreed not to duplicate each other's efforts.

The new partners will have a big impact on the International Standards Organisation (ISO), which is still driven by international votes.

The work done by Ansa and ISA will form the basis of ISO standards for the 1990s.

Ansa's premise is that no one supplier can cover all a user's IT requirements, and while OSI will allow different computers to talk to each other, it is not suited to allowing discrete applications to talk to each other across a network.

The project aims to get a widely accepted set of open distributed processing standards onto which all ESPRIT projects can converge. By the time funding runs out in five years, it hopes to have achieved the basis for European industry to develop common distributed systems.

The team continues to work on a reference architecture developed under ALVEY, and has a test bench under development. The project is talking to open systems standards bodies, COS and SPAN, but also wants links with the Open Software Foundation, led by IBM. (Source: Computer Weekly, 10 November 1988)

UK launch for flexible CAD system

A German-designed user friendly CAD system called Abracad has been launched in the UK. Its aim is to provide microcomputer users with a speed and ease of working hitherto largely restricted to minicomputer users.

Abracad will run on IBM pc ATs and compatibles, IBM RT6150s or Sun Workstations, using either the Unix operating system or MS-DOS. Since the software is the same for either system, upgrading for multi-user network systems is easy.

Originally developed by Marcus Computer System GmbH, Abracad is marketed in the UK by Goodwin Marcus Systems, a subsidiary company.

Features of the software include: parameterized parts, which allows shapes like nuts and gear wheels to be held in memory and added to the drawing by typing in a few key dimensions; associativity, which permits a drawing component to be stretched in the X-axis, the Y-axis, or at a specified angle while retaining the correct proportions for holes, nuts, etc. (dimensions and cross-hatching are then automatically recalculated and reapplied); the bill of quantities generator, which cuts down a long chore to a matter of minutes; and simulation, with which a shape can be moved along a predefined path, particularly useful with designs which have to be tested for collision control. The price is £3,250 for the software.

Contact: Goodwin Marcus Systems, 10 Spinney Avenue, Goostrey, Cheshire CW4 8JE; tel. 0477 34188. (Source: Manufacturing Chemist, November 1988)

United States of America

Superconductor research at national laboratories

American Superconductor (Cambridge, MA) has acquired the exclusive rights to develop and market high-temperature superconductors from the US Department of Energy's Argonne National Laboratory. The agreement marks the first time that a national laboratory has licensed its superconducting technology to private industry. Argonne produces superconducting ceramic coatings by oxidizing a suitable metallic precursor. For example, a wire coated with a 1:2:3 alloy of yttrium, barium and copper is heated in the presence of oxygen to yield a superconductive yttrium-barium-copper oxide coating. More research will be needed to develop a practical superconducting wire. However, Argonne is seeking a patent for its process. American Superconductor had previously obtained the exclusive rights for another process involving metallic precursor technology developed at MIT. The firm will provide Argonne with $100,000 in funding for research on bonding superconducting oxides to metal substrates and use of ion-beam sputtering to deposit superconducting thin films. (Extracted from Chemical and Engineering News, 17 October 1988)

NSF unveils new computer network

Academic computer users throughout the United States moved a step closer to nationwide integration when the National Science Foundation's upgraded computer network, NSFNET, was inaugurated. With a transmission rate of 1.5 million bits per second, and improved switching technology, the new network should allow researchers throughout the country to work interactively with NSF's six supercomputer centres as well as with data bases and other resources, but demand is so great that the capacity of the network may be exhausted in as little as 18 months.

After being put out to tender last August, the contract for the upgrade and maintenance of NSFNET was awarded to Merit Inc., a consortium of eight universities in Michigan that had been successfully operating a State-wide computer network. The expansion of NSFNET by Merit has been done in co-operation with IBM, which helped to develop the switching and routing system, and MCI, a long-distance telephone company, which has supplied digital and fibre-optic land lines. Both of the companies have provided their services free.

Computer networks in the United States have grown up through a rather haphazard aggregation of regional systems and commercial enterprises and the resulting proliferation of electronic mail systems and transmission standards has caused as much frustration as communication. Although the expanded NSFNET unifies some of the smaller networks, it is still not easy to move between NSFNET and other national systems such as BITNET and OMNET. But plans for further unification are being studied, and NSF has expressed willingness to act as a lead agency in any such programme.

NSFNET was designed to allow an increase in transmission rate by a factor of 30, to 45 million bits per second, to be achieved as the system expands. It is expected that users will invent new applications as capacity and reliability increase. The most popular use today, electronic mail, was added as an afterthought to the first networks. (Source: Nature, Vol. 334, 4 August 1988)

US electronics body issues HDTV warning

The American Electronics Association (AEA) has renewed warnings that if the US does not develop high-definition television (HDTV) technology, its semiconductor, personal computer and automated manufacturing industries will suffer.

The market for HDTV is expected to be worth $40 billion within the next 20 years. The AEA made a similar warning several months ago when a sub-committee issued its report on HDTV. The AEA has released a detailed economic impact report showing the domino effect of not having HDTV technology.

The report says that US HDTV manufacturers must hold at least 50 per cent of the HDTV market by the year 2010 to maintain the 70 per cent share of the personal computer market held by US companies today.

A coalition of government, industry and academia is suggested by the AEA as a way of developing a prominent presence in the HDTV market. Japanese electronics companies have already spent over $700 million on HDTV development. They can already produce experimental picture tubes that have the clarity of a photograph.

The AEA estimates the US has five to 10 years to catch up with the Japanese. The first Japanese HDTV systems are expected to be available by 1991 for about $3,000 to $5,000 each. Their sales will be limited at first because a different broadcast signal is needed. However, VCRs, cable TV and satellite HDTV transmitters will be available for the first buyers. (Source: Electronics Weekly, 30 November 1988)

US and Japan team up for DRAMs

Ramtron and NMB Semiconductor (Tatevama, Japan) have agreed to co-develop a 4 M-bit DRAM using the new ferroelectric materials' technology Ramtron has been working on for several years.

The combination of Ramtron technologies and NMB DRAM processes could keep DRAMs planar through several more density generations, eliminating the need for trenches, stacking capacitors or other complex structural changes all other DRAM makers are committing themselves to. This would be a drastic development in the DRAM business, especially since none of the companies making trenches or stacked

capacitors, Japanese, European, or American, have been able to yield well enough to prove these techniques are thoroughly economically viable.

Ramtron's ferroelectric materials will be used in this development as linear dielectrics, not as non-volatile memory elements. The development should not be confused with non-volatile ferroelectric memories. The materials, even when used linearly and not switched, as in non-volatile applications, have more than 100 times the dielectric constant of silicon oxides, allowing the size of the capacitor to be shrunk to one of the smaller elements of each memory cell without resorting to 3D structures. In the new design metal pitches would again become the determining factor in circuit density.

But while Ramtron has been modelling, fabricating and characterizing new cell designs for about nine months, they are a long way from being proven as commercially viable.

Ramtron is also expected to announce a few more partners in the near future.

To date, Ramtron and Krysalis Semiconductor (Albuquerque, New Mexico) are the pioneers in bringing ferroelectric materials into the memory arena, first as non-volatile devices.

Critics of ferroelectric materials point out that there is a "wearout" mechanism and many chemical incompatibilities with the other materials used in IC fabrication, and that the layering of ferroelectric films within IC structures has not been done successfully. They believe the only successful devices have the ferroelectric films on top of a complete IC structure, separated by a protecting oxide layer. That would not get the densities to make a planar 4 M-bit DRAM.

NMB is familiar with nitrides, used in its current 256 K-bit DRAM design, which it obtained from Inmos. That design gives the highest speed 356 K unit in the industry and has created such demand for the NMB product it prompted NMB to convert its new 1 M-bit DRAM fab module over to 256 K-bit units. NMB is also familiar with Ramtron through that 256 K project.

Under the agreement Ramtron is responsible for the device design, the process and getting it up in production. The design team is operating in Colorado Springs, with a production engineering team from NMB. Ramtron has sent a process development and integration team to Tateyama which will live there for two years, as will the Japanese team in the US.

NMB will have sole rights to manufacture the resulting device, with Ramtron collecting royalties. They will jointly own the process technology. Ramtron has not given NMB rights to its non-volatile RAM technology. (Source: Electronics Weekly, 2 November 1988)

Regional reports: Asia

(1) **Computer market**: as shown in table 4.4.7, which is based on the number of units, the computer market in The Republic of Korea has shown growth averaging 46 per cent annually since 1983; there were 3,481 units in 1986. There are 1,971 minicomputers, 56.6 per cent of the total.

Status of computer utilization in the third world

Republic of Korea

Table 4.4.7. Trend of number of computers, by type, installed in the Republic of Korea (number of units)

Year	Very large	Large	Medium	Small	Very small	Total	
1980	31	46	111	143	199	522	
1981	42	66	137	167	221	633	
1982	60	84	174	210	238	766	
1983	76	114	214	318	392	1 114	
1984	105	137	265	461	678	1 646	
1985	128	164	312	614	1 257	2 475	
1986	139	178	393	800	1 971	3 481	
1986 growth	8.6	8.5	26.0	30.3	56.8	140.6	over 1985 per cent
1986 as share	4.0	5.1	11.3	23.0	56.6	100.0	of total per cent

Very large: $1.5 million or more
Large: $0.7 million or more (but less than $1.5 million)
Medium: $0.3 million or more (but less than $0.7 million)
Small: $0.1 million or more (but less than $0.3 million)
Very small: $50,000 or more (but less than $0.1 million)

Source: Korea Information Industry Association (KIIA)

Table 4.4.8 shows primary users. Private sector enterprises are first with 2,613 units, or 75 per cent of the total, followed by educational and research organizations with 421 and financial institutions with 29 units.

Government organizations have only 157 units, but that number is expected to increase under the national trunk computer network programme.

As shown in table 4.4.9, which shows manufacturers, 38 per cent of the market is held by IBM with 496 units, DEC with 259 and H.P. with 161.

At present there are 43 mainframe manufacturers in Korea and 42 manufacturers of peripheral devices, and there are 14 companies involved in data transmission. With regard to foreign affiliates, 45 manufacturers have made investments, beginning with IBM 20 years ago in 1967. The total includes $87 million from US manufacturers. $40 million from Japanese manufacturers and $10 million from others. Of the Japanese companies, Toshiba and Mitsubishi entered the market in 1969 and 1970, but the biggest Japanese player is Fujitsu.

Table 4.4.8. Number of computers, by type and sector, installed in the Republic of Korea (as of end of 1986)

Sector	Very large	Large	Medium	Small	Very small	Total	Share of total (%)
Government	17	17	62	32	29	157	4.5
Education and Research	7	13	48	122	232	421	12.1
Accounting and Insurance	40	40	58	51	101	290	8.3
Business	75	109	225	595	1 609	2 613	75.1
Total	139	178	393	800	1 971	3 481	100.0
Type share of total per cent	4.0	5.1	11.3	23.0	56.6	100	

Source: Korea Information Industry Association (KIIA)

Table 4.4.9. Number of computers, by type and manufacture, installed in the Republic of Korea (1985)

Manufacturer	Very large	Large	Medium	Small	Very small	Total	Share of total (%)
IBM	88	88	86	123	111	496	20.8
Fujitsu	10	11	48	12	1	82	3.3
Sperry		6	25	10	3	61	2.5
Cyber	3	12	4	1	5	27	1.1
Prime	0	1	33	37	17	103	4.2
DEC	1	2	41	71	144	259	10.4
NCR	4	6	13	5	65	93	3.8
HP	0	1	13	106	41	161	6.5
Honeywell	0	2	1	15	19	37	1.5
Burroughs	0	1	3	26	21	51	2.1
Eclipse	0	0	8	48	27	83	3.4
Wang	0	0	1	9	84	94	3.8
Others	3	19	36	151	710	928	37.5
Total	128	164	231	614	1 257	2 475	100.0

Source: Korea Information Industry Association (KIIA)

Table 4.4.10 shows trends in the structure of Korea's computer industry. If one considers the place of the computer industry within the electronics industry in terms of changes over time in the makeup of such things as production volume, one sees that the shares of exports and domestic demand have grown in the last six years, but the share of imports has remained about level.

Computers are used chiefly for personnel, payroll, accounting and administration. It is thought that their use will expand to the fields of top management and business planning (table 4.4.11).

(2) **Data communications market:** data communications has grown at an average annual rate

Table 4.4.10. Trends in structure of the Korean computer industry
(unit: million dollars)

Production, Import, Export		1980	1981	1982	1983	1984	1985	1986	Previous year ratio
Production volume	Electronics industry	2 852	3 791	4 006	5 558	7 170	7 285	10 611	45.6
	Computer industry	9.0	30.6	47.4	207.2	428.4	519.3	880.2	69.5
	Share (%)	0.3	0.8	1.2	3.8	6.0	7.2	8.3	-
Exports	Electronics industry	2 004	2 118	3 047	4 204	4 352	6 687	6 687	53.6
	Computer industry	6.2	11.8	36.4	115.2	261.8	396.5	706.6	78.2
	Share (%)	0.3	0.5	1.6	3.7	6.2	9.1	10.6	-
Domestic demand	Electronics industry	805	1 171	1 308	1 674	2 026	1 964	2 185	11.3
	Computer industry	2.7	7.1	8.3	66.8	105.9	90.5	155.9	72.3
	Share (%)	0.3	0.6	0.6	4.0	5.2	4.6	7.1	-
Imports	Electronics industry	1 460	1 743	1 979	2 683	3 163	3 107	4 483	44.3
	Computer industry	87.0	110.0	159.0	204.0	247.0	283.2	473.4	67.2
	Share (%)	5.3	5.7	8.0	7.6	7.8	9.2	10.5	-

Source: KIIA Electronics Industry Statistics (production and demand)
Office of Customs Administration statistics (exports and imports)

Table 4.4.11. Application of computer systems in the Republic of Korea
(1st row is number of respondents; 2nd row is percentage. Multiple responses allowed)

	Enterprises		Teaching/ Research Institutions		Government-Related Institutions		TOTAL					
							1986		1985		1984	
By Sector / Fields of Application	Present	Planned	Present	Planned	Present	Planned	Present	Planned	Present	Planned	Present	Planned
1. Production Control	90 (7.5)	62 (8.0)	0	0	0	0	90 (7.3)	62 (7.5)	21 (8.3)	30 (11.9)	9 (3.2)	27 (9.6)
2. Inventory Control	135 (11.3)	78 (10.0)	0	2 (4.9)	0	0	135 (11.0)	80 (9.7)	27 (10.7)	13 (5.1)	24 (8.5)	18 (5.4)
3. Product & Materials Control	137 (11.5)	72 (9.3)	2 (5.7)	2 (4.9)	0	0	139 (11.3)	74 (9.0)	32 (12.6)	24 (9.5)	24 (8.5)	21 (7.4)
4. Commercial Transactions	158 (13.2)	82 (10.5)	0	0	0	0	158 (12.8)	82 (9.9)	40 (11.8)	36 (14.2)	42 (14.9)	21 (7.4)
5. Accounting & Finance	188 (15.8)	97 (12.5)	6 (17.1)	6 (14.6)	0	0	194 (15.7)	103 (12.5)	47 (18.6)	37 (14.6)	42 (14.9)	30 (10.6)
6. Personnel & Payroll	207 (17.4)	69 (8.9)	10 (28.5)	8 (19.5)	0	0	217 (17.6)	77 (9.3)	61 (24.1)	18 (7.1)	60 (21.3)	18 (6.4)
7. Engineering Design	91 (7.6)	71 (9.1)	4 (11.4)	8 (19.5)	2 (33.3)	2 (33.3)	97 (7.9)	81 (9.8)	9 (3.6)	30 (11.9)	15 (5.3)	24 (8.5)
8. Advertising & PR	16 (1.3)	20 (2.6)	0	0	0	0	16 (1.3)	20 (2.4	0	2 (0.8)	0	3 (1.1)
9. Research & Planning	77 (6.5)	97 (12.5)	3 (8.6)	4 (9.8)	0	0	80 (6.5)	101 (12.2	0	0	0	0
10. Top Management	55 (4.6)	100 (12.9)	2 (5.7)	4 (9.8)	0	0	57 (4.6)	104 (12.6)	7 (2.7)	49 (19.4)	3 (9.1)	39 (13.8)
11. Korea Information Industry Association	39 (3.3)	30 (3.9)	8 (22.9)	7 (17.0)	4 (66.7)	4 (66.7)	51 (4.1)	41 (5.0	9 (3.6)	14 (5.5)	63 (22.3)	81 (28.7)
TOTAL	1.193 (100.0)	778 (100.0)	35 (100.0)	41 (100.0)	6 (100.0)	6 (100.0)	1.234 (100.0)	825 (100.0)	253 (100.0)	253 (100.0)	282 (100.0)	282 (100.0)

of 12.8 per cent, and reached 19,251 circuits at the end of 1986. The share of international circuits is 0.3 per cent, however, and online operation is thought to be in the beginning stage.

