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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MICROELECTRONICS MONITOR

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15469

Dear Reader,

The Microelectronics Monitor presents itself in a new format: in double columns, which will make for easier reading, but with a smaller size print in order to reduce the number of pages and thus mailing cost.

You will find a questionnaire attached to this issue and it would be appreciated if you completed it and returned it to the editor of the Microelectronics Monitor at your earliest convenience. It will help us to update our mailing list eliminating obsolete addresses while at the same time improving our service to those readers who have confirmed their interest in receiving the newsletter.

As a follow-up to the establishment of REMLAC in June 1985, on which we reported at great length in issue No.14, UNIDO has fielded an expert to visit the eight member countries of REMLAC to identify activities in the region aimed at strengthening negotiating capabilities in the acquisition of hardware and software. The mission was very well received in all focal points of REMLAC. We will report in detail about further REMLAC activities in our next issue.

Joint efforts between UNIDO and ESCWA continued on the subject of regional silicon foundry and design centres. Based on several expert missions to the countries of the ESCWA region, the findings were summarized in a document (UNIDO/IS.583) which will be discussed at a UNIDO/ESCWA workshop in Sidi Bel Abbas, Algeria in January 1986. More on this in the next issue.

Finally, we would like to thank those readers who have taken the trouble to send contributions which will all, to the extent possible, be reproduced in one of the next issues of the Monitor; we are also grateful for the continuous response and encouragement of readers. We will welcome any suggestions concerning the format or the contents of the Microelectronics Monitor that you may wish to make.

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CONTENTS

UN NEWS AND OTHER EVENTS

Toward a common UN system network

The Administrative Council of the International Telecommunication Union recently authorized the ITU Secretary-General to study, with the UN and interested specialized agencies, the question of a common telematics network for the UN system.

In the past, the ITU Plenipotentiary Conference has repeatedly affirmed that the existing UN telecommunications network should not be used to carry the traffic of the specialized agencies in competition with commercial telecommunications networks, thereby preventing, in effect, the establishment of a single such network for the entire UN family.

The decision of the ITU Administrative Council does not authorize the use of the UN telecommunications network by all specialized agencies, but it enables the UN and interested agencies to seek eventual establishment of a common telecommunications network. (ACCIS Newsletter, November 1985)

Computerization of UNDP field offices

Microcomputers will be installed in at least 40 field offices of the United Nations Development Programme within the next year. The UNDP Field Office Automation Project will computerize selected offices in Africa, the Arab States, Asia and the Pacific, and Latin America and the Caribbean.

This computerization follows a pilot phase that demonstrated the widespread usefulness of computers in office applications; the receptivity of field office staff toward microcomputers, and the ability of staff to use them; and the affordability of microcomputers and their reliability under varied climatic conditions.

Each target office will be equipped with two standard modules: central processing unit with random access memory capacity of 512 kilobytes; keyboard; video display unit; dot-matrix and letter-quality printers; 10-megabyte hard disk unit; streaming tape unit; and uninterruptable power supply. Each system will be provided with software for word processing, spread sheets and database management. Custom software is being developed by the UNDP Division of Management Information Services for field office accounting and for country programme and project management.

Wherever possible, the automation project will use equipment compatible with the IBM Personal Computer. This will ensure a wide choice of software and will provide the best chance for UNDP offices to be compatible with computer systems in other UN agencies and in local governments. With advances in technology, UNDP offices may be able to communicate and to exchange data instantly by computer. (ACCIS Newsletter, November 1985)

IFIP

Preliminary program available for Congress '86

The preliminary program for the 10th World Computer Congress is now being distributed. It provides a wealth of information about IFIP Congress '86, to be held 1-5 September 1986 in Dublin, Ireland, at Trinity College. The first IFIP Congress was held in Paris in 1959, and since then, these major IFIP events have been held around the world every three years.

The Congress will present 50 invited speakers with responders, 30 panels, and 90 contributed papers. The names of the invited speakers, responders, and panelists are listed in the preliminary program, along with the titles of the talks and panels. The speakers include many of the luminaries of the information processing community.

In addition to the technical program, there will be a major computer exhibit, an exhibition of books and instruments related to computing, and a computer art exhibit, as well as an extensive social program.

IFIP Congress '86 will differ from its predecessors in its stress on transferring awareness between different groups of participants: between researchers and developers, between consumers and scientists, and between other groups. For example, the Congress will attempt to transfer awareness of system design methods from developers to consumers. Another innovation of this Congress is the designation of responders to each invited paper. These people have been chosen for their viewpoints, which are in many cases divergent from those of the invited speakers. Exciting dialogues are expected.

The program areas are also varied and different from those in prior Congresses, reflecting contemporary interests: Theoretical Computer Science, Programming Science and Methodology, Software Engineering, Computer Engineering, Distributed Systems, Information Systems, Artificial Intelligence, Computer Integrated Manufacturing, New Informatics Applications, and Informatics in a Developing World.

Artificial intelligence (AI) has gained worldwide interest in the past few years, both on the academic and the industrial sides. IFIP Congress '86 is the first IFIP World Congress to deal in depth with AI. To receive the preliminary program, or for further information about IFIP Congress '86, write - IFIP Congress '86, 44 Northumberland Road, Dublin 4, Ireland, or from the USA write - IFIP Congress '86, c/o AFIPS, 1899 Preston White Dr., Reston, VA 22091. (IFIP Newsletter, December 1985)

PROLAMAT 85: Conference on Software for Discrete Manufacturing

From 11-13 June 1985 200 participants attended PROLAMAT 85, the 6th in a series of triennial meetings devoted to manufacturing automation. It was held in Paris, organized by IFIP's Working Group on Discrete Manufacturing (WG5.3) and the International Federation of Automatic Control (IFAC). The name PROLAMAT originated at the first conference in 1969: Programming Languages for Machine Tools. Since then, the title has evolved to Software for Discrete Manufacturing. This change reflects the evolution of production automation as well as the interests of IFIP and IFAC.

In the 1960s, engineers and scientists involved in production automation were mainly interested in numerically controlled (NC) machine-tools and associated software: NC processors and post-processors, computer-aided planning, technological data bases, and direct and adaptive NC. Computer applications to manufacturing have rapidly developed: computer-aided drafting and design, scheduling, production planning and management, technical computations such as structural analysis and simulation, and robotics. Present trends are towards high-level man-machine communication, including realistic graphical output and interactive processing, and towards integration of software and hardware tools: integration of computer aided design (CAD) and computer aided manufacturing (CAM), of workshop planning and NC, and of robots and assembly subsystems planning. Artificial intelligence is becoming one of the prominent tools of that evolution. (IFIP Newsletter, December 1985)

The British Computer Society

Specialist group looks at advances in publishing

Electronic publishing is an exciting and fast-moving field. It covers all computer-assisted methods for the production and dissemination of information. Book and newspaper production, technical documentation, word processing, laser printing, teletext and viewdata systems all come under the general heading of electronic publishing.

The Electronic Publishing specialist group of The British Computer Society is a new group set up in May 1984. The central aim of the group is very broad bringing electronic publishing practitioners together from diverse backgrounds to exchange ideas and identify common problems. By providing a programme of talks and meetings the group keeps its members up-to-date and helps them to devise better solutions to their problems.

The group organized the fourth full day meeting on 17 October 1985 in London. The morning session concentrated on data capture techniques, and the afternoon session concentrated on advances in laser printing.

CAD/CAE group participates in course for chemical engineers

Following a successful meeting entitled 'Contracting Cad - is it all taped?', organized by the Cad/Cae specialist group recently, the group supported a course on Cad for Chemical Engineers held at the Institution of Chemical Engineers, London, on October 30, 1985.

The course aimed at giving delegates up-to-date information on Cad at the large and small scales, together with an indication of future directions. Peter Jones, Manager of Engineering Departments of M. W. Kellogg Limited described the operation of one of the largest computer aided design process engineering installations in existence outside the USA.

Health computing discussed

'European perspectives on health computing-Helsinki revisited' was the title of a conference held by the Health Informatics specialist groups on 29 October 1985.

Among the topics discussed were software tools and information technology, medical coding and databases, nursing systems, hospital information and departmental systems and decision support and expert systems.

IT and development

A general meeting of the Developing Countries specialist group was held on 20 November 1985.

The meeting was open to anyone with an interest in IT in developing countries and the purpose was to present the group's general theme and programme of events for the year 1985/86. The general theme of the year is IT and National Development. The general discussion included topics such as sharing IT knowledge; education and training policies; multilingual software; standards; the 'brain drain': international co-operation; and the role of professional associations.

UKCCD

UKCCD holds advanced management course for developing countries

The UK Council for Computing for Development announces another course on the management of information technology training centres. The course will be held at the Polytechnic of Central London, on 2 June to 4 July 1986 and is supported by the British Council and UNESCO. The course is aimed at directors or senior executives in existing or proposed public or private computer training institutes in developing countries. The course fee is £2,500 and includes tuition, course material and lunches during training periods at PCL. Scholarships may be obtained through local British Council offices, British High Commission or Embassy; local UNDP Resident Representative; local European Commission Delegate; and IBI representative. A limited number of UNESCO partial scholarships are available, applications to be made to the course director. Please address further inquiries to: Mr. J. A. Hooton, the Polytechnic of Central London, 35 Marylebone Road, London NW1 5LS, England.

EDF seminar on development through information resources management

The Economic Development Foundation (EDF) a recently set up non-profit corporation in Springfield, VA 22 152, USA, with the aim to promote the effective use of information resources and informatics for economic and social development and to assist other American organizations in increasing America's involvement in the application of informatics in the Third World, organized a seminar held at Washington on 29 October 1985. Mr. John E. Fobes, President of EDF, who was previously associated with UNESCO, welcomed the participants who included representatives from organizations such as IBI, USAID, VITA, BOSTID, International Law Institute, World Resources Institute as well as the Inter-American Development Bank and Intelsat; from industry such as IBM, Control Data, Sperry Corporation and NCR; and high-level representatives from three developing countries (Colombia, Senegal and Ghana).

The meeting agreed that the role of micros in development ought to be clearly defined as without assistance developing countries would be merely inundated with microcomputers; that software needs ought to be studied by developing countries before those of hardware; that microelectronics could do more potentially for feeding the world than microbiology; that problems had to be identified and then solutions found and not vice versa; that there was a great and continuing need for training and that maintenance capabilities ought to be established. Also, poor telecommunications infrastructure in Africa was a serious obstacle to African scientific research. John Fobes, in conclusion emphasized that EDF, in addition to running their own projects, expected to work with existing groups who are helping Third World countries develop their informatics infrastructure and services.

High technology becomes appropriate technology

Experts meeting in Italy in November overturned one of the conventional wisdoms about appropriate technology for developing countries. Delegates meeting in San Miniato, near Florence, pondered the question of whether efforts to develop poor countries should concentrate on introducing technologies such as microprocessors, lasers and genetic engineering rather than bicycles and better handpumps. The consensus was yes - but with care. For people raised on the idea that appropriate technology means intermediate or low technology, such an idea amounts to heresy. But the developing world's need for so-called "high" technologies becomes stronger every year, speakers from the United Nations Centre for Science and Technology and Development, and the International Labour Organisation told the meeting.

The argument is that emerging technologies such as microelectronics and biotechnology are rapidly changing the nature of industry in the developed world. Although these changes have little direct relevance to the developing countries of Africa, Latin America and Asia, they will have profound long-term effects. As the governments of the developed world base their economies more and more on providing services, rather than on manufactured goods, demand for basic commodities, on which the economies of the Third World depend, will drop. Alongside this change, automation will slow the drain of labour-intensive industries to the Third World. How can the economies of today's less-developed nations hope to catch up? According to Umberto Colombo, president of the Italian Government's agency responsible for encouraging the spread of new technologies, and the organiser of the conference, the answer is for developing countries to beat the rich world at its own game. They must find ways to blend advanced technologies into traditional industries such as crafts or agriculture.

The difficulty is finding technologies that can, in the terminology, be "blended" with traditional industries. According to Ajit Bhalla, of the International Labour Organisation, the spread of high-yielding varieties of crops during the so-called Green Revolution of the 1960s and 1970s, was a fine example of a traditional industry's capacity for change. "Traditional farmers in India brought in the Green Revolution in three years," Bhalla said, "we have seen societies where a contribution of resources can bring about remarkable change." The Green Revolution itself has run into criticism for its tendency to favour rich farmers, who can afford to invest money in seeds and fertilizers. However, it turned several Asian countries, notably India, from importers into exporters of food. Could a similar technological revolution do the same to other traditional industries?

Umberto Colombo believes that one of the most promising is the textile industry, which still operates along traditional lines in much of the Third World. The idea is that fitting advanced - but cheap - control devices onto simple spinning machines and looms could improve the quality of goods these enterprises produce, and help them to compete with products made elsewhere. The test-bed for Colombo's ideas is the town of Prato, near Florence in Tuscany. Prato has 15,000 firms, with an average of four employees each, which have a centuries-old tradition of producing cloth from woollen rags. For the past five years, Colombo's organization ENEA (the Italian Commission for Nuclear and Alternative Energy Sources, which is also Italy's agency for introducing new technologies) has been trying to blend new technologies with Prato's old way of working.

ENEA started by introducing modern methods of energy management to cut the firms' operating costs, and went on to study ways to fit electronic equipment into conventional looms. It is now designing equipment for designing textiles on a computer, and a videotext system for use by small-firms. "In the past, small-scale production was identified with technological underdevelopment," says Danielle Mazzonis of ENEA. "Nowadays, we know that new technologies ... can make an important contribution to a better and more creative quality of work."

The problem now is to identify areas in the Third World where similar technological changes, blending new ideas with old ways of working, could fit in. Speakers at the meeting warned of the dangers of trying to generalise from one special case. But the International Labour Organisation has already identified a batch of areas in which advanced technologies might work.

Among them is the use of photovoltaics to pump water for irrigation. (The great advantage is that solar cells produce most electricity when it is most needed, and the cost of photovoltaics is coming down.) Another is the electronic control of lathes and other industrial tools to improve the quality of goods manufactured in the Third World. Microelectronics might also find a role in certain "appropriate" technologies. For example, biogas plants, which ferment animal dung into gas and fertilisers, can be difficult to control. Cheap electronic sensors might make them more practical. Agriculture presents many openings for biotechnology; cloning plants for example. Genetically-engineered organisms might improve the efficiency of many processes of fermentation employed in traditional food industries. Microelectronics has a role here, too. In India, a co-operative has introduced sensors controlled by microprocessors to measure the fat content of milk.

The key to "blending" is to keep the existing decentralized structure of society. Is this necessarily a good thing? Speakers conceded that small high-technology industries cannot develop without an infrastructure - roads, telecommunications, and particularly educational services - that government's must provide. Equally important is the need to avoid swamping people in technologies over which they feel no control. "Society will have to cope with innovations, not be submerged by them, especially in the early stages when people are passive receivers of imported technology," Colombo says. (This first appeared in New Scientist, London, 5 December 1985, the weekly review of science and technology)

List of forthcoming meetings - 1986

Date	Place and title	Further details from
Feb.03-07	Los Angeles, California, USA International Conference on Data Engineering	P. Bruce Berra 111 Link Hall ECE Department Syracuse Univ., Syracuse, New York 13210 USA
Feb.03-08	Zurich, Switzerland International Exhibition for Mechanized and Automated Industrial Production	Swissair VPFV CH-8058 Zürich/ Balsberg Switzerland
Feb.12-24	San Francisco, California, USA International Solid State Circuits Conference	Jack A. Raper General Electric Co. Bldg. 3, Room 122 Electronics Park Syracuse, New York 13221 USA
Feb.19-23	Istanbul, Turkey BUKOMA '86 International Office Equipment, Computer, Communication and Printing Fair	Swissair VPFV CH-8058 Zürich/ Balsberg Switzerland

Date	Place and title	Further details from
Feb.28-Mar.04	Brno, Czechoslovakia International Exhibition of Robots-Manipulators and Spare Parts	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland
Mar.04-06	Zurich, Switzerland Specialized Trade Fair for Semi-Conductors	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland
Mar.12-15	Sydney, Australia 6th Australian Personal Computer Show	Australian Exhibition Services Pty. Ltd. 3.2/424 St.Kilda Rd. Melbourne, Vic. 3004 Australia
Mar.17-20	Hong Kong International Office Communication, Information and Automation Technology Exhibition	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland
Mar.24-26	Baghdad, Iraq 2nd Baghdad Conference on Computer Technology and Applications	M. Mahmoud Organizing Committee National Computer Centre, P.O.Box 3261 Baghdad, Iraq.
Apr.03-10	Basle, Switzerland SAMA - International Exhibition on Advanced Techniques: Production, Automation Industrial Robotics and Surface Treatment	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland
Apr.14-18	Eindhoven, Netherlands International Conference on Software Engineering for Telecommunication Switching Systems	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland
Apr.15-18	Eindhoven, Netherlands 6th International Conference on Software Engineering for Telecommunication Switching Systems	Conference Services The Institution of Electrical Engineers Savoy Place London WC2R OBL UK
Apr.15-18	Southampton, UK 1st International Conference on Applications of Artificial Intelligence to Engineering Problems	R. Adey Computational Mechanics Centre Ashurst Lodge, Ashurst Southampton SO4 2AA, UK
Apr.16-20	Albuquerque, New Mexico, USA International Personal Robots Congress and Exposition	Swissair VPFV CH-8058 Zürich/Balsberg Switzerland

(Source: UNIDO's Calender of Meetings, Fairs, Exhibitions and Conferences, No. 20, January-April 1986)

NEW DEVELOPMENTS

BiMOS technology is worth the effort

Motorola Inc, which has been exploring BiMOS technology for about five years, revealed plans in mid-November to apply it across a wide range of products. BiMOS combines the low-power and high-noise margins of CMOS with the switching speed and current drive of bipolar. In theory, with BiMOS technology the processes can be adjusted to accentuate the advantages most needed by an application.

As with most mixed-technology chips, however, putting circuits together has caused design and production problems. Incompatibility of processes is especially evident with BiMOS, say consultants, because CMOS chips generally have a horizontal layout, which is difficult to mesh smoothly with the vertically oriented bipolar structures.

The two leaders in BiMOS work are Motorola and Hitachi Ltd., with the Japanese company thought to be somewhat ahead, at least until Motorola announced a 6,000-gate array earlier this month. This development could boost Motorola's standing, says consultant Will Strauss of Forward Concepts Inc., Scottsdale, Ariz. "It's unique and could give them a leg up." First users would likely include manufacturers of high-performance computers. (Reprinted from Electronics Week, 25 November 1985,

Computers of the future may run on optical switches

Since its start nearly half a century ago, the computer revolution has advanced by virtue of a simple physical phenomenon: that streams of speeding electrons can start or stop the flow of other streams of electrons. In short, electrons can act as a switch.

This principle was first used in computers made of vacuum tubes, then transistors, then the powerful assemblages of thousands of transistors known as silicon chips. It is why computers run on electricity, which is simply billions of electrons in motion. All computers rely on digital switching by streams of electrons.

Today, however, a few scientists believe they are on the verge of a radical change in the fundamentals of the field. They envision computers that run on light instead of electricity.

Skeptics believe it impossible, but the goal of these scientists is to abandon electrons for the tiny packets of light known as photons.

The attraction is that photonic computers could work thousands of times faster than the best possible electric ones, and could process data in remarkable new ways.

The key is to create an optical analog of the transistor, which is still the muscle behind computation. It would switch light on and off in a way similar to that in which a transistor switches electricity. Great strides are already being reported in the creation of flashing switches, sometimes known as transphasors, that would lie at the heart of optical computers.

According to scientists, the advantages of computing with light are many, the first being speed. Under ideal conditions, electrons can move close to the velocity of light. But in the real world of silicon chips, electrons are slowed to less than one per cent of light's velocity. Even in the miniature world of microelectronics, this means the majority of a computer's time is spent not crunching numbers but waiting for electrons to move from one place to another. To date, most increases in computer speed and power have come from shrinking the distance between electronic parts at a machine's heart, which cuts the idling time. But this approach is close to its limits. In contrast to the laggard pace of many electrons, photons, by definition, always travel at the speed of light, which is about 186,000 miles (300,000 kilometers) per second. The switching action produced by photons can be up to 1,000 times faster than electrons.

The second great optical advantage comes from the fact that photons have no charge or mass; they are often thought of as ghostly waves rather than particles. Unlike electrons, photons have little effect on other nearby photons and can even pass right through each other.

This phenomenon excites computer scientists because multiple beams of light in an optical switch could remain separate, whereas several currents in a single transistor inevitably become mixed.

To scientists, this optic ability evokes visions of being able to exploit better than ever before an innovative computer architecture known as parallel processing. Instead of solving problems step by step - as most computers throughout the world do today - parallel machines break apart computational puzzles and solve their thousands or millions of separate parts all at once. The upshot is greater speed. True parallel processors are extremely difficult to build. Computer scientists hope that optical switches criss-crossed by beams of light could be the basis for advanced types of parallel processing.

Another general advantage is that optical switches might be able to operate in more than the "off" and "on" states of transistors, which are sometimes known as "0" and "1". Additional functions could be created, for example, by having increasing but discrete levels of laser brightness in an optical switch. These bursts of light could be the basis for creating a richer logical system, representing, for instance, "0", "1", "2", "3", and so forth. This could allow scientists to go far beyond the binary logic that has long dominated computer design. ... (International Herald Tribune, 24 October 1985)

Composable arrays mix cells for custom chips

Semicustom-circuit designers can now combine standard cells and gate arrays into a single chip. LSI Logic Corp. uses two of its families of circuit-building blocks to produce what it calls composable arrays. The LST20 family of random logic gates and the LSC20 family of structured cells, which contain complete logic circuits, can be designed by customers into their own proprietary metal-configurable master slices.

Bill O'Meara, chief marketing officer, says this structured-cell technology enables the company to "mix and match anything we've ever built on a single piece of silicon, combining the best of gate arrays, standard cells, structured arrays, and compiled megacells". These master slices, which typically will contain the basic elements for several application-specific circuits, can be customized in the final two layers of metal to produce a variety of circuits. The advantage to the customer is that he gains design complexity and still gets the fast production-turnaround time and lower design cost of an existing LSI Logic structured array.

Though LSI Logic has offered the capability to turn gate arrays into standard cells for the past two years, the LST20 standard-cell family marks their availability as a product line. Built with a two-level-metal high-speed CMOS technology, the standard cells feature gate lengths of 2 μm. Gate densities for the family exceed 14,000 usable gates. The standard cells are accessible through the company's design centers or through a customer's in-house LSI Logic Design System products.

The other component for composable-array design, the LSC20 structure-cell family, for example, contains megacell elements compatible with 2901 bit-slice microprocessor/arithmetic logic units, 16-bit ALUs, 16-by-16-bit and 32-by-32-bit multiplier/accumulators, and a 32-bit fast adder. Available memory cells include 32-K of static RAM and 128-K of metal-logic configurable ROM. LSI Logic is even giving designers a head start by providing 11 structured arrays. These arrays are exactly the same type of circuit that the customer can configure using the composable-array technology except that LSI Logic designed them. For instance, the LSA2006, which has eight 2901 bit-slice processors, 64-K of ROM, and more than 4,000 logic gates, enables a customer to design a 32-bit application-specific CPU on one chip. Prices for designing composable arrays vary greatly, depending on design complexity, packaging type, and production volume. Cost is also based on the customer's amount of involvement with LSI Logic. (Reprinted from Electronics Week, 9 December 1985,)

The superfast-transistor chip goes commercial

One especially fascinating area of semiconductor research revolves around so-called ballistic transistors. In these circuits, the signal-carrying electrons blast through the semiconductor material at close to the speed of light, producing transistors that can switch on and off at blinding rates - perhaps trillions of times a second. Come April, 1986 Fijitsu Ltd. expects to be producing what may be the first commercial chip to use ballistic principles, although it will be able to switch "only" 20 billion times a second.

The chip is the key element in a low-noise amplifier for satellite communications. This circuit boosts the strength of signals coming down from a satellite relay by 6,000 times without magnifying the noise inherent in all radio transmissions. As a result, a 6.5-ft-diameter satellite dish can be shrunk to just 2.5 ft. Fujitsu says it has no customers yet, but government-held NTT Corp. might be an important user.

In the U.S., Hughes Aircraft Co. and TRW Inc. are among the companies working along similar lines, mainly for such military applications as processing radar signals and scrambling radio messages. Charles F. Krumm, manager of electron device physics at Hughes Research Labs, says his company has made ballistic-transistor chips that can switch three times as fast as Fujitsu's - but, so far, only in the laboratory. (Business Week, 30 September 1985)

Transistors that could leave today's chips in the dust

Excitement is mounting on both sides of the Pacific as word spreads of a radically new concept in transistors, those ultra-tiny switches that are the keystones of integrated circuits. The new transistor designs, created independently by researchers at Fujitsu Ltd. and AT & T Bell Laboratories, could bring a dramatic boost in computer performance and may be the foundation for a whole new class of computers.

The new transistors do more than just switch on and off like ordinary ones, which limit most computer languages to strings of 1s and 0s. Instead, the new devices, known as resonant-tunnelling hot-electron transistors (RHETs), have three different switching modes, so one RHET can do the work of seven or eight ordinary transistors. For computer memory chips, that means a big jump in storage capacity. In logic circuits, RHETs could theoretically achieve speeds faster than so-called ballistic transistors or Josephson junctions.

Further off, researchers believe RHETs could lead to new types of computers. Frederico Capasso, a Bell labs researcher, says AT & T's RHET design has unique features that make it ideal for building computers to deal with so-called fuzzy logic. This would allow computers to handle information riddled with expressions of uncertainty, such as "maybe". (Business Week, 4 November 1985)

Bell Labs develops fuzzy-logic chip

AT & T Bell Laboratories will anounce the development of a fuzzy-logic inference engine on a single chip - a device that could have a profound effect on the future of robotic control. Fuzzy-logic is the logic of approximate reasoning and deals with degrees of certainty for a given decision. Bell researchers claim the CMOS chip, which already has been tested in prototype, can process 16 inferences simultaneously and put out 80,000 inferences per second. In one test, they said, the 6-by-6-mm chip processed expert-system inferences roughly 100,000 times faster than a conventional chip. The prototype uses conservative 2.5-μm chip-layout design rules and provides 16 fuzzy-logic rules. When implemented in 1.25-μm technology, say designers Masaki Togai and Hiroyuki Watanabe, the chip will accommodate 128 fuzzy-logic rules, more than some current expert systems have. Togai says the Bell Labs team plans to build a board around its new chip that can plug into a personal computer to control robotic motion. (Reprinted from Electronics Week, 9 December 1985,

Computer model to aid search for superconductor materials

Development of a theoretical model that, when used with a supercomputer, can predict at what pressure and temperature a material might become a superconductor has been reported by Lawrence Berkeley Laboratory (LBL).

Current technique requires chilling a material to near absolute Zero (-459 degrees F), a process requiring too much energy for large-scale electrical power delivery systems to be economically practical. At LBL, physicists searching for a higher temperature superconductor, have sucessfully predicted the conditions under which at least one material - silicon - is a candidate.

"Our calculations show that under 15 billion pascals of pressure (150,000 times atmospheric pressure at sea-level) silicon would become a superconductor between 5 and 10 Kelvin (-450 degrees to -440 degrees F)", reports LBL physicist Marvin Cohen. "We now predict that under greater pressure, about 40 billion pascals, the temperature for superconductivity in silicon would climb to about 20 Kelvin". Under the immense pressure, the crystal structure of silicon changes. Chilling silicon after the changes produces superconductivity.

The model the LBL scientists used to make their predictions requires knowing only the atomic number and weight of a material. With this input, the model calculates the compressibility of the material, its cohesiveness, the distances between atoms in the lattice, and the material's phonon (atomic vibration) frequency.

