OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

19734

MICRO-ELECTRONICS MONITOR

Vol. 1, No. 1 June 1980

CONTENTS

CONTENTS (continued)

I. NEWS AND EVENTS

Centre on computer software development

A feasibility study, underwritten by a grant of $US 150,000 by the Government of Macau, has been started on the desirability of establishing a research and training centre in Macau to help develop computer software for developing countries.

The proposal has been endorsed by the Government of the People's Republic of China. The Government of Portugal is willing to co-operate in establishing the centre.

The centre would help to disseminate information about the potential benefits of computers in maximizing socio-economic welfare in developing countries and offer software packages and application systems geared to their needs. It would also offer training in software development methods, particularly to technical personnel in the user countries. (Source: ACCIS Newsletter, 7(3), September 1989)

Computer security

With the proliferation of computers and computer data, everyone has become concerned about security - the security of data which needs to be preserved from accidental disclosure, modification, destruction or delay, and the safety of the collection, manipulation and distribution of the data as information.

Computer security is a sensitive issue for large organizations - Governments and businesses. If the integrity of the computer system is open to malicious attacks, public confidence will be threatened. According to an article by Robert H. Courtney, Jr. in Information Age, security is a people problem and employee security awareness programmes pay off. Without employee support, according to Courtney, security programmes cannot be successful.

The United States Government, recognizing that existing criminal laws were insufficient to address the problems of computer crime, enacted the Computer Fraud and Abuse Act of 1986 to improve the Government's response to computer crime. This law focuses federal criminal prosecutions on those whose conduct shows a clear intent to enter, without proper authorization, computer files or data belonging to others. Recently (in July 1989) a federal grand jury made its first charge under this new law.

The United Nations system, like any other organization, is also vulnerable to threats to computer security. The control and management of computer security can help to offset threats. The Administrative Committee on Co-ordination (ACC) and the external auditors have addressed the problem of security in the United Nations and have identified vulnerable areas which should be examined more closely. At its fifth session, ACCIS will also discuss the problems of computer security. The paper (ACCIS 89/021) before ACCIS recommends the establishment of a technical panel to consider the broad spectrum of computer security issues, and make recommendations on co ordinated measures to meet the specific needs of the United Nations system.

The steps necessary to ensure computer security do not necessarily involve the expenditure of large sums of money but the costs of any particular threat do need to be estimated. Concerted action and collective approaches to the problems of computer security may be the best response to the problems. (Source: International Herald Tribune, 27 July 1989; Information Age, Vol. 11, No. 2, April 1989; ACC/1988/PB/R.35, 2 September 1988; ACCIS 89/021)

Africa and the United Nations

Africa and the United Nations: the Mid Term Review of the United Nations Programme of Action on Africa is the title of an information kit which has just been published by the Non Governmental Liaison Service (NGLS/Geneva). The kit contains information on the situation in Africa, and insights into the international dialogue on the subject; it also highlights a number of differing perspectives on African recovery and development.

The United Nations Programme of Action for Africa's Economic Recovery and Development 1986-1990 was agreed at the United Nations Special Session on Africa in May/June 1986. The Programme of Action was based on a dual commitment: on the one hand, African Governments undertook to implement wide ranging economic and social policy reforms; on the other, the international community committed itself to supporting Africa's efforts. The Mid-Term Review, which took place in New York from 12-24 September 1988, looked at both the "Critical economic situation in Africa and the problems and constraints facing Africa's development efforts" and the "Response of the international community, including the United Nations system, and its commitment to support and complement Africa's efforts".

The NGLS/Geneva kit contains: the Final Report of the Mid Term Review; the Report of the United Nations Secretary-General; the Report of the Organization of African Unity; Africa Recovery, Vol. 2, No. 4, December 1988, and an "Overview" of the Mid Term Review, prepared by NGLS/Geneva. To obtain a copy of the kit (stocks are limited), or further information on the United Nations Programme of Action, please contact: Tony Hill, Programme Officer, NGLS/Geneva, Palais des Nations, 1211 Geneva 10, Switzerland. (Source: ACCIS Newsletter, 7(2), July 1989)

Update on DUNDIS

The United Nations Secretariat is currently updating the Database of United Nations System Databases and Information Systems (DUNDIS), in preparation for the publication of a new edition of the Directory of United Nations system data bases and information systems. Organizations of the United Nations system have been sent forms containing their records for verification. The new edition of DUNDIS, which will appear in Spring 1990, will contain descriptions of information systems and services and computerized data bases produced by the United Nations system. A section on United Nations system developed applications software is being added to the new edition. It is anticipated that the new edition will contain at least 50 per cent more entries than its predecessor, which was published in 1984. (Source: ACCIS Newsletter, 7(2), July 1989)

Landmark decision at ITU conference

In a landmark decision, the Plenipotentiary Conference of the International Telecommunication Union (ITU) (Nice, France, 1989) has agreed to authorize the use by specialized agencies of the United Nations telecommunication network.

The United Nations operates a telecommunication network composed of a series of leased circuits

linking United Nations headquarters in New York and United Nations offices and commissions, as well as major peace keeping centres. Hitherto, this system has been operated exclusively for the United Nations; the specialized agencies have been obliged to use commercial national and international telecommunication networks.

The Conference resolved "that the United Nations telecommunication network may carry the traffic of the specialized agencies which participate voluntarily on condition that:

1. The specialized agencies pay for the telecommunications service on the basis of the cost of operation of the service by the United Nations and tariffs established by administrations within the framework of the current basic instrument, Administrative Regulations and practices of the Union;

2. The use of the network is restricted to the principal organs of the United Nations, United Nations offices and programmes, and the specialized agencies of the United Nations;

3. The transmissions are limited to information exchanges concerned with the conduct of the business of the United Nations system;

4. The network is operated in conformity with the current basic instrument, Administrative Regulations and practices of the Union."

The decision, established by virtue of Resolution No. COM 8/1 of the International Telecommunication Convention, comes 17 years after the proposal was first made to the ITU. The United Nations system has been pursuing over a long period the goal of opening up its telecommunication network to the specialized agencies; successive Plenipotentiary Conferences in 1952, 1959, 1965 and 1973 refused its request to sanction agencies' use. In 1982, however, the refusal was accompanied by an instruction to the Secretary General of ITU to continue to co-operate with United Nations system organizations in the study or communications within the United Nations system.

The extension of access to the United Nations telecommunications network fulfils one of ACCIS' most important and actively-pursued goals. At the third session of ACCIS, in 1985, members agreed that:

> "... the development of a telematics network for the United Nations system as a whole remained one of the priority objectives of ACCIS, since it would promote greater efficiency as well as significant savings ..." and that "the development of such a network was essential to the achievement of ACCIS objectives".

Furthermore, ACCIS considered that:

> "... since the development of such a network was essential to the achievement of ACCIS objectives and ACCIS was representative of the entire United Nations family, it would be in the best position to contribute, together with the United Nations, to the consultations to be conducted by ITU and to make a significant contribution to the study to be undertaken."

ACCIS authorized funds to acquire some of the necessary information, which contributed to the analysis provided to the Plenipotentiary Conference by the United Nations.

The issue now before ACCIS is whether to continue to play an active and positive role in developing the use of the United Nations telecommunications network in accordance with the ITU resolution. The topic will be discussed at the ACCIS meeting in September 1989. (Source: ACCIS Newsletter, Vol. 7, No. 2, July 1989)

World information service on artificial intelligence

One of the world's most comprehensive data bases on artificial intelligence and related topics is now available to all countries. Anyone with access to a computer terminal connected to a telephone line will be able to search the Turing Institute's data base, which contains more than 50,000 references, with abstracts, to articles in journals, research reports, conference proceedings and books.

The Turing Institute, in Glasgow, has previously made its data base available to the dozen or so companies that are its affiliate members in Europe. Now, the Institute has teamed up with Data Star, based in Switzerland, which claims to be Europe's leading on-line data base 'host'. Data bases held by Data-Star can be accessed by terminals on a world wide basis.

At Glasgow, the AI data base is updated daily. A new tape is sent to Data-Star every month to provide what is said to be an unrivalled source of the latest information on research applications and market trends in such matters as expert and knowledge based systems, machine learning, patterr recognition, advanced robotics, neural networks, software and many other aspects of AI.

Announcing the new service, Professor James Alty of the Turing Institute said: "This data base has been built upon our excellent library which, in the space of five years, has established itself as the best AI library in the world. It is used by a wide range of customers in a number of countries. The establishment of this service on Data Star will make it available to a wider range of industries who will benefit from AI exploitation. For example in medical diagnosis, in financial advisory services, in law, in engineering process control, in business and in computer aided design and manufacture."

Maintaining contact with research institutes around the world, the Turing Institute at present holds some 16,000 articles from about 180 journals; a similar number of papers from key conferences and workshop meetings; 9,000 reports from about 200 research institutes throughout the world, and a further 9,000 monographs, textbooks and collected works. (Source: Spectrum, No. 220/1989)

Largest particle accelerator completed

The world's largest particle accelerator has been completed at a cost of almost $1 billion. The Large Electron-Position Collider (LEP) is circular tunnel 16.6 miles in circumference that is located near the French Swiss border. The LEP project took seven years to complete and involved a consortium of 14 European nations. Permilab's Tevatron particle accelerator in Illinois previously was the world's largest accelerator, but the proposed Superconducting Supercollider would be 53 miles in circumference. When it is built, it will be the world's biggest particle accelerator, but completion is at least 10 years off. In the LEP facility, electrons and positrons will collide and annihilate each other, producing heavy, unstable particles with high energy levels. Some similar particles are

thought to have been present immediately after the universe was formed. As the particles disintegrated, they formed the various forms of matter.