The makeup of communication subscribers is 58 per cent financial institutions, 31 per cent private enterprises and 16 per cent government. In regard to circuit speed, 48.7 per cent are 1,200 b/s, 37.3 per cent are 2,400 b/s and 0.8 per cent are 9,600 b/s.

(3) **Machine information policy**: the Korean Government has promoted three policies in the hardware industry: (1) a national production policy to rationalize imports and encourage domestic production of parts; (2) a technology development promotion policy for development of technology through joint ventures; and (3) a domestic demand promotion policy that includes a system for designated purchase of industrial machinery, aid for leasing of Korean computers and preferential purchase of domestic products by public institutions.

(4) **Human resources**: software production began in the 1980s, and has grown at annual rates of 30 to 40 per cent. As shown in table 4.4.12, the number of information processing technicians now exceeds 10,000 persons.

The Korean Government has promoted increased use of machine information through establishment of various education and training systems. A national qualfication system has also been implemented; almost 8,000 persons have been qualified now.

Republic of the Philippines

(1) **Computer market**: the number of computers introduced and the number of installations in the Philippines increased in the first half of the 1970s. But that upward tendency was slowed in the second half of the decade by factors like economic recession and the deflation and drop in the value of the peso caused by the oil crisis.

Average annual rates of growth from 1980 to 1986 were 13.6 per cent for mainframes, 16 per cent for minicomputers and 17.3 per cent for microcomputers.

Table 4.4.13 shows the number of mainframe installations, by manufacturer, in 1986. IBM led with 53 per cent, followed by NCR and Burroughs. Of the minicomputers, 33.1 per cent are from IBM, followed by NCR and DEC (table 4.4.14). IBM clones constitute 26.9 per cent of the microcomputers, with IBM and Apple next in line (table 4.4.15).

It is predicted that the number of computer installations will increase by 15 to 20 per cent annually in the next few years. The most growth is predicted for microcomputers, which have a good cost-to-performance ratio. And demand for larger computers is expected to grow as the economy recovers.

Table 4.4.13. Number of mainframes, by manufacturer, installed in the Philippines (1986)

Manufacturer	Number	Share (%)
IBM	120	53.1
NCR	45	19.9
Burroughs	36	15.9
FACOM	17	7.5
Sperry	8	3.5
Total	226	100.0

Source: Philippine Computer Society (PCS)

Table 4.4.12. Trends in numbers of information processing technical personnel in the Republic of Korea (units: persons, percentage)

Year	Number of employees	Job category: Professional engineers (senior engineers and researchers)	System analysts (incl. senior researchers)	Programmers (incl. researchers)	Operators (incl. technicians)	Key punchers	Total
1984	383	1 271	2 359	518	1 710	6 241	
		(6.1)	(20.4)	(37.8)	(8.3)	(27.4)	(100.0)
1985	87 899	429	1 565	3 432	720	1 465	7 613
		(5.6)	(20.6)	(45.1)	(9.5)	(19.2)	(100.0)
1986	118 159	571	2 081	4 747	893	1 483	9 775
		(5.8)	(21.3)	(48.6)	(9.1)	(15.2)	(100.0)
1987	141 345	704	2 412	5 310	816	1 406	10 648
		(6.6)	(22.7)	(49.9)	(7.7)	(13.2)	(100.0)

Source: Korean Information Industry Association (KIIA)

Table 4.4.14. Number of minicomputers, by manufacturer, installed in the Philippines (1986)

Manufacturer	Number	Share (%)
IBM	269	3.1
NCR	74	10.2
DEC	66	8.9
Burroughs	53	5.7
Datacom	92	5.6
Wang	33	5.1
Hewlett-Packard	35	4.8
Basic Four	32	4.4
FACOM	30	4.2
Sperry	8	3.5
Micromation	21	2.9
Other	98	13.6
Total	226	100.0

Source: Philippine Computer Society (PCS)

Table 4.4.15. Number of microcomputers, by manufacturer, installed in the Philippines (1986)

Manufacturer	Number	Share (%)
PC/XT AT clones	3 809	26.9
IBM PC XT AT	2 767	19.6
Apple clones	2 481	17.5
Apple II II+ IIe III	1 869	13.2
Tandy (TRS)	711	5.0
FACOM	311	2.2
SORD	299	2.1
NEC PC	170	1.2
Sharp	140	1.0
Hewlett-Packard	112	0.8
Other	1 481	10.5
Total	14 151	100.0

Source: Philippine Computer Society (PCS)

(2) **Software market:** it is in the field of software, rather than production of computers, that growth will be seen in the Philippines.

From a worldwide perspective, the software market is expanding more than that for hardware. In the US alone, sales of software have reached $41.6 billion. Sales in the Asia-Pacific region will reach $7 billion in the next five years.

Within the Philippines software market, the scale of exports increased in 1986, reaching $6.5 billion. Of that, 65 per cent was packaged software, and 35 per cent was customized software. By machine type, 80 per cent was for minicomputers and microcomputers, and 20 per cent was for mainframes. The software market is expected to grow at an annual rate of about 12 per cent.

In connection with that, in 1985 the US provided 64 per cent ($3 million) of the software in the Philippines. It was the only supplier of spreadsheets, word processing programs and graphics software. It provided at least 90 per cent of operating systems, data bases and utilities. The Japanese share in 1984 was 1 per cent.

(3) **Human resources:** at present, 150 schools and training institutions are providing information processing education. Information processing technical personnel number about 19,000, of which 70 per cent are involved in installation, 5 per cent in hardware marketing support, 4 per cent in software consulting, 7 per cent in EDP training and 14 per cent in overseas projects.

(4) **Software export:** imports of computer equipment are subject to sales tax and surety bonds; the sales price has to be raised 55 per cent above the import cost. But the Philippines is too far behind to begin the production of hardware. It will be essential to encourage software capabilities; striving to export software will be of central concern to the industry. In the field of applications, banking systems, weather, transport, government and military business are already covered.

The Philippines software sales strategy is to create an export industry on a world scale. It is thought that software produced in the Philippines will be 40 to 50 per cent cheaper than that from the advanced countries. Some $6 to $7 billion of software is exported to the US now, primarily for data input and program development. This is not to be exported just to the US, but to Canada, Europe, Australia, Japan and eastern Europe as well.

In addition, the computer society has sent people to Chicago, San Francisco and New York. They have made active efforts to negotiate with government organs, and to obtain support from IBM, to expand opportunities for exports to the US.

Kingdom of Thailand

(1) **Information processing in the public sector:** the first two computers in Thailand were installed in 1964. Many computers have been introduced since then, but the country is still in the beginning stage of computerization. Statistics on the number of computer installations are being collected since 1977 by the NSO (National Statistics Office) and submitted to the NCC (National Computer Committee). The NCC promulgates State computerization policy to government organs and national enterprises and authorizes projects. Because it was difficult to grasp the situation of the private sector by means of a survey, only the public sector was covered. At the end of 1986, 58 per cent of the organizations had computers and 18 per cent used outside services; 24 per cent had neither introduced nor used computers. Thus there was still much room for computerization in government organs and national enterprises.

The number of microcomputers in use has reached 1,616. That was still low in comparison with other countries, but it was 7.3 times the figure for 1985. Computer related spending in the public sector came to 628.7 bahts ($23.9 million or 4.029 billion yen at the 1986 average exchange rate of $1 = 26.299 baht = 168.52 yen), of which 62 per cent was for hardware and 13 per cent for software.

The number of information processing technicians was about 6,500, of which six per cent were analysts, 22 per cent were programmers, 9 per cent were operators, 26 per cent were data recorders and 37 per cent perform data entry. A future increase of close to 4,000 persons is envisioned.

Computerization plans are being pursued in a number of ministries now. For example, the Ministry of Public Health has established a master plan for a public health information system and the Ministry of Justice is using an outside service now and plans to set up a mainframe within two years. Moreover, the Bureau of Power has introduced CAD for the planning of electrical transmission. The Bureau of Highways, the Land Bureau and the Metropolitan Management Bureau are considering the introduction of CAD. In addition, the Bureau of Petroleum has used process simulation to improve oil/gas separation plants.

(2) **Information processing in the private sector**: it is estimated that there were about 90 mainframes, 900 minicomputers and 12,000 microcomputers in the private sector in 1984. The fields in which they are used are banks and the financial sector, air transport and the manufacturing sector. Computerization is rapid in the financial sector because of fierce competition; 4 billion bahts have been invested in banking systems. Progress in online services, card services and home banking is expected. Production plans and various controls are used in the manufacturing sector, and computerization for effective management is accelerating. CAD has already been introduced in the textile industry, which is Thailand's main export industry, but all the systems have been imported from the US and France. Small CAD systems like Auto CAD are widespread.

(3) **Hardware**: the hardware industry consists of production of ICs and printed circuit boards and assembly of computer peripherals and microcomputers. Otherwise there has been complete dependence on imports. The Government has adopted a policy of investing, through its investment commission, to promote computer production. At present a 20 per cent tariff is levied on computers and computer media, and national and corporate taxes increase the levy to 37 per cent, but there are no other restrictions.

(4) **Software**: software comes bundled with hardware from the major hardware providers. There are at least 30 software houses in Thailand, and progress is rapid. Users in Thailand want software that can handle the Thai language, and Thai language word processors are widespread. The software industry is encouraged by the Government and the recently established National Computer Center receives subsidies for software development. There are no laws to protect software, so a problem has arisen in that copying is common at the microcomputer level.

(5) **Data communications**: data communications are transmitted on leased voice grade circuits at 2,400 b/s following the standards of CCITT (V.26). Dial circuits are used for backup. The quality of data transmissions is said to be below the expectation of users, but it will be improved through packet switching technology in the near future.

(6) **Human resources**: it is said that the number of information processing technicians will increase rapidly. The Computer Society is presently creating a data base of system analysts, system engineers and programmers. Job turnover is quite high; the average length of time in one position is said to be four to five years, with nearly everyone in the public sector transferring to the private sector. There are computer departments in nine colleges now, and 35 colleges have basic computer courses. Many high schools have prepared courses, although they are not mandatory at that level. User education is normally conducted by sellers. The NSO has actively conducted general computer training for 20 years. However, most of the courses being provided are basic. NIDA (the National Institute of Development Administration) and IBM have established an Information Systems Education Center (ISEC) that offers training in computer handling, information systems and basic fields of application in computer science. But again, most of the courses offered are basic; a curriculum of high-level education is necessary. There is, as yet, no standardized testing system for evaluation of technical personnel.

The conversion of Thailand to information use is still at a low level, but an annual doubling of computer availability is anticipated. The primary constraints on computerization are budgetary limitations and the inadequacy of capable manpower. However, the necessity of computerization is widely known, and great growth based on a clear-cut government policy is likely.

Republic of Singapore

(1) **Computer market**: the progress of computer use in Singapore dropped 50 to 60 per cent as a result of the recession of 1985. But the computer industry regained its vitality with the improvement of the economy. In 1987 sales reached $534 million, an increase of 20 per cent over 1986.

Looking at shares by manufacturer, mainframes are dominated by IBM, followed by Unisys, NEC, Fujitsu and NCR. For minicomputers the order is IBM, NEC, NCR and DEC. The largest market, for microcomputers, is divided between IBM and IBM-compatible computers, including Japanese and Taiwanese products.

At least 56 per cent of businesses were computerized by 1986, and at least 86 per cent of the large enterprises used computers. The largest group of users was that of financial institutions, followed by oil companies, manufacturing and government.

There are many foreign-capital and joint venture computer plants in Singapore. Apple and India's Tata Group have plants that produce mainframes and microcomputers.

There are also CDC, Unisys, Tandon, Seagate and other plants for peripheral equipment. There are many disk drive plants; gross production in 1987 was 460 million dollars. TI and NEC have IC plants. These plants are the results of successful Singapore government policies.

Networks with good quality are available, and great efforts are being made now for CAD/CAM and EDP using the Chinese language. There is no particular tariff on software imports; the guidelines of a free economy have been maintained.

The Government has designated software development as a major growth industry, and has

taken measures to encourage foreign companies to establish development centres. Participants so far include IBM, DEC, DG and NEC.

(2) **Human resources**: There are over 6,000 information processing technical personnel, a sixfold increase over seven years. The number is expected to exceed 10,000 by 1992. The English Computer Society test, the Computer Specialist Certification Association test and the National Computer Association programming test are available to improve technical ability.

Under a December 1980 agreement with the Singapore Government, the Government of Japan established the Japan-Singapore Institute for Software Training (JSIST) as a project of the Japan International Co-operation Agency for the purpose of fostering key information processing personnel in Singapore.

To provide technical co-operation under this five-year project, the Government of Japan sent 16 specialists on a long-term basis and 47 for short periods, provided computer hardware and software valued at about 8 million Singapore dollars (at the 1980 average exchange rate, $1 = 2.141 SD = 226.74 yen) and trained 23 local instructors from Singapore in Japan. For its part, the Government of Singapore guaranteed operation of the institute, employed local instructors, recruited students and took responsibility for institute operating expenses. The first phase ended with many successes, and the second-phase project is now under way.