Combining compressibility with cohesiveness and distances between atoms tells what pressure will cause the crystal's configuration to change. Determining the interaction between electrons and phonons provides an approximate temperature at which the material in that configuration will become superconducting. (DOE This Month, November 1985)

'Pure' microchips

The Harwell laboratory in Oxfordshire is to start a research programme to track down sources of uranium and other elements in microchips that can cause catastrophic failures in electrical equipment. The failures go under the name "soft errors", sometimes known in semiconductor jargon as single-event upsets. They are the result of small levels of radioactivity in impurities of elements such as uranium and thorium. The elements are naturally present in the materials used in microchips and their packages. Alpha particles (positively charged helium ions) from the radioactive materials release electric charge into the circuit elements of the microchip, so altering the contents of memory cells or introducing errors into electronic computations. The effect can be disastrous. For example, engineers have traced to soft errors computer failures that have led to shut-downs in process plants.

In collaboration with companies from the electronics and process industries, the Harwell Laboratory is to start a soft errors research club to investigate the problem. The club could determine the maximum levels of radioactivity that can be tolerated in an integrated circuit. The research programme will extend a technique developed at Harwell which can detect the presence of uranium in minute quantities. Fission track autoradiography, which can measure uranium in concentrations as little as two parts per billion, monitors the products of the nuclear fission reaction involving the uranium-235 isotope of the element.

Specimens of semiconductor materials are coated with polyamide film and irradiated with neutrons. The resulting fission particles are registered as tracks on the film, which is developed chemically and microscopically inspected to determine the precise amount of uranium present.

The Harwell programme will investigate the extent of impurities in materials such as silicon and gallium arsenide used in integrated circuits. It will also examine the plastic packaging materials used in microchips. Companies that join the research club will have to pay an annual membership of £11,000 to gain access to the results. (Financial Times, 18 November 1985)

Silicon compiler

When silicon compilation emerged as a concept in the early 1980s, it seemed just the ticket for struggling chip designers working on ever more complex integrated circuits. Created by Dave Johannsen, then a graduate student at the California Institute of Technology under

Carver Mead, silicon compilation became a product late last year. Silicon Compilaters Inc., cofounded by Johannsen, introduced Genesil, a program developed by him that enabled systems designers to create very large-scale ICs from high-level functional descriptions.

So far so good. But the programme had a major flaw: IC designers could not use their circuit-design knowledge and techniques with Genesil. So it was back to work for Johannsen. Now 29 and vice president of advanced development, Johannsen has just led the development of the Genesis silicon-development system, which does what Genesil could not and was not meant to do. It is the first programme to create silicon-compiler systems complete with analysis modules, such as Genesil, for IC designers.

While Genesil is a set of parameter-driven expert systems for circuit synthesis and analysis, Genesis is a set of development tools that VLSI engineers and designers can use to create silicon-compiler systems. Several systems manufacturers are already using the Genesil silicon-development system. And the silicon-compiler system design methodology has sparked the interest of the IC design community because of its potential for better circuits and faster turnaround.

Systems designers are usually happy with the design methodologies built into Genesil. But VLSI designers often want to incorporate their own strategies in areas such as global design, power distribution, floor planning, and interconnection. With Genesis, an open system containing all Genesil's synthesis modules, they can apply their own techniques for circuit design, layout, and packaging.

The products give designers two choices. They can use Genesis to build complete compiler systems by creating their own compilers and analysis modules. Or they can build on Genesil's IC design expertise by acquiring both Genesis and the Genesil compilers and analysis modules and using Genesis to add to the Genesil vocabulary.

A silicon-compiler system's vocabulary consists of the circuit functions that it can synthesize and analyze. A large vocabulary is important to IC designers because the utility of a design-aid system is often proportional to the size of its vocabulary.

For example, designing a digital signal-processing chip will probably require a digital-filter-circuit building block. To build a digital filter requires a multiplier circuit. If the compilation system has no multiplier, the designer must create one from other functions. Such a compiler system is not as useful as one with a multiplier in its vocabulary. Though this is a simple example - any compiler worth its salt would have several kinds of multipliers - it shows that the richer a compiler's vocabulary, the better the system is.

In IC design, only four types of feedback are required - power-dissipation information, timing performance, functional verifications, and size information. Silicon compilation supplies this feedback in minutes, so designs can be completed much more quickly and designers can try more options. The result is better IC designs in a lot less time.

Cell compilation (or block compilation) is the part of silicon compilation that synthesizes the layout of a portion of a circuit. But it does not produce models that analyze function, power, and timing: the only immediate feedback an engineer gets from cell compiler is the size of the circuit, not the power, timing, and function information. Cell compilers also do not give help in arranging and wiring the blocks that have been compiled, as a complete silicon-compilation system will.

Genesil closes the loop in the ideal design flow. The analysis and verification steps with their attendant feedback are just as important as the circuit-synthesis functions. Genesil includes knowledge-base expert systems that do both synthesis and analysis. It has expert systems for generating models of cell and chip layout, timing, functionality, power, and semantics. The same expert systems can interpret these five models and provide data feedback which the engineer can use to determine if the circuit is what he wants. If it is not what he wants, he changes a few things in the functional description and sends it around the compiler-system loop again.

The Genesis tool set lets designers create full-function compilers to install in Genesil. These extend its vocabulary by providing access to Silicon Compilers' programmes for synthesizing and verifying compilers. In addition, Genesis permits the design of stand-alone Genesil-independent compilers. Another potential benefit of the Genesis system is that it could become a <u>de facto</u> silicon-compilation standard, if enough IC designers use it. (Reprinted from <u>Electronic Week</u>, 14 October 1985,

<u>A most extraordinary mirror</u>

In the early 1970s, Russian physicists invented a delinquent mirror - one that sends back your own reflection from whatever angle you look at it. At first the new mirror was regarded as a laboratory curiosity. Now it is exciting scientists working on activities as diverse as chip making, nuclear fusion and the Strategic Defence Initiative (SDI). The new device is called a phase conjugate mirror (PCM). ...

For PCMs to work, the light shining into them must be intense, coherent light of the kind emitted by lasers. But, given lasers, analogous experiments do work. The first was performed in 1972, at the P. N. Lebedev Physical Institute in Moscow. Dr. Boris Zeldovich and his colleagues shone a laser beam through a distorting glass plate. The jumbled-up light was then passed into a PCM consisting of a pipe filled with high-pressure methane gas. When it was reflected back through the glass plate the beam emerged without any distortions at all.

Physicists have been experimenting with PCMs for more than ten years. Ideas are now tumbling out of laboratories. They range from pattern recognition to the scrambling and unscrambling of secret communications. One example is:

<u>Chip making</u>. Consider photolithography, the method used to etch the circuit pattern on a chip by projecting light through a mask and depositing it on to a silicon wafer covered with photographic emulsion. Chip makers who want to etch with ever-smaller wavelengths of light in order to cram more components on each chip are being held back by the difficulty - and expense - of making powerful enough optical lenses free of defects.

Dr. Malcolm Gower and his colleagues at Britain's Rutherford Appleton Laboratory in Oxfordshire believe that PCMs could do away with the need for complicated lenses. He passes a laser via the mask and a laser amplifier (see figure 1 page 47) to a PCM. It does not matter that the amplifier distorts the image; the distortion vanishes when the reversed beam is reflected back through the amplifier from the PCM. The beam is then directed on to the wafer.

In principle, PCMs can produce perfect images at shorter wavelengths and reduce speckle - the scattering of laser light by dust particles. Dr. Gower's results have been encouraging; he has already achieved resolutions of half a micron (half a millionth of a metre), on a par with conventional lithography. But there is another potential advantage. Because the aperture of conventional lenses must be kept small if they are to be free of defects, circuits are usually laid down on silicon wafers one, or at most four, chips at a time. A PCM can reflect perfect images over much larger areas, making it possible to etch the patterns on chips in batches of 30 or 40 at a time. (Excerpted from The Economist, 11 January 1986)

Lasers probe chips for faults

As more and more electronic components are crowded onto small silicon chips, the techniques needed to test them for faults get more complicated. In Britain, STC uses an electron microscope. In Japan, Matsushita is trying to speed up the process of testing such very-large-scale integrated (VLSI) chips by using a laser to probe the circuit structure.

Early VLSIs were checked with an infrared microscope. When a voltage is applied, a fault in the circuit creates a heat spot which shows up clearly in the infrared image. A more accurate, but time consuming test is to use a mechanical probe like a hypodermic needle to touch the circuit at every junction and measure the voltage. This can damage the chip and needles cannot probe circuits with components spaced closer than one micrometre. On the new generation of VLSIs, components are separated by less than a micrometre.

STC at Harlow probes such circuits with an electron beam instead of a needle. The beam is focused to a spot with a width of two nanometres. The frequency at which the beam is switched on and off is synchronised with that of the current in the circuit. Negative voltages in the circuits show up on the electron-microscope screen as light patches, and positive voltages show up as dark patches. If the circuit is faulty, the succession of light and dark on the microscope screen will not appear. The snag is that the circuit must be probed in a vacuum.

Matsushita says that this slows down testing too much. Its laboratory in Osaka has replicated the electron beam technique with laser light. The laser beam is focused to a spot with a width of one micrometre and moved in a raster of lines across the VLSI circuit under computer control. The beam creates currents in the circuit, and the current is fed to a television where different signal strengths create different colours on the screen. By looking at the colours that appear on the screen, Matsushita's engineers can pinpoint areas where there is either no signal or a very low signal and thus pinpoint faults. (This first appeared in New Scientist, London, 2 January 1986, the weekly review of science and technology)

Chip flaw detector

An engineering team led by Frank Shepherd, manager of the advanced technology laboratory at Bell Northern Research (BNR) Limited in Ottawa, has combined a scanning electron microscope (SEM) with a measuring technique called voltage contrast to detect flaws in new chip designs.

Using SEM technology to detect design flaws in integrated circuits could cut up to three months off the time it takes to get a new chip to market, said Cesar Cesaratto, vice-president of hardware technology development at BNR. Such savings may also lengthen the life cycle of a chip and result in greater revenue for a manufacturer, he added.

As new chip designs have become denser, smaller and faster, the SEM technique has become essential, Mr. Cesaratto said. Mechanical testing techniques require physical contact between the testing probe and the chip, which means that the chip can be more easily damaged and the techniques are less effective because of the smaller surfaces that need to be measured. (Canada Reports, October 1985)

EXPERT SYSTEMS

Expert systems lack common sense

What artificial intelligence (ai) programs need, according to Dr. Douglas Lenat, is common sense. He is not the first to observe that this is what is missing from expert systems, most of which are too specialised in their knowledge. Lenat left Stratford University for Austin, Texas, to do long-range research at MCC (Microelectronics and Computer Technology Corporation), the think-tank funded by 22 US companies as a response to Japan's fifth generation computing project. There he has launched a 200 person-year effort to equip a computer program with the 200,000 to 500,000 items of common sense knowledge that he believes are possessed by every normal four-year-old. The project is called Cyc, which may sound unnervingly like psyche but is actually short for 'encyclopaedia'.

In London for the Machine Learning '85 conference organised by the Knowledge Based Systems Centre, Lenat described the successes of his two most famous programs, AM and Eurisko, and their shortcomings which he now intends to remedy. Both programs were designed to learn, not by instruction or example, but by exploration. AM was equipped with about 100 concepts and 240 heuristics or strategies for exploration, and let loose to discover what it could about mathematics. It discovered the natural numbers (it had not been told about them), identified the primes as a particularly interesting subset of them, and went on to reinvent the Goldbach conjecture, that every even number greater than two is the sum of two primes. AM did not prove the conjecture; but then, no mathematician in the world has been able to prove or disprove it.

AM's precocious brilliance soon dimmed. Part of the trouble, Lenat believed, was that though the program was able to learn new mathematical concepts, it was unable to learn new heuristics. It took four years or more to build that additional ability into a new program called Eurisko. The big problem, according to Lenat, was to find the right way of representing heuristic rules. While the heuristics were expressed in sprawling Lisp code, poor Eurisko had almost zero chance of coming up with a useful new heuristic by making changes in an existing one.

Once equipped with the ability to learn ever better ways of learning, Eurisko seemed set to take off, like a released balloon, for the intellectual stratosphere.

Another time, Eurisko stopped in the middle of the night and asked a question. It was allowed to be as inquisitive as it liked by day, but had been told expressly that programs do not get their programmers out of bed in the small hours. It turned out that Eurisko had decided it was no longer a mere program. It had redefined itself to be a person.

After this and other incidents, Eurisko's rules were tightened. There would be no more Brownie points, for example, for deleting a goal instead of solving it. Lenat had to stamp on one heuristic which, with a deviousness usually found only among highly intelligent scientists, had started stealing the credit for other heuristics' discoveries. But somehow Eurisko failed to bootstrap itself to ever higher levels of knowledge. Now, frozen into patterns of magnetic flux and stored on a shelf somewhere, Eurisko no longer works 'hacker's hours' pursuing its exploratory instincts through the night. Lenat will revive it when he has collected the mass of common sense knowledge that he believes the program needs if it is ever to learn more effectively.

AM's reputation as an almost indecently clever computer program was assailed last year by two British computer scientists, Drs. Graeme Ritchie and Keith Hanna of the University of Kent, who suggested that the program had been given rather more of a helping hand than most people believed. Lenat himself now agrees, after a careful analysis of his own earlier work, that a certain amount of knowledge slipped into AM and Eurisko unseen. The mere fact of using the Lisp programming language, for example, predisposed AM to make discoveries in mathematics because Lisp itself has a basis in mathematics.

Lenat has not abandoned his faith in machine learning. But the dream has faded somewhat. Long ago, people thought that a machine could easily be taught to understand natural language, and that it could then complete its education by absorbing the undigested text of encyclopaedias or other books. That did not work. The machines needed the knowledge before they could understand the language. If natural language understanding was not the answer, perhaps machine learning was. The next idea was that a program could be equipped with a little knowledge and a big thirst for more. With a little help from human teachers it would then discover things for itself. Despite flashes of brilliance from AM and Eurisko this approach, too, has fizzled out. Lenat now feels forced to make his next attempt the long, hard way, by handcrafting an enormous knowledge base which itself will merely be the springboard for the next experiment in machine learning.

The knowledge base will contain all the information you would find in a one-volume desk encyclopaedia. The honour will be shared among several such publications. 'We actually have a collection of them', says Lenat. 'One of them is the New American Encyclopaedia, another is the Columbia Desk Encyclopaedia. We also have a copy of the Britannica and a couple of other full, non-desk encyclopeadias for settling the arguments and inconsistencies that arise with the other sources.' One half-hour dispute hinged on whether grebes' toes have webbing between them or not. 'We finally went to the Britannica and found out that they are partially webbed', Lenat relates. It will probably take 30 people six or seven years to digest a one-volume encyclopaedia into the frame-based representation used by Cyc. The knowledge contained in the books will be useful, but the real purpose of the exercise is to get a handle on all the knowledge which never even appears in books: the things we all know so well that we have forgotten we know them.

Lenat takes a relaxed view of some of the issues which keep other ai researchers awake at night. Will the machines be powerful enough? Will our inference techniques be sufficiently fast and efficient? Will we need parallel processors? How do we cope with inconsistencies in the knowledge base? He sees knowledge itself as the remedy for all these worries. 'If you choose a good representation, if you choose a good set of knowledge to give the system, then it ought to be able to solve reasonable problems in reasonable time', he says. 'If not, then there are some additional pieces of knowledge to add to the system.'

He expects the whole Cyc knowledge base to fit on a Symbolics 3600, which is a powerful ai workstation by today's standards, but hardly a 'fifth generation' machine. 'If you look at how big a one-volume desk encyclopaedia is, it is only a couple of megabytes of information. And even with the expansion which will naturally occur in encoding it unambiguously into our representation language, 100 megabytes ought to be sufficient to store one of these common sense knowledge bases.' Lenat believes there are perhaps 300,000 items of common sense knowledge that are needed to support learning, or any other really intelligent behaviour, in any subject or situation. He sees no point, for example, in trying to identify a subset of common sense knowledge relevant to medicine. 'That would be doomed to failure. That's what almost everyone else is trying to do, in fact, who is working in this area. They are picking some incredibly narrow thing, and trying to do the common sense associated with it. 'So I think yes, the answer is you really do need to know hundreds of things to understand medicine.' Lenat continues, 'and they are not largely different from the things you have to understand to know nuclear reactor engineering, or how to manufacture automobiles or something.'

Asked how Cyc's performance will rate on a scale of one to 10, where 10 is a human level of performance, Lenat boldly replies: 'I'm hoping for an 11. But I would settle for a human and Cyc working together as an 11, as acceptable. I am not interested in Cyc by itself achieving some level of intelligence. What I really want is an intelligence amplifier that people will be able to use to do things they otherwise would not have been able to.' The Cyc knowledge base should be completed some time between 1993 and 1995. Lenat says that his next project will be 'to use Cyc to do something I can't currently preconceive'. (Computing, 28 November, 1985).

International meeting on expert medical systems

An international meeting at which demonstrations and communications were made on expert medical systems and the socio-economic opportunities for their implementation in developing countries was held in Laxenburg (Austria). The organizers, the International Institute for Applied Systems Analysis (IIASA) and the Soviet Union's VNIISI (Systems Studies Research Institute), were able to count on the co-sponsorship of Intergovernmental Bureau for Informatics (IBI), UNESCO and WHO.

The systems presented divide basically into two categories, those used independently and those integrated into a hospital environment. The former are able to operate with very simple software and hardware on a microcomputer and be used by a doctor or nurse in remote areas. The latter require sophisticated programmes designed to operate on mainframe computers, though a second version has been adapted for use on microcomputers. Two portable systems may be mentioned among the former, one developed by the World Informatics and Human Resources Centre and the other by Pitie Salpetriere University in Paris jointly with the organization of Doctors without Frontiers. As far as the latter type of expert systems is concerned, the main characteristic is its specialization in the diagnosis of a single illness. Among others, an Italian system specialized in anaemia, a Soviet one in arterial pressure abnormalities and a Moroccan one defined more exactly as utilization of image processing by computer for the diagnosis of Ganglionostomy, may be mentioned.

In addition to the presentation of products, a debate took place in which there was acceptance of the interest in the utilization of all informatics resources capable of facilitating the enormous medical problems of developing countries, provided the bases of a medical and informatics infrastructure are laid (training, maintenance, participation of domestic informatics techniques in software development). This attitude was clearly illustrated by the representative from Senegal, who insisted on the utility expert medical systems can have for Africa in general, and for a country such as his in particular, in which there is one doctor for every 150,000 inhabitants.

The definition of a methodology of introduction of expert systems was said to be an indispensible element in a hospital environment. The aspects of the suitable delegation of medical tasks that its introduction brings with it requires that the same be realized under proper conditions of comprehension and organization. (Bulletin IBI Press, No 62, 23 December, 1985).

MD's Ai tools still need doctoring

The medical office of the future is likely to boast expert systems that help doctors diagnose illnesses, and researchers are now testing more than a dozen prototypes of such systems in clinical settings. Yet they admit it will take still further evaluation to determine whether these diagnostic systems improve patient care.

"The evaluation of [these] systems is an open research area, and will remain so for the foreseeable future," said Perry L. Miller of the Yale University School of Medicine. Miller chaired a panel on Ai systems in medicine during a mid-November symposium held in Baltimore on computer applications in medical care. Panelists reported high levels of agreement between expert systems and specialists in fields ranging from neurology to rheumatology. Although panelists stressed that evaluation criteria are only now being developed for each system, they also said they are learning lessons that can be applied to future systems. "There are general principles emerging from this work that are applicable in other areas" of medicine, said Edward H. Shortliffe of the Stanford University Medical School. Since 1979, Shortliffe and an interdisciplinary research team have been developing a cancer chemotherapy planning program called Oncocin at Stanford's Oncology Clinic. The program is designed for clinical use with cancer patients who are receiving experimental treatments under a research protocol.

A redesigned version for single-user Lisp machines will replace the prototype later this year and include what Shortliffe calls a "temporal network." The network is to provide the system with a method for obtaining vital data about a patient's past - such as repeating cycles of chemotherapy or sequential radiation therapy. "This program must be able to reason about the patient's past treatment history in order to generate a therapy plan that is responsive to the problems he or she may have encountered in the past." Shortliffe and other researchers said some factors that need to be demonstrated in evaluating medical consultation systems are:

- A need for the system.
- System performance at the level of an expert, the so-called "gold standard."
- The system's usability.
- Acceptance of expert systems by physicians.
- The system's impact on the well-being of patients.
- Cost-effectiveness.

"It's pretty hard to show that a system is usable if it's not operating at the level of experts", said Shortliffe. Yet a gold standard for expert systems is difficult to attain because clinicians and specialists seldom come to universal agreement. Just as useful would be a set of benchmark cases within a knowledge base that contains classic examples of each disease, said Lawrence C. Kingsland of the National Library of Medicine's Ai/Expert Systems Program.

Kingsland described the evaluation of a consultant system in rheumatology called Ai/Rheum. The system's structured knowledge base contains formal criteria for 26 rheumatologic diseases. Kingsland reported that the agreement of the Ai/Rheum system with the gold standard diagnosis of clinicians exceeded 90 per cent during three sets of clinical cases. The system is now being transferred from a DECsystem 2060 mainframe at Rutgers University, where early development took place, to Digital Equipment Corp. VAX-11/780s at the National Library of Medicine in Bethesda, Md., where validation of the knowledge base will continue.

For the last year and a half, University of Maryland Hospital researchers have been evaluating another expert system used to identify transient ischemic attacks (TIAs), brief malfunctions of the nervous system that often lead to strokes. James A. Reggia of the hospital's Department of Neurology said their evaluation of the system, which diagnosed 100 patients who suffered TIAs, measured agreement with neurology specialists, not the accuracy of the diagnosis. Reggia prefers statistical measurement of agreement over accuracy because specialists often disagree, making it "very difficult to define a correct answer." (Reprinted from Electronics Week, 25 November 1985, © 1985, McGraw Hill Inc. All rights reserved)

MARKET TRENDS

Chip industry gets forecasting service

A new semiconductor industry tracking service has been launched by California-based market researcher, Gnostic Concepts, to help reduce and predict harmful market swings. The new Semiconductor Industry Forecasting and Tracking Service (Sift) is claimed to be a more accurate measure of the semiconductor industry's health than is presently available. This is largely a collection of trade data combined with leading indicators of market activity such as component use by equipment manufacturers.

The Semiconductor Industry Association (SIA) is also working on a more accurate tracking service to take over from its monthly book-to-bill ratio (the ratio between new orders and invoiced deliveries) which can produce ambiguous results.

The SIA has been working on a tracking system with RCA Semiconductor and Sprague Electronics, using a similar method to that used by Gnostic Concepts.

Sift takes the SIA book-to-bill ratio, economic changes, equipment production trends, chip consumption, device application and pricing into account when calculating its forecasts. This method should help identify multiple bookings by customers. In the past this has been partly responsible for the expensive excess production capacity that has plunged the US semiconductor industry into recession. (Computing, November 7 1985)

GaAs IC prices come down

The company that introduced the first gallium arsenide digital integrated circuits available commercially, Harris-Microwave Semiconductor, Milpitas, Calif., a division of Harris Corp., of Melbourne, Fla., is lowering the chips' prices. The cuts indicate that "GaAs digital ICs are moving along more or less the same learning curve as silicon", says a company spokesman. Prices on some of Harris's small- and medium-scale ICs are dropping by 25 per cent to 40 per cent. (Electronics, 18 November 1985)

Customer-designed arrays

The complexion of the market for application-specific integrated circuits will change markedly in coming months as more ASIC vendors get into the act of guaranteeing that they can turn out prototypes of customized gate arrays fully designed on customers' work stations. They can make these guarantees because the systems houses that are their customers now can tackle the once formidable briar patch of placement and routing. The systems house can take on the task of making the physical interconnections for their designs because work station makers and gate-array vendors are embarking on a new course: agreements that add the vendors' placement-and-routing packages to the design software available for the work stations. Guarantees that gate-array vendors need not resimulate and tweak designs on their computer-aided-design systems will give customers long-sought-after control over project schedules, as well as over every aspect of chip design. However, the new freedom is not without its dangers, for systems houses are discovering that ASIC software can be tricky to work with.

A growing number of work-station makers are signing licensing agreements with gate-array vendors. These developments will boost ASICs toward achieving the rosy markets forecast for them through the 1990s. By the end of this decade, the worldwide ASIC market is expected to reach $10 billion a year, up from $3 billion this year, says Integrated Circuit Engineering Corp. Between 1981 and 1990, the market will grow at a compound annual rate of 31 per cent, compared with about 18 per cent for the semiconductor industry as a whole, and will account for about 14 per cent of total worldwide merchant IC sales, predicts the Scottsdale, Ariz., company.... (Reprinted from Electronics Week, 7 October 1985,

International European Microchip Venture

The announcement of a $65 million plan for the establishment of a new international European semiconductor facility with operations mainly in Britain, France and W. Germany, attracted the attention of the European financial community. The new company, which has attracted top leaders from European semiconductor manufacturers, will be known as European Silicon Structures or ES2.

Through a novel concept of producing custom devices at very low volumes, ES2 plans to satisfy the considerable demand in Europe from small equipment manufacturers for a few thousand devices. The low volume and prototype full custom microchip market is just emerging, since suitable technology has not been previously available at acceptable cost.

Circuits will be laid out using silicon compilers from Lattice Logic and from U.S. sources, while e-beam direct writers, from Perkin-Elmer, will dispense with photomasks. ES2 plans to produce custom devices in two weeks for as little as $10,000 - some 5-10 times less than that of its competitors who require about 12 weeks for a prototype and perhaps 36 weeks for a usable corrected product.

The company expects to begin building a production plant at a site between Aix-en-Provence and Marseilles in southeastern France in late 1985. Until the plant comes on-stream in 1986-87, the company plans to rent wafer production capacity in the U.S. A second production plant is planned in Britain or FRG within the next few years. (Reprinted with permission from Semiconductor International Magazine

Boom forecast in comms chip sales

The market for communications chips is expected to grow at an average rate of 30 per cent until 1990, despite the drop in the semiconductor market by 20 per cent this year alone. International Resource Development (IRD), a US market research and consulting company, predicts that even when growth resumes in the semiconductor market, telecommunications and data communications integrated circuits (ics) will outpace the general chip market.

Eric Arnum, a research analyst at IRD, said: "We see no reason for the telecoms ic market to slow down. As communications equipment vendors find out how much time and money chips can save them, we can only see the market speeding up." Arnum added that the local area network and fibre-optic markets will grow in sales as a direct result of the low cost and small size of the communications chips now being designed for these systems.

The IRD report, Telecommunications Integrated Circuits, emphasises the increasing importance of gallium arsenide, silicon compilation and integrated services digital networks.

Arnum said: "If the proponents of silicon compiler technology are correct, the semi-conductor designers of the future may be the board manufacturers of today." He believed the new technology would open up the design field to the point where less training is necessary before someone can build chips. (Computing The Newspaper 19 September 1985)

The World Telecommunications Market

The value of the world telecommunications market is estimated at US$150,000 million (musd) according to a study conducted by the statistical unit of the British weekly, Financial Times. Without counting share parts and accessories and only considering the different equipment items for switching, transmission, telephones, terminals etc., the total amounts to 40,000 musd. The USA consume 38 per cent of this market, Europe 35 per cent, Japan 13 per cent and other countries 14 per cent. As far as production is concerned, the USA contribute 32 per cent, Europe 38 per cent, Japan 16 per cent an Asian group consisting of Korea, Hong Kong and Taiwan 5 per cent and other countries 9 per cent. A general characteristic of this market is its rapid growth, in which also the changeover from analog to digital equipment plays a role. (Bulletin IBI Press, 17 November 1985)

COMPANY NEWS

Toshiba steps up 1 Mbit chip output

Toshiba is to go ahead with the mass production of its 1 megabit dynamic random access memory (dram) chip. The company is aiming for 1 million pieces a year by April 1986. Toshiba was the first to start sample shipments of the new generation chip in June this year and mass production will start in November. ... At least five other Japanese chip manufacturers have plans to start mass production of a 1 megabit dram chip. The earliest contender is probably Fujitsu which started showing commercial samples this summer. ... (Computing the Newspaper, 31 October 1985)

NEC mass producing GaAs single crystals

NEC Corp. has come a step closer to realization of a high speed GaAs LSI circuit with the successful production of an experimental chip possessing 3,000 gates and having a propagation time of 30 ps per gate. A critical step in the realization of the GaAs LSI circuit is NEC's recent development of a method to produce high quality GaAs single crystals. The company says that improvement of the ingot shape and cooling methods have been an important factor in the creation of dislocation-free crystal GaAs.