The LEP contains the world's biggest superconducting magnet, which is 17 miles in diameter. A major goal of the LEP is the generation of "zee zero" particles in large quantities. The "zee zero" particle is one of the particles that carry the weak nuclear force. It is comparable to the photon, which carries the electromagnetic force. The disintegration of about 100,000 zee zero particles will have to be studied to determine whether a fourth neutrino exists. If it does exist, it would imply that there is a fourth family of matter. The LEP is expected to generate one zee zero particle second. The question of whether there is a fourth family of matter could be answered by September 1989. Other research goals will include finding the sixth or top quark and creating the "Higgs boson", a higher order of particle whose existence has been postulated by theorists. (Extracted from New York Times, 8 August 1989)

Alternative wafer cleaning method developed

Mitsubishi Electric and Taiyo Sanso (both of Japan) have jointly developed a semiconductor wafer cleaning system that causes no pollution. It uses a high-speed spray of ice particles at temperatures no higher than -50°C. One version uses particles measuring 0.1-30 microns in diameter, spraying them via vapourized nitrogen pressure. The other uses particles 30-300 microns in diameter and sprays them with a pneumatic spray gun. The density of the ice particles and their size can be altered according to the wafer's configuration. Taiyo Sanso and Mitsubishi Electric developed the new cleaning system because semiconductor makers find it hard to get rid of submicron dust particles using ultrasonic wave and brush scrub cleaning systems. Also, the industry has been trying to develop a cleaning system that does not use solvents such as trichloro ethylene and chlorofluoro-carbons. (Extracted from Asian Wall Street Journal, 19 June 1989)

AEA, SIA to press reform of dumping rules

Senior executives of the American Electronics Association and the Semi-conductor Industry Association have agreed to press for fundamental reforms in the international dumping code and the US antidumping law. The joint committee proposed rewriting principles and practices to deter dumping and submitting that proposal to the US Government for inclusion in US law and administrative practices.

The group also agreed to urge the US Government to present the proposal for inclusion in the General Agreement on Tariffs and Trade.

The committee drafted a policy statement on market access in Japan by foreign semiconductor manufacturers. It recognized increases by several major Japanese users, but noted the lack of improvement in overall market share.

Despite ongoing negotiations between US producers and Japanese users, the group advised retaining sanctions until the administration has reviewed their overall effectiveness.

The AEA/SIA formed the joint steering committee in the fall of 1988 to address international and competitive issues, emphasizing implementation of the US/Japan Semiconductor Trade Agreement of 1986. (Source: Computer, August 1989)

Computers in the City conference

The sixth Computers in the City conference programme, organized by Blenheim Online, focused on the problems facing the systems supporting the investment industry and the capital markets. Emphasis this time was placed on the issues of management control, where problems stem from the nature of the financial marketplace which has become even more complex. The international panel of speakers at the conference illustrated the universal nature of these problems with examples drawn from a range of competing marketplaces.

The main conference, entitled "Cost effective technology for the 1990s", covered three days, each consisting of four sessions.

The conference was complemented by three one day workshops, each focusing on a specific business or technical area within the securities and investment industry. Entitled "Risk management assessing the options and the payoff"; "Information handling capabilities for effective dealing" and "Measuring the value of systems and maximizing the return on IT investment", they were aimed at users and at technical staff.

The Computers in the City conference took place on 14-16 November 1989 at The Barbican Centre, London. (Source: Press release, 12 September 1989)

Will users get burnt by flare up of sunspots?

Computer users worldwide are facing a new threat to their processors and data: sun spots.

Sunspot activity is at its highest for 30 years - and the worst is yet to come, scientists say.

Solar flares throw out very high energy cosmic rays which rain down on the earth's surface. The highly charged particles can cause electrostatic spiking in computer chips and cables.

On a larger scale solar emissions affect the electromagnetism of the atmosphere, which can interfere with national power supplies at ground level.

The 11 year sunspot cycle is due to peak in 1991, but solar activity is already considerably higher than at the same stage in the last cycle.

Solar astrophysicist Victor Gaizauskas from the National Research Council of Canada, says that if there is no research into the effects of sunspot activity on computer failures the issue will be forgotten for another 11 years.

However, Gaizauskas points out that the only way to find out if solar activity is to blame when the payroll system goes down is to put a cosmic ray counter inside the computer to measure whether the failure coincides with a burst of radiation. (Source: Computer Weekly, 21 September 1989)

Grappling with global digital networks

The world's first international link between integrated services digital networks (ISDNs) is expected to go live in October. Users of 300 ISDN basic rate access lines and 10 primary rate access lines on trial in the Dutch port of Rotterdam will get a direct link to the Federal Republic of Germany's national ISDN service to Darmstadt.

The Dutch German link, however, is the exception rather than the rule. The trouble is, none of them are implementing compatible systems.

The problem lies in the complexity of ISDN standards. Not only are there basic physical attributes such as plug and socket specifications, bit rates, signaling voltages and private network-public network interfaces to be sorted out, but there are also software considerations, such as the signaling protocol.

Of all the areas of standardization crucial to international interworking, the signaling protocol is the most important. It determines which services and features can be made available over a link.

On the face of it, there should be no problem. Worldwide, the ISDN signaling standard is C7, short for CCITT Signaling System Number 7 a message based protocol developed by the Consultative Committee on International Telephone and Telegraph. But despite international agreement on C7, there is still enough room for individual interpretations to make them incompatible with one another.

A particularly important area of the C7 specification for those looking to set up international data links over ISDN is the User Part, or UP, a software protocol. There are basically two types of UPs, the Telephone User Part, or TUP, and the Integrated Services User Part, or ISUP. The former is sufficient to set up and maintain a simple telephone call, but the latter is needed to support all of the advanced features that make ISDN such a sophisticated offering.

The French may implement the full set [of ISUP] but everyone else is implementing a different subset. The United Kingdom, for instance, has so far only committed itself to implementing TUP, albeit with a few value-added voice functions. And the Italians are implementing their own special subset of the ISUP. So are many of the others. The bottom line is that none of them are compatible.

Still, under pressure from the European Commission, moves are being made to implement a pan European ISDN by 1993. And other countries have made tentative steps towards international ISDN compatibility. In May, for instance, AT&T, British Telecom and Japan's Kokusai Denshin Denwa announced the first international digital links over the public switched telephone network.

Despite the small amount of progress made, international ISDN is still an elusive dream. Even the Rotterdam trial is not what it seems. The switch used is a System 12 from Alcatel's Federal Republic of Germany subsidiary SEL, developed to German ISDN specifications and not Dutch requirements. Although its links to the Federal Republic of Germany's national telephone network are secured, it is likely to remain an incompatible island in the Dutch system.

Unless agreement is reached soon between different national ISDN providers, the world's ISDN users are going to be faced with cross border incompatibility problems for many years to come.

II. NEW DEVELOPMENTS

First hot electron transistor fastest bipolar device

The first hot electron transistor has been demonstrated to be the world's fastest bipolar device to date by a team of AT&T Bell Laboratory researchers, according to Anthony F.J. Levi, the Murray Hill physicist who received patent US 4,839,141 on 9 May 1989 for a description of the operation of the device. Team members Young Kai Chen, Richard N. Nottenburg, and Morton B. Panish are expected to receive patents on other aspects of the technology.

The average electron velocity through the new transistor has been measured as 4×10^7 centimetres per second. At room temperature the first laboratory devices have attained a bandwidth of 165 gigahertz - more than five times as fast as the fastest silicon bipolar transistor.

The transistor is made of indium gallium arsenide (InGaAs) on a substrate of indium phosphide (InP). Fundamental physics determined the choice of these two materials, said Levi. At room temperature InGaAs has a small band gap (the minimum amount of energy required to excite an electron from the valence band into the electron conduction band in a semiconductor). InGaAs's band gap is only 0.8 electronvolt, compared to 1.4eV for gallium arsenide, so that a transistor made of InGaAs requires less power to switch it on and off. In addition, the electrons in its conduction band have a lower effective mass than those in a wider band-gap material, enabling them to travel faster and with less scattering.

Also key is the unprecedentedly heavy doping of the n type and p type layers. In the InP substrate are grown an InGaAs contact, collector, and base, topped with an InP emitter. All the layers are n type except for the base, which is exceptionally heavily doped p type (1×10^{20} impurities per cubic centimetre). Such heavy doping levels were made possible by advances in molecular beam epitaxy (MBE) developed by Panish. The substrate is customarily heated to 500°C during crystal growth, but the new MBE technique lets it be heated less, to below 400°C, enabling the substrate to absorb more dopant. (Source: Spectrum, July 1989)

GaAs grown via molecular epitaxy

Thin films of gallium arsenide have been grown via molecular epitaxy on depressions etched into glass optical fibres by P.K. Bhattacharya et al. of the University of Michigan. The researchers sampled light signals in fibres and amplified the electrical signals that resulted from interaction of light with the gallium arsenide. The next step - applying amplifiers and detectors to single crystal silica fibres - may help produce optoelectronic data processors that combine the speed of light, the massive number of signals transmissible by fibres and the amplification ability of electrical signals. The new approach avoids some of the technical problems of trying to integrate optical fibres and semiconducting circuits through connecting grooves or holes in the semiconducting device. (Extracted from Chemical and Engineering News, 17 July 1989)

Philips discovery heralds in new IC generation

Philips researchers have demonstrated that metal semiconductor-transistors, or MISFETs (metal

insulator semiconductor field effect transistors), based on a GaAs (Ga,Al)As heterojunction, display a negative differential resistance at room temperature over a considerable operating region.

This discovery opens up the possibility of a completely new generation of integrated circuits using GaAs - both for analog and digital applications - with a considerably simpler structure than was possible with traditional field effect transistors, or MESFETs (metal semiconductor field effect transistors). With the new circuit devices, a circuit with only a single transistor is sufficient for many functions.

The work, carried out in collaboration with the Centre Hyperfréquences et Semiconducteurs of the University of Lille, was supported by the French Ministry for Research and Technology.