In 1980, by the way, the unemployment rate was high, but it has steadied now.

(3) **Information use policy**: the Government of Singapore has launched an IT Plan (Information Technology Plan) for planning of information technology. The plan, which is fully supported and encouraged by the Government, consists of the following pillars: (1) IT industries; (2) IT applications; (3) surveys and education; (4) IT information; (5) IT communications; (6) creativity and business environment; (7) IT culture; (8) arenas and (9) key factors of IT.

These have the purposes of assurance of high-level technicians, international education, maintenance of links with leaders, strengthening of international competitiveness, encouragement of small-business computerization, progress towards communications networks, development of new technology and integration of technical information. Thus Singapore, led by the Government, is working to encourage the growth of information industries.

Malaysia

The monetary value of information processing hardware in Malaysia is $250 million; software and consulting account for another $120 million.

(1) **Computer market**: there are 150 mainframes installed, and 400 minicomputers. Some 60 per cent of mainframes and 50 per cent of minicomputers are used in the public sector.

Considered by manufacturer, IBM has overwhelming strength as a supplier of mainframes, accounting for 55 per cent of the total. Other companies like ICL, NCR, DEC, Wang and NEC constitute 3 to 8 per cent of the total. Data General, Perkin, H.P., Olivetti, UNIVAC, Fujitsu and Hitachi have minicomputers installed. Almost all the microcomputers are 16-bit IBM compatibles; NEC and Apple have penetrated the market to a small extent.

The shares of computer installations in various sectors are shown in table 4.4.16. The government/citizen services sector and the banking/finance/insurance/business services sector together account for over half the installations. Computerization has not made much progress in the field of agriculture, which is Malaysia's main industry.

Table 4.4.16. Shares of computer installations, by sector, in Malaysia (1986)

Sector	Share (%)
Government and citizen services	30
Banking, finance, insurance and manufacturing business services	22
Manufacturing	10
Utilities (electric, gas, water, transport)	8
Education and research	8
Trade	5
Agriculture	4
Other	13
Total	100

Source: Malaysian Computer Society (MCS)

There are nine domestic producers; three companies are active now. No manufacturing is done domestically, only assembly. There is no particular policy to encourage domestic manufacturing; there is a free market. Foreign-capital manufacturers also handle sales and service. There are no joint venture companies at present, but the Government is negotiating for their establishment in the near future.

(2) There is no policy to develop or encourage software either. Software copyright legislation has passed the Parliament, but has not taken effect yet. Almost all software is written to order. Development is going on in the fields of banking, finance and agricultural management, and software is also used for accounting and inventory control.

(3) **Data communications**: telephone networks have developed nationwide, but data networks are still experimental.

Online systems have begun to be used actively in banks and financial institutions. There are, however, few systems that use data bases, and most of those belong to the Government. POS, ATM and electronic fund transfer equipment will increase hereafter.

(4) **Human resources**: there are about 3,000 to 4,000 information processing technical personnel; they are attached to about 30 software houses.

There are seven universities in Malaysia; almost all have computer courses. There are also specialized computer schools and a system of qualification tests has been implemented. But although there are beginning and intermediate programmers, there is a great shortage at the advanced level. The basic points of computer education can be provided domestically, but the co-operation of the advanced countries is necessary in regard to networks, distributed processing, data bases, CAD/CAM, CAI, UNIX and so on.

One educational institution with government ties is the Malaysian Personnel Bureau Training Center (INTAN); it receives support from the Government of Japan.

(5) **Information use policy:** in August 1987 the Government announced a plan to encourage use of computers, at a cost of $120 million to $140 million. These funds are to be used for creation or expansion of traffic information systems, online networks, service industries, energy management systems, personnel management systems and so on. Thus the computerization of Malaysia will go forward.

Republic of Indonesia

The first computer installation in Indonesia was an IBM punch data processing system used by the national railway in 1936, seven years before independence. Since then computers have been introduced by police headquarters, the Ministry of Defence and Security, the Ministry of Finance, banks and others, primarily institutions with ties to the Government. There is a broad range of applications, from simple tasks to high-level applications.

(1) **Computer market:** more than 1,000 computers, from mainframes to minicomputers, have been installed.

Minicomputers are used primarily in the large cities, many in manufacturing and trade. The demand for microcomputers and personal computers has increased rapidly.

Almost all manufacturers of large and small computers have entered the market. These include IBM, of course, and also Honeywell, Digital, Data General, Wang, H.P., NEC, Fujitsu and so on.

(2) **Applications by field:**

(1) The central government has the greatest influence on the Indonesian economy. It considers the active use of information at the national level to be necessary to achieve efficient competitiveness and to provide better public services. The computer holds an essential place in government administration.

(2) Jakarta was the first of the local governments to install computers, in the 1970s. They are used for such things as automobile taxes, property taxes, personnel, fiscal affairs and inventory control.

(3) Courses have been established in at least 12 universities and there is new demand in fields like CAI. Computer science is taught at a number of universities, but the lack of training programmes has become a problem. It is necessary to properly provide computer guidance and make full use of computer facilities.

(4) All the banks and insurance businesses, both public and private, have been computerized now, and credit companies are also becoming computerized.

(5) The oil industry is the biggest user of computers. Online applications such as refinery scheduling systems, petroleum product order control systems and shipping control information systems have been set up.

(3) **Progress of computerization:** computerization in Indonesia began with mass data processing of payroll accounts. Applications including the census, logistics and personnel management have been developed and have led to savings of time and cost and to improved efficiency.

At first there was only punch processing in Jakarta, but the spread of small, inexpensive Wang computers led to the dispersal of processing.

Moreover, data communications technology has enabled transmission of information to remote areas and processing and there have been improvements in telephone networks and the domestic communications satellite Paraha. It has become possible, therefore, to connect mainframes in Jakarta to minicomputers away from the capital, and there is progress in standardization, integration and distribution.

The pattern at present is that decisions are made in Jakarta and operations are carried out in the branches; single processing is being replaced with multiprogramming and multiprocessing. Applications have been introduced and there has been progress in airplane reservation systems, banks, the oil industry, urban development and weather systems. Research and development of data bases is going forward, and such things as IMS and DL I are in use. These are just a few examples of advanced applications, but it is certain that they will increase.

(4) **Tasks:** one problem for users is the shortage of software packages and software houses. That has had a major, deleterious effect on the popularity of microcomputers.

The supply of talent has been propped up by graduates of the major universities that have acquired computers. However, the establishment of more EDP training schools and training of software engineers have become urgent tasks.

(5) **Policy:** the Central Procurement Committee, led by the Ministry of Foreign Affairs, was established in 1980. This committee co-ordinates and approves procurement of computers and other items valued at $300,000 for government entities. Because government entities are the major users of computers, the policies and recommendations of this committee exert a great influence on ventures and manufacturers. Its recommendations form the standard for deciding the most effective way to use information processing to fulfil five-year plans.

The goals of the five year plan are encouragement of exports and promotion of exports of non-petroleum products. There is the restriction that enterprises that bid on government construction and procurement projects must, if the value of the contract is at least 500 million rupiahs (about $390,000 or 65.7 million yen at the 1986 average exchange rate of $1 = 1,282.6 rupiah = 168.52 yen), export rubber, coffee, timber or other specified

Indonesian products in an amount corresponding to the value of the contract.

The private sector had a Computer Users Society that started as an association of IBM users at the end of the 1960s, but now it has become the Indonesian Computer Society (IPKIN) with more than 900 specialists. It plays an important role in the Indonesian computer world.

Republic of India

A total of 2,971 general-use computers and minicomputers were installed in India as of 1985. Those of foreign manufacturers included 117 from IBM, 129 from DEC, 54 from Burroughs, 38 from H.P., 20 from Univac, 12 from Prime, 13 from DG and 16 from Wang.

There were 77 domestic hardware manufacturers in 1987, and 148 software houses.

The Indian Government has long applied national production policies under strong government controls, but in 1984 those were relaxed as follows: (1) companies with no more than 40 per cent foreign capital were allowed to produce computers up to 32 bits; (2) computer imports up to one million rupees were permitted under general permits, and imports of most electronic components for computers became possible; and (3) importatation of computers with high technology became duty-free.

However, high duties are imposed on other imports. All goods imported under the general permits are subject to a duty of 150 per cent, and there are duties of 60 per cent for computers over one million rupees, 60 per cent for floppy disks, Winchester drives and serial printers, 75 per cent for electronic components and 80 per cent for software on media other than paper.

Data communications connect hosts at the government ministries in New Delhi. These links are now being expanded to State and local government buildings.

The actual and forecast numbers of information processing technical personnel are as shown in table 4.4.17.

Turnover is not serious at present, but the brain drain to other countries is regarded as a problem.

Democratic Socialist Republic of Sri Lanka

In 1986, 107 Sri Lankan enterprises had introduced computers; they are used primarily by government entities, public institutions and national banks.

However, no hardware has been manufactured domestically; it has all been imported. The major manufacturers are as shown in tables 4.4.18 and 4.4.19.

Since 1985, tax preferences have been applied to imports of computer-related equipment. The general tariff is 35 per cent, but imports of educational equipment is duty-free and the duty has been reduced to 5 per cent for other computer equipment.

Table 4.4.18. Number of mainframes, by manufacturer, installed in Sri Lanka (1985)

IBM	87
Wang	50
Burroughs	10
Nixdorf	24
DG	1
DEC	4
ICL	3
NCR	17
Total	196

Source: Indian Institute Technology (IIT)

The domestic computer industry consisted in 1986 of 20 hardware sales entities, 19 software companies and 17 computer education entities.

Islamic Republic of Iran

Computer installations in Iran in 1987 consisted of five or six IBM model 4300s, 50 IBM model 370s, 50 minicomputers and 1,000 personal computers. There are also a number of model 68, model 65 and model 63 Hitachi computers.

Table 4.4.17. Numbers of information processing technical personnel (actual and forecast)

Year	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	Total
Phd	71	79	88	97	105	440
MS	825	1 050	1 275	1 500	1 725	6 375
BS Eng.	495	630	765	890	1 000	3 780
BS Eng Comp.	195	210	230	250	265	1 150
Comp. Technicians	750	1 000	1 250	1 500	1 700	6 200
Operators	2 000	2 500	3 200	4 000	5 000	16 700

Source: Indian Institute Technology (IIT)

Table 4.4.19. Number of personal computers, by manufacturer, installed in Sri Lanka (1985)

Sinclair	2 000
IBM	300
BBC	250
Tandy	200
Commodore	200
Aquarius	200
Wang	100
Canon	100
Apple	50
Sord	40
NEC	30
Others	30
Total	3 500

Source: Indian Institute Technology (IIT)

Computer imports must be investigated and approved by the HIC (High Information Committee). Direct imports from the US are prohibited; imports come primarily from Europe. Import totals are as shown in table 4.4.20.

Table 4.4.20. Value of computer equipment imports into Iran (unit: 1,000 rials)

Year	Value
1980-1981	146 674
1981-1982	6 440
1982-1983	1 236 271
1983-1984	177 225
1984-1985	222 754
1985-1986	618 355
Note: Average exchange rates, in rials per dollar were:	
1980	70 615
1981	78 328
1982	83 602
1983	86 602
1984	86 358
1985	90 030
1986	91 052

Source: Iranian customs clearance statistics

IBM (with an 80 per cent share), Honeywell, NCR, Univac, CDC and DEC had penetrated the market prior to the revolution, but since the revolution computer-related foreign affiliates have been absorbed and have become State-run enterprises.

Republic of Turkey

Computer imports were liberalized in 1984, and in December 1986 the 10 per cent duty on large and medium computers was cut to 1 per cent. Software is duty-free. As shown in table 4.4.21, imports of computers and software increased 50 per cent [as in text] from $69.9 million in 1985 to $140.6 million; future progress is anticipated.

Table 4.4.21. Computer-related imports into Turkey (unit: $1 million)

Item	1985	1986
Computers	62.2	127.6
Software	0.9	2.1
Spare parts	5.8	8.8
Diskettes, etc.	1.0	2.1
Total	69.9	140.6

Source: Foreign Trade Council

Exporting countries' monetary shares of the import market are shown in table 4.4.22, with the US and FRG making up the majority. Shares of units installed are shown in table 4.4.23; FRG leads with 32 per cent, followed by Japan, Taiwan, Republic of Korea and Hong Kong, which are all closely matched. The US accounts for only 6 per cent of the units installed, which suggests that the computers it provides are large.

Table 4.4.22. Monetary shares, by country, of computer-related imports into Turkey (1986)

Country	Share (%)
U.S.	28
FRG	21
UK	14
Italy	7.5
Netherlands	5
Japan	4
Others	20.5
Total	100

Source: Foreign Trade Council

Table 4.4.23. Computer units imported into Turkey, by country (1986)

Country	Share (%)
FRG	32
Japan	13
Taiwan	13
South Korea	12
Hong Kong	11
UK	8
USA	6
Others	5
Total	100

Source: Foreign Trade Council

Sales volume by manufacturers of large and medium computers is shown in table 4.4.24. IBM accounts for over half. Total sales of nine manufacturers increased from 56.3 billion lira in 1985 to 110.2 billion lira in 1986. Fields of application are shown in table 4.4.25, with accounting and inventory control being predominant.

Table 4.4.24. Sales of large and medium computers in Turkey (unit: 1 billion lira)

Manufacturer	1985	1986
IBM	29.0	51.2
Burroughs	5.8	13.6
NCR	6.7	10.6
Nixdorf	1.4	10.5
Saniva	4.1	7.2
UTE	3.1	5.4
Teleteknik	2.2	5.0
Eltex	2.3	3.6
Bim Grup	1.7	3.1

Note: Average exchange rates were $1 = 521.98 lira = 238.54 yen in 1985 and $1 = 674.51 lira = 168.52 yen in 1986. Thus 56.3 billion lira was about $107.86 million or 25.72 billion yen in 1985, and 110.2 billion lira was about $163.38 million or 27.53 billion yen in 1986.

Source: Foreign Trade Council

Table 4.4.25. Computer application fields in Turkey

Field	Composition (%)
Accounting	20
Inventory	20
Current accounting	18
Invoicing	17
Promissory notes	10
Wages, salaries	9
Other	6
Total	100

Source: Foreign Trade Council

There is no problem at present with a shortage of information processing technical personnel.

Arab Republic of Egypt

The computerization of Egypt has just begun; it is almost completely dependent on imports. The import volume was $32.1 million in 1984, $30.3 million in 1985 and $26.1 million in 1986, a slight downward trend. Market shares by country are 67 per cent from the US, 13 per cent from Japan, 8.4 per cent from the UK and 6.1 per cent from Italy.