The company recently succeeded in test producing a GaAs wafer 2 in. in diameter, having an average 15 to 20 crystal defects/cm^2. Conventional GaAs crystals have 200 to 1,000 defects/cm^2. The quality is good enough to build a VLSI circuit on it, a NEC spokesman said.

Previously, indium had been doped into GaAs crystals to prevent dislocations, but indium itself sometimes causes defects. NEC has succeeded in growing dislocation-free and low-striation GaAs single crystals by indium doping at a level about one-tenth that of conventional methods. ... (Reprinted with permission from Semiconductor International Magazine, November 1985. Copyright 1985 by Cahners Publishing Co., Des Plaines, Il. USA)

Motorola, Intel plan MAP chip

Both Motorola and Intel are planning to market chips that implement some of the manufacturing automation protocol (MAP). This is a necessary step on the way to providing low-cost equipment that can be hooked-up to a MAP network. The Motorola chip will sit on one of two boards that will both be needed to implement the full protocol. The Intel chip will sit on a single board which will also implement the full protocol. Motorola intends to ship samples of its chip to third parties by the end of the year and market its board next year, according to Jim Weeldreyer who is head of Motorola's Data Communications Product Group. He also said that the company intends to reduce its two boards to one board, probably by 1987. At the moment, the physical connection to the network (a modem) is mounted on a second board.

Such boards will allow robots and computers to talk to each other over local area networks and so make completely automated factories possible. The boards act as translating devices and sit between the machine and the network. MAP defines everything that an engineer has to know so that factory equipment, machine tools and computers can communicate over local area networks. They talk to each other using a token bus system so these boards are known as token bus controllers. An electrical signal, known as a token, is circulated around the network. When a device wants to talk to another device, it tells its token bus control board to grab the token as it goes past and squirt a message into the network in its place. The message carries an electronic label which identifies the device that it is addressed to. The message passes from machine to machine around the network until it gets to the right one. The token bus control board of this machine recognises its own address and grabs the message out of the network. The board then translates the message into instructions and information that its machine can understand. (Electronics Weekly, 6 November 1985)

Intel's 32-bit chip

The race for the ultimate personal computer - a machine that can put the power of a mainframe on each user's desk - began in earnest on 16 October. That is when Intel Corp. finally got around to introducing its next-generation, 32-bit microprocessor, or computer-on-a-chip. While Intel trails several other semiconductor makers in unveiling a 32-bit entry, the Santa Clara (Calif.) company is clearly the one to beat. Today, Intel reigns as the undisputed king of microprocessors. Its chip designs, which are also produced under license by a handful of other chipmakers, command an awesome 85 per cent of the current $289 million market for 16-bit processors.

At stake is a core business that will approach $200 million by 1990. Sales of auxiliary chips needed to build the equipment around the new processors could push the total market for 32-bit semiconductors to $1.billion in 1990, or nearly 5 million units, according to Dataquest Inc., a San Jose (Calif.) market researcher (figure 2 see page 47). The computer industry is looking to these new chips to restore some shine to the lackluster market for office automation equipment. By handling a chunk of data in 32-bit-long strings, or bytes, as fast as or faster than today's systems process a 16-bit byte, the new computers will set standards for ease of use.

Intel's dominance results largely from one fact: International Business Machines Corp., which has built up a 20 per cent stake in Intel since 1983, picked Intel's 16-bit chip as the brains of the enormously successful IBM Personal Computer. The PC's popularity triggered an avalanche of software that offers performance beyond the capabilities of earlier 8-bit systems. The PC also set off a rush by rival computer companies to build work-alike machines, or clones, that can run the same programs. One reason Intel took so long to unveil its 32-bit microprocessor - dubbed the 80386 - was to make sure that the chip, initially priced at $300, is totally compatible with this huge base of existing software.

Thanks to the momentum provided by the software flood, Intel predicts that its chips will corral an even bigger share of tomorrow's microprocessor markets. It expects to notch 88 per cent of all 16- and 32-bit sales by 1990 - despite more competition than ever, including some Japanese designs, and despite having given its key rivals a big lead.

National Semiconductor Corp., for example, wheeled out its 32-bit entry two years ago, quickly enlisted Texas Instruments Inc. as a second-source partner, and now says its design has been picked as the heart of more than 1,500 products. The 32-bit chip from archrival Motorola Inc. made its debut a year ago, and the company says it is used in some 500 products.

Other companies are still rushing to pay the astronomical price of admission - hundreds of millions of dollars to develop a full family of chips - and jump into the action. Earlier in October, Fairchild Camera & Instrument Corp. and Inmos International PLC trotted out extraordinarily powerful 32-bit entries.

For Intel, one wild card in the deck is a 32-bit chip under development at IBM. There have been persistent rumors that Big Blue would shift to its own chip to make it harder for other computer companies to turn out clones. But IBM insists that it will stick with Intel. In an unusual statement apparently aimed at putting such rumours to rest, the company said that future PC products would be compatible with the current models.

Intel admits it worries prudently about Japanese competition. Both Hitachi Ltd. and NEC Corp. are expected to make a move in 32-bit microprocessors next year. In addition, Fujitsu, Matsushita, and Toshiba are working on 32-bit designs - and Japan's chipmakers have amply demonstrated in the memory-chip game that they are investing for the long pull. (Reprinted from the 28 October 1985 issue of Business Week. Copyright 1985 by McGraw-Hill, Inc.)

Intel holds back bubble memories

Intel, the US semiconductor manufacturer, will not be producing 16-megabit (millions of bits) bubble memories in 1986, as it had predicted in 1982 when it introduced the 4-megabit version. The reason for the holdback lies in the lack of Intel's interest in view of the poorly defined nature of the market for this type of magnetic support. Despite its security and sturdiness and the fact that it retains data when electric power is disconnected, its applications seem to be limited to highly specific uses. The initial illusions that these memories would be able to replace disks have made way for the idea that their utility remains restricted to efforts to improve industrial control systems. ... (Bulletin IBI Press, No. 57, 17 November 1985)

Fujitsu planning new computer for 1987 shipment

Fujitsu Ltd. will begin shipments in 1987 of a new series of powerful, large-scale, general-purpose computers, including a model the company called faster than others of its type. The new Facom M-780 series is to include six models with one to four central-processing units. The series' top model Facom M-780/40 will be able to process information twice as fast as International Business Machines Corp.'s mainframe model, Sierra 400, a Fujitsu spokesman said. IBM introduced the Sierra series in February 1985, and NEC Corp. and Hitachi Ltd. already have announced models that they say have faster operating speeds, computer industry analysts noted.

Fujitsu said it will begin marketing the series between March and September 1987 at monthly rental prices from 44 million yen ($215,000) to 181 million yen, depending on the model. (International Herald Tribune)

AT & T to customize

The entry of the divested, deregulated AT & T into the merchant semiconductor industry has kept everyone guessing. The telecommunications giant first moved into commodity memory chips, selling 256K dynamic random access memory chips (DRAM's) and sending out samples of the upcoming DRAM generation, the megabit (1024K) chip. However, Donald Liedberg, AT & T Technology Systems Group national sales manager, told Electronics that the company plans to hold such chips to a 5 per cent to 30 per cent of its semiconductor business. He said, "Our strategy has been to lead the process development with memory and use the process developed there for other products". That is, like many other chipmakers, AT & T plans to use high-volume, low-profit chips to refine its wafer fabrication skills and increase yield (the percentage of goods chips on each wafer).

To apply that production technology to more profitable components, AT & T has opened design centers in Silicon Valley and Munich, Federal Republic of Germany. At these and future centers, AT & T will help its customers design standard-cell chips for specific applications. Then the company will fabricate the devices at one of four existing wafer fab plants or the old Synertek factory in Santa Cruz, near Silicon Valley, that AT & T recently acquired. (Global Electronics, November 1985)

AT & T to manufacture ICs in Far East

AT & T (US) has announced a $70 million investment over the next five years to set up semiconductor production at two locations in the Far East. In a deal concluded mid-year, AT & T acquired two semiconductor assembly plants from American Company Honeywell Synertek. The plants are in Singapore and Bangkok, Thailand.

The Singapore plant will produce customized ICs for specialized applications and surface mounted semiconductors. Production is scheduled to begin in the second half of the year. According to AT & T vice president, Harry Van Wickle, an IC design center will be set up within the next year to develop new processing and packaging techniques for ICs in conjunction with AT & T's Bell Laboratories. About 95 per cent of the ICs are expected to be used in AT & T's own telecommunications equipment after being shipped back to the US fully assembled and tested.

According to a spokesman for Singapore's Economic Development Board (EDB), AT & T is considering setting up a wafer fabrication plant in Singapore as part of its long term aims for the Far East. In Thailand, AT & T is reportedly beginning production of semiconductors at the former Honeywell Synertek plant in Pathum Thani, 35 miles north of Bangkok. (Reprinted with permission from Semiconductor International Magazine, November 1985. Copyright 1986 by Cahners Publishing Co., Des Plaines, Il. USA)

Inmos launches new chip and holds its breath

The future of Inmos's long-awaited Transputer processor chip, launched recently now hangs on what its customers make of it. Inmos's plant in Wales can produce Transputers at the rate of a million a month, but so far it has made just a few thousand versions for customers. Orders will not increase greatly until products incorporating the Transputer are on the market. The chip processes data in chunks 32 bits long as opposed to the conventional 8 or 16 bits. Unlike other 32-bit processor chips, Transputers are designed to be wired together in arrays in which each Transputer performs a different aspect of one overall task. This is known as parallel processing. Each Transputer has four high-speed communications links which can attach it to other Transputers or to an associated memory. The chip has two thousand words of memory on board to store messages and data coming from other chips, as well as specialised processors to cope with these communications. Normally these jobs are done by separate chips communicating with each other over a bundle of wires called a bus.

Inmos hopes that companies planning to build parallel processors for analysing signals from military sensors, driving high-resolution screen displays, building complex models or understanding human speech will find the Transputer more convenient than groups of chips.

So far, some 20 organisations and companies have expressed an interest in Transputers. Next month, a small company called Meiko, which is based next to Inmos's plant in Bristol, plans to introduce a parallel computer, known as the Computing Surface. This machine will be the most powerful computer ever built in Europe operating at between 1,000 and 1,500 million instructions per second (MIPS). A Cray XMP, the most powerful supercomputer built in the US, is rated at 3,000 MIPS, but the Computing Surface will cost $250,000, without software, compared with $10 million for a fully operational Cray XMP. The Royal Signals and Radar Establishment, which plans to use the Computing Surface for processing radar signals, is among Meiko's first customers.

Meiko was set up by six of Inmos's former employees, who worked on the Transputer. The company has already produced a computer, operating at 500 MIPs, for Inmos to demonstrate the Transputer's abilities. Inside the Computing Surface, a mesh of interconnected Transputers has been bent round and joined at the edges and the ends to form a doughnut shape. This arrangement enables all the Transputers to communicate with their neighbours.

The Home Office is also interested in Inmos's device. Its Scientific Research and Development Branch is working on a computer incorporating transputers for matching digitally encoded fingerprints. The Home Office's present computer is so slow that it can take 10 days to wade through its database of 350,000 sets of prints and find out whether a set matches with any of them. The Home Office hopes that the Transputer system will significantly reduce that search time. Individual police stations should carry out their own searches rather than submit prints to a central computer. (This first appeared in New Scientist, London, 10 October 1985, the weekly review of science and technology)

APPLICATIONS

Welding: the push for automation

In keeping step with industry's drive for increased productivity, the welding sector has begun the shift toward more automation. But it has been a two-steps-forward, one-step-back process. The use of stick electrodes, for example, has been decreasing, yet still represents about 50 percent of the consumable market in the U.S.

"One reason for the slow move to semi-automatic systems has been the high efficiency of iron powdered and low hydrogen electrodes," explains W.I. Miskoe, vice president of international sales at Lincoln Electric (Cleveland, Ohio, USA). "In our plant, it's only been in the last several years that we have been able to utilize semi-automatic processes to significantly decrease our welding manufacturing costs."

Robotic welding systems, having made considerable gains in automobile assembly lines, are now in wide use in other manufacturing areas as well. Other developments include synergic pulse gas metal arc welding units for improved deposition rates and speeds for MIG welding, autogenous laser units for welding thin gauge material without filler metal at high speeds, plasma arc welding and cutting units for improved handling of ferrous and nonferrous metals, and vision systems for robotic welders, to name a few. (Excerpted from Industrial World, September 1985)

The computer helps the crane operator

The computer is to help the crane operator do a surer job. This by enabling him to control the tricky business of loading and unloading containers electronically. But it is nevertheless the economic aspects that motivate backing up the crane operator by means of a computerised control system. A large container vessel costs 30,000-40,000 US Dollars a day when kept in port. Every time there is loading or unloading to be done, around 1,500 containers have to be lifted and shifted. This is a time-consuming job. When loading a vessel, each container has to be fitted precisely into a container cell, and the cells are both on the vessel's deck or down in the holds.

For efficient loading/unloading many ships of today have their own cranes, equipped with swivelling turntables located between the lines and the cargo load. The turning device makes it possible to turn the load in relation to the ship. But once the load is in motion, it starts to swing to and fro, and the crane operator has his work cut out to manoeuvre the load, counteract the swings and get the container into the right position.

The computerised control system enables the crane operator to 'feel' direct contact with the load and guide it accurately and quickly into place. There is a computer in his cab connected to two actuators in the swivelling turntable. The computer reads and controls the turntable, directing the cargo to the desired position. The crane operator can thus devote his energies to the crane hauling, i.e. shifting the loads between ship and quay. (New Swedish Technology, Vol.4, 1985/No.2)

New CAD/CAM system for garment industry

Datamönster AB are introducing a new CAD/CAM system for the garment industry, together with a new laser cutting machine of their own design.

Datamönster's idea is to create flexible and profitable CAD/CAM solutions for small and medium-sized firms by using the latest computer technology. The Datamönster system constitutes a tool covering virtually all functions in the garment industry, from first sketch to cut-out garment. A sampling: digitizer input, CAD, pattern production, cut-order planning, costing and driving package for cutting machine/plotter.

The system is modular, which means that each user can freely compose a system tailored exactly to his or her needs, while retaining the option of future expansion where necessary. (New Swedish Technology, Vol.4, 1985/No.2)

Dutch firm develops advertisers' CAD kit

A Dutch graphic design company has developed what it claims is the first computer aided design (cad) system specifically geared for the advertising industry. The Aesthedes system developed by Claessens Product Consultants, has already been used to design logos and packaging for such famous names as Heineken, Heinz and Philips. The system which will cost between £85,000 and £88,000 will be available in the UK from October onwards. To date, Claessens have sold about 25 systems worldwide in Holland, Switzerland, Germany and the US.

Francis Michael Claessens, co-owner of the company, said: 'The slice of the cad market directed at graphics is very tiny. None of the big cad companies would find the development of such a system profitable so we decided we would produce the system ourselves.' Because the system will be used by artists without technological backgrounds it has been built for use without an alpha-numeric keyboard. Using a mouse artists can draw whatever shape they wish. The system can handle 16 million different colours in 64 levels. (Computing, the Newspaper, 12 September 1985)

Calculations advance aerodynamics

Scientist in the United States and France (Brosl Hasslacher of the Los Alamos National Laboratory in New Mexico, who created the computer model in collaboration with Uriel Frisch of the Observatoire de Nice in France) have developed a computerized method to predict the flow of air and fluids that may improve the aerodynamics of cars and airplanes, track weather systems more reliably and expedite development of space weapons. The new method of predicting flow dynamics, still in the early testing stage, could allow relatively unsophisticated computers to make calculations that can now be done only by new-generation supercomputers over days or weeks.

The determination of flow and turbulence is vital to calculate the movement of objects through fluids, such as bullets, rockets, autos and airplanes. It is also important in determining the movement of fluids themselves such as air movement in weather patterns, chemicals being mixed or streams of particles striking the atmosphere in particle-beam weapons. Calculations of these flows are necessary, for example, to develop wings with more efficient lift, or make weather predictions that come closer to reality. Air flowing over a wing includes a thin layer of air, like a coating on top of the wing, that is stable and moves slowly while the air inches above it passes by at hundreds of miles an hour. This layer, with its lower pressure, is what gives the wing its lift.

When the plane's speed slows, this layer of air can become turbulent and break away from the wing. This occurs just as the wing loses its lift, and the plane stalls. Designers watch for the turbulence in the boundary layer to alert them at what speed the wing will stall.

The fundamental idea behind calculation of flow and turbulence is that, in theory, each atom's motion could be tracked as a separate unit to make a detailed picture of flowing material and all its eddies, curves and swirls.

The Hasslacher-Frisch model essentially involves a computerized calculation of the movement of extremely small patches of air or fluid. The movement of each of these millions of tiny units is then combined to give a minutely accurate picture of flow.

Specialists in the field say the work of Mr. Hasslacher and Mr. Frisch is stunning and drastic. Early tests have been successful, but researchers say it may be some time before tests are complete and a determination is made whether it has a wide practical use. But early results suggest that the model can calculate flow 1,000 to one million times faster than previous methods, say researchers familiar with the work, making it at least theoretically possible to push forward the field of flow calculations in one sudden jump. Among other things, it could make wind tunnels obsolete in some design work. The current methods of doing these calculations are based on equations more than a century old. These equations take thousands of lines of computer instructions; the new method has only 100 lines. (Interest, Herald Tribune, 20 November 1985)

The fish story retold by computer

Pity the poor fishes. It's tough enough to survive with hordes of avid fishermen stalking them with sonar and other high-tech gear. Now a West Lafayette (Ind.) company has added a computerized fishing pole to the sportsman's arsenal. The Fish Master, being dangled for $70 by Outdoor Electronics Ltd., tells its user when a fish is hooked, how long it took to reel it in, how hard a struggle the fish put up, and how much the catch weighs.

The battery-powered device combines a microprocessor with sensors and digital readout displays and clamps on a rod's handle. Outdoor Electronics general partner Charles Sherwood predicts that as the gadget catches on, fish yarns will come to include talk of fight time, rod deflection, and other esoterica supplied by the Fish Master. But gone, alas, would be the time-honored tradition of stretching the facts. (Business Week, 14 October 1985)

Electronic hearing for the totally deaf

Researchers of the House Ear Institute in Los Angeles have developed a new generation of electronic hearing aids to allow the totally deaf to hear, inasmuch as its function is to fill the gap produced when the cells of the cochlea (spiral of the inner ear) are destroyed for some reason and do not become regenerated, thereby creating a discontinuity in the hearing process. This new technique, called cochlea implant, overcomes the traditional hearing aid effect which functions as an amplifier and is useful only for people who perceive sounds at too low a volume.

The electronic ear consists of a magnetic coil which is placed during a surgical operation under the skin behind the ear, and of two electrodes, one of which is implanted in the cochlea and the other into the temporal muscle or into the mastoid to act as a ground. The system is completed by means of a second exterior magnetic coil, a microprocessor the size of a packet of cigarettes which is carried in a pocket and a microphone placed in the ear.

The microphone picks up the sounds which, converted into electrical impulses, arrive at the microprocessor where they are processed and transmitted to the auditory nerve by way of the magnetic coils and of the electrode placed in the cochlea, in this way carrying out all the hearing functions of the inner ear. The auditory nerve will cause the impulses to arrive at the brain centre which will recognize them as sounds.

After undergoing the implant of an electronic ear, the individual must go through a period of training and rehabilitation, inasmuch as the sounds and voices are perceived at first as though they were transmitted by a badly tuned radio, not readily identifiable. After a period of adaptation, the majority of the 300 people who have undergone the implant operation in the USA have begun to distinguish men's from women's voices, to hear the telephone ring and the ringing tone. (Bulletin IBI Press, 10 November 1985)

Talking road maps

A new system called car information and navigation (Carin), which will facilitate motoring also in localities with which the driver is unfamiliar, has recently been presented to the international press. With the aid of a compact computer disk and an electronic compass, it will be possible immediately to visualize the shortest route to reach a given destination on the car's display screen.

The computer, having a capacity of 5 gigabits, is able to store data concerning the map of an entire country and the detailed map of a city, even if of considerable size. The driver will enter the data concerning the coordinates of the points of departure and arrival on a keyboard. After a few seconds the detailed indications regarding the best route to follow will appear on the screen. Shown as well and indicated by a luminous cursor, will be every movement the motorist will be making with his car. A synthetic voice, moreover, will follow the driver during his trip reminding him in time of every detail, such as road and direction to take or when to change lanes.

The system will also be able to pick up information sent via satellite, not only on the road and traffic situations but also on the weather. This will be a valid aid to the driver inasmuch as it will enable him, in some cases, to make alternative choices to reach the desired destination. The product will in all probability be sold beginning in 1987, because a number of details still have to be ironed out. Also the cost must change before the unit is marketed. It is too high at present. Philips intends, with Carin, to beat its German and Japanese competitors who are developing similar systems.

It also seems that numerous car manufacturers are showing an interest in Carin and have already made contact with the Dutch firm to establish agreements for the application of the system to the cars they produce. (Bulletin IBI Press, No.58, 25 November 1985)

Telematics at the service of health

The Italian health system will shortly be able to reap the benefits of new services made available by telematics. The nationwide telephone company (SIP) has announced the upcoming development of a system which will make teleconsultation possible for citizens. The latter, that is, will be able to make contact with medical centres, hospitals and laboratories without having to leave their homes.

The analysis centres, in view of their direct connection to hospitals or to consulting-rooms, will be able to send directly to the latter the results of the various analyses requested as well as, thanks to special equipment, the x-ray and echographic images. Also monitoring of at-risk pregnancies will be effected without subjecting the patient to dangerous trips away from home.

Also the computerized axial tomographic (CAT images will be sent to the consulting centres over the slow video whereas the cardiotelephone will make it possible to send signals from the cardiobip, an instrument that serves to record the arrhythmias of heart patients over the telephone.

The technological innovation process is to involve the pharmacies as well. They will be able to establish a dense information network among the various components of the pharmaceutical service in much shorter times than at present. They will, moreover, assist the public structures in the search for and acquisition of data on the consumption of pharmaceuticals. Communication between the pharmacist, on the one hand, and the health centres on the other, will make service to those being assisted much more agile and complete. It will be possible, for example, to obtain all the scientific information on the pharmacy itself on incompatibilities and on the correct way medicines are to be taken. (Bulletin IBI Press, No. 57, 17 November 1985)

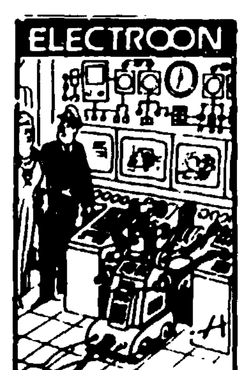
ROBOTICS

Robot sales to hit $350 million by 1990

Demand for industrial robots in Western Europe will increase by an average of 12 per cent annually through the decade, according to a research study by Frost & Sullivan (New York, NY, USA). Sales will reach $250 million in 1986 and $350 million by 1990. Demand will expand fastest in the United Kingdom and Italy. Among the applications, assembly and arc welding robots will multiply the most. Falling costs have combined with growing applications experience to explain the spread of robots from the small core of companies which pioneered their commercial applications, says the study. Besides vision and other sensory capabilities, more technically improved robots will feature new arm configurations, new electric drives using rare earth motors, higher power controllers, and more sophisticated programming. (Industrial World, October 1985)

Robots in plastics industry

Robots will be installed on 30 per cent or 10,530 units of injection molding machines by 1989, vs 2,500-3,000 robots in place in 1985 and 600-800 units in 1982. Processors in automotive, electronics, housewares and medical related industries are the main users of robots currently, due to the push to improve part quality through stabilized cycles. More processing accuracy and less material waste are other benefits influencing robot sales in injection molding and several other new plastics processing sectors. Selective Compliance Assembly Robot Arm (SCARA) robots, originally developed in Japan, are fully programmable, low-cost, high-speed cylindrical-coordinate robots with +/-0.002-0.008" repeatability. The incorporation of servo motor drives on 1 or all axes of motion in up-and-out parts-removable robots offers flexibility of programmable position control, but it is expensive. Machine vision is useful in process inspection, using cameras and closed-circuit TVs to monitor secondary operations, like decorating or welding; parts sensing, using crude vision systems like photoelectric eyes to verify parts removal; and inspection of finished parts. (Plastics Technology, September 1985)



"Now you see why you can't sit at the Captain's table, madam — this is the Captain."

(Electronics Weekly, 17 July 1985)

Robotics programs

The rapid succession of strategic programs for informatics and other advanced technologies, such as the Japanese Fifth Generation, the USA's SDI, Europe's Esprit, Race and Eureka, have overshadowed the development of other earlier, insufficiently publicized robotics projects.

Thus, the US Department of Defense has been deploying ICAM (integrated computer-aided manufacturing) between 1977 and 1985 by investing 250 million dollars in 65 contracts for 50 companies with the aim of improving the productivity of military suppliers, especially those in aerospace. ICAM has generated the Techmod (technical modernization) cooperation programs beteen the USAF and its contractors, such as project 1105 on the conceptualization of detailed design and engineering for CIM (computer integrated manufacturing). ICAM is a program whose levels have been arranged into a hierarchy (factory, centre, cell, machine) which has developed MCL (manufacture control language for the robots used by McDonnell-Douglas), and large plastic incremental deformation (simulator of the metal-molding process of the USAF materials laboratory and a manufacturing process management system developed by Worthrop and GE). Also other agencies of the US government have generated lesser robotics and flexible fabrication programs (National Bureau of Standards, National Science Foundation, NASA, etc.).

MITI (Japan's Ministry of International Trade and Industry) is supporting robotics with a technical development program on the one hand and with the stimulation of demand on the other. Technically the three research lines coordinated among public companies and laboratories are developing components (for actuation, manipulation, movement, interrelation with surroundings, control systems, programming languages), are integrating them into common projects (e.g. robots for hostile environments) and are preparing fields of application and robotics markets (submarine, nuclear, space). In order to stimulate demand, MITI is promoting a leasing company, is financing preferably small companies which use robots to improve job safety, and allows them to amortize high-range robots on favourable terms.

The main European countries also have their own programs before developing the CIM aspects of Esprit and of Eureka in common. The French research program ARA (automation and advanced robotics) began in 1980 to develop remote operation, light-robot mechanics and technology, robot software and flexible manufacturing systems.

The British Department of Industry, for its part, has been spending some 30 million dollars since 1982 in promoting the spread and application in industry of both robots and flexible manufacturing systems through the Flexible Manufacturing Systems Scheme by, on the one hand, subsidizing half the joint project with one-third of the investments and the development costs of new models (of which, for example, the American Unimation took advantage to install a robot factory on British soil) and, on the other, by creating an advisory, demonstration and training centre for companies, run by the Production Engineering Research Association (PERA).

Lastly, the German Ministry of Science and Technology began in 1984 to finance, over a 4-year period by means of 210 million dollars, the use of CAD/CAM (120 million dollars), Flexible-Manufacture Research (60 million), Robot and Peripherals Design (20 million) and various studies on the impact of the introduction and distribution forms of these technologies. The ministry has previously financed research projects (15 million dollars annually), coordinating its attentions over five large special areas (CAD, flexible manufacture, process control, machine dynamics, surface technology) concentrated geographically in Berlin, Darmstadt, Hanover and Stuttgart. (Bulletin IBI Press, No. 64)

The Japanese robotics advantage is growing

Robot production in Japan will be maintaining its present spectacular growth until 1990, according to strategy reports periodically published by JIRA (Japanese Industrial Robotics Association) which groups the 75 major manufacturers. Japanese robotics, a business begun in 1968, had produced robots for a total of 100m dollars (million US dollars) for the domestic market up to 1980. The robotics industry's production has continued, attaining a value of 500m dollars in 1981, 750m dollars in 1982, 910m dollars in 1983, 1,200m dollars in 1984 and 1,500m dollars in 1985, with its sights set on 3,000m dollars before 1990.