Compared with the recent hot electron devices, which display similar effects, a MISFET has two definite advantages. First, the structure of a MISFET is simpler: a single heterojunction compared with a number of 5 nm-thick layers of GaAs and (GaAl)As; and second, there is a clear region with a negative differential resistance and not merely discontinuity in the characteristics. This is of special importance for certain analog applications, such as frequency doublers. (Source: Electronics Weekly, 6 September 1989)

Advantages of semiconductor nonvolatile memories

Semiconductor nonvolatile memories offer numerous advantages over traditional magnetic core memories for future aircraft, missiles and satellite systems. Those advantages include major increases in computing power and major decreases in weight and electrical power requirements. In the interim, some aircraft, such as the B-2, may use volatile memories with a battery backup - less desirable than nonvolatile memories, but allowing faster and more powerful computers to be used. One of the major technological advances in semiconductor nonvolatile memories has been in ferroelectronic technology, which has resulted in practical read/write nonvolatile RAMs. These RAMs combine the speed and ease-of-use advantages of static RAMs, the high density and potential low cost of dynamic RAMs, the nonvolatility of EEPROMs, and high levels of radiation resistance. (Extracted from Aviation Week, 17 July 1989)

Nonvolatile Bloch line memory chips

Hitachi (Tokyo, Japan) has developed nonvolatile Bloch line memory chips with 1 kbit capacity that operate at 1 MHz and are contained in a 2.4 x 5 micron memory cell. The technology is capable of 5 Gbit memory chips with less than 5W-power dissipation. Bloch line memory technology uses micro magnetic Bloch line structures within the magnet walls lying between magnetic domains to store data as against the use of the actual magnetic domains as with conventional magnetic storage disks or tapes. Magnetic domains are typically 10-20 microns in length and 0.5-1.0 microns in width compared to typical Bloch line dimensions of 0.2-1.0 micron lengths and 0.01-0.1 micron widths. The technology has the potential to enable Gbyte memory capacity in cigarette case-sized recording media. (Extracted from New Technology, Japan, September 1989)

Cylindrical DRAM boosts storage space

Mitsubishi Electric has developed a cylindrical memory capacitor for use as a 64 Mbit dynamic random access memory (DRAM). It was developed by improving a stacked capacitor and giving its storage electrode a cylindrical construction.

The capacitor stores electric charges necessary for actuating transistors and is used in combination with transistors to compose memory cells which serve as the DRAM's data memory unit.

Since the capacitor's storage capacity is proportional to its surface area, use of this cylindrical design enables full use of the surface area to substantially increase the capacitor's storage capacity. The storage capacity can be easily boosted by increasing the cylindrical electrode's height.

The cylindrical construction is practical and can be formed by adding a few wafer processes to the processes for obtaining the conventional stacked construction.

These improvements enable a storage capacity of over 30 fF, which is sufficient for compensating the circuit operations, even with a miniature memory cell having an area of 1.5 μm^2, which is necessary for 64 M DRAM. (Source: Electronics Weekly, 6 September 1989)

InP semiconductor technology

Researchers are developing indium phosphide-based semiconductor technologies that vastly outperform GaAs circuits. Scientists are working on manufacturing processes for making high-quality substrates and growing the bulk materials as well as researching actual semiconductor designs. The technology's deployment depends on epigrowth technologies such as organo metallic chemical vapour deposition and gas-source molecular beam epitaxy to make the basic InP structures. InP surface properties enable metal-insulator semiconductor field effect transistors (MISFETs) as well as high performance heterostructure bipolar transistors (HBTs) for optoelectronic circuitry. The technology also encompasses semiconductors made from indium gallium arsenide and indium aluminium arsenide. Several companies have developed experimental InP semiconductors such as Thompson CSF's (in conjunction with the Naval Ocean Systems Center) MISFET with three times the power/unit gate width of GaAs FETs and AT&T Bell Laboratory's HBT with per stage power consumption of 4 mW and per stage propagation delays of 50 picoseconds. Others developing InP technologies include Fujitsu, NASA Lewis Research Center (solar cells for space use), Spire (Bedford, MA), Colorado State University and Texas Instruments. (Extracted from Electronic Engineering Times, 17 July 1989)

Neural networks chips developed

Bell Communications Research (Bellcore) (Morris Township, NJ) has developed a computer chip which simulates the human brain's neural networks. The "brain" chip incorporates electronic artificial neural networks which correspond to the brain's neurons and synapses. The chip is comprised of six neurons which are connected by 15 synapses that function as independent processors. The chip also learns in two phases, a student phase and a teacher phase. In the student phase, input is fed to the neurons while the chip produces whatever output it desires. Under the teacher phase, the teacher directs the output into the known correct phase. Learning occurs after the strengthening and weakening of electronic neurons. The chip has potential voice pattern recognition applications.

Meanwhile, Intel's (Santa Clara, CA) new neural computer chip can perform 16,000 multiplications simultaneously, a total of two billion second. Neural nets, modelled on the brain's thousands of tiny connections, may be the solution to computers' problems with pattern recognition. Intel's chip is the first with enough power for an entire computer, which combined with a non-volatile memory, gives it the ability to contrast and store patterns in a manner similar to that of the brain. The semiconductor maker is currently exploring potential applications for the chip, of which a small quantity has been provided to the US Navy. Navy researchers helped design the chip and have built a computer that will use it. They hope to use the chip in non-nuclear weapons systems. (Extracted from MIS Week, 24 July 1989 and Wall Street Journal, 4 August 1989)

Holographic computing work station

Recognition Technology (Westborough, MA) has introduced the HG5000 holographic computing work station to permit engineers to see instantaneous interference patterns formed by structural defects or vibration modes of a part. The method substitutes for the time consuming method of exposing photographic plates that are usually necessary to record holographic interference patterns. The new work station utilizes a video camera to find out interference patterns generated by interactions of a reference and reflected laser beam. The holographic technique supplies a way of comparing the vibration modes of an object with those calculated by finite element examination. United technologies is using an HG5000 system to find out mode shapes and vibration frequencies of jet engine parts such as blades and vanes. It is also employing the system to inspect abradable seals and various composite materials. (Extracted from Machine Design, 20 July 1989)

Study reveals hard disks run longer in humidity

Computer hard disks can run five times longer in air at 50 per cent relative humidity than in dry air and 50 times longer than in a vacuum, according to a study by Northwestern University researchers. The study was funded by IBM. The magnetic head scrapes particles from the disk every time the disk starts or stops. The debris oxidizes in humid air, thus lowering the surface energy. Because the particles are relatively small, they do little damage to the disk. The particles are larger in dry air or in a vacuum and the buildup in time clogs the space between the head and the disk. However, the advantage of operating disks in humid air applies only to systems in continuous operation. (Extracted from Chemical and Engineering News, 7 August 1989)

New optoelectronic chip demonstrated by IBM

IBM has demonstrated a very dense optoelectronic chip for receiving data over fibre-optic lines at a much faster rate when compared to current devices. The chip contains 50 times more optical and electronic components compared to similar chips. Such devices permit data transmission of at least one billion bits/second, up to 10 times faster compared to current fibre optic lines. IBM is also experimenting with a similar chip for transmitting data; as only two chips will be needed for transmission and reception, the devices will offer advantages including speed, reliability and relatively low cost. With the increasing power of computers and transmission of graphics, the speed of the new chips will be useful in the future. (Extracted from Wall Street Journal, 24 August 1989)

Silicon crystals may be grown at 300°C

Silicon crystals can be grown at 300°C, resulting in fewer defects, according to A. Tash of the University of Texas (Austin). Silicon crystals are normally grown at 900°C as silane gas comes into contact with a substrate. The high temperature results in some defects that prevents the development of higher density chips. Extra energy in the low-temperature reaction is provided by an alternating electromagnetic field, which produces an argon plasma that transfers energy to the silane. (Extracted from New Scientist, 22 July 1989)

Hydrogen may superconduct at record temperature

Physicists believe that hydrogen could become a superconductor at high pressure, but their estimates of the temperature at which it makes this transition have varied widely. Now researchers at the University of California at Berkeley and Lawrence Berkeley Laboratory have calculated that hydrogen should become a superconductor in the range 14 to 300 K (up to 27°C). This means that it could have the highest critical temperature, T_c, of any superconductor.

The physicists, T.W. Barbee, Alberto Garcia and Marvin Cohen, calculate that the transition will occur at around 400 gigapascals. Recently, Ho Kwang Mao and Russell Hemley at the Carnegie Institution in Washington DC compressed hydrogen to 250 gigapascals between diamond anvils and found indirect spectroscopic evidence that it had indeed changed from an insulator to a metal. The pressure they achieved, however, fell short of the superconductor range.

Barbee and his colleagues calculate the critical temperature from first principles. Their approach, they say, was successful in predicting superconductivity in compressed silicon. They say that the most probable value for the critical temperature is 230 K.

If experimenters manage to make hydrogen a superconductor, they may gain insight into how high temperature superconductivity works. The phenomenon occurs in complex materials. Hydrogen, however, is the simplest material. (This first appeared in "New Scientist", London, 12 August 1989, the weekly review of science and technology)

High temperature superconductors may make better interconnects

Researchers at Cornell University have developed a package system simulation method to determine if high temperature superconductors would make better interconnects for CMOS digital circuitry than conventional materials. In a test of the modelling method, researchers specified interconnect technology similar to that used in NEC's SX-2 computer for a CMOS 500,000 circuit processor operating at room temperature and then a similar processor using superconductive interconnection at 77 K. The model indicated a 6 fold improvement in performance for the superconductive chip.

Intel (Santa Clara, CA) researchers say copper (Cu) may be a good option to aluminium (Al) as an interconnect material. This is because of copper's low resistivity and good dependability. (A major limitation on aluminium one or two generations from now is foreseen by the researchers.) The researchers examined the benefits of supplanting aluminium with copper using a system simulation programme based on device, circuit and system models. They discovered that the propagation delay of interconnection is major when the effective

channel length is 0.5 micron or under, hyper corrosion is an issue. Researchers deposited nickel as a protective film since it is inert to corrosive settings. Corrosion trials were conducted by depositing the samples in a solution containing 1 mole HCl (4 per cent solution) boiling at 100°C for one hour. Sheet resistance was gauged prior to and following the test. Corrosion was noted on less than 5 per cent of the nickel coated circuits. (Extracted from Semiconductor International, June, July 1989)

A million lasers squeeze onto a square centimetre of semiconductor

The world's smallest lasers - cylinders of semiconductor that are roughly one tenth of the thickness of a human hair - have been made in the United States. The team, from AT&T Bell Laboratories and Bell Communications Research, in New Jersey, deposited 600 alternating layers of gallium arsenide and aluminium arsenide on top of a substrate of gallium arsenide, then etched through the layers to create an array of tiny lasers.