The Government of Egypt has taken positive action to attract overseas capital in the computer industry. The US is the leader in terms of assistance from overseas; that assistance includes the following: (1) A computer centre has been donated to Cairo University and programmers' salaries have been paid with aid funds. (2) Full backing, including funds, will be provided for a plan to establish an Investment Agency data bank. (3) Grant aid for a national data network project were pledged in February 1987. (Source: Johoka Hakusho, 25 August 1988)

VIII. FACTORY AUTOMATION

Teaching robots touch and tininess

Early researchers in robotics had good reason to concentrate on getting their charges to see and hear before they taught them to touch and smell. Much technology had already been invested in capturing and transmitting sights and sounds. Telecommunications, satellite reconnaissance and medical imaging all demanded advances down the same road.

Now their priorities are changing. The performance of the semiconductor parts that make up touch sensors are improving dramatically and their price is dropping. And there are several other reasons why the hitherto mild interest in "tactile sensing" displayed by industrial and military customers is turning into a healthy appetite.

The type of robot that has sold best in the past few years has been **assembly-robots.** People who make these machines - which in turn make consumer-electronics goods, typewriters and even other robots - believe that their market will survive only if robots can learn to feel the components they handle.

Getting machines to work outside the largely predictable world of a laboratory requires them to understand their surroundings. Robots need to improve their skills of **object recognition.** Vision needs to be supported by touch to do that cheaply. Artificial-vision systems (which sometimes use lasers, infrared light or ultrasound instead of visible light) can provide rough information about the shape and location of an object quickly and with relatively little computer power. The problem is shadows, holes and unusual viewing angles, all of which confuse artificial eyes. Sorting out such confusions, given only visual clues, requires computers with sophisticated and expensive artificial-intelligence programs. To find out whether a dark spot is a shadow or a hole, it is easier to send out a feeler to poke at it.

Computers work best when they help people rather than try to replace them. The same is likely to be true of advanced robots. **Telerobots** - partly-autonomous machines controlled by people - can augment or replace abilities which handicapped people have lost. They can also project human abilities into dangerous or inaccessible places. Telerobots would be particularly useful in space. The National Aeronautics and Space Administration (NASA) spends $50.75 million a year on various robot and automation projects. Some say it should spend more.

A good telerobot needs "force reflecting" technology which is a sort of sense of touch. The movement of an operator's body needs to be

transmitted to the robot; the forces and textures felt by the robot must, in turn, be relayed back to the operator.

Building good tactile sensors is no pushover. Not only do they need to provide information about force, position and texture; they must also be flexible and rugged. An appealing approach would be to use extremely small and dense microchips as touch-sensors. They would be able to capture and process the vast amount of data involved. But such chips are fragile things.

While the search for the durable, feeling chip goes on, Dr. Jim Clark and his researchers at Harvard University's Department of Applied Science have hit on the idea of using magnetic fields to feel. The team uses a thumb-sized balloon filled with liquid silicone. Inside the top of the balloon (the part that will do the touching) are hundreds of tiny magnets made of rare-earth alloys. When the balloon presses down on something, it deforms to accommodate the object's irregularities. This deformation moves the magnets around, changing the pattern of their magnetic field.

At the bottom of the balloon is a detector chip with a dense array of magnetic-field sensors. It records the distorted magnetic field and relays the data to a microprocessor which generates an image of the touched object. It also determines the direction and intensity of the forces acting on the balloon. The Harvard team hopes to have a prototype finger with the new sensors ready by next summer. The drawback to Dr. Clark's approach is cost. An earlier, much less dense, chip cost $500. And sticking the magnets (which are themselves expensive) to the balloon takes many man-hours.

An alternative is to arrange simpler components in subtle ways. The Massachusetts Institute of Technology (MIT) has several such research programmes under way. One of them, led by Dr. John Hollerbach, uses electronic devices called capacitors embedded in a rubber matrix. Capacitors store electric charge. The amount of charge they store depends on how close their two parts are to each other. When the sensors in such a rubber touch pad come into contact with an object, the distance between the two halves of each disturbed capacitor changes. This in turn changes the amount of charge it can store, which can be measured. The information is sent back to a processor embedded in the rubber. It is fairly easy to determine an object's location, general shape and weight (or how hard it is being squeezed) from such data.

The whole array is just 3 mm thick and made of cheap materials. It is also rugged and easy to produce. Now the MIT team must make it more flexible.

Researchers at the Microelectronics Applications Research Institute (MARI) in Newcastle-upon-Tyne have followed a similar approach. The Newcastle sensor consists of conducting wires in thin rubber tubes packed with carbon granules. When pressure flattens a tube, the granules are pressed closer together. This makes more current flow from the wire through the rubber to copper strips below the tubes. Dr. Zenon Rzepczynski, one of the sensor's developers, says it can detect features that are separated by just 1.27 mm - which would make it nearly as sensitive as a person's fingertip.

The next problem is to invent a hand that can use such sensors. The best approach is the subject of some philosophical debate. The main question is where engineers should look for their inspiration: to biology or to mechanics?

Dr. Stephen Jacobsen, who is director of the Centre for Engineering Design at the University of Utah, is firmly in favour of biology: it works, and its designs have spent millions of years evolving to get better. His belief is incarnated in the Utah Dextrous Hand. Except for minor details (its thumb is accompanied by only three fingers), the hand is like the real ones on which it is modelled. It is the same size, shape and strength but much faster. Its fingers can ring a bell 70 times a second.

With 32 motors, 19 joints, 500 pulleys and thousands of yards of tendons (made of a custom-made composite of Kevlar and Dacron), it is the world's most sophisticated artificial hand. But it is not really practical. It is too expensive (costing $90,000-100,000) and uses too much power (it comes with a desk-sized generator). It is also too complicated for most applications outside the laboratory.

Perhaps function and materials should dictate design. One proponent of this view is Dr. Ken Salisbury of MIT. When he was a graduate student at Stanford University, Dr. Salisbury produced a mathematical analysis of grasping in order to determine the best number and orientation of fingers for a good grasp. The Stanford (or Salisbury) Hand has three fingers arranged in a triangle, uses no special cables and operates with 12 motors.

The University of Pennsylvania's Grasp Laboratory takes a middle road. Unlike its biological counterpart, two of the three digits on the Pennsylvania Hand can zip around the outside of its palm, allowing the hand to change its configuration - a clever substitute for a wrist. The palm gives it, in effect, an extra finger to help it grasp without making it unnecessarily complicated (the palm has no moving parts). It can also cup objects, which often simplifies grasping, and speaks volumes about the shape and size of the object it has palmed.

One trick that its inventor, Dr. Nathan Ulrich, copied from human biology is the use of coupled joints. The last two joints on a human finger are coupled, which means that - in the absence of an external force - the joints move in unison. (Try bending the tip of your finger while keeping the rest of it straight.) The advantage of coupling is that when part of the joint encounters a force, the other part can continue to move. That is why it is possible, though scarcely comfortable, for a man to hang on to a ledge by his fingertips. Also, a coupled joint needs only one motor (or muscle) to power it, which makes it lighter, simpler and more efficient.

Many roboticists believe that their next step forward will have less to do with robots' shape, senses or intelligence than with their size. They envision the creation of robots that are no larger than insects.

Big robots have heavy and expensive motors and power supplies, welded arms and kilometres of wire

and cable. Governing all this hardware are a few square inches of microchips. If all the parts of a robot were as reliable, inexpensive and compact as its microprocessors, the jobs they could do would change dramatically.

They might not compete for many jobs with the powerful, stationary machines in factories. But smallness would be an advantage for many other sorts of work. Researchers picture a fleet of midget aeroplanes that observe farmers' fields and direct automated watering and fertilizing systems.

Dr. Rodney Brooks at MIT offers a simpler and more feasible robot for curing fractures in wires. A small robot "caterpillar" crawls along a wire in an underground gas or water pipe looking for cracks. As the robot moves, it measures the electrical conductivity of the wire between its front and hind legs. When this conductivity drops, signifying a break, the robot stops and solders itself in place, patching the break with its body.

Flocks of such "microbots" working together might be able to do some big jobs more efficiently than large machines working alone.

Such insect-sized robots are little more than a fantasy for now - a fantasy which several groups of scientists are intent on indulging. Their success depends largely on the progress of resarch into microdynamics: their creators have to shrink gears, levers, cranks, springs and other mechanical devices until they are many times thinner than a human hair. The ultimate aim is to fabricate sensors, motors, controlling computers and other systems together on a single microchip.

The key to achieving this is silicon micro-machining, a logical extension of the sculpting techniques used for almost 30 years to make tiny integrated circuits. First a wafer is coated with thin layers of metal, silicon dioxide or other materials. Then the shape of the desired component, such as a gear, is painted on to the materials using a laser and photo sensitive chemicals that harden when exposed to light. When the coated wafer is bathed in solvents, all of the materials are etched away except for the parts that are shielded by the hardened chemicals. Then more solvents strip away the chemical coating, leaving the underlying material intact. The result is a three-dimensional, though flattish, structure. By repeating the process, other components can be placed precisely on, near or around the first one.

Microchip-machines can already be found in many cars. Fuel-injection systems are now equipped with microchips to improve engine performance by monitoring the pressure of the gases produced during combustion. These pressure sensors are thin silicon membranes etched beside the control unit's electronics.

Although microsensor technology is fairly well developed, work on other micro dynamic parts is just beginning. Many of the early efforts are auspicious. Earlier this year workers at a laboratory of the University of California at Berkeley made some slotted cranks and gears with interlocking parts only one fifth of a millimetre long. The smallest gear yet produced has teeth the size of red blood cells. Dr. Kaigham Gabriel, Dr. William Trimmer and their colleagues at AT&T's Bell Laboratories in New Jersey have made miniature tongs smaller than an ant's mandibles. An air-driven turbine, also made at Bell Laboratories, is slightly more than half a millimetre wide and rotates at 24,000 rpm - faster than the engines of many jet aircraft.

One problem for miniature machines is power. They are, for example, many times smaller than most batteries. But there is some encouraging news about miniature motors. As they are so small, static electricity counts as a powerful force. Researchers at MIT and Berkeley hope to harness this force in tiny electrostatic motors. Such motors are not a new idea - Benjamin Franklin built the first one - but they are generally too weak to drive large equipment.

Electrostatic motors turn the attraction between electrically charged plates into mechanical energy. In the people-sized world, the air between the plates usually becomes charged and sparks of static electricity jump from plate to plate, short-circuiting the motor. But, for complicated reasons, air in gaps a few millionths of a metre wide is a good insulator, so the motors do not short-circuit. Tiny electrostatic motors can produce as much force as tiny conventional motors and they are more efficient users of the energy that powers them. They are also simpler to build.

Still, microbots will remain science fiction for many years to come. (Source: The Economist, 15 October 1988)

Steadier robots make accurate workers

A group of European researchers has built a robot arm that avoids a major problem in the design of the next generation of robots - the mechanical equivalent of Parkinson's disease.

Robots used today in manufacturing plants are very stiff and heavy, and need powerful motors to drive them. Their bulk limits the loads that they can carry and often prevents them from reaching objects in awkward places. But if designers make the robots any lighter, their limbs oscillate wildly when an operator tells the robot to move from one place to another. This makes it impossible for the robot to position itself or pick up an object with any degree of accuracy.

A team of Belgian, French and Federal Republic of Germany researchers has developed a computer model which predicts the size and frequency of the oscillations. Engineers can then use this information to suppress the movements of the robot arm, using an electronic feedback loop. This allows the robots to move a load without missing the target or oscillating. The team has developed different models depending on whether the robot has to stretch or contract its limb. The researchers claim that this technology will allow people to build robots that are five times as fast as robots today. Their system should be on the market by the end of 1990.

Another important factor in building robots that work more quickly is to make sure that they are programmed to perform an optimum series of movements for each of their tasks. At the moment, it is a very slow and expensive process to work out this pattern of movements.

Another ESPRIT project, which involves a Federal Republic of Germany manufacturer of robots,

called Kuka, and Renault, the French car manufacturer, is modelling robot tasks on computers using programs to work out the best set of movements for each. The aim is to combine both projects and assemble robots that do not wobble and will execute a perfect pattern of movements.

Kuka is already using the research in designing and testing systems for its assembly lines, where several robots have to work together on different jobs, such as welding or painting. It is expensive to stop a production line to reprogram a single robot, so the aim is to produce a system that can design and test a line before the robots start work.

The partners in this project have written a series of computer programs which analyse and model each task, the design of the system and the way that it is tested. Over the next year, they will try to link the programs so they can share the data they produce. The team estimates that this could save about DM500 for every hour a manufacturer uses a robot. (This first appeared in New Scientist, London, 3 December 1988, the weekly review of science and technology.)

Cross-eyed robots start to see like people

Researchers in the United States have conquered an important problem in producing robots that can "see" like humans. A film of the work from the University of Rochester, in New York, shown to delegates at an Alvey vision conference in Manchester, demonstrates how the team has solved the problem of vergence - one of the fundamental actions of human eyes. The scientists have done this by mimicking nature, so the robot's "eyes" act in a very similar way to our own.

Vergence is the ability to focus on an object as it moves towards you, with each eye acting independently.

Chris Brown, associate professor of computer science at the university says his breakthrough has been made possible by advances in computer technology, and the availability of fast and accurate motor controllers.

His laboratory in the United States has access to parallel computers which speed up every process. New developments in motor controllers mean he can buy systems off the shelf which are fast and accurate. These controllers drive the separate robot "eyes", which are in fact cameras and can swivel at 200 degrees per second, close to the speed of human eye movements.

Brown, who is visiting the robotic research team at Oxford because of its excellence in robot control systems, says his vergence system, produced in collaboration with Dana Ballard at Rochester, is in fact limited to "gross" vergence - it is based on an average of everything the robot's camera eyes see before them.

Brown's team has analysed each of the images received by the two cameras with a cepstral filter. This is a piece of software, developed at New York University and originally used as a model of stereopsis - the stereo function of our eyes. The software cross-correlates between the two images by finding the displacement between them represents the smallest error between the two pictures. The software then tells the cameras to move to that displacement.

Previously the filter has been used to compare tiny bits of each of the images, but Brown's team compares the whole picture. The filter takes an average across the picture, and focuses on the largest area which has a uniform disparity between the image from each camera. As a man walks towards the camera, and takes up the majority of the image, the system verges on him. This way the images from each of the two robot eyes stay overlapped and focused.

Brown thinks there are a number of reasons why his team was able to solve the problem of vergence. The most important of these is its "biological" aproach. His team has used software algorithms which are close to the way humans process information. For example, Brown's vision system has a dominant eye, as do most humans.

Much of the recent work on vision has taken what the Rochester team calls a "dead eye" approach, where the robot eye is equivalent to "a human stuffed full of novocaine, and sat in a wheelchair". If you have very little control over the world around you and are simply pushed through it, then experiments have shown you are less good at understanding what you see - at processing the visual images which reach your eyes.

The next step for Brown is to understand the complicated control system which keeps human vision processes in a carefully structured order and decides when to use each process. He wants to give his robots the ability to plan and control so they can work in a world which has not been designed to suit their needs.