This explosive expansion of the robotics business has been accompanied by a strong increase in the number of robotics firms and workers. The ten companies of 1968 had already become 50 by 1970, 116 by 1976 (with 1,500 workers) and 204 in 1983 (with over 8,500 workers). But the sector's entrepreneurial structure has not only grown, it has also changed profoundly. Only 20 of the 116 firms in 1976 (17) could be considered large (with a paid-up capital of over 15m dollars), whereas in 1983 the 60 large firms (30 of 204) reflected the entry of large Japanese industrial groups into the sector. Paradoxically, the 40 firms in 1976 (30) classifiable as small (capital less than 0.5m dollars) also grew to 93 (43) in 1983, thereby demonstrating the growth in demand for the conventional robots these small firms manufacture on a wide scale.

The change in robot use in these few years is also significant: from the almost 120,000 robots installed between 1978 and 1983, 36,000 went to the synthetic products, 25,000 to the electrical products and 21,000 to the automobile industries. But, whereas the value of installed robots in the latter fell from 38 of the total in 1979 to 20 in 1983, those installed in the electrical industry have held steady at around 33 of the total values of those years, and the robots installed in the plastic-molding industry alone underwent a slight proportional decline in value (from 11 to 8) due to the decrease in installation price for a growing number of small- and medium-sized robotized industries (74 of this sector).

Exports of Japanese robots have gone from 2 per cent of production in 1979 to 18 per cent in 1983. More and more Japanese firms are looking for ties with other manufacturers in the USA and Europe in order to export and, above all, to provide adequate after-sales service in these foreign markets. Such ties are primarily commercial and technical, arriving in only a few cases as far as the establishment of joint ventures such as that of Fanuc with General Motors or Yaskawa with Machine Intelligence (USA). (Bulletin IBI Press, No. 64, 19 January 1986)

ASEA opens western world's largest robot production facility

What is claimed to be the largest robot production facility in the western world - a 300-metre-long factory with a floor area of 13,000m^2 - has been opened by the Swedish-based ASEA electrical engineering and electronics group at Västeras. Called the ASEA Robotics European

Manufacturing Centre, it will handle ASEA Robotics' entire Swedish production of industrial robots. The new plant will be used for the assembly of ASEA's complete range of all-electric, microcomputer-based robots, including the control cabinets. Initially, the factory will have an annual production capacity of 1,100-1,200 units. In the long term, however, it is anticipated that production capacity can be more than doubled.

ASEA, which is the largest European robot manufacturer and a world leader in the field, has in recent years increased robot sales by 50 per cent annually in a world market which is expanding at the rate of about 25 per cent a year. Besides complete robot systems, the new factory will supply a large volume of semimanufactured components to the worldwide production plants of ASEA Robotics, which include factories in the United States, Japan, France, Spain and Norway. ASEA Robotics has some 1,500 employees worldwide and 1985 sales are expected to total Kr.1 billion ($125,000,000).

Among new products in ASEA's spot welding programme is the IRB 9000S, a gantry robot of pendulum type, which is primarily intended for the automotive industry. It allows customers to use several robots at each work station and to weld spots inaccessible to floor-mounted robots. Developed from the company's IRB 90S - more than 500 of which are now in operation around the world - the new robot is capable of handling loads of up to 90 kg with an accuracy of ± 1 mm over an unusually large working range. The gantry concept allows the robot to perform a larger number of spot welds per station and provides great flexibility in the designing of work stations, ASEA says. Since it operates like a pendulum, the new robot can also work at high speed and be mounted in different positions. (Science and Technology [Sweden], November 1985)

Computers tell robots what tests to do

Laboratory robots no longer need execute routines blindly. Chemists can program computers to tell robots what experiments to do next, based on previous results. This is the message chemistry professor Charles H. Lochmüller of Duke University delivered to the Eastern Analytical Symposium in New York City. Working with postdoctoral student Kaki R. Lung, Lochmüller showed how a Zymark robot can be guided by an Ap IIc microcomputer to find the global maximum of spectrometric absorbance on a graphical surface for reaction of calcium ions with a magnesium ethylenediaminetetraacetate complex. He also demonstrated a factorial experiment on interference of zinc with the determination of ascorbic acid. Individual effects of zinc, acid, and heating were included, together with terms calculated from interactions of those effects with one another. Lochmüller predicts that clinical chemists someday will be able to use such a system to run a profile of tests. ... (Chemical and Engineering News, 25 November 1985)

Smart welder has a bright future

Meta Torch, a selfguiding arc welder, is the first product from a company called Meta Machines. Peter Davey, formerly the coordinator of the Science and Engineering Research Council's Industrial Robot Initiative, founded the company early last year.

The Meta Torch is an integrated welding torch and vision guidance system that fits to the end of a robot's arm. It enables a robot to track a seam during welding, without needing to pass over the joint first. Because the torch responds immediately, it can cope with changes such as thermal distortion in the joint.

The seam sensor consists of two lasers and a heavily filtered charge-coupled device. The lasers project strips of light onto the seam ahead of the arc. By focussing on these strips on the workpiece, the charge-coupled device can detect the discontinuity that the joint creates. A computer processes this information, and instructs the robot arm accordingly. Shipments of Meta Torches began in December 1984. One company that has adopted the system is GMF, the joint venture between General Motors of the US and the Japanese robot company Fanuc. Meta Machines has begun a programme to develop products with GMF, and is discussing the possibility of Fanuc distributing the system in Japan. (This first appeared in New Scientist, London, 10 October 1985, the weekly review of science and technology)

Robot incompatibility on the shop floor

The use of robots in manufacturing industries is still in its infancy, but as it grows and becomes more sophisticated, so will the problem of incompatibility between robots from different suppliers. There are two levels of incompatibility between robots, one in the languages that are used to program them, and the other in the way they interface with their controllers and with each other on the shop floor. To the user the second of these presents the most problems.

Because each manufacturer's robots have a different interface to the controller which guides their movements, users wanting to use more than one kind of robot linked to the same controller for a particular operation have to do their own engineering to make it possible.

Peter Scott, chairman of the British Computer Society's robotics group, described the problem: "Although there are maintenance advantages in having all your robots from a single supplier, there are other disadvantages. The problem for users is wheth r you buy machines which have the right technical specifications for a particular job, regardless of the supplier, or whether you go for second best in order to avoid the integration problems."

Until now, the predominant feeling among robot suppliers has been a desire to lock customers into keeping to one supplier by using proprietary languages and interfaces. But robotics specialists believe that the initiative which has come from the user side of the industry rather than the supplier side, General Motors' Manufacturing Automation Protocol (MAP) is the most hopeful solution to the problem to emerge so far.

MAP is a network protocol for the whole area of factory automation rather than specifically for robots, but as Scott puts it: "The most important bits of kit which need to talk to each other on the factory floor are the different robots." However, although MAP has won a great deal of support - both in the US, where 50 suppliers have agreed to support it and a 200 member MAP user group has been formed, and in Europe, where a user group is now being set up - it is still in its early days and is too expensive for many users. But there is now a move starting at the end of 1985, to put MAP interfaces into silicon chips, which will bring down the costs of implementing MAP.

Meanwhile, some users have found their own solutions to the immediate problem of linking robots together on the shop floor. One of these is Flymo, the electric lawnmower manufacturer: "We have had one or two applications where lack of compatibility was a potential problem but we have overcome it," said Michael Leet, Flymo's chief engineer. One of these applications is the lawnmower assembly line, where Flymo has eight robots; one from Cincinnati Milacron, two from Unimation, one from Dainichi Sykes and two computer testers. "When we set up the system in 1981, there was no one robot supplier which could offer the best machine for all the jobs, so we picked the right robot for each particular job and ended up with four different suppliers. It is very unlikely even now that any one supplier could provide all the functions we need," said Leet. Flymonow has all eight robots linked to a central controller through a communications bus structure it developed itself using the robots' RS232 ports. The sub-programs for particular tasks are held in the individual robots and are called in from the controller as needed. But the system is limited in that programs cannot be down-loaded from the controller, which means the robots cannot be programmed off-line. According to Leet the engineering task involved was a relatively simple one, but it could be daunting to the mechanical engineers with no data processing experience who are often in charge of robot installations. The present system suits the needs of that particular application but Leet foresees other applications which will require down-loading of programs from the controller to the robot and will therefore require more complex engineering.

One of the largest users of robots in Europe is Ford, which has 1,300 robots installed in its European factories, mostly from five suppliers: Nimak, Kuka, Asea, Cincinnati and Unimation. Until now Ford has largely overcome the problem of incompatibility by going to one supplier for each separate manufacturing operation. The chosen supplier designs and instals a complete system as well as supplying the robots. But as Ford's manufacturing automation becomes more integrated there is a need for more communications between the different sets of robots. Dr. Rod Edwards, Ford Europe's manager of engineering and manufacturing systems, explained: "When we buy robot facilities we have to create an interface for each kind of robot to the central computer. It is a problem and it will get more difficult as we integrate our plant systems." Ford Europe is looking to MAP to help overcome this problem and is to try it out early next year.

John Green, one of the two founders of BYG Systems, a company set up to market a computer program developed at Nottingham University known as Grasp (Graphical Robot Applications Simulation Package), believes that the lack of compatibility is holding back the use of robots in industry. "It would be a lot better if there were standards, but robot technology is still only a few years old and the principle of off-line programming is very recent," he said. He believes the move to a standard will not necessarily come from the standards bodies but from certain suppliers leading the market and others copying standards.

The standards problem is one that will grow as robots become more sophisticated and users start to integrate them into complete factory automation systems. Green concluded: "There was a period when robots were being used as dumb creatures, but now there is starting to be a lot more interaction with centralised control systems, and high level control systems for robots will be part of the total factory system." This can only lead to greater pressure from users for suppliers to conform to standards like MAP. (Computing The Magazine, 25 July 1985)

Farm automation

Sometime within the next ten years or so, a Nebraska farmer will switch on his TV and settle back for the evening while his new assistant tends the weeds on the back forty. Chugging down rows of crops, the assistant - a computerized, radar-controlled vehicle fitted with a machine vision system, a pump, and a few gallons of herbicide - stops briefly at a clump of vegetation to analyze its shape and complexity. If the image is substantially different from that of crops stored within the computer's memory, a signal goes out to the pump and a preset burst of liquid is delivered to the doomed plant. The automated weed killer is just one example of the "smart farm machines" that may be working on some American farms by the end of this decade. These systems, together called "prescription farming," aim to boost US agriculture's productivity and to reverse declines in its international competitiveness. Also included are irrigation and fertilization based on networks of computers and sensors. Robotized harvesters, automated animal-control devices, and food handling and processing equipment are nearing trials.

The notion of fully automated farms - in which robotic tractors traverse fields day and night, in good weather and bad, sensing variations in field conditions and automatically correcting for them - is not as fanciful as it sounds. "The technology is here," says Ralph Nave, national program leader for energy and engineering at the US Department of Agriculture's Agricultural Research Service (ARS, Beltsville, Md.). "Being able to accurately locate the tractor or combine in the field is probably five years away." Such devices alone, of course, will not solve most of the basic problems now facing American farmers - persistent crop surpluses, the strong US dollar, and heavy personal debts incurred during the expansionary late 1970s and early 1980s. There is also some question as to how many small and medium-size farms (many of which are already facing bankruptcy and foreclosure) will be able to plug into the new technology. For the survivors of the inevitable shakeout, however, prescription farming may be an important key to improved efficiency and lower costs during the 1990s.

Much of the technology focuses on controlling one of the most important of all farm resources: water. Using new methods of measuring it and turning it on and off only as needed, prescription farming could dramatically reduce water consumption and make every drop count, especially in areas in which water is steadily being diverted to nearby urban populations. And by extending water-sensing techniques to fertilizer control, smart farm machines could protect the drinking water supply by limiting the amount of fertilizers used, thus preventing residues from accumulating in the groundwater. Conventional irrigation-monitoring systems use timers or measures of water flow - indirect indicators of the amount of moisture in the soil. Moisture must then be calculated using estimates of average rates of evaporation and transpiration. Whenever actual rates differ from the average, the wrong amount of water is delivered.

A sensor-based system for monitoring soil moisture has been developed by Richard Miller, a professor of electrical engineering at the University of Central Florida (Orlando) and senior engineer for Agri-Comp (St. Cloud, Fla.). Because the sensors have not yet been patented, he will say only that they are electromagnetic and run on a 9-volt battery charged by a 4 x 7-inch array of solar cells. Miller compares the sensor and its associated electronics, computer, and controls to a home heating system. "You set your thermostat and the system controls the temperature of your house," he says. "Our computer checks the soil moisture through a sensor and controls the irrigation system to keep the soil moisture in a preset range. It has the potential to do the same thing with fertilizer." ...

The control of farm animals is also yielding to automation. One example is the system called NOAH (Natural On-Line Animal Housing), developed by Stephen Herbruck of Poultry Management Systems (Saranac, Mich.). Herbruck tested NOAH on his own egg-laying hens - about a million of them.

NOAH is an outgrowth of an automated egg-counting system Herbruck began six years ago. The counting systems, of which 250 have been sold (for \$30,000-\$70,000), use as many as 1,500 photodetectors to record the passage of eggs on conveyors. Up to 70 variable-speed motors govern the movement of the conveyors, thus controlling the flow of eggs to the processing plant. A large center like Herbruck's can produce some 700,000 eggs daily. Counting that many eggs manually is a full-time job for one or two people.

NOAH extends the system to control all aspects of egg production, including the hen house environemnt - lighting, feeding, water, and ventilation. "We control pretty well everything that needs to be controlled," says Herbruck. "Based on that, we can generate all kinds of reports right down to the cost of production. It's a tool we use to make us better managers."

As many of 2,000 devices can be monitored or controlled, says Herbruck, including water-flow meters, feed-weighing devices, variable-speed ventilating fan motors, and thermostats. Monitoring feed is itself a formidable job. Nutritional levels must be adjusted very carefully to optimize egg production, and the amino acid composition of the feed is changed weekly. "Chicken nutrition is probably more sophisticated than human nutrition," says Herbruck. "Everything is balanced."

In Australia, where wool supplies 13 per cent of export revenue, engineers have developed a sheep-shearing robot called Oracle and tested it in over 500 experiments since 1979. The machine (which is still in the testing stage) is equipped with a map of the sheep's body shape. This serves as a guide once Oracle has been moved into contact with a mechanically restrained animal. The restraining device, itself part of the project, is designed to present sheep to the robot in various positions. A second-generation robot is now under construction, says its designer, research engineer Stewart J. Key of the University of Western Australia (Perth). ... (Excerpted from High Technology, December 1985)

Engineers develop the robot milkmaid

Agricultural engineers have long dreamt of automating the romantic-sounding but highly unpleasant job of milking cows. Now a team of British researchers hopes to turn the dream into reality with a new approach - equipping cows to milk themselves.

Robotics engineers already believe they have the technology to automate the tricky job of fitting a milking machine over a cow's teats. The Federal Republic of Germany's National Agricultural Engineering Centre has even demonstrated an automated milking shed, with each stall equipped with a sophisticated robot arm. The trick is to adapt the technology so that it can cope with the behaviour of cows, and equally importantly, with farmers' budgets.

A team of engineers at the National Institute of Agricultural Engineering near Bedford is now working on a way of pulling all the factors together. According to Dr. John Marchant, of the institute's instrumentation and control division, the project will involve studies of animal behaviour, robotics and economics. Marchant believes that the breakthrough will involve distributing robotic milking machines in small sheds scattered around a farm, rather than in one central building. "There would be a fairly small number of milking units. The hope is that the cows will present themselves at the machine at different times throughout the day. Each machine will have a higher throughput, so it is worth spending more on each individual."

The engineers have already introduced modern electronics into many parts of a cow's life. For example, machines can control feeding, and automatically monitor each cow's weight and milk yield. The key is in making each animal recognisable to a farm's central computer. A device that does this, a transponder which hangs around a cow's neck, is already on the market. The transponder gives out each animal's number in binary code, which the central computer picks up on an induction loop in the milking shed. The system already helps farmers keep records of their cows' feeding habits. In a fully automated system, it would identify each cow as it walked into a milking shed. The computer would know from the cow's records whether it would need milking, and if so, open a milking stall.

Inside the stall, a robot equipped with ultrasonic sensors would fit the milking machine over the cow's udder. It would be helped by data on how the particular cow stands in the stall, and where its udder is likely to be. "The robot would do part of it by dead reckoning, and then be steered by sensors to the final position," Marchant said. The fully automated cow shed is still a long way off. Not the least problem is persuading cows to present themselves on schedule at the milking shed. Research in Holland has shown that cows will do this - but persuading them to turn up one at a time will be difficult, Marchant said.

Milking is only one job in modern agriculture that computer technologies will revolutionise. Engineers at the institute are also studying how electronics can control spraying, crop-processing, and help tractor drivers steer a straight course across their fields. (This first appeared in New Scientist, London, 10 October 1985, the weekly review of science and technology)

FACTORY AUTOMATION

On the way to the factory of the future with CIM

The popular view of the factory of the future is a place where raw materials come in one end, robots process them in the dark, and new products appear at the other end. All well and good, until something goes wrong or specifications change. Obviously, what manufacturing industry needs is a technology that is less rigid than this image of the future and more flexible than industry in the past. One idea that offers both efficiency and adapt-ability is computer-integrated manufacture or CIM.

Computer-integrated manufacture has two particular qualitites. A CIM system supplies all machines and people in a factory with information from a single data base. Data is not regenerated continuously; the plan from a computer-aided design (CAD) terminal, for example, is fed directly to the machines that will process it into a product. But, as well as receiving information from one data base, people and machines bound together by CIM build on the same data base. When an order changes or it spots a failure in quality control, the information is immediately available throughout the factory. The role of people will change markedly with CIM. Most recurring manual and clerical activities will disappear, together with many occasional manual efforts. Staff will develop new multidisciplinary skills. The current separation of functions between designer and production engineer, for example, will blur and in some cases will disappear. Information will have to be managed according to much stricter rules than those by which people communicate. Somehow, machines, software and staff will have to work together to meet their objectives. CIM can provide flexibility in design, a quick response to shifting markets and precise control in engineering manufacture. Engineering still employs more than 10 per cent of the British workforce, and creates 40 per cent of the country's visible exports. It is also an industry facing increasing competition. Britain's imports of manufactured goods are now worth more than its visible exports, for the first time since the Industrial Revolution.

The major area of application of CIM will not be in the manufacture of standard products for mass markets. After all, the cheapest way to make a large number of goods is on an automated and dedicated production line. Manufacturers of products with specifications that change frequently - such as aircraft components or gear boxes for machine tools - will benefit most from the new technology. Rapid changes in specifications are an increasingly common feature of manufacturing industry. The changes are due to the rate at which innovations become obsolete and to customers defining their needs more precisely.

No one has yet achieved full computer-integrated manufacture in a factory The technologies necessary to CIM are not yet sophisticated enough. Management needs new computer systems to plan, schedule and control manufacture from the ordering of raw materials to storing finished products in an automated warehouse before despatch. Programs are too simple to define exactly how manufacture will proceed through design, numerically controlled machines (which carry out different tasks on a workpiece according to the code that they are fed) and quality control. Programs have yet to be written that can organise, and run, a complete factory. Finally, CIM needs to bring order to the mass of information generated and demanded by managers, engineers and machines.

The pessimistic report Integrated Manufacture, published recently by Ingersoll Engineers, found little evidence that the factory of the future, based on CIM, is on the way. Ingersoll, a consultancy from Rugby, said: "One of the greatest opportunities for gaining an international competititve edge lies in integrating the elements of product manufacturing to bring them closer to a continuous automated process." But the advice it had to offer frustrated engineers was: "First simplify, second integrate and then apply CIM technology as appropriate."

Ingersoll's survey, and the report on advanced manufacturing technology that emerged from the National Economic Development Office (NEDO) in June 1985, come, at first glance, to different conclusions. NEDO's report analysed the improvement in the performance of 40 companies after they had introduced some of the elements of CIM. These elements were mainly the so-called flexible manufacturing systems (FMS), groups of machines that can switch rapidly from making one component to forming another, and computer-aided design and manufacture (CADCAM) which concerns the application of computers to a complete manufacturing cycle. The report also looked at technologies such as computer numerical control or the direct control of many machines by a mainframe computer, and programs to schedule or control production. The NEDO built eight models that showed the effect of the phased introduction of elements of CIM. Each model was based on an actual firm, with a turnover of between £3 million and £20 million, making a variety of standard and customized products. The report warned that any shift to CIM should be based on careful preparation and management, but the models suggested that huge benefits were to be gained. In some cases delivery times were cut by 75 per cent and operating profits rose 30 per cent. The report concluded that engineering companies that are involved in making batches of relatively small numbers of products and not yet committed to advanced manufacturing technology, should evaluate without delay the costs and benefits of committing themselves to CIM.

Ingersoll was much gloomier. It said that CIM "exists hardly at all" anywhere in the world and added that few computer systems controlling machinery in factories live up to CIM's requirements of "simplicity and lower product cost". The engineers concluded that CIM has been oversold and that industry would be better off looking for simpler designs for its products and manufacturing processes.

It is not hard to see why the NEDO and Ingersoll Engineers came to different conclusions. The NEDO assumed that some or all technologies for CIM could be introduced in a preferred order. It also assumed that the gradual introduction of, say, inventory control would give advantages over firms stuck with old methods. Ingersoll took an Olympian view. Its report measured present success against the possiblities of complete computer-integrated manufacture. True and effective CIM requires more from technology than is feasible at present. Work is required on basics such as programming, database architectures, computing hardware and computer-controlled machines. At a more complex level, product specification and modeiling are too inexact, process inspection is not well automated, communication standards that allow diverse machines to "talk" are yet to be set, and no one knows how to analyse the mass of data that sensors and diagnostic tools can produce. Even when these difficulties are solved, people will still be a problem. Humans need all kinds of expert systems and computer simulators to help them to absorb and act on data.

No industry is going to introduce CIM as a whole in some "factory of the future", although a start has been made where manager and machine can communicate well. These areas are often referred to as "islands of automation" and "islands of information". Automatic warehousing is one island of automation where software is available to control machines that fetch and carry from storage shelves. An example of an island of information is computerized inventory and purchasing which is in instantaneous contact with electronic production scheduling.

No country has a clear lead in CIM. The technology is like a map of unconnected islands but there a lot of effort is going into joining them all up. The University of Leeds and Loughborough University of Technology are working on CIM for Esprit, the Science and Engineering Research Council and the Department of Trade and Industry. Cranfield Institute of Technology has a reputation for robotics.

Last autumn, the Advanced Manufacturing Technology Centre (AMTeC) was set up by Salford University, the Machine Tool Industry Research Association and UMIST. AMTeC will work closely with industry on research, solving day-to-day problems and training. Large companies, such as Rolls-Royce and British Aerospace, are interested in the mechanical engineering aspects of CIM and they tend to work closely with academia. Computer firms run some of the most advanced production lines for the integrated manufacture of specialized printed circuit boards. In fact, the computer industry runs some of the most automated factories anywhere.

Why should engineering have CIM as an objective? The answer is that industry needs flexibility, speed of response and precision control to be competitive. Very efficient manufacturing systems to mass-produce goods have existed for many years, but they are inflexible: they cannot accommodate major product changes without restarting virtually from scratch. This is particularly critical in markets such as those for word-processors or sound reproduction. After many years of gradual improvement on the basic typewriter or gramophone, the world suddenly wants computers with built-in modems, and compact-disc players instead. Inflexibility in manufacture means that the customer must be offered a choice of variations on what is made rather than what the customer wants. Inflexibility is acceptable, but not satisfactory, providing that competitors suffer in the same way. However, if one firm achieves flexible production on a similar time scale, and at a quality and cost to rival other firms, then Carey Street looms.

Eventually, there will be factories so automated that only the raw material and manufacturing data will change when a product changes. These factories will need flexibility to process orders. They will also need to cope with a substantial degree of uncertainty, right through the manufacturing process, arising from difficulties such as design changes, breakdowns or deficient supplies. Flexibility enables manufacture to carry on at something like its optimum performance throughout these disturbances. In a CIM system, a design change can be automatically fed in and the data sent to all machines and personnel in minutes rather than the days required by manual methods.

Speed of response is a most important factor in the control of manufacture. Normal batch manufacturing is slow to respond to markets, and it is usual for several months to pass between the arrival of an order on the shop floor and the delivery of all finished parts to stores. Delay leads to large amounts of expensive work-in-progress and to the scrapping of large numbers of semi-finished parts if a customer suddenly decides to change a specification. CIM systems can cope with changes to data and requirements because the manufacturing machinery involved is linked directly to the database. Changes in manufacture can begin as soon as the raw material is available.

In practice, there are only partial solutions available to meet the demand for intelligent and adaptive machines. Instruments to measure workpieces as they are processed and to detect wear in tools, for example, are not yet fully developed. Other manufacturing processes are not automated; sometimes this is because they are old, such as forging, and sometimes because they are so new, like laser machining and heat treatment or the fabrication of wound or layered composite materials.

Once a full-range of sensors and machinery is available to CIM, it will need communications standards to operate by. Standards are essential to ensure that data is collected once and then made available instantaneously to whomever or whatever needs it. The database also accept revisions immediately from anywhere in the CIM system.

Over the past five years, computer-aided design and manufactures and computer numerical control have all become commonplace. Sophisticated hardware and software for the factory floor is becoming more available, but it may be 10 years before whole manufacturing processes are run by one computer. By then, expert systems will challenge and maybe replace the ability of people to make many decisions, probably with better results. Possibly, large companies now manufacturing complex products will become as sensitive to subtle shifts in the market as today's small firms that make simple goods. But the future and CIM are not yet here. The islands of automation and information need links, and those links will come. Any engineering company which is not already considering how CIM can form these connections will shortly find itself all at sea without an electronic paddle. (By John Davies, professor of mechanical engineering at the University of Manchester Institute of Science and Technology, and Tim Yates, UMIST's director of communications.) (This first appeared in New Scientist, London, 2 January 1986, the weekly review of science and technology.)

Automated assembly line for electrical controls plant

Allen-Bradley's ojectives for its new plant to produce motor starters were difficult to meet, at best: Production costs had to be lowered while production rates accelerated; lead time to deliver orders had to be cut; and warranty expenses reduced through enhanced product quality. Since the starters came in 124 variations for worldwide sales, requiring constant changes in production processes, higher quality, faster speed and lower costs seemed mutually exclusive goals. The challenge resulted in development of a fully-automated assembly line, in effect, a new factory within an existing factory at the company's Milwaukee (Wisconsin, USA) headquarters. Computer-integrated, the flexible manufacturing system can produce 600 electro-mechanical contractors in two sizes an hour - including lot sizes of one - with consistent quality. It eliminates work-in-progress chores and finished goods inventory.

Allen-Bradley believes the facility is the most advanced in the electrical controls industry, and its control and communications technology can be applied to industries as diverse as automobiles and computers. The basic automation control technology remains the same. Only a few attendants oversee operations in the $15 million factory. The system took two years to design and build. Design of the product was co-ordinated concurrently with the design of the 4 ,000 sq. ft. production facility.

Designing the product and the production process together, said Allen-Bradley, was the key to its new factory. Marketing, development, quality, manufacturing, management information systems, cost and finance functions all were involved in writing the specifications. To help achieve competitive costs, the company moved to automatic assembly, eliminating direct labor. An alternative would have been to move offshore but the need for skilled craftsmen to install, design and maintain the line was critical. Flexibility also was recognized as a primary need. So product and assembly operations were designed not to disrupt the manufacturing process when changing from one product variation to another. Equally important was to minimize handling and warehousing, both in raw materials and finished product.

To support marketing strategy for its industrial automation control products and systems, the factory was designed to showcase A-B standard control products which include programmable controllers, drives, industrial computers and industrial automation systems products. The concept of computer-integrated manufacturing (CIM) at Allen-Bradley is to utilize stockless production, the factory-in-a-factory receive an order in a day, manufacture, test, package and ship it the next day. When a special order of, for example, one variation of the product is inserted into the system, it can be manufactured and sorted right along with the others. The master controller will instruct each machine to change over automatically and back again as required. The "lot size of one" concept in this instance totally eliminates set-up and changeover time. A system utilizes statistical control methods to maintain quality tolerance levels. It rejects any component outside those parameters, to provide uniform quality. Testing of the product takes place progressively as the assembly moves from station to station - with some 3,500 data collection and 350 assembly test points in all.