The lasers are between 1 and 5 micrometres wide and 5.5 micrometres long. They can fit onto a chip at densities of more than a million per square centimetre.

Conventional semiconductor lasers emit light from their edges, parallel to the plane of the chip, but these lasers emit their beams from the surface of the chip. This means that unlike conventional semiconductor lasers, the new lasers can be made in exactly the same way as ordinary integrated electronic circuits. The lasers also require an exceptionally low current to drive them - 1 milliampere - which makes them attractive for use in communications.

According to Jim Harbison, of Bell Communications Research, arrays of these chips placed back to back could act as optical connections between electronic chips, or in optical fibres. Another possibility for the long term is that such arrays of tiny lasers might form the connections in so called neural networks. These are computer systems which simulate the human brain. (This first appeared in "New Scientist", London, 12 August 1989, the weekly review of science and technology)

Superconducting chips forge satellite links

Scientists at NASA have created a superconducting thin film etched with circuitry that can process microwaves for communications. Development of this film is part of an accelerating effort by the space agency, the Pentagon and telecommunications companies in the US to design superconducting circuitry for satellites.

The microwave circuit resonates at a frequency of 33 to 37 gigahertz, and so serves as a prototype for working circuits that can process signals within that range. It was developed at NASA's Lewis Research Center in Cleveland, Ohio, where the agency researches into superconducting materials.

Most communications satellites sent up by the US receive and transmit signals within a range of 11 to 14 gigahertz. This bandwidth is becoming cluttered as more and more satellites receive and transmit information. Many European and Japanese satellites have leapfrogged the Americans and now operate communications satellites at 20 to 30 gigahertz, which also allows data to be processed much faster.

NASA eventually wants to be able to place satellites with microwave filters (which divide out tune bands of frequencies), antennas and sensors, all using superconducting materials. Superconducting circuits can handle more information than current equipment, yet they occupy less space and are lighter. One help is that the temperature needed to cool the latest superconducting circuitry, about 77 kelvin, can theoretically be maintained passively in space, dispensing with the need for liquid nitrogen for cooling.

Rui Bhasin, a physicist who led the research at Lewis, fabricated the circuit on a superconducting substrate of lanthanum aluminate. Scientists are trying out a number of different substrates, but many have too high a dielectric constant to process microwaves. This constant is a measure of a material's ability to propagate an electromagnetic wave.

The researchers used a laser to deposit a vapour of yttrium, barium and copper oxide as a thin, solid film onto the substrate. They then etched the circuitry onto the film. Microwave signals are carried through the circuit at the interface of the film and the substrate. The current density achieved by the circuits fabricated so far is two million amperes per square centimetre, which engineers in the field of satellite communications consider high enough to process microwave signals. (This first appeared in "New Scientist", London, 12 August 1989, the weekly review of science and technology)

Method to deposit superconducting films onto silicon

A low temperature method that can be utilized to deposit superconducting thin films directly onto silicon, the core of semiconductor computer chips, has been developed at North Carolina State University. The method can be utilized to acquire current carrying capabilities not previously found in published literature for superconducting films deposited on ceramic substrates. A 650°C temperature was utilized to produce stable thin films on strontium titanate. The films carried a 5 mil A cm^2 current without superconductivity loss at 10K°, a temperature at which liquid nitrogen can be employed for cooling. Films were also made at 500°C, which still carried 1 mil A cm^2 currents although they were not as defect free. (Extracted from Ceramic SB, August 1989)

How viable is quantum well transistor technology?

Semiconductor manufacturers are stretched to produce memory chips with a feature size of around 0.6 microns and processors with a feature size of 0.8 microns. To continue developing faster processors suppliers will have to develop chips with feature sizes well below the most compact offerings, and with a very low power consumption in order to avoid the problem of the chips melting down.

It is currently considered that 0.3 microns is the size limit for most integrated circuits and that circuits less than 0.1 microns are unlikely.

The problem is that when you pack circuits this tightly, the electrons passing through the circuit begin to exhibit some of the properties of waves.

The electrons begin to take on wave like properties when they are confined to a region with dimensions smaller than their quantum mechanical wavelength - that is their apparent size. The quantum mechanical wavelength is dependent on the electron's energy.

In today's computer designs this means that electrons can jump between the etched wires on the silicon so that you do not always know where your electrons are. In practical terms these elusive electrons will mean that your computer may give you the wrong answers.

By contrast, tomorrow's quantum well transistor technology depends on resonant tunnelling and the electrons' wave like properties. Researchers are beginning to look at ways of taking advantage of the distinct (quantum) energy levels of the electron. If energy is given to an electron it will send the electron whizzing to another one of the energy levels it is allowed, even if this means passing through a barrier - resonant tunnelling.

The aim of quantum well transistors is to have little dimples in a very thin semiconductor film sandwiched between other semiconductor material. The wells are taken to be about the size of an electron's quantum mechanical wavelength and therefore electrons are expected to exhibit the phenomenon of resonant tunnelling and escape from the wells.

In addition, quantum well transistors recognize that electrons can have several discrete energy levels, unlike today's binary computers that are based on the principle that either electrons flow or they do not. By recognizing these different states the processors no longer only work in binary - the on-off mode.

This means that the greater the number of different quantum states the quantum well semiconductor recognizes, the fewer equivalent conventional transistors are needed.

Advances in material science mean that suitable semiconductors are now becoming a possibility. One technique, called molecular beam epitaxy, allows the building of very thin layers of gallium indium arsenide and aluminium indium arsenide, which can be used for the semiconductor layers in the quantum well.

These structures are so small that a one centimetre square chip could hold 10 billion quantum transistors. These can then be stacked to form a three dimensional device, which enables a vast amount of computing power to be concentrated into a very small volume. (Source: Computing, 13 July 1989)

Tungsten used in submicron gate arrays

Motorola (Chandler, AZ) researchers have come up with a triple level metal technique for submicron gate arrays using tungsten (W) for the initial metal layer. The W offers dependable contacts that can resist temperatures higher than those used for assembly without impacting transistor behaviour. Researchers deposited approximately 100 angstroms of pure titanium (Ti) to realize acceptable contact resistance and then titanium nitride (TiN) using reactive ion sputtered (RIS) films. Pure argon and pure nitrogen gases were united to deposit the film and gas composition and flows were adjusted to achieve a TiN stoichiometry of approximately 1.0 to achieve a stable barrier. The researchers then CVD deposited TiN to enhance the union of tungsten to silicon dioxide. The mix of RIS and CVD TiN is said to offer good contact resistance, good junction integrity and thermal stability with superb step coverage. Using this technique on a 1.0 micron gate array test vehicle the researchers showed nearly 100 per cent contact step coverage and say that it is appropriate for submicron circuits. (Extracted from Semiconductor International, June 1989)

Fastest ever gate array developed

Toshiba (Japan) has developed a gate array with a delay time of 0.35 ns and 51,000 gates. It uses bipolar ICs as well as complementary metal-oxide semiconductors, which consume less power. Toshiba says the device is the fastest, most condensed gate array ever. It was produced by laying a 0.8 micron line across a 4 M bit DRAM. One bipolar transistor is shared by two adjacent gates, thereby making for a smaller logic circuit. Shipments of the new device will begin in two years. (Extracted from Japan Economic Journal, 8 July 1989)

Fast computers

Active Memory Technology Inc., Irvine, California, manufactures the Distributed Array of Processors (DAP) 610, a massively parallel computer. A recent press release claimed that the computer runs at 40 billion Boolean operations per second.

Computer speed is conventionally measured in millions of floating point operations per second (megaflops) or millions of instructions per second (MIPS). Following the abbreviation tradition, billions of Boolean operations per second would be shortened to bbops, which we think should be pronounced bebops - like the well known style of jazz music.

Bbops interjects a refreshing note of popular culture into computer lingo and certainly conveys the notion of speed more than flops does. (Source: Spectrum, September 1989)

VHDI scheme produces board density rivalling that of the chips

Semiconductor designers and manufacturers are unleashing a flood of integrated circuits featuring ever higher clock rates and greater functionality packed into smaller spaces. Chips with submicron design rules are now commonplace; however, many of the packaging and interconnect schemes used to package them date back to the days of 3.0 to 5.0μm design rules. As a result, the full power of the new chips has remained largely untapped.

But improvements in packaging and interconnect technologies will release that power. One such advance comes from UniStructure Inc. of Irvine, California. The company says that with its very high density interconnect technology, board and module densities at their best can match those of the chips themselves.

An important component of UniStructure's VHDI scheme is a proprietary multilayer interconnect technology, supported by liquid organic dielectric casting. In the process, an adhesion promoting material is sputtered along with copper onto a substrate coated with liquid organic resin. The result is that the entire surface of the substrate becomes electrically conductive.

UniStructure obtains the fine line geometry advantages of photolithography by imaging and developing the signal pattern right on the substrate. The conductors are grown to the right width and thickness in an electroplating copper solution.

The advantage of building interconnects with dimensions this small is evident when compared with present boards; they are based on technology that lays out the conductive grids on a 100-mil scale.

Moreover, the boards that carry the small interconnect geometries can measure up to 18 by 18 inches. Neither thick film ceramics nor thin films can match the fine line dimensions or get the same electrical performance. In addition, the substrate sizes they can produce are limited.