The same team at Rochester is also close to announcing a breakthrough in yet another of the fundamental functions of our eyes. This is called the "kinetic depth effect", and news of this work is to be unveiled at a major conference on vision. This is an even more powerful tool in understanding depth than stereo vision - the fact that each of our eyes sees a slightly different picture of the world.

Scientists in robot vision have already conquered a number of the other functions of human vision problems such as the vestibulo-ocular reflex, the ability to fix our eyes on something as the head moves. (This first appeared in New Scientist, London, 15 September 1988, the weekly review of science and technology.)

Vision-equipped robot systems on offer

Sony (Japan) will offer systems with vision-equipped robots and flexible lasers to United States automated system makers. Sony's overseas factory automation division said it will offer Sony multi-assembly robot technology (SMART) systems to precision electronic part producers, computer and peripheral makers and auto electronic makers in upcoming months. A flexible laser soldering system will also be offered to very large scale integrated circuit makers and the firm is looking into offering other Sony-developed automation technologies to external customers. (Extracted from Metalworking News, 19 September 1988)

Experimental robotic manipulator

An experimental robotic manipulator that combines direct drive, static balance and AC brushless torque-ring servo motors has been developed by assistant professor H. Kazerooni at the

University of Minnesota. The robot employs low-speed, high-torque, brushless AC synchronous servo motors provided by Contraves Goerz (Pittsburgh, PA). The benefits of the direct-drive arms include being able to control wide-bandwidth and torque requirements are cut by some 25 per cent. The robot's parts are in balance and its motors are only loaded when they perform a task. Smaller motors can be used while obtaining higher speed, precision and repeatability. (Extracted from Robot World, October 1988.)

Ansaldo enters the robot era

Ansaldo is entering the robot business by specializing in multipurpose and special-purpose service robots capable of conducting activities in hazardous environments. Two of these robots (called Portans 1), are already in operation; they are employed to inspect radioactive nuclear components. Another more sophisticated robot, the SMT (Sistema Mobile Telemanipolazione [Remote manipulation Mobile System]) is nearing completion and will be employed in decontamination activities and decommissioning of chemical and other hazardous plants. In addition, Ansaldo is participating with other Italian and EEC industries at two EUREKA projects for the AUR (Advanced Underwater Robot) and the AMR (Advanced Mobile Robot). (Source: European Science News, August 1988)

Personal robot for the handicapped

Prab Command has introduced a computerized voice-activated personal robot to help the handicapped. The Command 1 robot, which responds to voice commands to the computer, supplies access to all telephone services. Users control the system to conduct interactive tasks in such business areas as R&D, engineering, desk top publishing, computer programming and other areas. The robot features a robotic arm to conduct tasks such as serving food or beverages, retrieving hard data from files for review by the user as well as other office and home tasks. Being licensed Prab Command to use the concepts and technology to develop the robots and market them to the disabled. The company introduced the Command 2 programmable rehabilitation robot for people afflicted by strokes or crippling diseases. This robot features a robot arm that is programmable to offer a controlled, monitored exercise programme for stricken individuals. (Extracted from Robot World, October 1988)

II. STANDARDIZATION AND LEGISLATION

Standardization

How CASE can work for users

Having automated everything else in sight, the computer industry has turned its attention to software, producing tools for computer-aided software engineering (CASE). More mature tools, more aware users, and endorsement from major players including IBM, all contribute to the growing acceptance of CASE - along with the dire problems of the software development crisis. DP departments are unable to keep up with the demand for information systems, and CASE tools could just be the answer.

In 1987, an Ovum report predicted that the CASE market would reach $1 billion by 1991, but this figure should probably be revised upwards. The report, Computer-Aided Software Engineering: Commercial Strategies on target in most other respects pre-dated IBM's announcement of its CASE strategy.

But if the growing industry is to meet the future well prepared, it must address standards. It was realised early on that software tools would have to do many things. Software has a lifestyle, and writing code is not the only problem in software development. Many of the problems occur elsewhere in the cycle, in the early stages of design and analysis, and especially in the later stages when code must be maintained while it is in use.

To get the best out of CASE it must address different part of the software lifecycle. It must provide tools to perform a wide range of tasks from capturing specifications to maintaining and modifying code. And these tools must be able to communicate information to each other.

The range of possible tools is beyond most companies' capabilities; even IBM's announced strategy is basically a framework into which third party tools will be fitted. So the industry has started work on a range of standards which will allow tools to be integrated together and work side by side on the same code.

Standards work is proceeding on a number of fronts, but these are not always very well co-ordinated, particularly between European and US developments.

IBM is an exception, having delayed its CASE strategy until standards are nearly available. The IBM approach consists of a number of elements:

- A repository and data model;
- A common tools interface;
- A structure which allows tools to be integrated;
- A common user access specification;

  Co-operative processing, which allows software development work to be distributed across different systems.

The repository is regarded as the most important part of the strategy. It holds information about the systems under development in a data base so that it is available for use by any of the software tools. The data bases used are IBM's set of standard SQL-compatible relational data bases.

The American National Standards Institute (ANSI) has been developing a standard which relates to data dictionaries, the Information Resource Dictionary System (IRDS). This has been nearing agreement for some time now.

In some ways the repository is equivalent to a data dictionary and IBM promises that it will eventually meet the ANSI IRDS definition.

It is not clear whether IBM's announcement or the IRDS agreement will come first. IBM's participation in the standards bodies would help it to track future developments in IRDS.

However, this standard is not without its problems. There have been disagreements between the

ANSI IRDS group and its equivalent in the international standards body, ISO, and some observers feel that the IRDS definitions are limited, in areas such as version control.

Version control is an important part of software development. Software developers work on a particular version of the code, and make changes to it. After a certain time the working set of code is firmed up as a new version.

Another problem is the relation between IRDS and the emerging standards relating to IPSES (integrated project support environments). IPSES have been a European term, developed from the US effort on an ADA environment called an APSE.

A European effort has been developing these environments, which will include data bases for systems information and interfaces for tools. IPSES will be independent of the programming language used, with languages being just as interchangeable as tools. It was decided that IPSES should have standard interfaces to allow interchange of tools and data, and thus the portable common tool environment (PCTE) was born.

PCTE began as an ESPRIT project, run by Honeywell-Bull, GEC, Olivetti, Nixdorf, Siemens and ICL.

The first PCTE implementation ran under UNIX on a Bull workstation and was ported to a Sun workstation. It is now marketed by GIE Emeraude in France, and the company promises VAX (Ultrix), HP9000 and Apollo versions for 1989.

PCTE has been used as a basis for numerous further research projects, including the Eclipse project from Software Sciences and CAP Sema Group. This was another ESPRIT project, which is nearing the market.

The most important US work on standard tool interfaces has been the common APSE interface set (CAIS). This was begun in 1981, when the US Department of Defense came up against an embarrassing problem. The army and the navy had both built APSES, but found that their tool interfaces were incompatible.

CAIS was published in 1985, and US manufacturers have been working towards it since then. Other countries' defence ministries may adopt it, but PCTE is more popular in Europe.

It is also becoming clear that part of the PCTE work will overlap with data dictionary-based standards such as IRDS. As well as a common interface for tools, the PCTE standard had to include a system which would help ascribe meaning to the information exchanged between them.

This was given by an object management system (OMS) which duplicates many of the functions of the data dictionary. It is not clear whether PCTE will absorb influences from IRDS, or vice versa: at present they are directed at two different kinds of machine. IRDS deals with large mainframes, while PCTE has had most impact in the smaller multiuser system environment where UNIX is beginning to flourish.

The original PCTE (1.4) specification was published in 1986. Since then, a whole host of groups have become involved with the standard.

A group called IEPG (Inter-European Program Group), formed by the defence ministries of the European members of NATO has been evaluating it for civil and military purposes. This has led to an improved PCTE specification, which adds security, and makes some progress towards independence from UNIX.

At the same time, other improvements have been made by a PCTE interface management board (PIMB), resulting in PCTE version 1.5.

A group of system suppliers has been working on tools which interface to PCTE (the PCTE added common tools, or PACT). Another group, SFINX, has been looking at integrating other tools from other ESPRIT projects into PCTE.

A formal definition of PCTE is being produced by yet another group, called VIP, using the Vienna definition method.

Suppliers are looking at this activity, and their developing market, hoping for something stable enough to turn into products. And, through the standards bodies, they hope to create this.

A technical committee of the European Computer Manufacturers Association (ECMA) is going to pull together PCTE 1.5, PCTE and the other strands, to create a unified PCTE version 1.6, which it will submit it to the International Organization of Standardization, ISO.

Further in the future, ISO has a group developing a standard structure for the whole process of software engineering. This would be analogous to ISO's seven-layer model for open communications: a structure into which suppliers can build products.

Products could be made which would meet specifications defined within the model, which will cover all the aspects of software engineering. It will be called the reference model for information systems engineering (RM-ISE).

So far the work is being carried on part-time, but British participation is through a technical panel formed by the British Standards Institution (BSI). This group is convened by Andy Bytheway of the Cranfield Institute of Technology.

A very early skeleton draft has been produced of the basis of RM-ISE. This is being debated by ISO committees worldwide. The intention is to include development, installation and use of software and to ensure that the model works independently of the chosen software development methodology, language and operating system.

More participation in the RM-ISE project is welcome and Bytheway hopes to get funding for a full-time project. It will be some time before real results are seen, but the model could form a basis for a healthy market for software tools and, just maybe, an answer to the software crisis. (Extracted from Computer Weekly, 1 December 1988)

Standards for evaluating industrial robot performance

Specifications for robots' performance statistics (often very conservative) have been the manufacturers' choice and since very few used the same test parameters, this made comparison shopping

difficult. The real characteristics of the robot were generally unknown. It was not necessarily an apple to an apple comparison. It became apparent to ASTM, in 1983, that there was a need for a standardized method(s) to evaluate industrial robots for performance so that a user could comparison shop with confidence. Also, it was apparent early that a common language was a necessity so that a buyer and the manufacturer could converse with each other. There has been an investment of a number of years of effort to develop and commonly agree upon standards that would meet the needs of both the user and manufacturer. The input for the standards came equally from users and manufacturers with a sprinkling of academia and consultants.

The ASTM undertaking to develop standards for robotic systems began with the commissioning of Committee F-28 on Robotic Systems. The committee was structured into four subcommittees on terminology, performance, classification and liaison. Work on the standards began in earnest early in 1984. It was decided that classification and performance should be tackled first. Terminology would be developed as the performance standard and the classification guide were being developed.

The first step was to make sure that everyone was talking the same language and Subcommittee F28.03 on System Categorization was given that task. The robot classification guide, after numerous revisions, was completed in early 1986 and after passing the test of review by the subcommittee, main committee and the Society, it was published as F 1034, Guide for Classifying Industrial Robots. It is an informational document that describes and gives names to the various types of robot configurations, work volumes and components that make up a robot. As all standards and guides are living documents, a revision is currently being processed to add information on the various co-ordinate systems in the industrial robot environment, as the co-ordinate system definitions are a very important part of robot language.

The co-ordinate systems specifically are the World Co-ordinate System, the Base Co-ordinate System, the Mechanical Interface Co-ordinate System, and the Test Equipment Co-ordinate System.

The various co-ordinate systems can be related with each other through the use of algebraic transforms.

The objective of the performance standard is to provide meaningful technical information for all without penalizing or slighting either user or manufacturer and to provide information that the purchaser can use in the selection of the proper robot(s) for specific applications. The performance standard defines the important criteria and the test methods for the evaluation of these criteria. The test parameters used are accuracy, repeatability, cycle time, compliance, overshoot and settling time. These can be used for screening purposes. The results of the testing as defined by the performance standard is by no means a complete description of a robot. This information needs to be supplemented with additional engineering information when considering detailed specifications and systems designs for the final selection of a robot.

The concept of "performance classes" is introduced. There are four in number. The first is a standard requirement, which is intended to provide an overall indication of robot performance without optimizing any specific parameter. The testing is to be performed under set conditions of payload, velocity and path to be traversed. The second test class permits specific changes in the test conditions to provide a means of optimizing the cycle time figure of merit as in some applications, cycle time is a very important parameter. A third test class also permits specific changes in the test parameters to provide the means of optimizing the robot repeatability figure of merit. There is a fourth performance class, which is labelled "special". This is to provide a means of optimizng other specific robot performance figures of merit, or combinations thereof, for specific applications or robot configurations.

The performance standard for industrial robots did not arrive at this point without a lot of help. About the same time ASTM was organizing F-28, the Robotic Industries Association was putting together the R15.05 committee for the purpose of also writing standards for industrial robots. It soon became apparent that a co-operative effort was necessary. This was not difficult to accomplish as there were several members who held memberships in both committees. While the performance standard was being developed, the end result would be two documents using two different formats, but with the same basic information. ASTM will publish its own robot performance standard. This was agreed upon at an early joint meeting.

The performance standard is not a safety standard and does not directly address the issues of safety related to robot operation and performance. It is the responsibility of the manufacturer and user to comply with the applicable federal, state, and local laws, rules and ordinances relating to health and safety. As with all voluntary standards, ASTM makes no determination whether this standard is to be used by the buyer or the manufacturer or whether any manufacturer is in compliance with the publisned performance standard. ASTM provides a legal umbrella based on its regulations and procedures and 90 years of experience in standards writing. ASTM's large membership roll also provides a large experience base to support the standards effort. (Extracted from ASTM Standardization News, September 1988)

Proposed standard for access to DBMS

A proposed international standard will provide access to different data base management sytems (DBMSs) running on multivendor workstations. The Remote Database Access (RDA) protocol, which uses a client-server model, will deal with the problem of mapping a query to the proper data base. As a result, neither the end user nor the programmer will have to know the locations of the data bases. The International Standards Organization (ISO) is preparing RDA, which is being reviewed by the newly formed ANSI X3H2.1 Task Group. The final adoption of the standard is expected in 1990, according to task group members, which include vendors Cullinet Software and Digital Equipment and users Rockwell International and General Motors. Part one of the RDA proposal, the "generic" part, deals with what is fundamentally needed to establish and maintain data base communications links. This part is currently in its second draft. Part two, "SQL specialization", will deal with how to communicate with a data base using the SQL language. (Extracted from Networking World, 3 October 1988)

Standards disagreement keeps DAT out of data storage

The computer industry is holding back from the full-scale use of cheap digital audio tape (DAT) as a storage medium because of the lack of a common standard for its format.

DAT was conceived as a format for tape-recording with stereo systems for the consumer market. The computer industry then found that DAT makes the ideal medium for storing large quantities of text and data as a backup for magnetic discs. However, although there is a fixed standard for DAT as a medium for audio recording, there is no standard for DAT as a store for data. As a result, there is confusion of different proposals, claims, counterclaims and technical misunderstandings.