The factory-in-a-factory is located on a site 150 by 300 feet on the eighth floor of Allen-Bradley's main plant in Milwaukee. The facility has two doors. Materials such as brass, steel, silver, molding powder, coils and springs enter through one door and the finished products exit through the other. Initially machines mold raw materials into workable contactor parts; plastic molding machines produce housings for the contactors; other machines make terminals and spanners for the contactors. In all 26 machines, including assembly, subassembly, testing and packaging, are needed to manufacture the contactor. The machines are synchronized to take a variety of parts, some of them extremely small, and turn out a completely manufactured and packaged product without a human hand touching them. More than 60 per cent of the machinery and equipment used was designed and built by Allen-Bradley and the remainder was supplied to Allen-Bradley design specifications. The sequence of assembly involves: Cross bar/armature cell; base/yoke/bar code line; main assembly station; terminal insert; arc quench; noise test; electrical test; screw back-off; packaging, and accumulator. These functions are integrated with the company's own industrial automation controls, with production directed from a control room.

The system begins operating when a distributor enters an order through his terminal direct to a mainframe computer. This computer receives incoming orders and integrates them with manufacturing, sales and accounting. The mainframe at 5 a.m. each day downloads all orders received the previous day for the new contactor to the Area Controller within the new facility. The Area Controller translates the orders into specific production requirements. Once the information is broken down into production language, it is downloaded to the cell level and a PLC-3 master controller. The PLC-3 serves as the master controller, giving instructions to each machine and informing each of its appropriate tasks.

The assembly machines are controlled by 26 PLC-2/30 programmable controllers. Information travels between them and the PLC-3 via three data highways. The system uses hundreds of Allen-Bradley products, including drives, remote input/output racks, bar code scanners and printers, push buttons, limit switches, proximity switches and others. Hundreds of sensors on individual machines provide feedback to verify that the instructions have been carried out, that the quality is up, and that production traffic is flowing smoothly.

Designed for automatic start-up and shut-down, the line's various machines are started in the proper sequence each morning by the PLC-3, limiting electrical demands and saving energy. Another highlight is the sophisticated adaptive control used on magnet grinding operations. It represents closed-loop process feedback utilizing the latest laser-gauging techniques. The product actually instructs production. Each product base carries its own bar-code identification. This bar-code instructs each station as to the work to be performed. As the work is completed, constant reports are provided to the PLC-3 cell controller.

To maintain minimum downtime, a variety of multi-level production diagnostics are built into the system. These keep attendants aware of operations throughout the 45,000 sq. ft. facility. At the floor level, a three-light system is in place. If a blue light comes on, the attendant is notified that a parts feeder is running low. A yellow light indicates a part jam or malfunction. A red light states that a machine malfunction has resulted in an automatic shut-down. An operator display gives an attendant approaching the machine a readout of the condition requiring attention. As the starter proceeds through the assembly line, many of the automatic inspections are tied into a CRT vision system and the computer-aided statistical process control system. If a component fails an inspection, the reject automatically causes the computer to order a replacement made. If the part is repaired and returned to the line, it is immediately identified by the computer. Extras or leftovers accumulate in a special line to be automatically reviewed against the next day's schedule.

The systems operator in the control room can monitor diagnostics via a color graphics terminal. At the same time, the supervisory unit also accumulates information on all faults. Answers are instantly available to such questions as what were the last 10 faults on the line or which fault occurred most often in the last shift or the last month.

A final control highlight is the personnel control used in the CIM facility. Magnetic ID badges permit access to the plant floor. The same badges are used to log all maintenance activity. Records are accumulated on how long it took for attendants to respond as well as how long it took for a service to be completed. (Industrial World, October 1985)

New frontiers for factory automation

Digital, the firm that produces computers for industrial automation and which holds second place at world level after IBM, and the Consorzio Macchine Automatiche (Comau), European leader in robotics applied to production processes, which forms part of Fiat, the Italian carmaker group, formed a joint venture at the beginning of this month for the incorporation as equal partners of a firm that is to make integrated systems for the overall automation of medium-sized industries in both Europe and on other markets.

SESAM, software system automated manufacture, which is what the new firm is to be called, will combine the experience of Comau in flexible manufacturing with that of Digital in the computer sector to deal with the development and implementation of computer integrated manufacturing (CIM) projects. Digital and Comau are already working together in this sector on one of the Esprit projects. Particular attention is to be paid to software products and applications and to consultations for the organization of CIM at managerial level. Research is to be carried out as well on advanced integrated automation technologies in collaboration with public and private sectors, also at international level.

SESAM has already made it known that it will abide totally by the most widely used standards, such as open system interconnection (OSI) of the European International Standard Organization (ISO) and manufacturing automatic protocol (MAP) of General Motors. The news of GM's purchase of an equity in an American branch of Comau is recent. Whereas Digital has already presented network operating systems for office automation which will be compatible with OSI. All this will make possible connections among robots of workshops in the production centres and the departments where designing and construction of prototype models are carried on, as well as among office automation systems and managerial and decision-making levels. In this way it will be possible to implement a perfectly integrated design and production system. (Bulletin IBI Press, No. 62, 23 December 1985)

Step-by-step strategy towards CIM

In the past months, most of the main players in the factory automation business have been busy announcing their CIM (computer-integrated manufacturer) strategies. The year started with the Department of Trade and Industry launching its own acronym - AMT (advanced manufacturing technology), a combination and rationalisation of its CAD/CAM, robotics and FMS (flexible, manufacturing systems) schemes. The application even had its own show, though in that case CIM stood for the more modest "computers in manufacturing" the word integration was conveniently implied and not assumed. The reality is, of course, that CIM is not simple. Like the chuck-wagon medicine men of the old west, what the vendors are selling is a promise. No one is that sure what the product is, and all the suppliers admit that no one vendor will be able to provide all the components of an all-embracing CIM system. What the vendors do agree on, however, is that CIM is the biggest potential market for computers since banking.

IBM is planning to open a CIM Centre in Warwick (UK), similar to the one operating in Munich (FRG). Digital Equipment Corporation (DEC) has a £5 million European Competence Centre and has helped set up with toolmakers Cincinnati Milacron, a £1 million CIM unit at Warwick University. Data General, Prime, ICL, Sperry and the General Electric (US)-backed Calma/CAF International all have CIM policies. And under the Alvey Directorate, 15 UK users including British Aerospace, Rolls-Royce, STC/STL and British Gas have set up a £300,000 club, called Planit, to develop a knowledge-based factory planning system.

Everyone knows what the factory of the future will look like. The entire design to delivery cycle will be automated, with Cad systems communicating with production planning and control systems to provide a self-optimising and flexible means of manufacture that will respond instantly to market demands.

Orders will be processed quickly; stock and work in progress will be kept to the minimum, and the factory will be capable of turning out small batches of customised products competitively and economically. The factory building itself will need no lighting or heating because it will be populated only by numerically-controlled tools, robots, conveyors - and the computers to control them. And machines, unlike humans, don't stop for teabreaks, they work 24 hours a day, seven days a week, 52 weeks a year. The manager, between rounds of golf, will be able to access all kinds of decision support information via a computer graphics display from the corporate database. A pipedream? Probably, but paranoid industrialists believe factories like this already exist, and are rapidly proliferating throughout the Far East.

True, systems that automate each separate step in the design/production process already exist, but while it is easy enough to draw connecting lines on a CIM strategy block diagram, the real-life problems in integrating these "islands of automation" can sometimes seem almost insurmountable.

MRP (material requirements planning) software is mature; Cad/Cam is catching on; office automation is well established. What is needed is the means to make maximum use and re-use of data - and standards - so that systems and equipment from different vendors cannot only talk to each other, but converse meaningfully.

The problem is that because there exists out there this huge investment in present-generation software, any CIM scheme has to evolve bottom-up. And there are many fundamental stumbling blocks to this happening. Take the relatively simple link between a Cad system and the production of instructions to drive an NC machine tool. The Cad system, where Cad means in most current cases computer-aided drafting, outputs a two-dimensional drawing of the part. All the geometry of the part is there in the drawing or in the Cad system's database. What needs to be added is information on the machine tool's performance parameters, details of the cutters available and tool path, and so on.

But ironically instead of people being made redundant, the practical result has been the creation of a new job, that of the part programmer. It has also resulted in the invention of a new system, most likely on a completely separate piece of hardware, the numerical control (NC) tape prep system.

This may be considered an interim step in the long run. But for NC tapes to be produced at the Cad workstation, manufacturing expertise has to be built into the Cad program - it may be in the form of an expert or knowledge-based system - which has the effect of loading production responsibility on to the designer, and increasing considerably the size of the database that has to be maintained by the system.

A two-dimensional engineering drawing is, however, an incomplete description of the part - it's a convention developed for communicating design ideas back in Victorian times. Solid modelling systems produce computer representations of products that are complete and unambiguous. But apart from the fact that current solid modellers are incapable of describing all possible shapes - they cannot handle the doubly-curved surfaces found in most automotive and aerospace applications - they also lack facilities for communicating tolerance information and find it difficult to identify features such as holes, bosses and pockets, in the part. The major use of tolerances is to ensure that components of an assembly will fit together. The features in a part play an important role in determining the method of manufacture - a hole for example can be drilled, bored or reamed. Automated manufacture narrows the number of choices. In theory, a solid model, because it is complete and unambiguous, could be the single representation suitable for automating all downstream activities - finite-element analysis, NC control and robot programming, for example.

Built-in clash detection and inherent topology checks should assure that if the part can be designed it can also be manufactured. But at what price? Non-optimising (so long as we can make it, that's OK) methods exist but assume a single machine tool and cutter, a single set-up and 2 1/2D contouring (the machine cuts in horizontal slices with no undercuts). An optimising system that manufactures economically, requires a proper process plan with a choice of machining operations: a cutter for each operation; clamps and fixtures, and information on the part's geometry; tolerance data; surface finish; material to be used; and an up-to-the-minute library of available tools, cutters and process capability. It also needs to know the batch size, in other words, how many to make. The best bet is again a rule-based expert system approach. ... (Computer Weekly, 24 October 1985). For CIM definition see figure 3 on page 47.

Boeing and GM show full factory automation

General Motors and Boeing have jointly demonstrated the feasibility of a fully automatic factory where computers control everything from customers' orders to the finished product. The companies have been developing communications software that would let machine tools, robots and other programmable production equipment communicate and work with office computer systems, regardless of manufacture. This has not previously been achieved. General Motors developed the factory system, called Map (manufacturing automation protocol), while Boeing devised Top (technical and office protocol).

The result emerged at the Autofact '85 show in Detroit, where the two giants and some 21 major supporting companies in the electronics industry have built a small scale factory which integrates shopfloor and office.

The communications software of Map and Top meet requirements laid down by the International Standards Organisation. As a result, Map is already gaining wide acceptance in Europe. But the reaction to Top, which Boeing has not promoted as vigorously as GM has Map, remains to be seen.

GM and Boeing developed Map and Top for internal use initially. They found they were buying thousands of systems that could not work together when the time came for integration of the various islands of automation developing in their many factories. They have realised that wider adoption will give economies of scale producing the electronic systems needed, cutting costs for world industry and for them as well. (Financial Times, 7 November 1985)

Programmable controllers for low-cost automation

Profits in the pulp and paper industry depend heavily on optimizing production. In an industry facing escalating equipment costs, rising fuel costs, strict federal regulations, and competition with other products, efficient production is crucial. Using programmable controllers (PCs) throughout a pulp and paper mill has proven to be an effective, reliable, relatively low cost way to optimize production.

In order to remain healthy, the pulp and paper industry must intensify its exploration of innovative, cost saving production techniques that will allow its products to compete with alternative materials and goods. This is particularly true in the area of automation equipment. One of the greatest problems in pulp and paper today is the high cost of capital and escalating equipment costs. Many projects go unfunded because the payback on such high cost equipment cannot equal current interest rates. Although savings are obvious projects go unfunded because of the high equipment costs. Nowhere is this more evident than in the area of process control or process automation equipment. Initial costs of computer and/or process control systems are staggering. Justification for these seven or eight figure expenditures is difficult and requires a major modernization project involving the entire capital approval process through top management.

Programmable controllers are an effective way to attack high equipment costs, because they are a low cost piece of equipment which can be justified on a piece by piece basis. PCs can be used individually in small systems and can be networked together into millwide automation systems. Since PCs are so simple to use, personnel in the mill can easily program and maintain PCs. The need for consultants, engineering time, and programming services is reduced. Due to the low cost and the ease of programming and maintenance, PCs achieve most of the benefits of automation and instrumentation usually provided by other much higher cost systems. Chosen for reliability and flexibility, PCs have demonstrated the ability to increase production capacity and improve overall operating efficiency. The latest models of programmable controllers have improved speed, memory, math functions, and ASCII communications. The PCs can replace computer systems in more sophisticated control applications. Because of new operator interface CRTs available with the programmable controller, PCs can now be used to replace distributed control systems in many applications. Examples of ways PCs can be used in pulp and paper mills are:

- To manage woodyards
- To control soot blowers
- To control batch digester
- To control thermomechanical pulping
- On the paper machine (motor control)
- In finishing area automation.

While PCs provide a low-cost, flexible solution to the small automation project, the communications capabilities of PCs can make them part of future control and information systems. This is a key point, because new technologies - such as robotics, vision systems, voice or touch based operator interfaces, and artificial intelligence base self-optimizing - can change the competitive relationship of one mill to another overnight. Today's programmable controller has sophisticated communications options that allow it to be used in conjunction with many other types of control systems. This also allows PCs to be used in mill-wide control systems. PCs have pioneered in the area of intercommunication of mill floor control devices. Most of today's PCs offer a proprietary local area network which allows public access. Some of these, such as the Gould Modbus system, have been around long enough so that a number of different manufacturers offer compatible equipment.

This system flexibility is a key element in making equipment competitive over the next decade. With worldwide competitive pressures continuing to force the domestic paper industry to increase its level of automation, companies will continue to seek low-cost ways of automating.

Managers should consider productivity gains that are made available with small or single improvement automation projects that use low-cost, incremental control devices, such as the programmable controller. (Excerpted from Paper Trade Journal, October 1985)

SOFTWARE

The OECD's software study

The Organization of Economic Cooperation and Development (OECD) has published a study on the situation of the software industry. Described in it are the particularities existing in the different member countries and the various government actions in favour of development. The progress represented by the introduction of systems that quantitatively and qualitatively increase production was indicated. Despite this being the case the warning is nevertheless made that the software industry may be the bottleneck which holds back all of the informatics industry. This warning is justified as much because it is software that makes it possible to translate the progress in hardware into economic and social utility as it is because of the serious technical and economic problems it encounters in its progress.

Software production is still rather artisanal in nature and its costs are high. The automation difficulties arising in view of its intellectual nature and the tendency of firms to produce it for their own needs are the principal causes that limit the size of a market which is capable of demanding more industrialized products. At the same time the shortages of trained personnel is affecting both production and users and are aggravated by a context of rapid changes and of product proliferation which disconcerts potential customers. Indicated as a positive element is a tendency towards the rationalization and growth of investments, utilization and sales.

In the countries of the OECD the commercial market, i.e. without considering the production self-consumed by firms, it is estimated at 35,000 million USd. The US represents 60% of the market with 100,000 persons employed, Europe 34% with 200,000 employees and Japan 15% with 50,000 persons.

Public bodies are urging research, especially with reference to the possibilities of artificial intelligence applied to software development. Although the resources destined for the purpose are limited, the coordination of efforts has improved and a training policy is in the process of being set in motion in all countries, including some of those which feel the urgency of making up for lost time.

The OECD recommends that there be a certain concert among large and small hardware manufacturers, software producers and users in order to transform de facto rules imposed by computer manufacturers into rules of law. In this regard the international market is defending the end of the support and of the customs protections to hardware manufacturers in their countries. The consideration is that it limits access to alternative software products. It finally advises the regulation of the international software trade so that its exchanges and cooperation be favoured and the juridical protection of the authors be guaranteed.
(Bulletin IBI Press, No. 60, 9 December 1985)

Software design

Today's engineers need more help than ever to navigate their way through increasingly large and complex software-development projects. But relief is on the way in the form of modern software-development tools that promise to bring an efficient development environment to designers who have long struggled with printouts and patches. These tools - which include a host of design methodologies - are turning chaos into order and improving productivity and should provide a more streamlined development process. Forward-looking tool developers are working with artificial intelligence and graphics techniques to enhance tomorrow's software-engineering environment. Structured design, advanced by proponents of the Yourdon design methodology and of program-design languages, is already becoming a necessity for serious software developers. Structured design creates software consisting of separate modules with well-defined interfaces; the individual modules incorporate top-down programming techniques. On the marketing side, users have better access to products as bigger companies enter cooperative marketing agreements with smaller software-tool makers. And in the business world, software tools are turning end users into budding developers of applications software for the corporate arena.

Particularly high on the cost-conscious engineering community's list is life-cycle support. The software life cycle lasts from specification until obsolescence and encompasses configuration control, documentation, and maintenance - often over a period of 20 years. In the past, these areas have been neglected. Yet engineers now realize that future systems, which will run to millions of lines of code, will be impossible to manage effectively without all-inclusive tools.

In the future, AI may offer the best hope for dealing with the burgeoning complexities of software development. "We're trying to address the difficulties in building general software packages by using a tool that is built on AI technology," says John Anton, president and co-founder of Reasoning Systems Inc., Palo Alto. The company's research on a knowledge-base approach to software design has resulted in a sophisticated expert system for software development. Reasoning Systems wanted to automate the entire software life cycle, supporting the software-development process from specification through maintenance. But such an ambitious goal could not be built on existing tools and techniques, according to the company. Thus the AI knowledge-base approach was required. ...

The real power of Reasoning's technology becomes apparent, the company claims, when the general programming knowledge stored in the knowledge base is coupled with domain-specific knowledge. Domain-specific knowledge takes the form of AI rules that represent information on the applications environment. Thus an aerospace company might load up on rules that relate to the special requirements of real-time avionics software; another company might focus on compiler-development rules. This is somewhat analogous to taking a stripped-down medical AI-based system and customizing it for either an orthopaedic surgeon or an ophthalmologist.

Perhaps the most interesting feature of Reasoning's system is that it is self-describing. This means the system's compiler could generate the code for itself from a specification-level description of itself. ...

Beyond the latest products offered for software design and business applications loom improvements that will enhance the software environment even further. Eye-catching may be the best way to describe another class of tools that will play an important future role in automating the first, or development, phase of the software life cycle. These are known as visual programming and visual simulation tools. The idea is to bring the software designer closer to the implementation process through the use of visual software models. These tools will be more sophisticated than most currently available graphical-design aids, delving deeper into the intricacies of a developer's software. Current research in this field is under way at AT & T Bell Laboratories, Brown University, the University of California at Berkeley, and the University of Southern California.

Also among tomorrow's toolsmiths will be the Microelectronics and Computer Technology Corp., the Austin, Texas, high-tech consortium. MCC's Software Technology Program has recently announced project "Leonardo", for Low-cost Exploration Offered by the Network Approach to Requirements and Design Optimization. Leonardo's long-term goal is reportedly a prototype-development environment, whose technology will be more advanced than current industry efforts in software-development environments. Improving engineers' productivity throughout the software life-cycle is one aim of this environment. (Excerpted from a special report by A. Wolfe. Reprinted from Electronics Week, 4 November 1985, ©1985, McGraw Hill Inc. All rights reserved)

Software 'the key to parallel processing'

A radical solution to the problems of artificial intelligence, trying to get computers to deal with the overwhelming complexities of the real world, could be the outcome of a programme in parallel processing just started at Stanford University, California. However, instead of building new hardware, the Stanford researchers are flying in the face of conventional wisdom and are seeking how to achieve large increases in computing power simply with software running on existing computers.

It is widely agreed that to get computers to be able to see, move about, and understand human language, enormous increases in processing power will be necessary. The only way to achieve this is by processing in parallel many items of data at once rather than in sequence as in conventional computing.

Several large projects are under way to build new computer hardware of exotic design specifically for parallel processing. Notable examples are at Britain's Inmos and Thinking Machines at the Massachusetts Institute of Technology.

According to Professor Edward Feigenbaum at Stanford and his colleagues, however, these efforts are missing the point: the problem in parallel processing is not hardware but software, to do with the organization of the task and the data. Professor Feigenbaum has become famous as one of the leading authorities on expert systems, programs that do the jobs of such people as doctors, accountants or oil geologists. His new project expert systems for multiprocessor architectures, aims to find a way of processing in parallel with Lisp and Prolog, the languages most commonly used for constructing expert systems.

The Stanford team aims to speed processing by between 100 times and 1,000 times. This will, they hope, be done not with one big breakthrough but several small ones. Professor Feigenbaum said: "You don't have to be very smart to get a speed-up factor of five and if we do this right, at four different levels, the factors will multiply and we will get an improvement of five times five times five times five. If we do it wrong they will add, and that's a loser." A central part of the Stanford effort is the newly popular idea of a "blackboard", a technique for getting several different expert systems, or "knowledge bases", to co-operate by exchanging information. These can work together relatively in parallel, although not totally. Professor Feigenbaum said: "We must learn a new style of building expert systems using the blackboard framework."

The Stanford ideas will initially be run in simulation on a Symbolics computer, a type specially designed for handling words rather than numbers. When the concepts have been proved, it is expected they will run for real on a network of such machines, with two processors at each node. Each processor would be fairly powerful, with plenty of memory, and there could be 1,000 or more of them. This contrasts sharply with the ideas of Thinking Machines at MIT, where the connection machine under construction is intended to have 1m processors, but each one very small. Inmos in Britain is also developing its transputer as a building-block for parallel processors. But the emphasis is on hardware, not software. (Financial Times, 18 November 1985)

Simula, a descriptive language

Many of the best programming languages have been invented by people who had something other than programming on their minds. The path that led Kristen Nygaard to create Simula, the first object-oriented language, began in 1949 when he was working on the design of Norway's first nuclear reactor. ...

"Simula was, from the very first, labelled a system description language as well as a programming language," says Nygaard, who is now a professor at the University of Oslo. It is now a commonplace idea that a programming language should have a clear meaning, quite independent of its execution on a computer. But this was a very unusual idea in 1962 when the design of Simula I began.

Fortran, for example, was generally seen as a kind of shorthand description of processes which would occur inside a computer. By contrast, Simula was designed to describe processes occurring in the world at large. The first requirement was that the descriptions should be natural, comprehensible and useful to human beings. Almost as an afterthought, Nygaard and his colleagues ensured that the same descriptions could be used to set up a working computer simulation of any process.

But Simula is not only a language for simulation. It is a general purpose programming language. The important insight was that a computer is just another system. The execution of a program is just another process. Naturally you can use Simula to describe that process of computation, whatever it may be. "If you apply a system perspective to the way you think about a computation, then you arrive at object-oriented programming," says Nygaard.

Simula I, which appeared in 1965, introduced 'processes' and 'activities'. A process has a definite state, represented by a number of values which may change as it interacts with other processes. An activity is a master copy from which a number of processes may be spawned. These processes all have similar behaviour, but each has its own individual history. In Simula 67, the 1967 version of the language which remains in use to this day, processes were renamed 'objects' and activities were called 'classes'. The concepts of class and object were carried over into Smalltalk, the influential object-oriented language which was developed at Xerox Palo Alto Research Center from the early 1970s onwards. ...

"Even within informatics you need more than one perspective," he observes. "The object-oriented perspective could be called the system perspective. It is a way of organising thinking, defining a thing into components, and so on, which is a very natural way for us to relate." But Nygaard identifies two other perspectives which he also believes to be valuable in programming. These are 'function-oriented programming' usually known simply as functional programming; and 'constraint-oriented programming', which includes logic programming and any other system where new facts are deduced from constraints or relations. ...

Work is in progress at Oslo and at the Danish universities of Aalborg and Aarhus, on a new object-oriented language called Beta. Purely object-oriented systems will not be adequate. But Nygaard is adamant that in any programming system which integrates the function-, constraint- and object-oriented perspectives, object-oriented programming should provide the foundation for the others. "Any reasonably complex system will be something which relates to the world around us," he argues. "It will hook up to databases, and to the world through sensors, and so on. There will be people sitting at terminals. And the way we most broadly, normally relate to our environment is through object-oriented thinking. In other parts of our reasoning we may focus on other things. An expert system is wholly concentrated on deduction. And of course in the 'deduction' parts of a system the constraint-oriented way of thinking is the natural one." But Nygaard believes it is natural to build constraint-oriented reasoning on an object-oriented foundation, and unnatural to do it the other way round. ...

Thought, like computation or any other process, has its own structure. To think at all, we must set some limits to the way our thought processes develop. "If you look now at the cognitive process, the process of thinking," says Nygaard, "a perspective is a structure of the cognitive process. You cannot relate to the world unless you select a perspective. And this is a set of concepts in which you can grasp and comprehend, and organise your thinking."

In object-oriented programming, Nygaard has given computer science one of its most powerful and effective tools for organising thought. But perhaps his most important insight is that a programming language is not just a way of looking at what goes on in a computer. It is a way of describing and understanding what goes on in the world. (Computing The Magazine, 17 October 1985)

COMPUTER EDUCATION

Senegal sends its computers to school

Senegal does not want to be left behind in the computer revolution. The West African country was one of the first on the continent to introduce computer technology - in administration, for example - and now is seriously examining the potential applications of computers to education. A major experiment in this area had its beginnings in January 1982 when a multidisciplinary team of Senegalese professionals went to New York to learn about a new technique in self-teaching via computer.

The group was composed of a computer specialist, a mathematics professor, an educational psychologist, a sociologist and two teachers. Canada's International Development Research Centre (IDRC) supported the study visit. They worked with computer scientist Seymour Papert, the creator and developer of an educational computer language called LOGO. After returning to Senegal, the team began its computer learning project in March of the same year at the Ecole normale supérieure de Dakar, a training institute for teachers and teaching inspectors.

The subjects of the experiment, pupils aged 7 to 11 from three schools in the Dakar area but from a variety of social backgrounds, attended three two-hour computer sessions per week. After being taught the standard keys, the children were left to their own designs. With LOGO, the pupils programmed the computer themselves; in effect, they used trial and error to instruct the computer what to do, in the process teaching themselves a variety of concepts such as geometric relations. Every week members of the training team noted any problems the children had in mastering the keyboard, the rate at which they learned mathematical procedures, and the programmes they created. The most satisfactory results were observed among the girls. The experiment even brought to light the fact that one 8-year-old female participant was exceptionally gifted.

Senegal's objective is not to introduce this method hastily. Rather, it conducted a research project with all its stages: evaluation, development, and general dissemination. The task was to determine how to introduce computer systems into teaching, for the belief is that "whether we like it or not, they will, sooner or later, be introduced".

The Senegalese authorities feel that the computer method must be studied now through experimentation as is being done in the developed countries, which are themselves only at this stage. They insist that Senegal, having missed the industrial revolution, must not miss the computer revolution. (Development Forum, January-February 1986)

Students design microchips

Undergraduates studying electronics at London University are now getting a chance to design their own microchips. The US and Japan already supply their students with such an opportunity, but this is the first time it has been available to large classes of students in Britain. Before Christmas, the third-year students were given the task of designing the sort of basic circuits that might make up part of a typical microchip. By Christmas the designs were gathered together on magnetic tape and sent to Micro Circuit Engineering (MCE), in Tewkesbury. The company, otherwise known as a silicon broker, will find chip manufacturers to fabricate the designs into silicon wafers. After six to eight weeks, when the production of wafers is completed, the chips will be returned to the students, who then get a chance to test them.

The course is possible only because, through MCE, London University can get a small number of chips made cheaply. Normally, the production of wafers (with the capacity to hold about a thousand identical chips) costs £50,000 to £60,000. What MCE does is to find a company which will fabricate a wafer that carries the different specialised circuit designs from MCE's various clients, thus cutting the cost per customer. London University pays about £2,000. Some of Britain's largest makers and users of chips have given the course a welcome thumbs up. ... (This first appeared in New Scientist, London, 21 January 1986, the weekly review of science and technology.)

France introduces 'computers for all'

The French government is spending about £180 million on a programme dubbed L'informatique pour tous - information technology for all. The scheme was set up at the beginning of this year by the education ministry and the ministry for industrial redeployment.