The upshot is that UniStructure designs and produces substrates and chip packaging units that dramatically slash the size of final modules. In some cases, prototype projects show the packaging density can be improved up to 7 times over what is possible with conventional interconnect schemes. (Extracted from Electronics, August 1989)

Silicon sensors

Since the early 1980s, the advocates of silicon micromachining have been touting the technology's potential to revolutionize the field of sensors and carve out vast new commercial markets. Now there are signs that silicon micromachined sensors may finally be primed to live up to that billing. Indeed, some market watchers are predicting explosive growth for the technology across a broad range of applications.

The new optimism stems from converging trends. New techniques such as silicon fusion bonding and the use of electrochemical etch stops are producing a new generation of commercial micro machined silicon sensors that are more complex and offer higher sensitivity and performance than their predecessors - all at a lower cost.

Research advances in the field are also coming rapidly, promising a wider range of even more sophisticated silicon sensors by the early 1990s.

For example, one of the latest laboratory techniques is called surface micromachining. It involves building up structures in polysilicon or other materials on a silicon surface, as opposed to conventional commercial approaches that rely on carving out structures in the silicon by selectively etching down into a wafer.

Fueling all of the activity is the continuing proliferation of microprocessors. As computing power gets cheaper, the sensors needed to link a central processor to the outside world are becoming a larger portion of overall system cost. In many cases, the availability of reliable low cost sensors can make or break a development project. And as system designers rely increasingly on distributed computing solutions, there is an ever growing need for so called smart sensors that incorporate more intelligence at the sensing site, either in the package or integrated onto the sensor die itself.

It is a trend that is spurring an intense effort in low cost sensor development. And many vendors - ranging from traditional broad based sensor suppliers to Silicon Valley startups - are betting their chips on [illegible] devices.

The growing excitement over micromachined silicon stems from a variety of factors. For one thing, besides its well known properties as an electrical material, silicon is an almost perfect mechanical material for building sensors. Though brittle, silicon has an elasticity greater than stainless steel's and a low mass equal to that of aluminum. Unlike most metals, it can be repeatedly stressed with no weakening or deforming. Silicon is also piezoresistive, exhibiting a large change in resistance when subjected to stress.

These and other attributes make possible a variety of sensor types based on tiny, three dimensional moving mechanical structures that are literally sculpted in silicon by the micromachinist, to provide quick and accurate sensing of real world phenomena.

And because many of the processes used for micromachining - such as masking, etching, and selective doping - are common to integrated circuit processing, it means that silicon sensors can be made in high volume using semiconductor style batch manufacturing techniques.

Silicon micromachined sensors have already shown startling success in some market categories. Today, low cost silicon pressure sensors have all but replaced conventional strain gage sensing devices in high volume, cost sensitive jobs in automotive manifold pressure sensing.

Silicon micromachined parts have opened up vast new high volume markets in applications such as disposable blood pressure sensors, a business that topped 6 million units last year.

Automotive silicon pressure sensors currently sell in the $10 range in volume, while blood pressure sensor chips can be priced as low as $2 to $4 each. Both types are rapidly displacing earlier sensor solutions that were bulkier and typically three to four times more expensive.

Pressure sensors are still the highest volume business. But the two fastest growing segments are in accelerometers and in custom microstructure sensors.

As with pressure sensors, the major market driver here is the automotive industry, which needs accelerometers in high volume at low cost for sensing jobs in air bag and smart suspension systems. Because of long automotive design cycles, volume applications are still two to three years away.

For smart suspension alone, the new automobiles will use from one to ten accelerometers apiece, and there is momentum in a multitude of new applications. These include jobs in heating, ventilation, and air conditioning; industrial applications for automated factory control; and aerospace, not to mention a variety of consumer applications ranging from appliances to wrist worn computers for scuba diving and new classes of home gadgetry.

The market watchers agree with the industry executives. Most forecasters expect gains for silicon micromachined devices for sensing a variety of parameters beyond pressure. (Extracted from Electronics, July 1989)

III. MARKET TRENDS AND COMPANY NEWS

Service agreements for network servicing

Computer and network equipment vendors are beginning to offer one-stop service agreements for network service. According to industry analysts, these multivendor service agreements would allow users to call one firm to troubleshoot a problem or co-ordinate maintenance. The vendor would also be responsible for finding qualified technicians. Users also avoid the inconvenience of having vendors finger point when a problem occurs. While users end up with added convenience, vendors add to their revenues as service providers. IBM, Digital Equipment, AT&T and Timeplex offer multivendor network service. According to Ledgeway Group (Lexington, MA), revenues from multivendor service contracts will be $3.8 billion in 1993 compared to $2.5 billion in 1989, a 15 per cent growth rate. (Extracted from Metalworking World, 24 July 1989)

Work station leasing

Leasing of work stations is becoming good business for rental and leasing businesses. Such firms are reporting increased demand from users, who are now familiar with the technology. Micro-Computer Rental (Piscataway, NJ), says that the company receives many calls from Fortune 1000 firms and small engineering businesses. In particular, they inquire about the SPARCstation line by Sun Microsystems. Liberty Credit (Merick, NY) feels renters are looking to hedge against inflation and equipment obsolescence, while DEC feels work station prices will have to decrease dramatically before buying is less expensive than renting. Some vendors are concerned about adding value to the leases, and some - like Sun - place tight requirements on rentals and leases. (Extracted from Computer Reseller, 19 June 1989)

Modem prices falling

Modem prices are falling faster than transmission rates are rising. According to Dataquest (San Jose, CA), prices should continue to drop into the 1990s. In 1986, a fast modem had a speed of 2,400 bps and a price of about $1,000; in 1989, fast is 9,600 bps and prices are below $1,000. Dataquest also believes that high-speed, dial-up modems will show the largest growth and by 1994, high end users will accept digital transmission technology, especially the Integrated Services Digital Network. International Data (Framingham, MA), also feels that prices will drop as speeds increase. Although more 2,400-bps modems exist than any other, the 9,600-bps modems are the most important in terms of revenue. In 1988, 9,600-bps modems made up 57 per cent, or $688 million, of the $1.2 billion modem market.

Several forces are driving the high-speed modem market: demand for high-speed transmission, technological advances, greater use of personal computers and greater use of computerized equipment (e.g., automated teller machines). For corporate users, connectivity and network management capabilities are primary driving forces. According to Electronic Mail and Micro Systems, 5 types of high-speed modems exist: full-duplex, which transmit at the same speed in both directions; half-duplex, compliant with V.32 modulation, which runs in one direction, but can change directions in micro-seconds; half-duplex, compliant with CCITT V.29 modulation, found in fax machines, run in one direction, but cannot change directions quickly; asymmetrical, which offers four lines in one direction at one speed and another line in the opposite direction at a slower speed; and a full telephone bandwidth modem. (Extracted from Computer Reseller, 26 June 1989)

Scanner market

US sales of scanners will reach $1 billion in 1993, against $25 million in 1989, being led by desktop and portable scanners, according to BIS CAP International. The scanner market is being fueled by the introduction of image processing software products, according to International Research Development. Among market trends, there is a move towards scanners that offer 256 shades of gray. Portable scanners will do well in the market, because they cost less than $500, which lures many first-time users. Another trend in the market is colour. Applications for colour scanners will probably include short-run publications, presentations at the low end, and ad proofing. Among the products already on the market, Microtek makes the MSF-300Z, a colour scanner that handles 24-bit colour photos and drawings up to 300 points/inch, plus 8-bit gray-scale photos and drawings at 300 points/in. (Extracted from Computer Reseller, 10 July 1989)

Increased demand for WORM disks expected

Optical write once/read many (WORM) disks and rewritable disks in both 3.5- and 5.25-inch formats will see dramatic rises, according to Market Intelligence Research (Mountain View, CA). The 3.5-inch rewritable format should reach shipments of 910,000 in 1993. Other 1993 projections include 70,000 shipments of write-once 3.5-inch disks, 103,334 of 5.25-inch WORMs, and 120,000 of 5.25-inch rewritables. Rewritable disks provide users with many options and resellers with more selling power. Another boost to resellers will be the use of 650 Mbyte 5.25-inch disk as an ANSI/ISO standard by the US National Bureau of Standards; most 5.25 inch disks already conform. One hurdle is that software is needed to configure disks to the user's computer. According to a Sony spokesperson, optical disks are not "plug and play" devices. (Extracted from Computer Reseller, 19 June 1989)

Market for silicon micromachining

Silicon micromachining may be on the verge of opening a real market, thanks to a few factors. Silicon, though brittle, has greater elasticity than steel and density as low as aluminium, in addition to being piezoresistive and capable of repeated flexure without weakening or deformation. A promising new process builds up microstructures on a Si surface, rather than relying on selective etching. The proliferation of microprocessors creates a demand for micro-scale data-gatherers. Finally, micro machining can piggyback technologically on microelectronics.

Micromachinists have deferred the "Holy Grail" - one chip integration of sensors and smarts - for attainable 2 chip products, such as a strain gauge for auto suspensions. With only 10 per cent of the new car market, such smart suspensions could comprise a $200-300 million market, according to NovaSensor. The Si based disposable blood pressure micro sensor market exceeded 6 million units in 1988. McIntosh Consultants (UK) sees the world non-pressure micromachined Si-sensor market growing from $21.3 million in 1987 to $.04 million in 1990, with flowmeter and accelerometers sectors each exceeding $50 million in that year. Frost & Sullivan (New York, NY) sees the US semiconductor sensor market growing from $340 million in 1986 to

$534 million in 1990, excluding micromachined mechanical parts (e.g., nozzles). NovaSensor projects a $3.6 billion overall Si sensor and microstructure market in 2000. (Extracted from Electronics, July 1989)

Laptop computers

A fierce competitive battle is shaping up for space on businessmen's laps. With sales of laptop computers growing several times faster than those of desktop machines or clunkier, suitcase sized transportable computers, the three market leaders Japan's Toshiba and NEC, and America's Zenith - are hustling out new, lighter, faster models. Meanwhile others are jumping into the market, from heavyweights such as IBM and Compaq to Silicon Valley start-ups.