The computer industry can now buy the mechanisms for DAT and build them into data recorders. The DAT mechanism enables the recorders to back up more than 1 gigabyte of data from a computer system, on a two-hour audio cassette, at a tenth of the cost of using professional computer tape. Computer tape must also be changed many times to achieve the storage of one DAT tape.

Conventional DAT recorders cannot be used for data, because 0.7 seconds of a recording is lost when the operator switches the recorder from replay to record. This does not matter for sound, but would be disastrous for data. Data recorders must incorporate circuitry that can join recordings together very accurately.

There must also be much more efficient correction of errors. Listeners may tolerate a small audio glitch caused by damaged tape, but users of computers cannot risk the corruption of their data.

The DAT audio system has two levels of error correction. Mathematical checks on short blocks of data reveal any missing bits. These are then reconstructed from extra "redundant" bits, recorded slightly further along the tape. If the blemish is too large for this first level of correction, the recorder uses redundant bits from spaces further along the tape. If this second level fails, the recorder mutes the sound.

For data held on DAT, a third level of error correction spreads the redundant information even further. Different companies are using different checks. (This first appeared in New Scientist, London, 29 October 1988, the weekly review of science and technology)

Robot pendant standard

Simplified, standardized designs for hand-held robot teach pendants will increase the acceptance and the effectiveness of the technology, according to the developers of the first proposed US robot pendant standard. The R15.02 Human Interface Subcommittee of the Robotic Industries Association (RIA). The subcommittee's proposed standard addresses issues such as controls, displays and labelling. To aid the manufacturer with the design process, a pendant configuration strategy is presented in an appendix. In developing the proposed standard, the subcommittee examined 26 different robot pendants. Contact: RIA, 900 Victors Way, P.O. Box 3724, Ann Arbor, MI 48106 (313/994-6088). (Source: ASTM Standardization News, September 1988)

Domestic bliss updated EIA style

With just a hand-held remote control unit, you can: turn on the lights in your living room and your television receiver; set your videocassette recorder to tape a future show; later turn off the TV and tune into your classical music radio channel for your favourite symphonic broadcast; and so on and on.

All this and many other scenarios will be possible with equipment that incorporates the new electronic bus standard for consumer products, the Home Products Link, to be demonstrated in the upcoming Consumer Electronic Show, to be held in January in Las Vegas, Nevada.

Developed by the Electronic Industries Association's Consumer Electronics Group, Washington, DC, the bus standard will let virtually any electric or electronic system that meets its requirements - appliances, and security and entertainment systems, for example - be controlled by the user from any location in the home. Control signals may be sent through any combination of different media - power lines, twisted pair telephone wiring, coaxial cable, radio frequencies and infrared light.

Once fully approved, the bus standard is expected to accommodate data rates of up to 10 kilobits per second. Contact: Thomas Mock, Consumer Electronics Group, Electronic Industries Association, 1722 I St., N.W., Washington, DC 20006; 202-457-4975, or fax 202-457-4985.

IBM bows to open pressure

Market pressure has forced IBM to introduce international open standards into its proprietary network offerings.

In a list of more than 50 products and services are two - OSI Communications Subsystem and OSI File - which will let users link up open standards networks to IBM proprietary networks under IBM's common applications environment, Systems Application Architecture (SAA). Users need no longer choose between its proprietary offering Systems Network Architecture (SNA) and OSI (Open Systems Interconnection) networks.

The products show IBM responding to market pressure, particularly in the US and European public sectors where OSI is becoming mandatory. IBM says the products will also allow users to comply with the UK Government procurement profile for open networks, GOSIP (Government OSI Profile).

OSI/Communications Subsystem will allow IBM users to communicate with "any other non-IBM system using compatible OSI protocols". Users can write their own applications to OSI using application programming interfaces and it provides network management capability for mixed networks, through the new release of Netview.

OSI/File Services is for the exchange and management of files between IBM and non-IBM systems using the OSI FTAM (File Transfer, Access and Management) protocols. IBM says it will allow files to be copied or moved from OSI networks to SNA networks and vice versa and lets users on one network remotely read, create, change or delete files on another network.

IBM also extended its support of the de facto standard TCP/IP to support MVS and announced the 8232 local area network channel station for connecting Ethernet LANS running TCP IP or manufacturing automation protocol (MAP) to IBM mainframes.

The products also conform to International Standards Organization and CCITT (the national telecommuniations companies standards body) standards.

SNA is not affected by the announcement. IBM will continue to develop SNA as its strategic proprietary network offering. Underlying this commitment, the company also announced a new release of Netview, the SNA network management software which will allow operators to control OSI networks from an SNA network node. (Source: Computer Weekly, 29 September 1988)

UK Government wants method in Europe

The UK Government has launched a £500,000 bid to establish its SSADM systems analysis and design method as a European standard by contracting a British Telecom consortium to take the method further with "major enhancements".

The new version four will take SSADM forward towards open standards with three critical enhancements.

It will cover the design of distributed systems, which no other method offers. There will be definitions of ways to link system designs easily to fourth generation language products. And the method will be developed to such an extent that companies using it will qualify for official quality standards from the International Standards Organization.

The new development contract is part of considerable promotional activity taking place among the government and commercial computing community. An accreditation scheme for SSADM consultancy and training firms has also been set up by the British Computer Society. The consortium developing the new version is led by British Telecom, which is overseeing quality assurance.

Also involved are Aims Systems, who will do most of the detailed technical work.

The third partner is the Federal Republic of Germany firm Softlab, which will work on data modelling, interfaces and distributed systems.

The method is used in 15 countries; in the UK there are over 100 commercial users.

The CCTA is keen to develop a standard method for Europe - and SSADM is a strong bidder. (Extracted from Computer Weekly, 6 October 1988)

Co-operative will develop tester

The fair and comprehensive comparisons of high-performance computer systems will be possible for the first time, if a new bench-marking foundation is successful in its ambitious goals.

The Systems Performance Evaluation Co-operative (SPEC) has been formed, under the sponsorship and instigation of Electronic Engineering Times, an electronics industry journal published by CMP Publications, by the major RISC system producers, Apollo Computer, Hewlett Packard, MIPS Computer Systems, and Sun Microsystems.

Their charter is first to develop a suite of open-standard benchmarks that will rate computer systems by concentrating on overall system performance. Rather than trying to test individual benchmarking tests, which run in seconds or minutes, the new EET Benchmarks will run applications that fully exercise advanced systems and require minutes or even hours to run.

The developments of the foundation will be copyrighted to guard against improper claims and the names of the foundations's works will be trademarked to guard against being attached to programs that are not authorized by the foundation.

The EE Times Benchmark Suite will be developed by a technical steering committee, initially composed of representatives from the charter member companies. (Source: Electronics Weekly, 14 December 1988)

European, US groups aim for one standard

Computer chiefs on both sides of the Atlantic have teamed up to develop a single communication format, which will allow computers to talk to each other in much the same way as the telephones do now.

The Corporation for Open Systems (COS) in the US and the European Standards Promotion and Applications Group (SPAG) plan to produce a set of tools which will allow computer makers to produce machines which work to an agreed common standard. A tool kit with 11 tools should be available towards the end of this year and an integrated tool kit should be available early next year.

Despite the Euro-US agreement the Japanese have not yet joined the club but a meeting in July with the Japanese standards body for the Promotion of Open Systems Interconnection (POSI) looks set to have paved the way for Japanese involvement.

As well as establishing these new tools to build machines which talk the same language, COS and SPAG will be selling each others' tools in their own markets, pushing the tools as an integrated tool set and providing full support. (Extracted from Electronics Weekly, 21 September 1988)

EC stresses need for standards

EUROCOMM 88, the telecommunications exhibition and congress, presented the European Commission (EC) with an opportunity to warn companies of the importance of increased co-operation on European standards.

Speaking at the congress in Amsterdam, Professor Tjakko Schuringa, director of telecommunications and information technology at the EC, reiterated the need for an early introduction of a public cordless telephone standard in Europe. He emphasized the importance of agreeing on a European standard before national administrations go their own ways.

The European Telecoms Standards Institute (ETSI) is currently drafting a CT 2 standard for the EC which is expected to be ready before the end of next year.

The European Commission believes that the possibility of a telecommunications alliance between GEC and Siemens resulting from a takeover of Plessey would benefit the European telecommunications market.

Schuringa said that he could see no reason to oppose such a merger in the telecommunications sector. He believes that restructuring of this type was important to avoid duplication of the cost of developing the next generation of public switches.

The European market has already seen a number of strategic alliances, most notably Alcatel and ITT. Schuringa is in favour of further rationalization with the formation of even larger groups. (Source: Electronics Weekly, 14 December 1988)

Legislation

Patent granted on processing method

One of the first American patents on the new high-temperature superconductors covers a processing method, rather than the compounds themselves. John Vander Sande and Gregory Yurek, of the Massachusetts Institute of Technology in Cambridge near Boston, made the granular ceramics used for superconducting more durable by forming the metal in the superconductor into an alloy with a noble metal, such as silver. The technique could be a key step towards making superconductors into wires and other shapes for practical applications.

Even before the process received a formal patent, MIT had signed an exclusive licence with American Superconductors Corp., a company based in Massachusetts and founded last year by Vander Sande and Yurek. American Superconductor Corp. has joint research programmes with the Oak Ridge National Laboratory in Tennessee and Inco Alloys International of Huntington, West Virginia. (This first appeared in New Scientist, London, 17 December 1988, the weekly review of science and technology)

Stretching law to suit technology

Laws of international copyright are being stretched to breaking point to embrace new technology, resulting in chaos which is damaging to users and IT companies alike.

Speaking at the Financial Times Professional Personal Computer conference in London, Gervaise Davis, a leading intellectual property lawyer from the US, voiced these concerns and called for "a modicum of industry co-operation and foresight" to bring order.

Davis, proposed the creation of an industry body to advise lawyers and courts on technology issues. The group could provide impartial advice to courts on specific lawsuits or company demands about likely implications for the industry as a whole.

"This industry should not let the accidents of litigation determine the availability of technology and standards to you and your customers," said Davis.

Looking at some pending law cases Davis criticised "look and feel" cases, such as the Apple versus Microsoft and Hewlett-Packard suit, which he described as "ill-advised". He also criticised cases pending or on appeal in the US which seek to protect contents of programmable array logic (PAL) chips as computer programs, because PALs are an "essential" tool for hardware designers.

These issues, he argued, "may have a material bearing on the future growth and economic health of the entire world-wide computer industry". (Source: Computer Weekly, 10 November 1988)

Shorter licences likely to appear

Tougher copyright laws will lead to software producers giving customers shorter licences for programs, Simon Chalton, licensing specialist with solicitors Dibb Lupton, told delegates at a software copyright conference.

Licences for shrink-wrap software are likely to drop to a maximum of three years, Chalton thinks, as the UK Copyright, Designs and Patents Bill, which will get Royal Assent makes programs much more worth protecting.

Since a licence means more now, vendors are unlikely to give users such a free rein, granting perpetual use. They will have to be more specific as to how they word the licensing agreement. They will also want to be able to review licences after a certain period, in case, for example, they want to sell the product to another vendor.

Chalton draws a parallel with credit cards which expire after a certain date, giving banks greater control. Software vendors should follow this practice and grant limited licences, he says.

Chalton's view is endorsed by Bryan Niblett, chairman of the British Computer Society (BCS) law specialist group.

Another effect of the new Copyright Bill may be to give protection to data within programs, Niblett believes.

Looking to future European Commission laws on copyright, Lord Lloyd of Kilgerran chided the UK software industry for not lobbying the Commission enough to push provisions made in the UK Copyright Bill. He goes so far as to recommend that UK copyright law should be included in the European Commission directive on copyright. (Source: Computer Weekly, 3 November 1988)

Europeans disregard COCOM rules

European firms are flouting COCOM technology trade restrictions by shipping banned 80386-chip-based personal computers to Eastern Europe via countries such as Taiwan.

Restrictions on software products are being avoided by sending the products by direct mail from the US. Despite the improving political climate in the Soviet Union, many companies feel unable to exploit the market for computing and IT products because of inconsistent and infrequently reviewed export regulations.

COCOM is a Paris-based organization that oversees regulations on technology transfers from NATO members and Japan to the Eastern bloc.

Last September it attempted to speed up the lengthy licensing process with a decision to allow member governments to grant export licences at their own discretion.

Relaxation of restrictions in the area of sophisticated telephone exchanges has freed European

companies to pursue orders from a potentially huge Soviet and Eastern market. Ericsson is to supply Hungary with an AXE international telephone exchange worth over £4 million, the first fully digital exchange for Eastern Europe.

UK telecommunications company GPT has received permission to export its System X exchange to Bulgaria. (Source: Computer Weekly, 6 October 1988)

Americans express patent dissatisfaction

The US Government is pressurizing Japan to reform its controversial patent system - the world's busiest. Officials of both countries will meet to try to resolve differences that threaten to trigger a full-scale trade dispute.

The Americans have condemned practices in Japan which, officials claim, discriminate against American companies seeking to protect their inventions in Japan. The revelation that key patents covering high-temperature superconductors are likely to go to the University of Tokyo rather than to IBM, whose scientists first reported the discoveries, exemplifies the conflict.

IBM may have lost its claim because Japan, like every country in the world except the US and the Philippines, protects patents from the date of application, rather than from the date of invention. A team at the University of Tokyo was able to scoop IBM by filing an application after IBM announced its discovery - but before the computer giant itself filed. American officials say privately that, sooner or later, their Government will have to bring its system of granting patents into line with those of the rest of the world.

Attacks on the Japanese system will focus on the practice of granting patents to minor variations of inventions, and the resulting overload on the Tokyo Patent Office. Last year, the patent office received some 780,000 applications. Most of these were for slight variations to previous inventions many originally presented by foreign inventors. Some 30 per cent came from the top 10 Japanese companies.

American companies claim to have lost the rights to inventions because, while they wait years for a patent to be granted, a Japanese company has been able to file on a minor variation that the original application did not specify.

Japanese companies, too, are beginning to lose patience with their system. A report published by the Bioindustry Promotion Committee, a group of academics and executives involved in biotechnology, said that the patent system threatens the country's future role in biotechnology.

Japan could use the legal muddle over patents for superconductors to strong commercial advantage if any of the 2,000 patent applications being filed in the country turn out to protect successful materials or processes. In the past, the Japanese have been willing to buy patent licences from the West, then make money by exploiting them commercially.

Now, Japanese companies are filing patents to protect almost all chemical compositions and processes arising from research on superconductors. Sumitomo alone has made 300 applications already.

This picture emerges from patent searches by the British Technology Group. The BTG has been compiling advice to warn British companies against losing out in this potentially lucrative new market through slip-ups in patenting procedures.

The BTG urges British researchers to file parents in as many countries as possible. There are at least six European patent applications filed each week on superconductivity. These show that British researchers have already missed out on materials arising from research.

But if researchers find out which materials are covered by patents, they can then develop and protect new processes and devices derived from them. These patents might well prove more valuable commercially than those covering basic materials, which could also cost more to defend.