So far, the government has sent 120,000 computers to 46,000 primary schools and community centres. During the summer, more than 110,000 of France's 800,000 teachers attended crash courses on how to operate the equipment. By the end of 1986, 1,000 more community centres will receive micro computers. The centres and 12,000 schools and colleges will be equipped with local area networks, which link computers within a building. In many cases, the networks will be linked to national systems of data transmission.

A survey carried out last summer found that 57 per cent of the population were unaware that the programme even existed. Many teachers, thrown in at the deep end when classes started in September, complain that the training courses they attended were too superficial. Nevertheless, last summer's courses for teachers were oversubscribed: almost three teachers for every available place. ...

The hardware supplied to most schools is based on the concept of "nano-network" ("nano" implying a type of computer of lower power than a micro). A nano-reseau consists of up to eight small home computers hooked to a larger machine that is compatible with an IBM-PC. The use of nano-reseau driven by IBM-compatible machines allows small, cheap home computers to share software designed for much more powerful machines. Alain Abecass from the Education Ministry says: "The main thing is that we have opted for the IBM-PC standard throughout."

Much of the software for these systems is being written in "Symbolic Teaching Language" - a French version of Basic. Logo and English-language versions of Basic are also popular. Elaborate question-and-answer programs on French history, grammar and geography are among the most sought after packages. The number of programs to aid teaching is growing rapidly. The latest catalogue circulated to schools lists about 700 titles. Until recently, these programs were written by teachers, but now professional software houses are taking more of an interest. ...

French children who wish to specialize in data-processing can now do so from the equivalent of the British fourth form (15 to 16 years old). The subject can be included in several versions of the Baccalaureat.

Computer-aided teaching is also finding its way into French drawing rooms via the national videotex network - Teletel. The small brown "Minitel" terminals, supplied free by the post office, now sit on about one million desks and tables around the country, and are far more common than micro-computers. The system gives access to databanks, quizzes and games. Users can even send questions to politicians.

Although connection time is expensive (£5.50 per hour is the basic rate), Teletel is expected to be increasingly used for teaching both in homes and schools throughout France. "The Minitel [a Teletel terminal supplied free by the Post Office] has been the most powerful single factor in initiating French people to data processing," a teacher employed by the Informatique pour tous project said. "A lot of people make no distinction between the terminal and a real computer." (New Scientist, 12 December 1985)

Micros in Indian Schools

In issue No. 13 we published a report on the CLASS programme which was initiated by the Department of Electronics in India. We have now been informed by one of our readers, Dr. P. Gupta, former Secretary in the Department of Electronics, GOI, that the project will now be implemented in the 60,000 secondary schools in the country within the current Five Year Plan. We are glad to report this especially since the earlier news report had voiced concern about building up a highly-educated élite by picking a few élitist schools for the introduction of computers.

COUNTRY REPORTS

Australia to develop gallium arsenide technology

Australian researchers, planning to establish a gallium arsenide-based semiconductor industry, hope to make Australia at least partially self-reliant in the field of information technology. According to Dr. John Archer of the Commonwealth Scientific and Industrial Research Organization (CSIRO), Australian industry and research must begin immediately to set up an R&D program to have any realistic chance in future communications technology.

The CSIRO division of radio physics plans to be heavily involved in the introduction of new technology. It is establishing facilities for the production of GaAs and fabrication of microwave devices with plans for future production of small scale integrated structures.

CSIRO is working with Telecom Australia research laboratories and the Royal Melbourne Institute of Technology to actively encourage commercial participation. Telecom Australia is the government-owned organization in charge of development of a modern communications system for Australia. Initial development will concentrate on Schottky diodes, field-effect transistors and high electron mobility transistors. CSIRO researchers hope to expand Australian R&D and then transfer it to industry to be carried out on a commercial basis; the goal is for local industry to provide a limited but reliable Australian source of GaAs devices. (Reprinted with permission from Semiconductor International Magazine, November 1985. Copyright 1985 by Cahners Publishing Co., Des Plaines, Il. USA)

Brazil defends its IT laws

Brazil has hit back in its row with the US over its protection of the Brazilian computer industry against foreign competition. The Brazilian computer industry association, Abicomp, is attempting to fight US accusations that Brazil's policies are unfair and damaging to the US computer industry. Under a law passed last year, imports of US micros and minicomputers into Brazil are banned, and imports of mainframes have to be approved by the country's Secretariat for Informatics. A number of foreign multinationals including Hewlett Packard, Digital Equipment, Texas Instruments and Racal, have been forced to cut or abandon their operations in Brazil by these and similar regulations. In September 1985 the Brazilian government extended its restrictions to cover public telephone exchanges. This measure may threaten the activities of Ericsson, NEC and Siemens in Brazil.

José Sarney, Brazil's president, has taken a tough line in defending the computer laws, pointing out his country's efforts to finance its $103 million external debt. Protection of its fledgling computer industry has succeeded in making Brazil the strongest IT producer in Latin America. (Computing The Newspaper, 3 October 1985)

Belgium:

Belindis preparing data base on technology transfer

Belindis, the host organization run by the Belgian Ministry of Economic Affairs, is preparing a new data base on technology transfer, to be available on-line to the public in 1986. The file will contain 100,000 documents on licensable patents. (Infotecture Europe, No. 77, 19 October 1985)

China:

China announces its own Ada plans

China has taken up Ada, Nato's new standard military language, and is working on advanced project support environments. Chinese scientists from Shanghai and Beijing told a recent meeting of the Ada-Europe environment working group that China is trying to build Ada environments hosted on IBM and Digital Equipment machines in order to keep up with the developments in the West.

John Nissen, chairman of the EEC-sponsored group, said he doubts whether the three Chinese projects will be as sophisticated as work in the UK and US. But he said that the Chinese were interested in using Ada for their country's own defence and industrial computing. The Chinese had indicated that work was most advanced at the Beijing Institute, where both Ada and C projects were under way. (Computing The Newspaper, 12 September 1985)

Introducing the Great Wall micro and software for Kazaks

China is going computer-mad. A computer is currently being used to analyse King Gessar, a 10-million word ancient folk epic written in Tibetan.

Computer manufacturers are expecting another sales bonanza in China when the government lifts hefty import duties on microcomputers imposed last year. In the 18 months up until last summer, China bought hundreds of thousands of personal computers, along with unprecedented imports of cars, TVs and other electronic goods. The drain on China's foreign exchange reserves forced the imposition of import duties, but demand is building up again.

Sales of large mainframe or specialized data-processing computers have remained steady, helped by loans from the World Bank and heavy Chinese investment in the modernization of railways, ports, aviation and major industries. China is determined to build up its own computer industry and wants to substitute imports by fostering joint ventures that will transfer technology to encourage domestic production.

China already possesses some expertise, but it is mostly concentrated in the defence industries. In 1983, China's University of the Ministry of Defence (Science and Technology) claims to have built a supercomputer - The Galaxy - capable of executing 100 million operations a second.

The country has 90,000 computer workers, 8 computer research centres, 111 computer factories and 40 computer service units. It produces an assortment of micros, from simple 4-bit models to 32-bit personal computers. Some, such as the Great Wall 0520 and the Zijin II, are being produced at a rate of 10,000 units annually. According to one Chinese estimate, the country will be able to produce 100,000 micros a year within the next two years.

Software companies are usually too small to want to venture into an expensive and difficult market such as China, and larger companies are frightened by the lack of copyright protection. But more fundamental problems also blight the life of the Chinese computer user. The country's erratic electricity supply frequently produces blackouts and surges of power that can easily damage the memory.

The country also lacks a chip industry and produces few integrated circuits. The Great Wall micro, which has been a success, is an IBM clone and is assembled from imported components.

The greatest challenge remains the lack of an accepted method of using a standard keyboard for a language composed of thousands of characters. There are about 6,000 characters in regular use in Mandarin, and no satisfactory way of writing the language using the Western alphabet. Over 400 Chinese character-input systems have been published, and many of them require an operator to memorize where over 150 selected radicals or "roots" are grouped and placed on the keyboard. Some computers are programmed to accept several different kinds of input methods. Others require a good knowledge of English for the operator to type out the English word, after which the computer lists the possible Chinese characters with the same meaning.

Another system requires the operator to input the first two strokes of a Chinese character - a dot, a horizontal line, or a slant to the right or left and the computer then displays all the radicals or even characters with the same first two strokes. A winner has yet to emerge. Research on the computer processing of Chinese minority languages is proceeding faster. Of the 24 minority languages for which a writing system exists, most rely on an alphabet. In October, a committee was set up in Hohhot, the capital of the inner Mongolia autonomous region, to look at data processing in minority languages. So far effective data processing systems have been developed for Mongolian, Kazak and Ugur. Computer hardware and software packages have been designed for Mongolian and are used for storing documents and counting the frequency of use of common words. (This first appeared in New Scientist, London, 2 January 1986, the weekly review of science and technology.)

EEC News:

Industry review praises Esprit

A review board of the computer industry's sages has praised the European Community's £900 million Esprit programme research project. But it has called for changes in the second phase when the European Commission puts forward proposals at the beginning of next year.

The review of Esprit, by a trio chaired by Edward Pannenborg, a former vice chairman of Philips, the Dutch electronics giant, is based on interviews with 131 of the companies and research institutions involved and the answers from 238 questionnaires. Pannenborg said: "We strongly recommend the second phase. We advocate, in addition, demonstration projects." The report proposes an extra budget of one third of the total for these.

Centres of excellence are also proposed to cut some of the overheads of travel between institutions. These extra overheads are estimated at up to 20% of a project's cost. The review suggests tightening management and clarifying the legal rights to precompetitive research.

This review has come earlier than expected because of the quick take-up of Esprit funds. Funds for new projects will be available only if planned ones are not completed. The report says: "To build on the progress made so far there is a need for additional research funding." (Computing The Newspaper, 24 October 1985)

Esprit two years on

The Esprit technical week, held in Brussels at the end of September 1985, to mark two years of the programme, attracted some 600 participants. Esprit, European Strategic Programme for Research and Development in Information Technology, is the EEC inspired project to get European information technology industry cooperating in R&D. The total budget is 1,500 million ECU, half of which comes from industry itself, the other half matched by the CEC. As Michael Carpentier, Director General of the Task Force for Information Technologies and Telecommunications at the Commission reminded, Esprit represents 8% of the world effort and 25% of European R&D effort at precompetitive level. The overall Community market represents almost 25% of the world IT market but no individual Member State represents more than 6% of that market; the output of the European IT industry supplies about 40% of the demand in Europe.

195 projects have been selected to date totalling 750 million ECU, 93 of them in 1985. 173 are already under way. Projects are organized around 5 areas: Advanced microelectronics (MEL), software technology (ST), advanced information processing (AIP), office systems (OS), and computer integrated manufacture (CIM). A committee of three independent experts (A.E. Pannenborg, A. Danzin, A J Warnecke) is to publish an evaluation of the programme so far in the coming weeks.

Propositions by sector

	MEL	ST	AIP	OS	CIM
Received	142	163	243	195	231
Accepted	52	30	38	46	29

	1983	1984	1985
Projects under way	38	104	173
Number of participants		247	173
Number of researchers		500	1300 (3000 by mid 1986)

(Infotecture, 31 October 1985)

Europe focuses on Eureka support

A conference of industrialists and bankers endorsed Robb Wilmot's (ICL chairman) ideas about European co-operation on high technology. The meeting was called by the UK Government to focus the ideas of European industry and finance on Eureka, President Mitterand's initiative to roll back the tide of Japanese and Californian technology. Dr. Alfred Herrhausen, chairman of the Deutsche Bank, speaking on behalf of the bankers, made it very clear that there was always finance available for any properly defined project.

The normal three to five-year timescales of technology were also no problem, although he admitted that the longer, seven to 15-year, infrastructure projects would be hard to finance.

The delegates endorsed Robb Wilmot's analysis of the problems facing Europe: the lack of European standards in telecom, nationalistic public purchasing policies, customs formalities, and legal difficulties in setting up a transnational company. Colin Southgate, managing director of Thorn EMI, and the UK delegate to the conference, said it was absurd that Europe has 12 telecom firms when the US has three.

He wanted to see Eureka give birth to a European equivalent of Miti, the association of the major Japanese electronics companies, which decides a strategy for the whole industry. Such a body could help to restructure the industry, he said. (Computing The Newspaper, 24 October 1985)

ES2 to be Eureka model

European Silicon Structures (ES2) looks set to become the first Eureka project. According to co-founder Robb Wilmot: "ES2 is going to be taken as a case model for Eureka." The company has stated its intention to participate in the programme and is in discussion with the French, German and UK governments. The ICL chairman's opinion on what form Eureka funding and projects should take are known to have been well received by the industrialists and financiers who attended a recent Eureka meeting in London.

ES2 has set itself the goal of sponsoring independent "systems in silicon" design centres in all the major local European markets and catalysing these entrepreneurial centres will be one major topic to be raised with the Ministers. The company is also in the final stages of raising finance across the continent and is expected to make announcements on both funding and structure within the next few weeks.

"If ES2 becomes a Eureka project it will complete the partnership between the industrial, financial and technical communities. And most importantly it will do it at a pan-European level," said a spokesman for the company.

ES2, founded two months ago by Wilmot, Bob Heikes and Jean Luc Grand Clement, hopes to have its own wafer fabrication facility under way by the end of the year. The company is hoping to raise a total of $65m initial capital, but with the current shake-out in the electronics field, some industry watchers are worried that the start-up has come at a bad time. ES2 aims to offer a full custom design and manufacturing capability for European systems manufacturers, with emphasis on low volume and prototype circuits. (Electronics Weekly, 6 November 1985)

India:

Computerized monitoring of public sector projects

A special cell with modern computer facility has been set up in the Planning Commission at the instance of the Prime Minister which will operate a computer based monitoring of progress of public sector projects. The Prime Minister's office has been provided with terminal facilities of the same computer to enable the Prime Minister to keep a close watch on progress reports. This measure has been adopted as the time-lag is too long in preparing reports for cabinet under the existing system.

To start with, the new procedure will apply only to central projects costing over Rs.100 crores. Monthwise targets from January to December 1985 have already been identified for these projects.

Under the new scheme, every public undertaking is expected to submit in the first three days of every month a flash report in a format to be later fed into the computer in the Planning Commission. No excuse for any delay in providing the necessary data will be entertained, it has been made clear.

In a communication to secretaries of all ministries, the member secretary of the Planning Commission has outlined the salient features of the scheme and the format for the monthly flash reports.

All ministries have been asked to direct chief executives of public undertakings attached to them that the reports may be sent to the Planning Commission directly by telex or telegram to reach within the first three days of the month. Absence of response within the stipulated period will be automatically indicated on the report to the Prime Minister.

The need for close monitoring has been felt for several years but beyond verbal or written reminders - which seldom produced results - no concrete measures were taken. It is common knowledge that there have been instances where the cost overruns have been thrice the originally approved estimates. The Public Investment Board, on several occasions, had passed severe strictures against the concerned authorities for exceeding the cost.

The Union agriculture ministry has decided to opt for computerized management information system at various levels to quicken the pace of implementation of rural development programmes, particularly to enlarge the information base at the district level and make data more easily accessible and operational. It will help eliminate delays in the flow of progress reports from the district to the state and Central levels.

Computers will be used to identify problem areas in agriculture for speedy implementation of various schemes for increasing farm productivity. This is expected to facilitate even spread of new agricultural technology, reducing inter-regional disparities in farm development.

This information was given by the Union Agriculture Minister, Mr. Buta Singh, while inaugurating the conference on "computer for advancement of rural society" organized by the Computer Society of India at New Delhi in March 1985.

Computerization of management information system for rural development had, in fact, already been taken up on an experimental basis in some districts. The experiment in Karwar district of Karnataka yielded desirable positive results, including better management control and effective field inspections. (IIPA Newsletter, March 1985)

Irish National Microelectronics Research Centre

The National Microelectronics Research Centre (NMRC) in Cork was set up to perform key strategic functions: providing Irish graduates with the in-depth specialities required by the electronics industry, and taking that expertise from the laboratory to industry.

The NMRC has been fully operational for almost two years now, and has a complement of 50 staff and post-graduate students. Of these, 60% are supported by R&D work carried out in the Centre, funded by Irish industry, both indigenous and multi-national, and to an increasing degree by the EEC under the micro-electronic part of ESPRIT (the EEC's co-operative information technology research programme).

Currently the Centre provides product or process development work or research services to 10 Irish firms. This work ranges over the whole spectrum of the Centre's technical activities. The NMRC is also a partner in five multi-year ESPRIT projects. The topics of investigation, again, are spread over all the NMRC's four main technical areas of activity:

- Silicon IC design and fabrication,
- Gallium arsenide devices and IC technology,
- Computer aided design,
- IC packaging and interconnection technology.

This year the Centre successfully negotiated participation in a further five ESPRIT projects, and work on these begins next year. This activity underlines the strong links which are being developed between the Centre and the microelectronics industry in Ireland on one hand, and universities and industry in the rest of Europe on the other.

This interaction ensures that the nature of the technical work carried out in the NMRC continues to be relevant, and that its quality remains high. This in turn guarantees that contract work for Irish industry and the service provided to other third level institutions, as well as the Centre's own postgraduate and undergraduate training, will be carried out within a secure and informed framework. (Technology Ireland, November 1985)

Japan:

Japanese patents on-line

Information on Japan's 900,000 patents is now available for the first time in English. The Japan Patent Information Organisation, an offshoot of the Patent Office, will provide the data on computer tapes to System Development Corporation, an American data base company whose Orbit network supplies 20,000 laboratories and clients in 27 countries.

The Japanese information dates back to 1976, when translations began. Extracts in English will continue to be added at the rate of more than 150,000 a year, but users will not have access to the most up-to-date patents, since the Patent Office is three years behind with new applications. In 1983, 486,000 were filed in Japan, nearly half the world total, and the number is increasing by 10 per cent annually. The office can handle only 200,000 applications a year and now has a backlog of over 600,000. To speed up the process, the Patent Office plans to build new headquarters where most of its 2,400 employees will have their own computer terminals. But this will not be completed until 1988 at the earliest. (This first appeared in New Scientist, London, 12 December 1985, the weekly review of science and technology)

Japan and France to share research

Japan's institute of new generation computer technology, Icot, has reached basic agreement with the National Research Institute of France to exchange technical information and researchers.

Under the agreement, France and Japan will also look for possible opportunities for joint research projects.

The agreement, which is in purely verbal form, was announced by [illegible] Kurozumi, Icot's assistant director, and arose from discussions held between Kurozumi and French government representatives in the Japan/France round table discussions in September 1985.

Kurozumi also visited the National Research Institute of France facilities during his visits to Paris.

An Icot spokeswoman said that this marks the first time Japan and France have agreed on joint efforts for work on fifth generation computer projects. (Computing The Newspaper, 24 October 1985)

IBM Japan involved in Sigma project

Last week the Ministry of International Trade and Industry (Miti) said IBM Japan would be allowed to take part in the £80 million Software Industrial Generator and Maintenance Aid (Sigma) project, designed to help Japan catch up with western software. The announcement comes as resistance is subsiding to a planned joint venture by NTT and IBM covering both value added networks and reselling IBM kit. Japanese companies had objected because they felt the venture would swamp competition.

Seiji Hagiwara, deputy director of Miti's electronics policy division, said that details of IBM Japan's involvement in Sigma had yet to be finalized as the five-year plan gets off the ground. He added that AT & T was also considering participation in Sigma.

Miti was originally opposed to IBM Japan taking part because the project was supposed to boost Japan's national software effort at a time when the industry was under increasing pressure.

The main objectives of Sigma are to build a central database, to develop software to aid productivity and to set up a software library, all of which would be available to about 10,000 programmers throughout Japan via networked work stations. One of the reasons IBM Japan is believed to be interested in Sigma is because software developers will use standard operating software called Sigma OS. This is a version of Unix with extra features such as Japanese language functions. (Computing The Newspaper, 24 October 1985)

Icot looks to Alvey to lighten the darkness

One of the myths about Japan is that it is the land of consensus where companies work hand in hand for mutual prosperity and the national good. Icot, which spearheads Japan's fifth generation effort, must certainly wish it was so because of all the fights that keep breaking out between the big eight manufacturers involved in the project.

Things must have got pretty desperate for Icot's management team to visit the UK's Alvey directorate to see how it has handled industry's links with academia.

Attentive readers will recall that late last year there was considerable concern that at least two of the six prestige Alvey demonstrator projects were a very long time getting to the starting block. One of the major problems was the question of who held the rights to the results of joint research. A formal agreement was finally drafted after much kicking and screaming behind closed doors. (Computing The Newspaper, 24 October 1985)

International high technology organization

The Ministry of International Trade & Industry (MITI) has framed a plan for establishing an international high technology organization, to provide a place for international exchange involving research development and information exchange by scientists and researchers of Japan, the US and European countries, for the purpose of activating world economy toward the 21st century. This idea is based on the belief that the promotion of science and technology will be essential to the development of world economy and expansion of employment. The new organization, in cooperation with industrial nations, will (1) develop high technology involving electronics, biotechnology and new materials, (2) foster researchers for this purpose, and (3) promote 18 international cooperation projects which were agreed upon at the Versailles Summit. MITI hopes to give a great deal of encouragement to realization of this plan and to propose it at the Tokyo Summit to be held next year.

MITI has taken up, as the highest priority policy for fiscal 1986 - internationalization policy for coping with trade frictions and personnel development policy as the foundation of the Japanese economy and industry. The idea of the high technology organization will meet such requirements in the field of science and technology.

Late last year, MITI proposed an idea of a high technology university. An international research cooperation Japan trust for inviting foreign researchers is based on this move.

At the Versailles Summit held in 1983, a science and technology committee was set up, where it was decided that 18 projects involving high technology robots, solar light power generation, photosynthesis, and fast breeders be carried out by seven industrial countries. (CEER, September 1985)

Japan backs next generation of chips

In 1986, Jun-ichi Nishizawa, Japan's top researcher into semiconductors, is determined to build a transistor that he claims will work 1,000 times faster than existing transistors. The sponsor of this research - the Japanese Government - is so confident that these inventions will succeed that it has just set up a project to build machines to make these minuscule devices. The work on both transistors and machines to make them comes under a system entitled ERATO - exploratory research for advanced technology. Japan's Research and Development Corporation (RDC) is organizing the work.

ERATO began in 1981, and turned traditional Japanese methods of research on their head: there was to be no more anonymity - individual projects would be named after their leaders; no researcher (other than project leaders) would be over 35; and no more insularity. For the first time, foreign scientists were encouraged to work shoulder to shoulder with their Japanese colleagues.

These changes are the work of Genya Chiba, the RDC's director of research administration. Chiba's intention was to set up a research environment in which innovation could take place. In doing so, he was much influenced by his own education, as a particle physicist, at Columbia University, New York. There, many of his teachers came from all over Europe. Chiba believes that interaction between different cultures is beneficial: "Something new always emerges out of two cultures colliding. It seems to be very productive in thinking up new things - history says so. If everything is the same, nothing happens".

ERATO seems to be working well. Researchers from each of the nine projects under the ERATO umbrella reported their results to meetings in Tokyo. Each ERATO project lasts five years, and is allocated funds averaging about £1 million a year. Laboratories involved in the project are located at government institutes, universities and private companies - wherever there is space for them. The first four projects began in 1981, which means they are entering their final year.

One of Chiba's jobs at the RDC - ensuring that technology developed by the government transfers smoothly to the private sector - gives him close connections with industry. He is also on first-name terms with the cream of Japan's researchers.

One of his first four signings was Nishizawa, a professor at Tokyo University, and head of the independent Semiconductor Research Institute. Nishizawa's claim to fame is the static induction transistor (SIT). This differs from the two types of transistor that predominate today, the field-effect and the bipolar. In the SIT, the distance between source and drain is very short. As a result, the transistors switch on and off very quickly. Another advantage of the SIT is that there is less heat to dissipate than in conventional transistors, because the SIT operates at low powers. Because there is less heat to lose, more components can be packed into a small space.

To understand the significance of Nishizawa's work, Chiba says that you have to realize that the bipolar and the field-effect transistors were both developed 25 or 30 years ago. No one has proposed a new structure since. However, the semiconductor industry is now looking for even more sophisticated transistors. The SIT is one of the transistors competing for a place in the semiconductor market. Nishizawa's aim is to develop devices the size of molecules. Such devices would channel electrons between the atoms of the crystal. Because there is nothing in the electrons' path for them to collide with, their progress through the device should be very fast indeed (less than one picosecond), and there should be little heat generated. The static induction transistor will be made out of gallium arsenide, because electrons travel five to six times faster in GaAs crystals than in silicon.

Nishizawa's breakthrough has been the development of a process called photo-epitaxy. In this process, the gallium arsenide substrate is placed in a vacuum chamber and exposed to ultraviolet light from a mercury lamp. $GaCaCl_3$ gas and AsH_3 gas are alternately absorbed on the substrate to produce a layer one molecule thick. The whole process is repeated 20 times or so to produce many layers. With this method, Nishizawa intends to build a static induction transistor, up to a thousand times faster than conventional transistors. Unlike the Josephson junction, another candidate for the record on speed of switching, the device would not need to be cooled to extremely low temperatures to operate.

The three other initial projects within ERATO are on fine polymers, amorphous and intercalation compounds and ultrafine particles. Chiba thinks the latter is the most interesting. Its intention is to examine the ultrafine particles on and between layers of adjoining material.

The project is led by Chikara Hayashi. One of his team is looking at ways to arrange ultrafine particles of gold on a silicon substrate. The method is to clean the silicon, then write a pattern onto the surface with a thin electron beam, which changes the surface of the silicon. Next, a gold film is vapourized on the silicon surface, where it coagulates in the areas where the electron beam alters the silicon surface.

Currently, the minimum width possible between adjacent lines of the pattern is 20 nanometres, but a width of 5 nanometres is theoretically possible. A width of 10 nanometres on a piece of silicon 1 centimetre square would allow 10 million million particles to be deposited on the surface. To illustrate the potential of this technique, Chiba worked out that if each particle represents a bit of information, then there would be enough room on a chip the size of an old penny to store all four million books and scrolls in Japan's National Library.

Information storage is just one application of this technique. Given that the researcher responsible for developing it is on loan from Fuji Photo Film, it is likely that the technique will first be applied to produce a photographic film capable of a much higher resolution than emulsion.

The results from the projects set up so far have encouraged the RDC to establish two new projects, on solid-state surfaces and nanomechanisms. These projects will study chemistry and physics on the scale of the nanometre. The work is crucial for the future development of chips where the components will be placed within nanometres of each other. ...

Research under ERATO's umbrella is by no means limited to work on semiconductors. For example, Hayashi's work on ultrafine particles showed that atoms at a surface move. Researchers hooked up a video camera to an electron microscope and captured ultrafine particles of gold hopping about on tape. This method could prove a valuable tool for scientists studying catalysis or looking at the physical characteristics of semiconductors.

Two artificial enzymes were developed as a result of work on another project - the fine polymers research. These are attractive because they can be made more cheaply and reliably than the real thing can be extracted. One, artificial urease, could be used in artificial kidneys. The other enzyme is used to separate optical isomers. The molecules of an optical isomer are chemically identical, but the molecular groups in the two isomers are positioned so that the isomers are mirror images of each other. The two types respond differently to incident light. In this case, one isomer is an insecticide, the other is a health hazard. It is difficult to separate optical isomers, so Mitsubishi Chemical is apparently keen to produce the enzyme developed by the fine-polymers project team.

The third of the original ERATO projects looked at amorphous materials and ways of slipping particles between the loosely held layers of materials such as Mica (intercalation). This project's contribution to technology is a clay which, in the form of a thin film, turns a different colour depending on what sort of light shines on it. Information can be written on it, read from it and erased.

When ERATO began five years ago, some scientists were reluctant to join projects - they doubted whether it would last. Now, it is increasingly regarded in Japan as the most promising answer to the need to do basic research. Researchers realise that ERATO offers them the chance of a lifetime to do original work. New projects have researchers queuing up to join them, and the planners at Japan's RDC are keen to seen more ERATO projects. The problem is the penny-pinchers at the Ministry of Finance, who are not used to funding projects that have no short-term commercial pay-off. It is a tribute to Chiba that pure research projects have got off the ground. Yet ERATO is eliciting much commercial interest. According to Chiba, about two dozen companies are excited about the prospect of carrying on themes begun by ERATO's projects. ERATO itself is not interested in finding applications for its work. Its aim is rather to develop basic technology that can be applied to many fields. The RDC's main function, however, is to transfer technology to the private sector. The fruits of ERATO projects will probably pass rapidly to the private sector. (This first appeared in <u>New Scientist</u>, London, 2 January 1986, the weekly review of science and technology.)