Zenith has just started shipping a new model called the MinisPort. It does everything a normal IBM-compatible computer does, but weighs under six pounds, and is about the size of a thickish A4 notebook. Zenith is rather proud of it, partly because it reckons the machine is better and cheaper than NEC's rival lightweight. But both Zenith and NEC could get a nasty shock from a product called "Dynabook" developed by Toshiba and so far sold only in Japan.

Toshiba's "Dynabook" is faster and about a third cheaper than Zenith's $2,000 MinisPort. Better, it uses standard-sized 3 1/2-inch diskettes. So its data can be plugged straight into many desktop computers, while the Zenith and NEC machines use non-standard disks to save power. Toshiba hopes to sell 90,000 of its new model in Japan alone in 1989, and in 1990 it forecasts Japanese sales of 200,000. Zenith's expectations are lower. So if Toshiba meets its forecasts, it should expand what in 1988 was only a narrow lead over Zenith in the world laptop league table (235,000 machines sold versus Zenith's 227,000).

Unfortunately for Toshiba, the company does not know when it will be able to introduce its pride and joy into America. It cannot export from Japan, because America is punishing Toshiba for selling "strategic" technology to the Russians. And it will take some time to tool up its American plant. The firm can guarantee an American launch only by the end of 1990. By that time competition for laptops will be even fiercer.

One competitor that Toshiba will certainly need to pay attention to, if only because of its name, is a Silicon Valley start-up also called Dynabook. This company - whose founders include a co-founder of success story Sun Microsystems and a co-developers of IBM's PC - is launching its own light, stylish laptop. Like Toshiba, it borrowed the name Dynabook from Mr. Alan Kay, a computer pioneer who coined the term to describe his dream computer. Unlike Toshiba, Dynabook has American rights to the name (but not Japanese rights).

But the most innovative technology is coming from a little-known Silicon Valley start up called Agilis which wants to sell computers to workers who do not have offices in the first place: geologists, aircraft mechanics, surveyors and so on. Its machines are portable, waterproof and grease-proof. Some have screens on which an engineer can sketch with a finger. By the end of the year Agilis promises equipment that will link its machines to other computers via radio instead of telephone lines or local-area networks.

Against Silicon Valley inventiveness the Japanese are ranging the strengths that made them masters of consumer electronics: first, cramming more and more power-miserly equipment into a smaller, cheaper package; second, responding quickly to demand.

Other new products are on the way. One is a colour screen for laptops: NEC unveiled a laptop with such a screen in July. Toshiba and IBM are jointly developing their own colour screen. Toshiba, for one, is confident that laptops will provide it with the success that has so far eluded Japanese firms in other parts of the personal computer industry. Aiming squarely at the mass market with its laptops, it hopes to move up from eighth to third place in the world microcomputer market within five years. That is a lot of laps. (Source: The Economist, 2 September 1989)

Amdahl corners a Unix market boom

Almost unnoticed, a $300 million a year market has developed in the IT industry, and one company has the whole of it. The market is for mainframes running Unix and the company is Amdahl.

Amdahl's director of business development in Europe, Ken Gorf, revealed last week that the company's strategy of developing a major secondary source of revenue is providing a big pay off. UTS, Amdahl's Unix variant, has contributed between 10 and 15 per cent of total revenues in each of the past two years.

According to International Data Corporation figures, Amdahl has 50 per cent of the market for Unix systems worth $1 million and over in Europe, and a little less than that world wide.

Demand is mainly coming from government and quasi government organizations, who want the standardization offered by Unix to open up competition and so reduce procurement prices.

Many customers and potential customers for UTS systems are Amdahl users already, but their applications are not new. Nobody has yet ported an MVS application onto a UTS system.

Amdahl is expecting the market to develop rapidly, and is hoping to derive 30 per cent of its revenues from UTS within five years. This year it is expecting to add 20 new UTS sites in Europe, and 50 world wide.

Amdahl is still the only company to offer Unix in native mode on a mainframe. IBM, ICL and Unisys all offer variants as guests under their proprietary operating systems, and Bull has announced plans to do the same.

Earlier this year Amdahl announced version 2.0 of UTS, containing a number of new features including symmetric multiprocessing capability.

Earlier versions of UTS will run in single system image mode, but with a master-slave relationship between the processors.

UTS 2.0 is now undergoing final trials at half a dozen field test sites - one in the UK - and is on schedule for first deliveries in October. (Extracted from Computer Weekly, 31 August 1989)

Imaging market likely to increase

Document imaging systems will have as much impact on the 1990s as personal computers on the 1980s, according to market research firm BIS Mackintosh.

Sales will grow by over 60 per cent a year from 41.4 million pounds sterling in 1988 to more than 1 billion pounds sterling in 1993 in Europe alone.

Over 80 per cent of major banking, government and insurance institutions in the UK, France and the Federal Republic of Germany recently surveyed plans to start using document imaging systems in the next three years.

Philips' marketing manager for image systems in the UK, John Pring, says there are big opportunities in the sectors studied by BIS, but growth will not be even across them. Philips believes imaging systems' main role is to help companies which hold large amounts of data they need to reference. Electronic imaging systems beat filing cabinets for speed and increase efficiency, the company says.

One of ....ps' main rivals, Wang, was the first vendor to launch a document imaging product, and now claims over 100 European customers. (Extracted from Computer Weekly, 5 October 1989)

The future of the printer market

The printer market is changing. According to the market research companies Dataquest, Information Data Corporation (IDC) and Romtec, the value of the total market for printers in Europe - from the big machines down to nine-pin dot matrix printers - is worth about $2.5 billion for 1989. To put this into context, the value of the computer market as a whole in Europe this year is estimated to be $50 billion.

The trend for printers, according to market research and many printer manufacturers, is a radical shift away from impact printers such as dot matrix, daisywheel and shuttle matrix towards non-impact technologies - lasers, inkjets, thermal transfer, liquid crystal shuttle (lcs) and light emitting diode (led).

Dataquest says that in 1987 the dominant type of printer technology was serial impact, with 88 per cent unit share or 3.5 million units.

Serial non-impact printers, where there is no striking of the page, but where characters are formed successively by firing ink droplets or transferring inks to the paper by a thermal process, enjoyed a modest 7.5 per cent market share, with 300,000 units shipped. Page printers, which include laser printers and print a page at a time, had a 4.5 per cent market share or 200,000 units.

In 1992 the picture is expected to be totally different. Dataquest says the numbers of serial impact printers sold will stay the same, to give a unit market share of 50 per cent. Serial non-impact devices, on the other hand, will have a 30 per cent share with 2 million units while page printers will take 20 per cent with 1.3 million.

The swing from impact to non-impact dominance will be to the detriment of existing technologies. The daisywheel is fading fast. The nine-pin dot matrix printer, currently accounting for 50 per cent of total printer sales, is expected to suffer, with more prevalent use of 18 pin and especially 24 pin machines. Some 25 per cent of printer sales are made up from 18- and 24 pin units today.

The line printer market is not regarded as vulnerable to attack from the non-impact camp. Applications being addressed by laser printers, such as word processing, letters and desktop publishing, where the prime requirement is quality, are not those addressed by line printers.

Looking ahead to 1993, however, the consensus is that line matrix printer revenues will fall while the band printer level is expected to hold steady.

Band printers are believed to resist the incursions of other technologies because there is little on the market that can compete with units working at 600 lines a minute and above for the price and reliability offered.

The European office printer market, which last year was estimated to be worth some $1.4 billion, which is expected to show the most dynamic growth, with laser machines prompting greatest expectations.

Indeed a new market has been identified by Canon and Hewlett Packard for a personal laser printer.

With 84 per cent of the world's laser printers driven by its units, Canon now thinks that market can be satisfied with its LBP-4 laser printer. With a throughput of up to 2,500 pages a month and a list price of 1,350 pounds sterling, it produces up to four pages of copy a minute.

Sales of laser printers incorporating the Postscript standard last year grew more quickly than the laser printer market as a whole. Romtec considers that the market for page description languages (of which Postscript is the leader), whether incorporated with the printer or bought separately, should increase at a rate greater than that for the whole market up to 1993.

Despite the euphoric launches of four-page-a-minute models, there are those who believe long-term growth will be associated with the 12-page-a-minute sector and above, which explains why value growth will come to exceed that for units. Such printers will largely serve multiuser systems and networks.

The average price of a laser printer has fallen in recent years because of price reductions and increased sales of low end lasers.

Costs of replaceable cartridges on lasers, currently working out at about two pence a page, will have to come down. But comparing that figure with thermal transfer's 8 to 10 pence a page, a band printer's 0.1 pence or a matrix's 0.05 pence, puts matters into perspective. (Extracted from Computer Weekly, 5 October 1989)

European alternatives to Far Eastern chip industry

The world wide chip shortage, which hit computer companies and other electronic equipment makers last year, is over. At least, this chip shortage is over with supply and demand once more in phase. But there is no guarantee that there will not be another in the next couple of years; indeed, some in the industry confidently expect it.

The shortage most crucially affected dynamic random access memories, taken by everyone to be the key product of the microchip industry.

Some manufacturers were able to adopt strategies which, even in a time of shortage, ensured that they were still able to get the DRAMs they wanted. Others have since recognized the importance of maintaining close contacts with selected suppliers in order to help protect themselves.

Not surprisingly, close contact is easier to maintain with local suppliers which are easy to visit regularly and easier to phone than those with plants

half a world away. But whether the lesson will be learned and heeded on a long term basis remains to be seen. For the time being, Japanese and South Korean companies dominate the DRAM market and European users have little option than to go to them.

However, the European chip industry is trying to pick itself up and position itself to compete more effectively with the Far East and the surviving US DRAM suppliers.

Their flagship is the Joint European Submicron Silicon Initiative, known as JESSI, a project involving initially Siemens and Philips but now also Plessey and SGS Thomson, the company which recently bought Inmos. JESSI seeks to give European manufacturers the technology to build 64-megabit chips, compared with the 1-megabit devices now being used in growing numbers.