Chris Vear of BTG believes that IBM's mistaken action in filing its patent application on the pioneering work of Georg Bednorz and Alex Muller after disclosing the idea - and thereby invalidating the patent - is only the tip of an iceberg.

So far, the most hopeful claims for Britain come from Cambridge University which is patenting superconducting wire - and from the University of Birmingham and ICI, which claim to have built a VHF radio receiving aerial that has zero signal loss. But BTG's new data base shows that the Cambridge patent may have been filed only in Britain, and will not offer legal protection abroad. BTG also fears that British researchers will jeopardize protection by talking about breakthroughs before filing a patent application. This would invalidate the patent.

BTG's data base already shows many extraordinary anomalies. Because of a quirk in US patent law, which allows researchers to rely on their laboratory notebooks to establish legal priority, IBM may, with a strong patent in the US on the discoveries which won the Nobel prize, while AT&T gets patents on the same materials in Japan and Europe. AT&T's patent claims are so broad that, if granted, the company could outmanoeuvre its rivals. But IBM may have the earliest patent cover on compounds containing thallium.

Companies in the Federal Republic of Germany have kept quiet about potential advances in superconductivity. BTG's searches show that Hoechst may have patented superconducting compounds of bismuth first.

The biggest legal muddle is on the materials containing yttrium. The University of Houston has spent more than $100,000 trying to protect Paul Chu's work on yttrium around the world, including the most remote African states. But Chu may be open to attack because he was slower than his rivals in putting ideas into practice. (This first appeared in New Scientist, London, 28 August and 29 October 1988, the weekly review of science and technology.)

Lock up your software

Nobody is sure who owns the rights to many basic software innovations or, indeed, how such rights are best established. Cases now wending their way through the courts could redefine the art of competition in the software industry.

In the short term, blatant piracy is still the software firms' biggest worry. Selling illicit copies of brand-name programs is clearly wrong and illegal just about everywhere. So lobbyists are pressing governments to crack down harder on pirates, especially in Asia. Meanwhile, software lawyers are turning their attentions to the potentially more important, and trickier, task of sorting out the ownership of the technologies and innovations which are used to create successful programs.

The most contentious lawsuits concern "user-interfaces" - a piece of jargon which means, roughly, the ways in which people use computers. Such lawsuits are crucial to competition, because a successful proprietary user-interface is perhaps the most powerful advantage a software company can hope for. When they have mastered one way of coping with a computer, users are loath to switch. Because IBM is trying to convert its millions of users to a user-interface that is in large part licensed from Microsoft, Apple's lawsuit threatens to derail IBM's efforts to create a lingua franca for computers. Deciding ownership could take years of legal manoeuvring. The grounds on which the decision is made could matter more than the name of the victor.

Computer software has a curious position in intellectual property law. In America, at least, it is virtually the only one of man's creations that can be protected both by patent and by copyright, which are very different. Patents protect the idea behind an innovation. Copyright, by contrast, protects the expression of a idea. Although Mr. Stephen Sondheim's libretto for "west Side Story" tells essentially the same tale as Shakespeare's "Romeo and Juliet", it would not impinge on Shakespeare's copyright (if he had one) because the ideas are expressed so differently.

Ever since American copyright law was extended to software more than a decade ago, companies have relied on it to protect their innovations. From the firms' point of view, copyright has several advantages over patents. Its protection lasts longer. A patented innovation loses its protection in less than 20 years; copyright lasts for at least 50. Copyright is also easier to get. To win a patent, an inventor must go to great lengths to prove that his invention is truly original; copyright is less demanding. The snag with copyright is that judges and lawyers are not yet sure how to distinguish the (unprotectable) idea of a computer program from its (protectable) expression.

The text of a computer program is protected from straightforward copying. And, just as a translated book is still protected under copyright, so is the translation of a program from one computer language to another. But further distinctions are harder to draw. Several American cases have set contradictory precedents. One, the Whelan case, would seem to give programmers sweeping rights to the techniques that they build into their programs - but so confusingly that some legal scholars worry that it might hamper innovation.

The Whelan case concerned software for managing dental laboratories. A court decided that the unprotectable idea of the program was its basic function (i.e., managing dental laboratories). Everything else is protected. This argument by exclusion presents problems. American law denies copyright to "procedure, process, system or method of operation". But what else is in a program apart from a basic function and procedures to implement that basic function? If there is something else, the Whelan decision also begs the question of how broadly it is protected. Would, for example, the first person to use a novel sorting technique to manage a dental laboratory have rights over that invention in another application?

Although some lawyers reckon that time will sort out such problems, others argue that patents are a better solution. Patents are designed to protect practical innovation, and lawyers can look to centuries of precedent to help decide what is protectable. So small companies can innovate without the fear of lawsuits.

Ever since a 1981 decision by the American Supreme Court cleared the path to software patents, software firms have quietly been backing up copyright protection of their products with patents too. But however promising patents may seem for sorting out the confusions raised by copyright, in the short term they can only deepen the mess, while lawyers rub their hands. (Source: The Economist, 14 January 1989)

I. SPECIAL ARTICLE

MEDICAL EXPERT SYSTEMS FOR DEVELOPING COUNTRIES: AN APPLICATION IN PRIMARY HEALTH CARE

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1. Problem overview

"Health for all by the year 2000" is one of the main goals the World Health Organization has set in its programme of work. This effort is to include assisting underdeveloped countries to establish an adequate standard of public health care. Currently, however, the cleft between health care in industrialized countries and underdeveloped countries seems rather to be on the increase instead of on the decrease. The majority of ailments people in developing countries suffer from could, in principle, be effectively treated by simple treatment strategies, but an awareness of treatment plans as well as resources is notoriously scarce in those countries where they would be most urgently needed.

By comparison, problems of malnutrition and famine show very similar features. The world's economy could produce enough food to feed the entire population. The seemingly insurmountable problem is the question of transportation and to date, no solution has been worked out to effectively tackle it. Therefore one of the biggest scandals in the community of nations remains that in spite of adequate food production, there are still hundreds of thousands of people starving to death.

As with food, the main problem in providing adequate health care is not the procuring of knowledge but that of its distribution. For centuries, tutoring on a personal basis or the transfer of knowledge through books were the two salient pillars of knowledge transfer. Correctly

performed personal tutoring provides an active transfer of knowledge when compared to books where written information is presented as a passive block of information waiting for the students' reaction.

With the advent of knowledge-based systems, the computer seems to be emerging as another viable means of transfering knowledge in a more active form, such as prompting medical personnel to make the appropriate responses. For developing countries especially, knowledge-based decision support systems on rugged and portable personal computers which are independent of AC supply, seem to offer a potential remedy to ease the problem of carrying medical knowledge right to the spot where it is needed most.

Primary medical care in developing countries is often provided by personnel with a very heterogeneous level of medical training, commonly called village health workers.

The main tasks of a village health worker include (1) to provide a diagnostic classification of a patient's disorder as an easily treatable and not life-threatening disease or as a potentially dangerous disease; (2) if appropriate, to deliver a treatment scheme compatible with his or her proficiency and therapeutic resources; and (3) to refer patients with potentially dangerous diseases to a professional nurse or doctor.

The availability of professional medical care has a direct bearing on the extent of a health worker's activities. If an information exchange with properly trained medical personnel is available, an improvement in the quality of medical care provided by health workers is warranted. Problems of maintaining an adequate standard of primary medical care therefore include implementing policies to provide for on-the-job training to improve efficiency and effectiveness and provide reference material which is easy to consult in unclear cases.

The purpose of this project is (1) to establish a knowledge-based decision support system for village health workers covering the most common diseases in developing countries; (2) to implement this knowledge-based system on portable microcomputers; and (3) to include tutorial features as well as a reference structure on the design of the system in order to meet the demands of on-the-job health workers.

In the following article we present a description of the system specification and design, show the structure of knowledge representation and system implementation, and summarize the current status of the prototype and future directions.

2. System design

Ample experience on the principles of teaching medical care to health workers has been accumulated over the years (Werner, 1980; Werner and Bower, 1982; Abbat and McMahon, 1985). In the design of our system we tried as much as possible to draw on that vast body of experience so as to avoid common mistakes frequently encountered in intercultural exchange programmes. For that purpose, the standard textbook "Where There is no Doctor" by D. Werner (1980), served as the primary source of reference. In addition, medical knowledge was also extracted from the relevant literature (King et al., 1978; King et al., 1979; Manson, 1982; Ilpunda et al., 1983).

As a second source we used the experience gained by G. Purenta who, as a member of the Austrian Committee for Ethiopia, worked for two months in an ambulatory care centre in the Tigre Province of northern Ethiopia. Working together with village health workers of different educational levels, he experienced the need for a flexible source of information to cope with primary medical care problems. Also, health statistics showing the actual distribution of diseases within a three-week period were used as a guideline for the selection of diseases in the design phase.

According to these statistics, a small group of diseases accounts for a large percentage of the disorders encountered. Accordingly, treatments of diarrhoea, parasitical infestations, eye diseases, skin afflictions and malaria made up approximately half of the daily work. A concentration on good quality health care in these areas would significantly improve the overall health situation.

The disease distribution presented pertains only to a specific situation which takes into consideration the geographical area (highland), political context (civil war), social environment (poverty, famine), infrastructure of health care (rural health centres closed, two town hospitals) and other factors. It is not possible to devise a detailed generic general purpose knowledge-based system suited for village health workers in different countries. For its proper function and acceptance, the system has to be tailored both the region where it is used and the people using it. Therefore the system presented in this study is specific, applying only to the northern part of Ethiopia, although general principles as outlined in the book by D. Werner (1980), are included.

In designing the system, we identified five problem areas to be represented in the system (diarrhoea, parasite infestation, eye diseases, skin diseases and common infectious diseases) and three different entry points into the system (diagnosis, therapy and drug prescription). These disease groups cover more than 70 per cent of the diseases encountered in the area studied.

If decision support for diagnosis is requested by the user, the system starts with a question-answer strategy to find an appropriate diagnosis, to suggest a treatment plan, and to give detailed advice on drug prescription, if necessary. At this level we assume that the village health worker is familiar with the most common medical terms so that he can answer each question with "yes", "no" or "unknown".

The diagnostic strategy is structured around the five core areas of disease mentioned earlier. Initially, the system tries to ascertain whether the medical problem as presented by the patient is not dangerous and would therefore fall within the range of competence of the village health worker. If none of the danger criteria are met, the system then goes on to ask questions about diseases ranked by their frequency of occurrence in an ambulatory care centre. If danger criteria can be ascertained, the system suggests referring the patient to a doctor or a professional nurse.

After deciding on the main complaint, the village health worker is prompted to answer questions posed by the system. The choice of entering a set of symptoms randomly is not offered. With this strategy, we attempted to elucidate the

diagnostic pathways of the system with a tutorial perspective. By following a predetermined sequence of questions a village health worker should become acquainted with a standardized method of efficiently noting the patient's medical history and carrying out a rudimentary physical examination.

At this point, questions are asked by displaying text on the screen, using D. Werner's terminology. Obviously this is not the most appropriate form of a user-friendly interface. An icon-based dialogue using symbols instead of text, with a pointing device for the user input, might be more appropriate for a broader range of audience and might also feature language independence (R. Trappl and W. Horn, 1983). In developing our prototype, however, we concentrated on the proper representation of knowledge and at this first attempt set aside the problem of an adequate user interface.

At the second entry point, the system uses the diagnosis established during the first step to suggest an adequate treatment plan consisting of general advice and drug prescription, if deemed necessary. It also provides the opportunity to start with a diagnosis independent of a pass through the diagnostic workup. While working on a treatment plan, questions about contra indications and, if still unknown, general patient data (e.g. age, weight) have to be answered. Finally, the treatment of choice is presented.

While determining an adequate treatment scheme, the system evaluates its knowledge on contra-indications, side-effects, treatments of choice, and price information pertaining to the drugs in its knowledge base. In the current implementation, the treatment scheme associated with the lowest cost for a complete course of treatment is selected from the set of equally effective schemes. Therefore, if the system is used for treatment selection on a regular basis, a significant cost reduction in drug expenditure will follow. User access to this module of the system is available independent of the diagnostic or therapeutic branch.

3. Implementation

A prototype of the system has been implemented on a portable personal computer (PC) by means of VIE-KET, the VIEnna Knowledge Engineering Tool (B. Pfahringer and Ch. Holzbaur, 1985). Similar to KEE (T.P. Kehler and G.D. Clemenson, 1983), and BABYLON (F. di Primio and G. Brewka, 1984), VIE-KET is a hybrid knowledge engineering tool which offers subsystems to handle various knowledge representation schemes such as frames, rules, PROLOG and LISP. In principle, the system could have been developed in a purely procedural language such as Pascal, Basic or Fortran, but the developing environment associated with a hybrid knowledge engineering tool significantly improves and simplifies the developing process.

According to the specifications worked out during the design phase, the system consists of several modules assigned to deal with specific knowledge domains. As the corresponding problem areas differ in their specific structure, the modules of the program differ in their implementation in VIE-KET.

3.1 Modules for diagnoses

In the two problem areas "diarrhoea" and "infestation with parasites", expanded decision networks guide the health worker to the diagnosis. At each node, a node interpreter evaluates and weighs a set of symptoms represented as premises of a rule and branches according to the relation between a threshold value and the sum of weights. In the simplest case, the premises of the rule are classified into IS-PRESENT (IP) and MAYBE-PRESENT (MP) premises. Finding one IP premise or two MP premises will cause continuation on the YES branch of the decision node.

Within the system, the expanded decision networks are represented using a frame structure. A general frame NODE with slots IS-PRESENT, MAYBE-PRESENT, YES and NO is defined. Attached to each NODE frame is a method NEXT-NODE that determines which branch will be followed after evaluation of the premises. Networks can then be incrementally built by creating new instances of the general frame NODE. The advantages of choosing frames as a representation tool include flexibility, a simple editing procedure and graphic display routines for debugging purposes. During an actual consultation session, the tree is traversed by sending NEXT-NODE messages to the actual node, and updating the node accordingly until the proper form of diagnosis is reached.

For the diagnosis of diseases affecting the skin and eyes, a rule-based approach is adequate. Each symptom is associated with two certainty factors ranging from -1 to +1. The first factor characterizes the relationship between a symptom and the disease currently in focus, where +1 indicates a pathognomonic symptom and -1 indicates the exclusion of the disease if the symptom is present. The second factor gives an indication of the relationship between the absence of a symptom and the disease.

In selecting the certainty factors, we opted for the introduction of a value restriction of 1, 0.7, 0.4, 0.2 and 0 for the positive and negative values respectively. Two physicians then independently scored the symptoms in relation to the diseases. This scoring scheme was conducted according to the physician's personal belief and in most cases the certainty factors turned out to be identical between the two physicians. In diverging cases, discussions led to a consensus.