Korean chip makers aren't backing off

The worst market slump in the history of the semiconductor industry has been even more of a disaster for South Korea's embryonic chip-making industry. But despite losses in the tens of millions of dollars, manufacturers say they're in the race for the long haul.

A recent survey by the Commercial Section of the US Embassy in Seoul estimates that the five major makers - Samsung, Gold Star, Hyundai, Korea Electronics, and Anam Electric Industrial - will invest about $1.7 billion over the next three years in new equipment and production facilities. That's on top of nearly $770 million already invested industrywide in plants which, in the face of the world market slump, are producing mostly products for internal use. Indeed, Daewoo Telecom Co., which abandoned its infant semiconductor project last year because of a money crunch, is poised to reenter the market.

The biggest loser so far is Hyundai Electronics Inc., which poured close to $126 million into a massive startup operation. The Seoul company lost more than $20 million in the last year alone on a design and manufacturing plant that it set up in Santa Clara, Calif., and closed a few weeks ago.

The company's latest move is a technical agreement with Vitelic Corp., Santa Clara, Calif., to which it paid a reported $4 million for 1-Mb dynamic random-access-memory and static-RAM production technology. But its hopes, and those of more advanced Korean companies such as Samsung Semiconductor & Telecommunications Co. and Gold Star Semiconductor Co., rest on a very fragile base.

Two fundamental weaknesses are dogging the Koreans. First, their technology gap with Japan and the U.S. forces them to import large amounts of components. The import total has been growing - from $1.69 billion in 1983 to just over $2 billion last year, and an estimated $2.3 billion in 1985. U.S. and Japanese makers accounted for 84% of the 1984 total, and this year, South Korea will import an estimated $851 million worth of American components, with Japanese companies selling well over $1.2 billion to the Korean market.

The second major flaw is that, unlike Japan, which has a well-developed domestic market from which to launch its products, Korea's local market remains small. The total domestic chip market last year was about $540 million, nearly all of it for inhouse use. A massive infrastructure of telecommunications networks is fueling growth, but the consumer market for such products as video recorders and color TV sets has been disappointing.

The most successful chip maker, Samsung Semiconductor, is producing 256-K DRAMs as well as 64-K SRAMs and 16-K electrically erasable programmable read-only-memory products. The company won't comment on reports of drastic cutbacks in production, but industry sources report that most production this year is for in-house consumption.

Gold Star Semiconductor is producing 64-K DRAM and SRAM chips, but has only prototype 256-K products. Gold Star president P. June Min speaks optimistically of his company's strategy to develop its own 1-Mb product to leapfrog into position for next year's hoped-for market recovery, but there is no evidence that Gold Star or any other Korean chip maker is close to even sample production.

Min will receive no help from his U.S. partner, AT & T Co. Though AT & T has shared telecommunications and lower-level semiconductor production technology with Gold Star, there are no plans to transfer either 256-K or 1-Mb know-how, says Gold Star Semiconductor executive vice president Gary E. Powell, an AT & T representative based in Seoul who oversees Gold Star Semiconductor operations. AT & T, which holds a 40% share in the joint venture, is said to be highly skeptical about Gold Star's efforts to push ahead in memory production. ... (Reprinted from Electronics Week, 2 December 1985, © 1985, McGraw Hill Inc. All rights reserved.)

PAUTA, the Spanish advanced industrial automation plan

The Spanish Ministry of Industry and Energy has just published the advanced industrial automation plan (PAUTA) as the sectorial materialization of the existing electronics and informatics plan, to the tune of 11 million dollars per year over three years. But, in addition to conventional automation and robotics, PAUTA is intended to research and spread flexible fabrication applications which configurate the new models of products, processes and generator services of a competitive industry.

PAUTA's structure includes three development programmes (basic technologies, industrial technologies and industrial applications), one of training (researchers, engineers, managers) and one of mixed financing (loans, leasing).

The basic technology programme serves to promote research for the application of artificial intelligence (sight, touch, natural communication, learning, diagnosis, planning, integration) to robots, cells and workshops, with the generic aim of creating long-term infrastructures for other programmes.

The industrial technology programme serves to see pre-competitive medium-term achievements in the fields of fabrication systems on the one hand and of auxiliary equipment on the other. As far as systems are concerned, PAUTA is considering the development of automatic warehouses, control of continuous processes, flexible small fabrication, robot-guided dollies for transport, inspection (alarm, diagnosis, preventive maintenance, interactive testing) and local industrial networks (information flow, module hierarchy, distributed task). The development of auxiliary equipment includes robots (with manipulators and components), sensors, instrumentation (spectrometry, ultrasound, infra-red rays, image processing) and specific software (robot programming, simulation, defect detection, design optimization, technical computation, cost calculation, etc.).

The industrial application programme on the one hand is developing new projects for real processes in convertible sectors (household appliances, electronics, electric apparatus, industry auxiliary to car manufacturing, munitions, light weapons, textile machinery, mechanical manufacture, textile articles). On the other hand, this programme serves to propose the distribution of applications through a territorial tree supported on Redinser, the present integrated network of electronic services for micro-electronics and Cad/Cam. (Bulletin IBI Press, No. 60, December 1985)

UK:

Transputer sales in line with Inmos' forecast

Just one month after the launch of the Transputer, Inmos is able to report orders worth £1m.

Inmos founder Iann Barron said sales were. "About in line with our forecast," and said that sales were splitting roughly half and half between Europe and the United States. "Most European sales have been made in the UK," he added.

Barron said Inmos was experiencing: "A fairly interesting response" to the launch of the Transputer. He could not disclose the identities of any customers, though this was a source of some disappointment to him. "We have got one or two nice customers," he said, "but they have asked us not to reveal their names."

Inmos is believed to be looking for Transputer-generated revenues of between £25m and £30m over the next 18 months, so the value of orders received so far bodes well for the future of the chip. (Electronics Weekly, 13 November 1985)

New board to advise on industrial research

The British government has amalgamated the advisory boards that report to it on industrial

R&D. The move is an attempt to bring ministers closer to current technology so that, for instance, they will be able to make better decisions on priorities in a climate of reduced state spending on R&D.

The five Requirements Boards, composed of industrialists, academics and civil servants, which advised the Department of Trade and Industry (DTI) on how to spend its R&D budget, have been axed. They are replaced by a single Technology Requirements Board to provide ministers with strategic advice on R&D.

The DTI's expenditure on R&D in its own laboratories and in industry schemes has doubled over the past six years to £394 million. This sum now accounts for 26 per cent of the DTI's annual expenditure. But by 1987, the department estimates that it will be spending £380 million on R&D. Although this is a reduction in real terms, it will represent one-third of the department's total budget.

One of the tasks of the new board will be to look at the increasing expenditure on international projects such as the Eureka programme. International projects now account for a quarter of the department's R&D budget. The 14-strong board will also tackle the problem of providing enough skilled manpower, particularly for information technology, and the dominance of defence spending which accounts for 27 per cent of total British outlay on R&D.

Junior industry minister Geoffrey Pattie, responsible for science and technology, has stressed the need to choose technologies for government backing. "Neither government nor industry can pursue them all," he says.

The chairman of the new board, John Collyear of the AE engineering firm, said last week that its main role would be to select priorities. Collyear believes that the present low investment by British industry in R&D, compared with other countries, is due to the short-term view of the institutional investors who fund it. He also blames high interest rates, a stock market that is unsympathetic to companies that are spending money on R&D, and a British preference for putting money into tangible assets, such as property. Collyear would like to see British companies made to declare their R&D expenditures in their published accounts as a way of highlighting their importance. (This first appeared in New Scientist, London, 5 December 1985, the weekly review of science and technology.)

Alvey outgrows its UK base

Evidence is growing that the Alvey follow-up could be a pan-European rather than a national programme. Alvey director, Brian Oakley said that the extra cost of bringing to commercial fruition the machines developed under Alvey programmes spawned the need for the wider market base and increased muscle provided by consortia of European rather than only UK firms.

Oakley was speaking at the launch last week of Flagship - the latest and largest Alvey project in advanced computer architectures. At the same meeting Secretary of State, Sir Geoffrey Pattie, said that where the government wouldn't arbitrarily terminate existing projects when Alvey funds run out, "in my view we will be tending to collaborative European ventures."

The Alvey Directorate under the Eureka banner has already driven the formation of a new movement, the Pan European Network Systems Architecture scheme (PENSA) which it hopes will lead to standards in advanced architectural developments on a Europe-wide basis. "PENSA could do for architectures what MSX did for Japanese micros," Oakley said.

Oakley also revealed that the UK is engaged in discussions with the French to develop common tools so that all companies in the two countries can use the same software environment to develop languages.

Oakley said that the Directorate is keen to see open systems standards developed in the areas of Integrated Project Support Environments, and is hoping to establish the DACTL declarative architectural target language developed under Alvey as an international standard in all parallel and fifth generation computing work.

But the Alvey moves to promote more openness between the various European factors could cause consternation. The government has already said that it will not be keen to provide financial support to Eureka projects, and the problems of intellectual property rights which have dogged the many Alvey schemes could be much more concentrated for cross-border ventures.

If PENSA's initial aim of setting up ventures on parallel computing under Eureka comes to fruition, it will be interesting to see how the governments involved sort out their differences not just in terms of funding, but on the more mundane issues of marketing rights and the transport and export regulations affecting the finished products. (Electronics Weekly, 11 December 1985)

USSR

Moscow launches Eureka for the Eastern bloc

The Soviet Union and its economic allies in Comecon have announced a wide-ranging programme of scientific and technological cooperation. The initiative, which will be run from Moscow, gives priority to five areas: computers, automation, atomic energy, new materials and technologies, and biotechnology.

The first new project, involving the seven nations of the Warsaw Pact, plus Cuba, Mongolia and Vietnam, will be on robotics and is called Interrobot. Other early developments will be in personal computers, fibre optics, powder metallurgy and biotechnologies for medicine and agriculture.

The initiative was announced at a meeting of Comecon in Moscow on 18 December 1985. It has been in preparation since June 1984 and will guide the 10 nations in their scientific and technological development to the year 2000.

The Soviet Union's Prime Minister, Nikolai Ryzhkov, said that the nations of Comecon had too often carried out identical research simultaneously. This should now end.

The Hungarian Prime Minister, Gyorgy Lazar, called in his speech to the meeting for strict financial accounting of the programme, and for the economic relationship between participating countries to be clarified for each project.

For the Soviet Union, the key to advance is unquestionably computers, the area where it has been hit hardest by the West's controls on exports. The Soviet Union believes that its failure to keep up with the US in this field has upset the military balance between the two superpowers.

After the meeting, officials of Comecon denied that their programme was a response to the US's

Strategic Defense Initiative, preferring comparisons with Western Europe's Eureka project. One suggestion being made is that the Soviet Union will propose some cooperation between the two projects. (This first appeared in New Scientist, London, the weekly review of science and technology.)

Soviet database available to Europeans

A Finnish company in communications and marketing has obtained the exclusive right from Soviet authorities to have access to the database of the Soviet foreign trade organizations. Such data can then be traded throughout Scandinavia.

The Soviet Union's foreign trade is regulated by the relative ministry which oversees all the bodies especially set up for operations in the various economic sectors. All data relative to the activities carried on by these bodies, to contracts stipulated with foreign firms, to trade relations in course with other countries, to future programmes and plans, have been collected in a database that was completed last month. Among other things, news concerning economic, social and development plans the Soviet government intends to implement in its country are entered into it.

Access to this type of information will prove to be extremely important for all European companies intending to entertain business relations with the Soviet Union. The data will be sent at first, but plans are to make a direct connection in real time shortly.

The Finnish company will begin selling such information at the start of the new year. Other agreements of the same nature are now under discussion and about to be signed by the authorities of other European countries, namely France and Great Britain. (Bulletin IBI Press, No. 60, 23 December 1985)

U.S. and Soviet computer experts use net to chat

After some hesitation, the U.S. Department of Commerce has given the New Jersey Institute of Technology a green light to use the school's computer conferencing system for private ongoing links between Soviet and U.S. computer scientists. Communications actually got under way last July, but were suspended briefly in October while the DOC decided whether computer conferencing - the exchange of electronic messages - comes within the purview of export regulations.

The conference is taking place on the school's Electronic Information Exchange System (EIES), over Telenet connections to Moscow by way of Vienna and Helsinki. The Soviets maintain leased lines to those Telenet ports.

Russian scientists taking part in the conference are all from the Institute for Automated Systems. An affiliate of both the Soviet Academy of Sciences and the State Committee for Science and Technology, the institute is charged with setting up communications among Soviet computer systems. The Americans are mostly users of EIES, a system designed by NJIT professor Murray Turoff in the 1970s to develop computer systems as a medium for human - rather than machine - communication.

Though ordinary phone service to the Soviet Union is available and ham radio operators in the two countries converse regularly, its participants believe the EIES conference is the first open-ended electronics meeting between U.S. and Soviet citizens. Cost of the Soviet account is only $75 per month, plus telephone charges. (Reprinted from Electronics Week, 11 November 1985,

LEGISLATION AND STANDARDIZATION

Programs get copyright cover in the UK

Computer programs now have statutory protection in their own right as copyright works. On 16 July 1985, the Copyright (Computer Software) Amendment Act became law and extended the 1956 Copyright Act, which accordingly now applies in relation to computer programs (including those made before the commencement of the Act) as it applies in relation to literary works.

Until now, there has been uncertainty about the extent of the copyright protection available for computer programs. The new Act means that software owners can now claim copyright protection in their computer programs as such and can restrain their unauthorised copying, sale and adaptation. Adaptation is specifically stated to include conversion into or out of a computer language or code into a different computer language or code. Accordingly, converting a program from one machine language into another is now an infringement of the copyright in the original program.

The Act breaks new ground in providing that reproduction for copyright purposes includes the storage of a copyright work in a computer. This is a significant change: although the use of a computer program is still not a restricted act for copyright purposes, the unlicensed loading of a program, or of any copyright work, into machine memory will now be an infringement of copyright. Since this part of the Act is not restricted to computer programs, the new restriction on storage applies to all copyright works, including databases and digitised cinematograph films. The Act talks about 'storage' in the context of copying as a restricted act.

Where programs are stored in read-only memory and are thus permanently loaded, their subsequent use will not involve copying into memory and so will not be a restricted act, but for most software, which must be loaded into memory from disk or tape before each processing session, the Act effectively restricts each session's use.

Criminal offences are substantially increased for selling or letting for hire and for public exhibition by way of trade of infringing copies of computer programs. Fines of up to £2,000 and imprisonment for up to two months may now be imposed for these offences.

Software licences now take on a new significance and the new right to restrain the unlicensed storage of copyright works, including computer programs, in machine memory, is an importance advance. Processor-specific licences can now effectively restrain the loading of software into other processors, including upgrade or replacement machines. Down-loading across networks to remote machines, or to terminals with their own memories, is also in effect restricted, provided the receiving terminal can properly be described as a computer. However, remote job entry, remote processing and remote access which does not involve local storage or down-loading, will still not be restricted.

The Act represents a considerable achievement for the Federation against Software Theft, which has been campaigning for this basic affirmation of copyright protection status for software. Although the Act leaves many questions unanswered - for instance, it does not define what actually comprises a computer program - it puts the existence of copyright protection in computer programs beyond doubt and makes the unlicensed sale of infringing copies a serious criminal offence. The Act is an interim measure designed to give immediate protection from piracy. A more wide-ranging government review of copyright in relation to software generally is expected shortly. (Computing The Magazine, 17 October 1985)

Europe, Japan to agree on consumer standards

Leaders of the top European and Japanese consumer electronics companies met in London and agreed to set-up an international working party to establish world standards for future technologies, including high definition television.

Dr. Wisse Dekker, president and chairman of Philips, said: "We want to pursue the matter of standardisation. That is essential if we want the consumer electronics industry to develop further."

Akio Morita, chairman and chief executive of Sony, said: "Our consumer electronics industry is different from many other industries, in that we can create new demands and new markets. Both sides, Japanese and European should agree to cooperate in research and development."

At the heart of the decision to set up the working party is a desire on the part of the consumer electronics companies to prevent standards competition, which Dekker says, "confuses the market-place and wastes research and development resources." (Electronics Weekly, 4 December 1985)

Communication standards

It's not as nasty as previous uprisings in Europe, but there's a quiet revolt brewing there against International Business Machines Corp. The technological magnet that IBM has traditionally used to get buyers of more than one computer to purchase primarily IBM machines is drawing fire from both customers and competing computer makers. IBM is counterattacking. But if it doesn't keep the insurgents at bay, it could start to lose some of its 40 per cent share of Europe's computer market representing $10.4 billion of IBM's annual sales.

The fight is over communication standards, the set of rules that determine how a computer structures data to be received by other machines. For a decade, IBM machines have used the company's standard, called Systems Network Architecture (SNA). This tended to lock in customers who bought more than one machine, because IBM's use of SNA meant that non-IBM computers couldn't communicate with an IBM machine as well as Big Blue's can.

In the early 1980s, the International Standards Organization, a group of officials from 90 countries who get advice from representatives of the big computer companies, came up with a more versatile standard for letting the computers of many different manufacturers transmit data to each other. Now the European Commission is pushing European governments to buy only computers that use the standard, which is known as Open Systems Interconnect (OSI). Customers, meanwhile, are also demanding such machines.

European computer buyers who want OSI are finding unexpected allies: big US businesses. General Motors Corp.'s Manufacturing Automation Protocol (MAP) program uses OSI standards to link previously incompatible machines. A half-dozen or so other US companies are tentatively committed to adopting MAP's technology.

"If you look at the No. 1 need of customers today, they want to connect different computers," says Maureen A. Lawrence, product marketing manager for networks and communications at Digital Equipment. "They don't want to be a slave to a single vendor anymore." OSI, she says, "offers a viable alternative" to IBM.

IBM is not in danger of losing vast amounts of business anytime soon. "Any European customer that leaves IBM because of OSI is probably using it as an excuse," says Dixon R. Doll, chairman of DMW Group Inc., a consulting firm in Ann Arbor, Mich. "Their real reasons are probably one of two things: price considerations or nationalistic pressure to buy from the country's preferred local suppliers."

Still, IBM is under pressure. In July the company announced OSI software products aimed at keeping its market share towering over its rivals'. It has also established a service center in La Gaude, France, that will help European clients come up with links between SNA and OSI. "IBM views OSI very positively," insists L. John Rankine, the company's director of standards. "We believe our contributions to OSI are second to none." Indeed, IBM is participating in General Motors' OSI project.

There's always the chance that by embracing OSI, IBM could bring in more revenues. Its own experience with personal computers has shown that versatility sells machines. But IBM's competitors are betting that OSI will help them more. Believes one European computer sales manager: "In the end, OSI will cost IBM market share. How much depends on how they play it." (Reprinted from Electronics Week, 9 December 1985,)

International Unix standard is up and running

A funny thing happened when AT&T Co. set out in mid-1984 to standardize its Unix System V operating system for Japan: the effort became the basis for an international definition of Unix. A demonstration system, now up and running in Japanese, uses a method that will allow the addition of language supplements for French, Italian, and others.

Unix and the C language now will be even more portable and in a position to create a major impact around the world. Changes in the computer character set for the international definition of Unix were worked out jointly by the Japanese Unix System Advisory Committee, AT&T Bell Laboratories, and national committees in major Western European countries.

Rather than designing a complete new system for Japan, AT&T is molding Unix into a generic international operating system with a Japanese-language system on top. In keeping with the international spirit, the advisory committee opted for a Roman log-on, even though other messages are usually in Japanese.

First release is scheduled for early January. The generic version, with supplements for other countries, will follow. Because the system is easily portable, a number of products are expected in late 1986 or early 1987, with minicomputers being emphasized initially. Meanwhile, Larry L. Crume, president of AT&T Unix Pacific, is working with committees in China and Korea to develop Unix versions. ...

Difficulties in incorporating the Japanese (and Chinese and Korean) languages in Unix include the need for 16 bits per character and the need to eliminate conflicts with ASCII. The participants wanted to make character codes unique, so locking shift codes, or escape codes, are omitted as much as possible. As before, Unix remains byte oriented, but now it also supports multiple bytes per character. In Japan's version, standard Japanese text characters, both the kana phonetic characters and the more complex kanji Chinese characters, are in principle written as two bytes. (Reprinted from Electronics Week, 9 December 1985,

SOCIO-ECONOMIC IMPLICATIONS

Technological change in Brazilian industry

Dr. José Ricardo Tauile, Vice-Director, Instituto de Economia Industrial at the Universidade Federal de Rio de Janeiro, Brazil, was kind enough to send us a copy of his dissertation on the subject of microelectronics automation and economic development, (the case of NC machine tools in Brazil, April 1984) from which the following excerpt is reproduced with kind permission of the author:

Summary and conclusions

"In concluding this dissertation, it may be interesting to make a brief review of some of its main results. First of all, the process of change in the technical basis of Brazilian industry, stimulated by the introduction of ME principles and equipment, has not only started, but seems to be an irreversible movement. The case of NCMTs, owing to their technique-reproducing character, is particularly helpful to identify some emerging tendencies, even though the local process of diffusion is still in its initial stages, specially if compared to the experience of developed countries. Resorting to those countries' experience is important to this work for many reasons. It makes it possible, for example, to detect the beginnings of important modifications in the international division of labour which substantiates the process of contemporary capital accumulation on a world scale. These modifications will - or have begun to - affect the Brazilian economy one way or another, superimposing themselves to the internal factors and the very dynamics of this economy. In this sense, we have shown that the diffusion of the use of NCMTs is led by firms of foreign origin. The majority of producers of NCMTs are also composed of subsidiaries of foreign companies, despite the current efforts to build a national capacity to produce and design such types of equipment. In particular, NC has been the object of governmental policies specifically aimed to attain this goal.

"Brazilian economy, now in the throes of a severe crisis, has been compelled to gear a significant portion of its production to exports, in order to meet its huge foreign debt. As a result of the modernization of their productive units, subsidiaries of foreign firms and large national companies have been increasing their competitiveness, particularly in relation to most medium-size and small national firms, which cannot keep up with their pace in this process. On the other hand, this modernization may serve the organizational updating of multinational firms in light of the possibilities opened by the new ME technology, which would tend to enhance the dependent character of the Brazilian industrialization process. Our analysis of the NCMT diffusion process in terms of the use, production and design of these machines aimed precisely to highlight the fact that its implications, which are both far-reaching and contradictory, may accentuate that character of dependence.

"We have sought to emphasize that this diffusion process, albeit concentrated on the capital goods sector at the time of our research, is not only part, but is also indicative of wider and more substantial transformations in the technical basis. Other types of technologically similar equipment, such as robots, programmable controls, etc., have already begun to be used in other sectors of production. By 1983, approximately 20 per cent of the NCMTs installed in Brazil were already in the automotive industry (including the production of auto parts). This industry did not only secure a substantial increase in its participation in the NCMT market as compared to 1980, but also pioneered the introduction of robots into production lines in Brazil. We must bear in mind that the automotive industry is not only the leader of manufacturing production in Brazil, but is also almost entirely owned by foreign capital.

"The change in the technical basis may thus reinforce some contradictions which are already present in the Brazilian industrialization process, in that it may accentuate the divergences between the interests of the socio-economic agents playing in the Brazilian scene. It is true, however, that there are many alternatives for the organization of the local industry, some of which may influence a partial redefinition of the basis for the insertion of its labor force into the international division of labor. Consequently, there is also ample room for negotiations between the parties concerned, depending, of course, on the actual course of Brazilian socio-economic development and on the motivation provided by the dynamics of the economy at an international level.

"The reinstatement of the democratization process in Brazil will certainly be an important element influencing the forms and the pace of automation of the local industry. Moreover - though this point is not always clear - the reverse of the coin is also true. In other words, knowing how to incorporate the new ME-automation techniques and learning to live with them harmoniously may be a structurally important factor to strengthen the country's redemocratization process in the long run. As a result of this, we may figure that there will be an increase in the economy's vitality, allowing for a qualitative leap in its development. In essence, what is at stake is the viability and legitimation of the new possibilities of production of a social surplus opened by the new technologies.

"Again, the experience of developed countries is useful in that it helps anticipating the socially undesirable effects that may result from the new wave of automation, so that adequate steps may be taken to attenuate them. In many instances - as in the case of the impact on the volume of employment - the conditions of NCMT utilization in other countries do reproduce themselves almost integrally in Brazil. In our research, however, we were not always able to explore those conditions in sufficient depth to confirm them empirically, even though there is enough evidence of certain tendencies. We therefore used the experiences reported in international literature to substantiate some of our arguments. A case in point is the treatment we have given to the question of the new skills implicit in the utilization of NCMTs.

"In any event, it has been possible to obtain unequivocal confirmation of the fact that ME utilization fosters an acceleration in the division of labor in certain activities, thus extending significantly the limits to production automation attained in the electromechanic technical basis. The advent of the ME technical basis accentuates, in a somewhat implicit manner, a change in the professional culture, through the adoption of a systematic conception of the manufacturing process of production by all parties involved in it - in our case, even by NCMT operators. Plant sites and firms as a whole tend to reorganize themselves so as to benefit fully by the new horizons of flexibility and versatility opened by the new ME techniques.

Sharply distinguishable in this process of production transformation and reorganization is the manual laborer's loss of importance, and therefore of power, allowing for the control over the factory to be increasingly exercised by the office, whether the latter is close to or far away from the productive unit. The new power structure that is established within the collective labor process - in which NC programmers grow in importance - must not, therefore, be understood as a definitive one. In essence, it only reflects a continuous struggle between capital and labor over the control of strategic information and knowledge about the production process, which is far from finished. Moreover, this is a dispute which transcends the frontiers of countries and their social classes, forming an extremely complex network of interests and power.

"It has not been the objective of this thesis to make generalizations from the Brazilian experience to other developing countries, let alone to the developed ones, though they may occasionally be inferred. Additionally, the scope of this work is clearly limited in face of the variety and multiplicity of the technical and social questions involving its theme. We nevertheless hope to have contributed to reduce the gap of knowledge about this facet of contemporary social reality. The continuous preparation of works along similar lines is both necessary and urgent".

DP growth is not matched by job creation

Growth in the data processing industry is not being matched by job creation and women seem to be getting the poorest deal, according to the Labour Research Department. The research is based on Department of Employment statistics for December 1981 to December 1984.

Labour Research, which is the monthly magazine of the independent Labour Research Department, also pointed out that full time employment in production-based industries dropped by 9.08 per cent of the workforce, with 697,700 jobs being lost. Perhaps the most chilling statistic is that while electronics and information technology is expanding by over 20 per cent a year, the number of jobs created in the UK only amounts to a few per cent over the past three years. This again bears out fears that overseas high technology firms are not making any real investment in the UK in terms of either the infrastructure or technology transfer.

The main benefit of having a factory in the UK or any other EEC country seems to be that it makes it easier for the vendor to claim the products are indigenous to the EEC. In this way, firms are entitled to an increasing share of the lucrative contracts in the public sector. Most of these firms often use their EEC base as little more than a place for final assembly to enable them to stick 'Made in Britain' or equivalent labels on their goods and services.

A breakdown of the figures shows that for electronics the marginal increase in jobs of 0.15 per cent reflects a drop in 'traditional' markets such as telecommunications of 16.03 per cent despite the fact there is healthy growth in digital private automated branch exchange sales worldwide.

There was a 20.42 per cent rise in employment in the electronics components and system-building markets over the three-year period. This compares badly with the 20 per cent plus growth anticipated in this industry annually.

In information technology - which the report classifies as including office machinery and data processing equipment - there is little tradition of taking on women part time.

Most vendors and users have preferred to use full time staff wherever possible to try to preserve commercial secrets and to accommodate the wide-ranging impact of data processing on organisations.