At this point, historians of the semiconductor industry may well be getting a nasty sense of déjà vu. After all, Inmos was set up by the UK Government in 1978, with public funds of 50 million pounds sterling, mainly in order to give this country capability in the then imminent 64 kilobit DRAMs market. At the same time another 70 million pounds sterling or so was offered to the UK chip makers GEC, Plessey and Ferranti.

The initiative was not a success. In the period since 1979, according to Dataquest, European chip makers have seen their share of the world market go down from 16 per cent to around 10 per cent. At the same time, the western European electronics industry as a whole has seen its import-export deficit rise from $10 billion in 1983 to $15 billion in 1986, according to the Organization for Economic Co-operation and Development.

Last year, the 12 nations of the European Community were running a deficit in high technology trade of $10 billion. By 1992, when the internal barriers are removed and - some believe - the barriers against the Americans, Japanese and other non-EC nations are strengthened, the position is likely to be much worse.

The arguments in the late 1970s were similar to the arguments now, a fact recognized by Dr. Michael Hobday of the Science Policy Research Unit at Sussex University. "European chip makers have depended to a larger extent than is healthy on single markets - military, telecommunications and other government customers. They need to demonstrate that they can go beyond telecommunications and the military into consumer sectors and dp."

But the shortage last year was not precipitated purely by the failings of the European industry. Users world wide were affected by the shortfall which bit hard because the industry is immature.

Three key reasons lay behind the shortage. First, Japan's Ministry of International Trade and Industry was constraining exports as a result of agreements with the US, which lengthened delivery times.

Also, the 1 megabit DRAM was in its very early stages of production. Yields were not as high as expected, and suppliers ran into problems meeting demand.

These factors were compounded by suppliers switching out of 256-kilobit DRAM production, because the older devices offered less profit.

So although users expected the switch to 1 megabit devices and designed their equipment to use the new chips, they could not get them. But at the same time, they could not switch back to 256 kilobit memories.

Prices for 1 megabit DRAMs are falling about 10 cents a month on prices which currently stand at around $14 to $14.50 for a standard device.

At the same time the trend towards a chip surplus has been stimulated by the changed shopping habits of major users who have reduced their orders. The PC sector has caused most concern. They have built up stocks in their dealer networks. As a result they are ordering fewer DRAMs this year.

A chip mountain or shortage can dramatically affect the price tag on a piece of kit because the price of DRAMs is key to equipment manufacturers' margins.

The European semiconductor industry is chasing a fast moving target. Already the technology is moving on from 1-megabit DRAMs with 4-megabit DRAMs becoming an urgent requirement. The industry would like to introduce them as soon as they make commercial sense and integrated office products are a likely early application.

Catering for future needs is where the JESSI project might be able to help. According to Hobday, "JESSI is a very good programme and it stands a number of chances of success. It demonstrates Europe is serious about entering the mainstream microcomputer industry."

JESSI follows on from Megaproject, a Siemens Philips collaboration to develop memory chips.

The purpose of Megaproject was to reduce the dimensions of chips. Currently tracks and devices are measured in multiples of 1.2 to 1.5 microns. "One micron chips are in development and pilot production", says Bentley of Philips components. "The target at the end of Megaproject is 0.7 microns. With JESSI, the aim is to move to 0.5 and then to 0.35 microns."

With a quarter of the linear dimensions, 16 times as many components can be packed into the same area of silicon. That should make 64 megabit DRAMs or 16 megabit static RAMs feasible.

JESSI, however, must overcome a number of challenges. One danger is that it could lead the industry to becoming Europe centred, warns Hobday. "That would only prolong the decline of the industry, not stop it." In other words, "the managers of the companies in JESSI have to develop an export-led dynamic, which means addressing the US and Japanese markets".

He is optimistic of JESSI's chances of success. Today there are some extremely good managers about in the European semiconductor industry, who have worked for US and Japanese companies and who now have an international perspective. (Extracted from Computing, 3 August 1989)

Japan's IS market momentum

The combined IS revenues of the top 10 companies in Japan soared by a massive 29 per cent last year in dollar terms to $44 billion. That was up from $34 billion in 1987.

Even taking into account the 11 per cent rise in the value of the yen during the course of 1988,

that still leaves a formidable 18 per cent growth rate - making Japan by far the fastest growing major IS market in the industrialized world.

This continuing IS momentum in the island nation helped the Asia Pacific region as a whole to increase its share of the world IS market from 22 per cent in 1987 to 25 per cent last year. That is compared with a drop of 3 per cent in market share for North America, an area that now accounts for only 38 per cent of world IS revenues and is likely to fall even further over the next few years.

Once again, at the top of the IS heap in 1988 was Fujitsu Ltd., the supercomputer to PC company that saw local IS sales rise by a healthy 28 per cent in dollars. Fujitsu's Japanese sales topped $9 billion last year, and the Japanese market now accounts for 83 per cent of its total IS revenues.

But while sales rose throughout the Japanese islands, the high yen, rising costs at home and growing fears of protectionism in foreign markets forced Japan's IS industry offshore in 1988.

Some Japanese firms even began to move their research and development activities offshore, especially to those Asian countries where they have already established a manufacturing and sales presence: Hong Kong, Singapore, South Korea and Taiwan - the so called "Four Dragons". At the same time, manufacturers are turning to Indonesia, Malaysia and Thailand for manufacturing because of cheap labour and other cost advantages.

The main IS product developments in Japan in 1988 and early 1989 were the office computer, or OFCOM, a configuration unique to the Japanese market, and the release of supercomputers.

Lower down the power scale, the mainframe continues to be popular despite its slowdown in other markets.

The obstacles to widespread PC use seem to remain the same: the difficulty of handling the complex Japanese language on a keyboard (which few Japanese have used); the delays involved in processing Japanese characters on anything less than a 32 bit microprocessor (which, according to NEC, is incorporated in only 5 per cent of the computers now used in Japan); the lack of standardization in Japan's computer industry; and historical differences in software development (spread sheets, for example, have not really caught on).

In the 1990s, the Japanese feel, the number of on line global information systems with as many as 100,000 terminals will steadily increase. To meet the anticipated demands of these large scale strategic systems, all Japanese mainframe manufacturers announced a wide spectrum of products in 1988, with special emphasis on a number of factors. These include: microcomputer/mainframe linkage (MML); the ability to handle large volumes of data with widely varying formats, including batch processing for management coupled with distributed processing for business; hardware and operating system software capable of multimedia transmission, in preparation for full scale implementation of the integrated services digital network (ISDN); and the ability to support multivendor systems and networks.

The Japanese mainframe computer market's product cycles are IBM driven. In 1988, IBM began shipping its AS/400 midrange computers. Partly in anticipation and partly in response to this announcement, IBM's main competitors here - primarily Fujitsu, along with NEC, Hitachi, Toshiba and Nihon Unisys - started delivering comparable systems. These companies typically compete on a cost basis, giving large discounts to government and academia. This tactic effectively excludes US firms from these markets, and generates an intense domestic price war. Recently, IBM was forced to adopt the same tactic, offering discounts of up to 70 per cent. The move is creating a backlash, with Japanese firms halving prices in response.

Also creating opportunities are new developments in laptops. Starting to appear in Japan are thin, ultralight full function laptops. The first is the NEC Ultralight, a 4.4 pound model for the US market. Seiko Epson Corp., has announced one even smaller. Soon to arrive (some have already been displayed at trade shows) are laptops with colour liquid crystal display (LCD) screens from Hitachi, NEC, Seiko Epson, Sharp Corp., and Toshiba. As might be expected colour costs a lot: the units are expected to sell for $10,000 abroad and ¥1 million in Japan.

Perhaps the most important long-range concern among the information service industry is Japan's growing internationalization particularly in terms of software and services imports. For example, 75 per cent of the data bases used in Japan originate overseas. When the supercomputer wars fizzle out over the next few years, data bases may be the new trade battleground. In the meantime, Japan's domestic market looks set to continue its rapid growth during 1989, providing an even stronger base from which its domestic IS giants can expand into markets in Europe and the United States. But, although these high growth rates may last through this year, Japanese companies must prepare to hit a domestic ceiling sooner or later - possibly in the early to mid 1990s.

US consortium of 4 Mbit DRAMs

The initial wave of support for the US Memories Inc., consortium, unveiled in late June, was not surprising. Though most experts expect US Memories to meet its timetable, the powers behind the new company, pushing to get the program on the road, confront formidable barriers, some of which caused US manufacturers to fall behind or quit the DRAM business in the first place.

Start with financing. The entry fee to the DRAM sweepstakes is staggering; US Memories' requirement for upwards of $1 billion requires backing from many sources. The production plant itself will likely cost more than $500 million, the ante for a state of the art fab line capable of the submicron geometries necessary for turning out the 4 Mbit DRAMs slated as the first product in 1991.

Then there is the need to orchestrate harmony in a consortium that eventually could number nearly 20 companies, in itself a daunting assignment in an industry not known for selfless teamwork. Time is of the essence, too, because meeting the 1991 product release date requires having all the fundamental elements - funding, technology, business plan, and antitrust exemption - pretty much in place by the end of this year.

Still, despite the obstacles, the consensus is that US Memories will meet its milestones close to schedule and put together a workable plan to produce DRAMs. Insiders say that the breakthrough came when IBM Corp., threw itself wholeheartedly behind the

plan that emerged under the auspices of the Semiconductor Industry Association. One of seven SIA members involved in the plan, IBM will license its own 4 Mbit DRAM design and manufacturing technology to the consortium.

The IBM link gives US Memories "instant credibility", says a consortium insider. Having the 4-Mbit design and process in hand neatly solves what had always been one of the toughest problems any co-operative US DRAM venture faced.

Other initial backers include Advanced Micro Devices, Digital Equipment, Hewlett Packard, Intel, LSI Logic, and National Semiconductor. The principal motivator behind the SIA committee that recommended establishing US Memories was Wilfred Corrigan, LSI Logic's chairman, who has been named chairman of the consortium.