It should be pointed out that the certainty factors assigned to each symptom are not only dependent on the relationship between a single symptom and the corresponding disease. The set of diseases as potential candidates for a diagnosis decreases as the diagnostic process proceeds. As diseases are sequentially worked on by the system, knowledge as to which diseases have already been rejected by the system becomes available. While scoring the symptoms of diseases which appear late in the diagnostic pathway, this narrowed solution space has a direct bearing on the importance and weight of certainty factors. Thus the ranking order of diseases influences the associated certainty factors.

An algorithm similar to the formula in the MYCIN system is used to combine certainty factors for the different symptoms in order to arrive at a final score. If the score exceeds 0.8 the diagnosis

of the disease being presently evaluated is concluded and the diagnostic procedure stops.

During the diagnostic process, the age and weight of the patient have to be provided. For all children under the age of 12 a malnutrition module checks their nutritional status according to a simple algorithm (weight for age) commonly called "road to health" (D. Werner, 1980). As malnutrition poses a major threat to the well-being of infants in developing countries, the computed nutritional status of the child is pointed out to the health worker in units of percentage of normal. Appropriate action is then expected from the health worker.

3.2 Modules for therapy

For the drug module, knowledge on the use and dosage of drugs is represented in a frame structure that can combine both declarative and procedural knowlege. Declarative knowledge on medication includes the period of time over which a drug should be given in order for it to reach its optimal effect, the contra-indications which have to be checked before administering a certain drug, warnings of side-effects, and additional advice related to drug usage. Procedural knowledge is applied to actually compute the required dose for a specific patient. The algorithm then suggests the number of tablets or capsules that should be taken every day for a certain period of time according to the prescription stored in the knowledge base.

The frame hierarchy includes an inheritance mechanism that conveniently represents different drug dosages for different diseases without creating two entirely different structures. For example, the frame "Mebendazole" contains information on this antihelminthic drug, including default dosage, contra-indications, side-effects and warnings. For the special case of threadworm infestation, the default dosage is however not appropriate. Therefore, another instance of the frame "Mebendazole" is created which only contains the special dosage for this disease. The rest of the information is inherited from the original frame.

Depending on the availability of drugs, the system could arrive at several different drugs representing the treatment of choice. In this case, price information is used to select the cheapest treatment scheme to be suggested to the health worker. The differences between two treatment plans can be clearly demonstrated in the treatment of ascariasis. Administering Mebendazole is on the average 7.5 times more expensive than treatment with Piperazine.

Apart from drug prescriptions, the system also suggests other therapeutic actions, if appropriate, such as bed rest, diet or inhalations.

4. Discussion and outlook

During the developmental phase, the ease of handling and the flexibility of an open system allowing access to the programming language proved to be important. Expert system shells usually abide by the paradigm of production rules and cannot easily support two certainty factors for one premise. In this case, a problem sometimes has to be adjusted to the developing tool whereas open systems allow for the tailoring of the tool to fit the problem. As a trade-off, programming effort is increased when using open systems.

Providing knowledge transfer of simple medical knowledge is among the tasks of the present system. However, without field tests, it is difficult to assess just how adequately the chosen structure serves this purpose. Clearly, several shortcomings deserve further discussion.

Proper usage of this system requires the user to be familiar with common medical terms. The system is not designed to interact with users who might need explanations of medical terms encountered in the dialogues. A smart dictionary could be developed to accomplish this task.

The development of a language independent user interface relying on image based computer interaction would be an interesting and useful extension to this system. However, most of the currently available computer systems that are also truly portable lack the technical specifications to allow for an implementation using high-resolution graphics.

A question-answering strategy to guide the user through the diagnostic and therapeutical workup has been chosen to help in acquiring diagnostic and therapeutical skills. This rigid and structured approach still awaits evaluation. It could very well be that a flexible strategy with free entry of signs and symptoms and subsequent diagnostic and therapeutic workup will turn out to be the more effective.

Several other attempts have also been launched to provide decision support for health care in developing countries at various levels. A similar approach focusing on microcomputer implementation has been taken in TROPICAID, a joint project between Médecins Sans Frontières and the Université Pitié Salpetrière in Paris, France, designed for use in Chad (B. Auvert et al., 1986). Field tests of this system are well under way and additional projects are at a planning phase. A preliminary evaluation provided evidence that a microcomputer-based system can support the daily work of medical personnel in a useful way.

Implementing a knowledge-based system on a personal computer naturally imposes restrictions on the design due to limited resources. To date, commercially available tools for PC applications lack either sophistication or efficiency, or both. Maintenance of even a small knowledge base is by no means trivial, especially if more than one expert contributes to the knowledge. Usually, a choice between two alternative approaches has to be made: (1) allotting significant resources to the construction and maintenance of an efficient and fast knowledge-based system due to insufficient tools available on PCs (thus sacrificing the rapid prototyping paradigm) or (2) using available tools for prototyping, thus forcing the user to spend considerable effort in time and attention while using the system (not an option with the intended audience of the present project).

For future projects, a reasonable trade-off would include the development of the system on a dedicated workstation for rapid prototyping, and, upon completion, a transfer to the custom PC for delivery of the final application using appropriate run-time versions. However, the software garden is as yet only sparsely populated with suitable tools.

For the knowledge-based system presented in this study, several aspects have to be worked out in

more detail before field tests might eventually be considered. The main and yet unsolved problem is still the task of developing a user-friendly interface tailored towards the educational level of rural health workers. An icon-based approach seems to be promising but is obviously difficult to achieve. Also, before field tests can be undertaken, a disease profile has to be established in order to provide guidance in the adjustment of the knowledge base towards the specific situation.

Finally, the system presented in this study should serve as a starting point for discussions and considerations on how knowledge-based systems might help to bridge the gap of the quality of health care in developing and industrialized countries.

5. Summary

A knowledge-based system has been designed and implemented to provide decision support for village health workers engaged in ambulatory health care in developing countries. Typical medical problems encountered by village health workers include diarrhoea, infestation with parasites, diseases affecting the eyes and skin, and several kinds of infectious diseases. Also the assessment of malnutrition is among the tasks village health workers have to perform. The hybrid knowledge engineering tool VIE-KET has been used to construct a modular consultation system that provides entry points for diagnosis, therapy and drug prescription. Medical knowledge is represented in the following ways: expanded decision networks are used to represent the diagnostic processes for diarrhoea and infestation with parasites. The diagnostic procedures for diseases affecting the skin and eyes are covered with a rule-based approach using two certainty factors. Treatment schemes and procedural knowledge about drug prescription are represented in a frame structure. Design criteria and interesting implementation aspects have been discussed and the current status of the prototype and future directions has been summarized.

6. Acknowledgements

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XI. RECENT PUBLICATIONS

The International Journal of Computer Applications in Technology is a refereed international journal, published quarterly, providing an international forum and an authoritative source of information in the field of computer applications and related information technology. The Journal is the official publication of the International Network of Centres for Computer Applications (INCCA).

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Industrial revival through technology

A number of industrial activities in OECD countries have for some time been slowing down or declining, which has led to their diminished importance in the overall industrial structure. These industries, which in the past were major areas of growth and fuelled economic growth after the war have often been significantly affected by the emergence of new suppliers from low-cost countries which have taken over growing shares of traditional markets of OECD industries. Expectations are therefore increasingly put into new technologies (i.e. new materials, biotechnology, and in particular, microelectronics-based technology) as a means of arresting the slowdown of these industries in OECD countries and even of recovering international comparative advantage.

This new OECD report examines the contribution which technology, in particular the new technologies, can make to revive so called "mature industries". Seven industries - printing and publishing, glass, textiles, clothing, food processing, watches and paper - which together account for some 25 per cent of OECD manufacturing output, have been chosen as illustrative case studies.

The report's findings show that microelectronics-based technologies are currently the most advanced of the new technologies used by these industries, especially in design and planning operations, and in production process control. Analysing their role in the production process, the report makes a broad distinction between, on the one hand, "core" technologies (i.e. the technologies whereby the particular goods are manufactured, for instance the spinning or weaving machines to produce yarn or cloth), and, on the other, "auxiliary" technologies for operations such as the moving of work-in-process between different work stations, and for transportation more generally, as well as for operations such as storing, packaging and dispatching. Because of the nature of the production process in most of the industries examined, core technologies are based on traditional rather than new technologies. These have been highly perfected over the years in order to increase output, enhance quality and reduce costs, especially of labour. In contrast, the auxiliary technologies are a typical area for microelectronics technologies - often still awaiting development - and may be a major factor leading to further transformation of these industries in the medium term.

While the prime focus of the report is on technology in the production process, the findings also demonstrate that technological change of the products concerned and of product development and innovation in general, whether consumer or investment products, are equally powerful tools for industry to open up new markets and trigger new growth. Furthermore, the report underscores the importance of the quality of management in mature industries and demonstrates with a number of examples how new managerial approaches have led to significant restoration of competitiveness and growth in areas which had previously come under pressure. The report thus also makes a strong plea for innovations jointly in production technology, products, and management to revive mature activities.

Mature industries in the OECD area continue to face employment problems, shedding labour in large numbers. The case studies suggest that accelerated substitution of new technologies for manual labour can be expected in a number of these industries in the future, with some adverse effects on total employment numbers. By the same token, the application of new technologies can be expected to help restore the international comparative advantage of the industrial countries in a number of these activities but is likely to benefit output more than employment. The report is available from the OECD Press Division, 2 rue Andre Pascal, 75775 Paris Cedex 16.

Low-Temperature Electronics

As electronics have advanced in technological sophistication, interest in low-temperature electronics has increased substantially. However, the engineer wishing to acquire a background in this field has had no sourcebook to turn to as there are no comprehensive books on the subject, and few survey articles which are up to date.

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Of CADs and CAMs

MAP, MKRP, GKS, IKBS, IGES, ISO, LAN, AMT, APT, AGV, CAPP, CMM, CAI, CAQC, FEA, CNC, DNC: those are just some of the terms defined in the Keyguide to Information Sources in CAD CAM, a reference guide to the well-established technology of computer-aided design and manufacturing.

The 300-page volume, which costs $65, is intended for engineers in all disciplines as well as academics, researchers, software managers, and production managers in automated manufacturing.

The book contains a survey of the history of CAD CAM, libraries and information sources; guides to literature, bibliographies, abstracting services, trade shows, journals, audiovisual materials; and a bibliography with a directory of information sources that includes US and international organizations involved with CAD CAM. Contact: Ergosyst Associates Inc., Old Post Road, Brookfield, Vt. 05036; 802-276-3161.

NGO directory published

The ACCIS Directory of United Nations system data bases on Non-Governmental Organizations is in the process of being printed. It will be available, free of charge and while stocks last, from the ACCIS Secretariat from the end of November 1988. The directory contains information gathered via a questionnaire from 25 United Nations system organizations on 61 data bases on Non-Governmental Organizations (NGOs).

The directory is arranged in three sections: a main section, containing entries describing the data bases; an annex listing departments, units and offices in the United Nations system dealing with Non-Governmental Organizations, and an index of subjects, data bases, printed products and names/acronyms of organizations, departments and units. All information is given in English.

The data contained in the directory were collected on a microcomputer using UNESCO's CDS ISIS (Mini-micro Version) software. The master file is being transferred to the Non-Governmental Liaison Service (NGLS/Geneva) for future maintenance.

The Social Basis of the Microelectronics Revolution by Alfonso Molina

Since the world woke up to the fact that a major technological revolution, the microelectronics revolution, was on the march, a great deal has been written by scholars and policy-makers attempting to grapple with the nature, threats and promises of microelectronics technology. Most of the analyses, however, have focused on the characteristics of the technology involved and on its likely social impact. In this respect, the technology itself and its processes of development have been accepted as largely inevitable. Only its impact remains as a relevant social issue for study. Authors have examined the impact of microelectronics in areas as diverse as employment, economic performance and competitiveness, education, military developments, the third world, and the prospects for privacy and political freedoms. A large literature of this kind now exists.

On the other hand, little attention has been given to understanding the social forces shaping the microelectronics revolution, notwithstanding the obvious importance of such knowledge for any effort aimed at controlling and directing its historical and continuing development. Not that this is surprising. Critical social analyses have always been in the minority, and all the more so with the technologies of the microrevolution, which have clearly rekindled hopes and visions of technological utopias. In addition, the very complexity of the issues involved in the historical process of social shaping of the microelectronics revolution is something that does not lend itself to easy treatment. Take as an indication the following picture suggested by two commentators, in relation to the development of the microchip alone - forget about computers.

The general aim of this book is to shed light on the social nature of the microelectronics revolution. In particular, it seeks to put into its socio historical context the development of the broad range of converging electronics technologies (i.e. semiconductors, computers, automatic control and telecommunications). A major concern will be to map out the major characteristics and trends dominating the current phase of development of microtechnology and also explore future paths of development, in particular, whether alternative forms of social and technological change informed by different more humane concerns are likely to develop.

In facing these issues, the approach of this book will be to look for the explanations of technological change, primarily in the nature of, and interrelations between, those social forces whose interests have played a dominant role in shaping the development of microtechnology within the advanced societies of the capitalist world. These are the social forces which have in practice exercised the dominant control of the basic human, financial, material, time and space resources necessary for all technological processes, and which, for the same reason, have most directly influenced and shaped the development of microtechnology. In this approach, the influence of non dominant social forces is taken as subsumed in the practical decisions and actions of the dominant social interests.

An appropriate name for this interplay of social interests shaping microtechnology is that of "dominant social constituency" of microtechnology. This name conveys the idea that the social shaping role of these forces is as much an inseparable component of technological processes as is the role of machinery, knowledge, and so forth, i.e. the technical constituents of technological processes. This is relevant because in the author's view both social and technical factors participate equally in giving technological processes their character; they interpenetrate, and the absence of either of them would make it impossible to explain the shape of these processes as they are in practice.

The book is divided into six chapters, plus an appendix. Chapter 2 focuses on the United States R&D system and attempts to systematize in an historical perspective the nature and role of the dominant social constituency of power which has shaped its development in the post-Second World War era. The appendix relates to this chapter and provides an analysis of the origins and development of the United States R&D system prior to the outbreak of the Second World War. It shows that a social constituency of power involving capital, government, the military and science did not arise for the first time in the United States during the Second World War. In chapters 3, 4 and 5, the analysis turns to the case of microtechnology proper, showing how the above social constituency of power has effectively shaped its development in a way which has mirrored the interests, tensions and changing relative weights of the constituents under given historical circumstances. Chapter 3 specifically deals with the social shaping of microtechnology from its early development in the Second World War to about the mid 1970s. Chapters 4 and 5 identify the main characteristics, trends and issues dominating the present development of the United States' microtechnology.

The global nature of the industries and markets involved in this development is accounted for through a comparative perspective which compares the case of the United States with that of Japan and Europe. The final pair of chapters, 6 and 7, looks at future development for society as it may arise from present trends. Here, the analysis is more theoretical and seeks to probe into the nature of the present social constituency of power, while also examining the issues involved in the emergence of an alternative social constituency whose interests put humanity at the centre of societal and technological progress.

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