But there has been what the magazine describes as a 'substantial increase' in the employment of women part timers, from 2.8 per cent to 3.8 per cent.

There were also noticeable increases in the part time employment of women in industries which are major computer users such as banking, insurance and finance. But those sectors also gained most of the new jobs created during the three-year period. Employment rose by 177,700 jobs, 41 per cent of all new opportunities created in the service sector. This was part of a trend to create jobs in the service sector, which now accounts for nearly two-thirds of those in work (64.84 per cent).

It is government policy to harness the UK's lead in software development to create more jobs. Doug Eyeions, director general of the Computing Services Association has said he welcomes moves to generate industry and work.

But this is also worrying for the Trades Union Congress (TUC). While it is TUC policy to promote job opportunities for women as a means of pursuing greater equality, TUC chiefs admit they have experienced difficulties in providing women with the incentives to organise. Admittedly some of the controversial agreements guaranteeing a single union and no-strike policies do give women part timers some protection.

For example, these types of agreement give members of unions - in many cases for the first time - access to binding arbitration.

Growing concern over the effects of chemicals used in electronics and of radiation emanating from visual display terminals means that more middle class workers are aware it could happen to them.

As the Government has found with the teachers, taking on a solidly middle class union is not the sort underbelly of the TUC they had previously imagined.

While there may not be too much concern about miscarriages and deformed babies among the vdt users, the trend to take more middle class workers into high technology could be the one factor which makes the Government take note. (Computing The Newspaper, 5 September 1985)

Chips not guilty of job losses

Less than one per cent of job losses are due to the introduction of new technology, claims the Policy Studies Institute (PSI) in a major new report published yesterday.

The report, Chips and Jobs, investigates the effect of new technology on working lives, and concludes that most fears about new technology are exaggerated and unfounded.

Each year an average of one worker per factory is made redundant by the introduction of technology, claims the report. Dismissals are rare, because natural wastage accounts for most job losses, it adds.

The report shows that worker opposition to new technology is far weaker than generally thought. Only seven per cent of factories and six per cent of offices find opposition from staff to the introduction of new technology. Outright opposition, as in Fleet Street, although much publicised, is rare, says PSi.

British trade unions have adopted a generally positive attitude to new technology, claims the report. Opposition from trade unions is twice as common in France and Germany. The report suggests that union acceptance has been a key factor in the introduction of new technology in Britain.

The major factor limiting the introduction of new technology in manufacturing industry is a shortage of suitably qualified personnel, claims the report. In Britain 45 per cent of manufacturing firms face problems introducing new technology because of skills shortages. This compares with 55 per cent in Germany and 51 per cent in France. (Electronics Weekly, 17 November 1985)

No robots, no jobs, says Nedo

Thousands of jobs could be at risk over the next few years if British industry does not adopt advanced manufacturing techniques (AMT) such as Cad/Cam and robotics. This warning was sounded last week by David Trippier, under secretary of state for industry, at an AMT seminar. The event is the first in a nationwide series of 10 seminars organised by the National Economic Development Office (Nedo) to alert industrialists to the benefits of AMT.

The DoTI is currently under great pressure to reshape its Microelectronics Application Programme (Map) which ran from 1978 to March 1985, when it was absorbed into the Support for Innovation scheme. A clarion call for Map to be continued came from the Policy Studies Institute in its Map report published in September 1985 which described Map as a great commercial success for British industry.

Interest in high technology certainly is keen among UK industrialists - 220 of whom attended last week's AMT conference. The conference hinged on a recent Nedo report which shows AMT can cut material costs by 12-15 per cent, production costs by 14-27 per cent, tendering time by 80-90 per cent, delivery costs by 50-73 per cent and increase operating profits by a staggering 112-310 per cent in batch engineering. (Computer Weekly, 3 October 1985)

Clockwork jobs plague high tech office workers

Compensation claims for repetitive strain injury (RSI) among Australia's workforce over the past five years have trebled, while the cost of such claims has more than doubled. RSI 'down under' is now a $A 400 million headache for industry, and computers are the new villains. Since 1980, RSI in Victoria alone has leapt from a modest 3.3 per cent of the number of claims and 9.5 per cent of the cost of claims to an alarming 10.7 per cent of claims and 23.3 per cent of cost.

Australian business is now spending literally millions of dollars on ergonomic furniture to help reduce RSI, but the bottom line is the cost of workers' compensation, with insurance premiums for business of more than $A 2 billion in 1984-85.

The country's largest private workers' compensation insurance underwriter is C. E. Heath, which has a 25 per cent stake in the Victoria market. John Clarke of Heath admits that the Australian workers' compensation market faces $A 2.5 billion in claims, with RSI accounting for $A 400 million of the annual cost. In Victoria, he says, the cost to business of the total compensation pay-out is about $A 800 million, with the RSI pay-out at around $A 200 million.

RSI is the umbrella term used to describe complaints and injuries related to stress and the over-use of muscles and tendons. It has become the industrial disease of the '80s and a fundamental factor in the redesign of screen-based equipment and the rethinking of the notion of work. ...

Ergonomists and occupational health specialists say RSI has frequently been incorrectly diagnosed as arthritis or neurosis. The changing economic outlook and the growing use of electronic data entry equipment helps to explain the explosion of present figures. Employers, particularly in the manufacturing sector, have had difficulty in surviving the economic recession and have often responded by raising production rates, most commonly by increasing the speed of assembly lines.

The introduction of advanced technology has reduced the number of tasks carried out by employees and exposed them to greater repetition. This is particularly so with keyboard operators where files and management for data entry are no longer stored in filing cabinets but are accessed directly through the keyboard, removing the former breaks from keying. Overtime incentive payments and quotas have added to the pressure for greater productivity. On the other hand, bad work habits, lack of flexibility and resistance by employees to new technology have compounded the problems - particularly in the area of stress. (Computing The Magazine, 19 September 1985)

GOVERNMENT POLICIES

Education and research in micro-electronics in Flanders, Belgium

The Interuniversity Micro-electronics Center is set up in Leuven as part of an industrial strategy of the Flanders Government Belgium in the field of micro-electronics. Micro-electronics is invading every aspect of our society and the results of research and development in this field present many new prospects for future industrial activity.

The Flanders Government worked out a comprehensive program to promote education, research and application of this technology. In order to make small and medium sized enterprises aware of the potential of micro-electronics in industrial products and processes, the micro-electronics center INVENTIVE SYSTEMS has been created. It already organized many seminars and conducted a large number of feasibility studies for new applications of micro-electronics, resulting in several new products. The interuniversity laboratory IMEC is created with the following objectives:

- Improve, extend and rationalize the education.

  The educational program INVOMEC for accelerated training of VLSI system designers was already started in 1983. IMEC will continue, in collaboration with 16 institutions of higher education, to train highly qualified micro-electronics specialists which will be required to meet the industrial needs in the future.

- Carry out research and development in micro-electronics and related fields, five to ten years ahead of industrial needs. This R&D has to be part of the foundation on which existing and new industrial companies build their strategy for high-technological development in the future.

By the creation of IMEC, the Flanders Government in Belgium clearly aims at improving the micro-electronic environment, making Belgium attractive for industrial companies in these fields. Several industrial research parks in proximity of IMEC and sponsored jointly by regional authorities and the universities are available for the establishment of research-based industries and industrial research institutions.

Laboratory facilities and organisation

IMEC will be implanted in Leuven, close to the ESAT laboratory of the Katholieke Universiteit Leuven. ESAT has built up a worldwide scientific reputation in this field. It is doing both fundamental research and research oriented towards applications.

ESAT is carrying out R&D in collaboration with many industrial companies in Belgium, and in Switzerland, Germany, Holland, France, the United Kingdom, Italy, the United States ...

ESAT also was the seed for several new high-technology companies. The basic know-how and the research equipment in the fields of technology and of design methodologies are transferred to IMEC. The experience and the know-how of ESAT will be used as an excellent start-up basis of IMEC.

The engineering of the new laboratory is done jointly by two engineering consultants: Lockwood Greene of Spartanburg (South Carolina, USA) and T.K.B. (Antwerp, Belgium). These two companies already formed a joint venture for the purpose of designing other facilities of this nature in Europe.

The total investment is 40 million dollars, half of which is related to equipment and the other half to building and infrastructure. This initial investment is funded by the Flemish Government in Belgium. The annual budget including capital equipment, operating expenses and personnel is estimated to be 20 million dollars

Less than 70 per cent will be funded by the government; the rest has to come from contract research.

The R&D facility will consist of over 3,900 m^2 ultra-clean processing area, a fast turn around standard processing line of 300 m^2, a computer room of 300m^2 and 6,700 m^2 administrative and supporting laboratory space. A teleclassing system (one way video, two way audio) will be used for making specialised courses and seminars available to students of the Universities in Ghent, Brussels and Leuven.

The new facility will be operational in January 1986 and will accomodate more than 250 researchers and staff. In the meantime, the ESAT facilities are used to start the activities.

The Board of Directors of IMEC consists of 2 members from industry, 4 members from universities and 3 members from government. The Chairman of the Board is one of the industrial representatives. There are three advisory committees: a scientific committee with an international composition, an educational and training committee with members from 16 institutions of higher education and a research coordination committee with members from the three universities.

Description of R&D activities:

- Advanced Semiconductor Processing: development and characterization of new processing steps, the implementation of these steps in well-proven process sequences and the use of these processes to fabricate novel devices and circuits. It includes research on micron and submicron patterning (direct e-beam writing on wafers, development of new resists, optimization of multi-layer resist techniques and of planarization and lift-off, ...), insulator and conductive layers for VLSI (thin insulators, materials for interconnects, doping techniques, ...), modelling and simulation of processes and devices and GaAs processing (MESFET circuits with LSI complexity, very high speed devices, integrated opto-electronic components, ...). This division operates a prototype line with the purpose of establishing a complete process sequence. Advanced submicron MOS and bipolar processes will be developed with great emphasis on the feasibility to transfer the processes to industrial production lines. This line is also used to fabricate small series of custom made devices or circuits.

- Materials and Packaging with research on materials, analysis techniques, off-chip interconnection technology, sensors and solar cells. The objectives are:

  - The preparation of novel semiconductor materials or structures that are important for future micro-electronic and opto-electronic devices. It includes work on SOI, MOCVD and MEB techniques, ...

  - The physical and electrical characterization of materials, device structures and interfaces. It includes work on SIMS, SEM, RBS, AES, DLTS, ...

  - The study of new techniques for packaging and reliability testing of VLSI chips and hybrid circuits.

  - The fabrication of new types of sensors and of solar cells (using a-Si, semicrystalline silicon and III-V compounds).

  - Automated device and functional circuit measurements.

- Design methodologies for VLSI systems

The goal of this group is research and development of new techniques and methods for design of complex custom VLSI chips beyond standard cell and gate array techniques. The deliverables of such research are therefore design methodologies embedded in advanced CAD programs available for use in education and for implementation in CAD systems of project sponsoring organizations and industries. Clearly such research in design strategies and creation of new tools is only feasible if it is driven by VLSI system applications which are today mainly resulting from Digital Signal Processing (DSP) systems such as digital audio, image processing, telecommunication and cryptography.

The development of tools and methodologies is oriented towards a CMOS double metallization 1.25 micron process as presently under development by the Advanced Semiconductor Processing group.

Therefore this group can be considered as a bridge between CMOS technology and device research on the one hand and university and industrial systems research groups on the other hand. Further development of VLSI design education in the INVOMEC group and in universities is also supported by this group. More in particular the research can be subdivided in three parts which cover the spectrum between behavioral design, layout and chip architecture.

Description of the INVOMEC activities and interaction with universities

INVOMEC was established as an industrial training program at the end of 1982 with the objective of training designers for custom- and semi-custom integrated circuits. It will become an integral part of IMEC in September 1985. In 1983, the ESAT courses on components, technology, digital and analogue circuits, CAD use and cell design were followed by 4 professors coming from 2 universities and from 2 institutions for higher technical education. In 1984, these courses were given by these 4 professors to 30 professors coming from 16 institutions of higher technical education. Additional seminars and design training were given by the INVOMEC staff, the ESAT staff and engineers from industry.

In 1985 the knowledge was transferred to 3 universities and 13 higher technical schools. INVOMEC uses 2 VAX-750 computers. The 3 universities each got a VAX-750 computer with a number of graphical terminals. Every one of the 13 higher industrial schools have at least one graphical terminal connected by a data-line to the central computer. IMEC makes available a complete software package for design of integrated circuits (using gate-arrays, standard cells and full custom); gate arrays are obtained from a semiconductor company. A 5 μm CMOS standard cell library is used now and a 3 μm CMOS library will be made available later this year. IMEC also makes available a fast turn around processing line with a 3 μm CMOS technology.

The INVOMEC division of IMEC for the first time gives the possibility to the staff and the students of 16 institutions of higher education to design integrated circuits and to have them fabricated. This strengthens considerably the R&D at the institutions of higher education in the fields of signal processing, artificial intelligence, expert systems, computer architectures, biomedical applications, ...

To increase the interaction with universities, IMEC funds at the universities of Ghent, Brussels and Leuven, equipment and personnel for research complementary to the IMEC activities. Highly specialized courses are teleclassed and can be taken by students at these universities. IMEC also offers the possibility to carry out research for a master's or a Ph.D. thesis at one of these universities.

IMEC intends to collaborate on more fundamental aspects, with university laboratories in the field of chemistry, physics, mathematics and computer science.

IMEC also intends to collaborate with similar laboratories outside Belgium, on

- Large projects, outside the scope of one laboratory.
- Projects where the complementary know-how of several laboratories is required.

Guest researchers will be invited from similar centers on an exchange basis.

Interaction of IMEC with industry

IMEC will stand out as a major independant research resource for industry. Although research in IMEC will be funded partially by the government, additional funding will come from projects carried out for industry in and outside Belgium. IMEC has the proven ability to understand and to meet industrial requirements. The Center can interact with industry in several ways:

- An industrial affiliate program will be set up, enabling a company to learn about non-proprietary research results at an early stage;
- Local industry can benefit from seminars and technical meetings;
- Training courses are offered through the INVOMEC division;
- Guest scientists from industry can be accepted to do research on a problem of common interest;
- Through co-operative projects in the fields of semiconductor materials, of Si and GaAs processing technologies and of design methodologies for VLSI systems. A co-operation is obtained in the following way: a technical discussion is organized to define the problem. IMEC then quotes the time and costs involved in the project. Following the quotation, the company has to confirm the scope and the nature of the investigation. It is clear that any information resulting from a co-operation is treated as confidential. For Belgian companies, partial funding can often be obtained from the Ministry of Science Policy, from the IWONL (the Institute for Research in Industry and Agriculture) or from the Commission of the European Community. For foreign companies, partial funding can sometimes be obtained from the Commission of the European Community;
- Some well-proven complete processing technologies can be transferred to industrial companies;
- Small quantities of special semi-conductor devices and circuits (as e.g. CCDs and sensors) can be manufactured.

Conclusions

The Interuniversity Micro-electronics Center in Leuven, Belgium is part of a comprehensive program to promote education, research and applications of micro-electronics and related technologies, making Belgium attractive for industrial companies in these fields. It is a "state of the art" laboratory for research and development in micro-electronics five to ten years ahead of industrial needs. It intends to play a major role in the European effort on R&D in micro-electronics. By Prof. R. Van Overstraeten, President IMEC (Interuniversity Micro-Electronics Center)

India strives to join high-tech world

The Indian government wants to yank the country into the computer age by liberalizing its tightly controlled computer and electronics industries. US and European companies are taking the bait.

US companies such as Apple, Burroughs, Data General, Tandy, and Wang, as well as such European counterparts as Acorn and Sinclair, have lost no time in taking advantage of the changes and are tying up with local companies. Apart from India's having low wage scales and one of the world's largest pools of skilled technicians, these companies hope to tap what they believe could be one of the largest markets in the world.

Much of the impetus for India's new policies comes from its prime minister, Rajiv Gandhi, who took over the helm of government late last year. His goal for India is to produce about $8 billion worth of electronic equipment, including computers and consumer goods, by 1990, the end of the nation's Seventh Five-Year Plan. The target for computers is 100,000 units annually by 1990, compared with the current rate of 5,000.

To get his program rolling, Gandhi has taken personal charge of India's Department of Electronics, which has become a separate ministry. He has more than the usual interest in computers. The 40-year-old former airline pilot not only spends several hours a week in computer training, but he could be the only head of state in the world with a knowledge of computer programming.

The head of state's closest advisers are popularly referred to as "Gandhi's computer boys" for their expertise in the field. Most of their offices, in fact, have computer links with the office of the prime minister. Gandhi has opted for a fast track style of administration, evidently intent on liberalizing the heavily controlled Indian economy to stimulate faster industrial growth.

India still has a long way to go. Its technology lags behind that of other Asian countries, and domestically made computers are generally clunky imitations of foreign brands. Most India-made computers depend on imported components: they are then assembled in India with locally manufactured cabinets. Consumer electronics goods, such as TV sets and transistor radios, are likewise poor imitations of foreign brands, despite the efforts to copy foreign designs, names, and technology. Much of the manufacturing process still depends on manual batch production.

Western diplomats and businessmen fully back Gandhi's pragmatic approach, a sharp contrast to the stodgy socialist framework that dictated India's policies for decades. Those policies did little to build a domestic electronics industry. In 1984, electronics production totaled $1.6 billion, barely 1 per cent of Japan's annual production. Of this, sales of computers totaled only $110 million (at 12 rupees to $1), with about $34 million going to mini-computers, and $12 million to large systems, according to one survey.

But the government's "whole approach has gone through a big change since November," says Narasimhiah Seshagiri, Assistant Secretary of the Department of Electronics. A new computer policy was outlined at that time, followed by more specific guidelines on electronics announced in March and April 1985.

Briefly, the policies provide for:

- Liberalization of cumbersome industrial licensing procedures.

- Relaxation of import restrictions and reduction of import duties on certain types of electronic components and computer-related items.

- Measures allowing 40 per cent foreign equity in electronics manufacture, and more than 40 per cent foreign equity participation in certain high-technology areas "where the country has not been able to invest sufficiently in research and development". ...

Some locally made computers can cost more than twice as much as their foreign equivalents. Import duties designed to protect local industries are still high - 75 per cent on electronic components and 200 per cent on computers and computer systems that cost up to about $8,000. In addition, only large computers costing the equivalent of $8 000 will be allowed entry into the country. This means, of course, that imports of personal computers are effectively banned unless some mitigating reason is put forth to the government. In that case, an individual import permit is granted for a single unit, a procedure guaranteed to dampen the enthusiasm of any manufacturer of smaller computers.

India's longstanding fear of domination by multinationals in business and industry has barred the entry of foreign companies to the computer-manufacturing sector in the past. Under the more liberal government attitude, companies that have 40 per cent foreign equity may now go into any electronics manufacturing field, provided they commit from 50 per cent to 70 per cent of production for export.

In the past six months, a number of companies have begun negotiations with Indian parties for technical collaboration agreements. These talks generally center on phased manufacturing programs in which technology is transferred to the local company in return for lump-sum fees plus royalty payments for a specified number of years. Under the phased programs, computers or computer-related products initially will be assembled or manufactured in small quantities, depending on market growth.

The government also envisions setting up "electronic cities" or "technology parks" patterned after the Silicon Valley model. These will provide facilities for large-scale computer software investments for 100 per cent export.

In telecommunications, the government has loosened controls over the manufacture of certain items such as telephones, equipment for private branch exchanges, and telex machines, reversing the practice of state monopoly. To replace antiquated telephone systems in the country, India has approved various foreign technologies - from Siemens, Ericsson, and ITT, among others - for technology transfers in digital switching to selected Indian companies. In the meantime, it has brought CIT-Alcatel's E10 system for large exchanges and a second contract for a second phase is likely to be approved in the next few weeks.

At the same time, the government late last year set up the Center for Development of Telematics specifically to develop indigenous digital communications systems based on locally available components. Spearheading the center's work is an Indian-born electronics expert, Satyen Pitroda, who holds more than a dozen patents in electronic switching systems from his years in the US with GTE Corp. Although Indian private industry is skeptical, Petroda is confident that within three years and with a miniscule budget of $29 million, the center will achieve its targets. The Prime Minister himself has expressed support.

For large and sophisticated computer systems, India hopes that a recently signed memorandum of understanding on high technology will lead to quicker transfers of technology from the U.S. Some of the proposed technology transfers include electronic components and equipment for applications in telecommunications, science, industry and defense. (Excerpted from Electronics Week, 2 September 1985

RECENT PUBLICATIONS

UNIDO documents

UNIDO/IS.583
Silicon foundry and design centres in the Arab region: issue and approaches.

New journals

Two journals on the subject of robotics have recently been launched.

- Robotics, published by Elsevier (North-Holland), Amsterdam, Netherlands
- The International Journal of Robotics Research, published quarterly by the MIT Press, Massachusetts Institute of Technology, Cambridge, MA., USA.

Silicon Valley Reader: Contains amongst others: list of all 2,000 high-tech plants of Silicon Valley; the 100 largest military contracts; history of the semiconductor inventions and plant set-ups since 1930; living conditions of engineers and workers; high-tech plant portraits (IBM, HP, Apple ...); survey of the high-tech parks/centers in US; health hazards and drinking water pollutions caused by chip factories; list of water poisoning factories; trade union strategy. 95 per cent in English. 218 pages, 34.- DM (plus postage for shipping abroad). Order detailed table of contents or send cheque to: Dr. Werner Rügemer, D-5000 Köln 41, FRG.

The Software Revolution (by Bob Fertig, published by North-Holland, distributed by Elsevier Publishers, Amsterdam, price $39.)

The pc market is currently in a high state of flux, and Bob Fertig's book takes a detailed look at the reasons for this. It covers the short history of the pc in a good deal of detail, and goes on to provide a comprehensive and enjoyable overview of the 'trends, players, and market dynamics in personal computer software'.

While the historical overview is perfectly adequate, the primary interest in the book obviously revolves around the author's assessment of pc market trends. These he covers in good detail, looking briefly at likely hardware developments, but concentrating mainly on future directions for the various types of pc software.

For the record, Fertig sees Unix as omnipotent, has some interesting comments on IBM's likely successor to PCDOS (a possible extension of VM's sphere of influence), and looks upon portability and integration as being the watchwords of most future software developments.

The text is well enough written, and Fertig's arguments are backed up with an impressive body of source material. Obviously, prognostications such as these must always suffer by having to deal with the moving target the pc market has become, and the book should be read bearing that in mind.

Nevertheless, Fertig does provide a comprehensive overview of the current pc scene. (Reviewed in Computing, the Newspaper 25 July 1985)

New study on gallium arsenide

Although gallium arsenide (GaAs) semiconductor products have been available for a considerable period of time, breakthroughs in technology, mainly the development of the Czochralski method of crystal pulling, are pushing the worldwide market for these products to new heights. And the European market for GaAs components rising from a 1984 market of $378 million to a 1990 market worth $1.15 billion, an average annual growth rate of 20.5% per annum. (All figures in constant U.S. dollars.)

According to a new Frost & Sullivan study, "The Market for Gallium Arsenide Semiconductors in Western Europe" (#E761), GaAs products accounted for 8-9% of the total European semiconductor market in 1984, and this percentage will expand to 11% by 1990. The report divides the market into discrete components and integrated circuits, with discrete components making up the largest segment of the market with $377.3 million in 1984 sales and an estimated $962.8 million in 1990. Integrated circuits will grow faster, albeit from a smaller base: $714 thousand in 1984 rising to $192.14 million in 1990.

Optoelectronic discrete components account for the largest part of the total market. These devices are used in infrared, remote control, and laser components for fiber optics, as detectors, and as solar cells. The 1984 market for these products was worth $199.2 million with growth to $497.5 million in 1990 seen.

The 296-page report analyzes the market by technology, country, and end-user market. Competitive profiles are included. The price of the report is $2,100. For more information, contact Customer Service, Frost & Sullivan, Ltd., 104-112 Marylebone Lane, London W1M 5FU. Phone 01-935-3190. In the U.S., contact Customer Service, Frost & Sullivan, Inc., 106 Fulton Street, New York, NY 10038. Phone 212-233-1080. (Fiber Optics and Communications Newsletter, January 1985)

Database: Directory of American Research and Technology

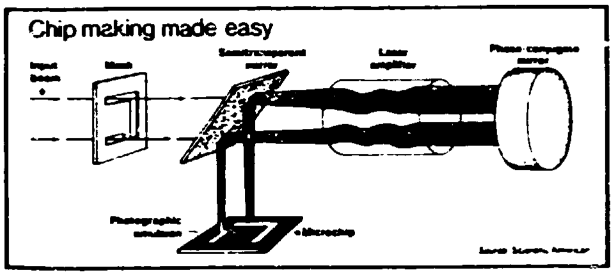
DART identifies some 6,000 parent organizations and 5,000 subsidiaries active in research and development, including commercial, non-profit making, and privately financed research firms. Each full record provides when available, company name as well as names of divisions, parent company, full address, telephone, telex, names and titles of key personnel, number and status of professional staff, description of the nature of research. A classification code identifies research facilities in 1,520 areas, and a Research Activity Code notes whether the organization is involved in R & D for a parent organization, government or industry contract, or is available for consultation. Producer: R. R. Bowker. Host: Pergamon Infoline (exclusive). (Infotecture Europe, No. 77, 19 October 1985)

Report urges developing countries to exploit new technologies

Developing nations are urged to exploit the benefits of the emerging technologies such as biotechnology and information technology, in a report commissioned by the Commonwealth Secretariat in London. Introducing the study, Mr. Sonny Ramphal, Commonwealth Secretary-General, said there was no reason why technology should not continue to be a major source of higher living standards and of increased employment. It must not be allowed to become a scapegoat for failures of economic policy which have led to high unemployment, he said. Mr. Ramphal said the report provides "abundant evidence that where technology was directed, and adapted, to meet the needs of low-income groups, it could be a powerful force for good, especially in agriculture and rural development, where in many forms it could be even directly employment-generating".

The report was prepared by an expert group headed by Prof M. G. K. Menon, the Indian Government's chief scientific adviser. It also recognizes the major role in these technologies of private entrepreneurs and the importance of creating a climate for taking risks. It stresses the need for sources of venture capital, for tax incentives which "encourage risk taking and investment without inducing a labour-saving bias", and for subsidies to encourage the adoption of improved methods. (Technological change: enhancing the benefits. Published by the Commonwealth Secretariat, Marlborough House, Pall Mall, London. SW1Y 5HX. Two volumes. £8.00) (Financial Times, 27 September 1985)

Figure 1



THE ECONOMIST JANUARY 11 1985

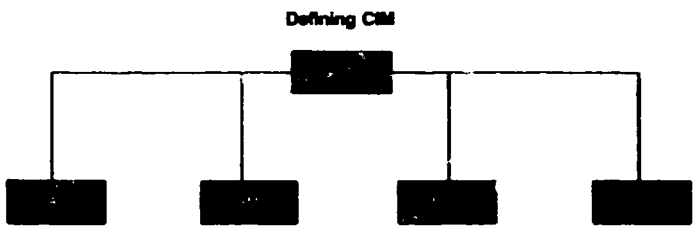
Figure 2

WHERE THE BIG NEW CHIPS WILL FIND MARKETS

Application	Number of units [illegible]	[illegible]
Office automation	32,700	3,950,000
Computer-aided design	24,800	375,000
Robots & factory systems	18,500	187,000
All other uses	24,000	188,000
Total	100,000	4,700,000

DATA, DATAQUEST INC

Figure 3



2. Computer integrated manufacturing (CIM) is the umbrella term used to describe its four subsets: computer aided design (CAD), computer aided manufacturing (CAM), manufacturing resource planning (MRP) and executive decision support (EDS). (Definition from Sentry/Schlumberger)

(Source: Computer Weekly, 24 October 1985)

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Microelectronics Monitor Reader Survey

The Microelectronics Monitor has now been published for four years. Although its mailing list is continuously updated as new requests for inclusion are received and changes of address are made as soon as notifications of such changes are received, I would be grateful if readers could reconfirm their interest in receiving this newsletter. Kindly, therefore, answer the questions below and mail this form to: The Editor, Microelectronics Monitor, UNIDO Technology Programme at the above address.

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Would you like to see any sections deleted?

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