The goal for the new co operative venture is ambitious: 5 to 10 per cent of the world 4 Mbit DRAM market by the mid-1990s. That market, as estimated by Scottsdale, Ariz., market watcher In Stat Inc., will amount to 876 million units at an average selling price of $11.05 apiece, for a total of $9.7 billion. Thus, US Memories could become a $1 billion company in its own right.

The impact on the US market would be even more dramatic. US Memories' share would be perhaps 20 per cent, which would help satisfy one of the consortium's chief aims: to make US equipment makers less dependent on foreign sources. Even domestic DRAM competitors Micron Technology, Motorola, and Texas Instruments say the consortium poses little threat to their own efforts, since they cannot begin to take away market share from offshore suppliers at present. (Extracted from Electronics, August 1989)

Cross European communications

Many large multinationals, such as Shell, Ford, DEC and IBM, already operate not only Europe wide, but world wide. Their information systems are already in place for the post-1992 open market. The companies who need to start focusing on Europe are the small to medium-sized companies, who must broaden their horizons and start thinking about business on a European scale.

A prime example of this is the insurance sector - French insurance companies are already trying to buy into the UK marketplace in preparation for the lowering of national barriers in 1992.

A key weapon for companies wanting to compete in Europe is the way in which they use, transmit and analyse information, both internally and externally. Communication of information internally means effective communication between departments, for example between an engineering centre and a manufacturing plant.

They could be located in different countries, but information must flow quickly and accurately between them.

Of equal importance, is external communication, between a company and its suppliers, customers and third party data bases, or information providers. These information providers include viewdata systems such as Prestel and its French equivalent Minitel. These services hold information relevant to their host country and a company planning to move into Europe needs access to them.

They will need information about the environment in which they are proposing to operate, for example data on major competitors and public sector requirements such as safety regulations and contractual requirements.

There are two main types of information flowing through and from an organization: unstructured, or structured.

Unstructured information is typically generated on an ad hoc basis and includes internal communications, perhaps letters, memoranda, facsimile and telex. Structured information is strictly formatted in data terms and may go out regularly, for example invoices and delivery notes and routine, bulk, clerical tasks.

Unstructured information is best communicated using an electronic mail system. As soon as people need to communicate with others located elsewhere then electronic mail is generally faster and more accurate than post or telex, and complementary to fax. A good system will include gateway facilities to the telex, fax and other services in each of the local countries covered.

The internationally recognized standard for electronic mail is the X.400 messaging standard. The requirement will, in most cases, be to link existing incompatible systems from a variety of suppliers. This is not as difficult as it first sounds. The X.400 and related standards have reached the point where it is practical to implement an X.400 messaging system with links to a variety of public and private systems across Europe.

X.400 can be used to establish a completely integrated messaging system, incorporating image and voice, as well as text. Standards for word processing and transfer of documents, such as open document architecture, are being set up and will be available soon, although proprietary systems are already available from companies such as Digital and IBM. The architecture allows text and image to be transmitted between different word processing systems, across national boundaries.

Publishing houses and newspapers in particular will benefit from such systems, as it will enable copy to be sent in from any location, on any system, edited using a different word processing package, typeset, photographs incorporated and then printed.

EDI (electronic data interchange) refers to the communication of either structured or unstructured information with the customers and suppliers of an organization. There is interest in the implementation of EDI based on X.400 services.

However, this could change with the introduction of FTAM (File Transfer Access Method), which is often more applicable for the exchange of structured information than X.400. FTAM may be better for large bulk file transfer since X.400 is optimized for message store and forward.

Information systems managers also need to consider pan European regulatory issues. The regulatory environment is changing rapidly, in part due to the intiatives of the European Commission and in accordance with the Open Network Provision framework governing public telecomms organizations. The two key objects of the open network provision are:

> Opening up of the equipment market through competition, implying the total removal of PTT monopoly supply. This has happened to different degrees in different countries.

- Defining value added network services (vans) into two groups, reserved and non reserved. Reserved services would be subject to ITT monopoly provision: non reserved services would be supplied competitively.

Exactly what services will remain in the reserved category is still under debate in various countries, and the outcome is expected to have a decisive effect on the vans market and the competitive provision of X.400 based services.

Such a network can help an organization meet the challenge of a European market place, through improved internal operations and better communications with customers, suppliers and others.

Effective business communication increases the efficiency of staff by providing faster information flows and improved access to information. This can now be done cutting across geographical, functional and organizational boundaries. (Source: Computer Weekly, 26 September 1989)

Cray and Hitachi cross-license patents

Cray Research (US), the world's largest supercomputer company, will cross license its patents with Hitachi (Japan), a major competitor. Both firms will have the right to use each other patents in designing computer hardware. Although similar arrangements are common in the computer industry, it is unusual for a US and a Japanese company to form such an agreement, especially in the supercomputer field. The agreement was reported in the Asahi Shimbun, a leading Japanese newspaper, and the report was confirmed by Cray officials. The arrangement does not involve any technology transfers between the two firms. Cray has similar agreements with IBM and Convex Computer.

The arrangement will enable Cray to use some of Hitachi's circuit design patents, while Hitachi will probably find it easier to increase its marketing efforts in the US. Cray produces most of the logic chips used in its processors, but must purchase other components, such as high-speed memory devices from Fujitsu. (Extracted from New York Times, 24 July 1989)

Cross licensing agreements

Compaq has signed a cross-licensing agreement under which it has access to patents filed by IBM before 1 July 1993. The agreement gives IBM similar access to Compaq patents. Under the terms of the agreement, Compaq will pay a fixed sum in five annual instalments. The sum includes royalties on any IBM technology that was used in clones of the IBM Personal Computer, XT, and AT. Compaq also has a licence to IBM's Micro Channel Architecture, although Compaq's president, R. Canion, has emphasized that it in no way changes the company's product direction. (Extracted from Computer World, 17 July 1989)

Suppliers of raw GaAs in difficulties

Gallium arsenide was supposed to have been the hottest technology around by the end of the 1980s. But although there have been a few notable success stories, there have also been some failures, and several companies have gone out of business altogether. Now the troubles have spread to the suppliers of raw gallium and GaAs wafers. Alcan Electronic Materials of Montreal was the first to give up: last month it agreed to sell its gallium metal business to French materials giant Rhône Poulenc Chimie. And Morgan Semiconductor of Garland, Texas, a large producer of GaAs wafers, is shutting down its crystal growth plant, though it will continue to market epitaxially grown GaAs. In Morgan's case, all its major customers failed at once: US companies Gain Electronics Inc., and Microwave Semiconductor Corp., both went out of business, and in the UK, Plessey Co., plc closed its GaAs IC foundry and General Electric Co., cut back production. (Source: Electronics, July 1989)

IBM and the supercomputer market

IBM has everything needed to enter the supercomputer market, according to observers. The company has several features in its favour: expertise in parallel processing and system software; state-of-the-art semiconductor R&D; large systems expertise; and old relationships with potential buyers. Presently, its 3090 mainframes with attached vector facilities provide much power without the speed. More importantly, IBM bought a 15-20 per cent equity share, worth $20-30 million, in Supercomputer Systems (Eau Claire, WI), which was founded by S. Chen, former designer at Cray. The firms are jointly producing a 64 processor supercomputer with a hundred times the performance of the Cray X-MP. According to Dataquest, the two firms are working on ways of integrating SSI's supercomputers with the IBM 3090 vector facility. IBM has installed more than three hundred 3090 vector facilities in the US and Europe. Internally, IBM is working on the RP3 and GPII supercomputer projects. The GPII has reached a peak of 11.5 GFLOPS. (Extracted from Communications Systems Network, 19 June 1989)

New computers for the science market

Digital Equipment will soon introduce a new line of computers aimed at the technical and scientific computing markets. The new computers will probably compete with Sun Microsystems' and Hewlett Packard's work stations. Digital's new DEC-station 2100 will cost under $10,000 and will compete with a similar new work station from Sun. Digital Equipment is the second largest US computer manufacturer. Until 1989, Digital had used the same basic Vax design for all of its equipment, including its most powerful computers. However, in early 1989, Digital introduced a work station using MIPS Computer's microprocessor, which is based on reduced instruction set computing (RISC). Computers based on the new design offer better performance at a lower cost.

Digital plans to make new Vax computers based on the RISC design when it modifies its computer line. However, these changes will demand that customers rewrite their existing software in order to use the new RISC design. Digital previously was able to claim that all of its software for the Vax design could be run on all of its computers. This gave it an advantage over IBM, which had many incompatible software programs. Digital will offer special hardware options for scientific computing applications. The firm's action apparently was prompted by the success of mini-supercomputer firms such as Convex Computer in attracting some of Digital's customers. Digital will introduce a new Vax 6400 version of its Microvax series of computers and several computers for use as central file servers for its MIPS based computers. (Extracted from New York Times, 10 July 1989)

Safety in numbers

After decades of survival in IBM's shadow, Hewlett Packard knows the value of a friend, or even an acquaintance. The computer maker's taste for

strategic alliances has earned it a reputation .. the most collaborative minded company in Silicon Valley. On 7 August, Hewlett Packard struck up yet another friendshi,, this time with South Korea's Samsung Group. The two companies aim to produce a high powered work station within two years that, at $5,000, is supposed to provide many times the processing power of competitors' models at about half the price.

This is the latest in a string of alliances put together by Mr. John Young, Hewlett Packard's chief executive since 1978. These alliances range from marketing and licensing agreements to ambitious joint ventures to develop new technology. Hewlett Packard's main motive is often to avoid being overwhelmed in some market segment by IBM, which has six times its sales.

Hewlett Packard's readiness to work with outsiders also reflects the way it works internally. It has had no redundancies since it was founded 50 years ago by two entrepreneurs in the proverbial garage. The loyalty of its employees is famous in a valley and an industry where job-hopping is endemic.

The company reckons its collaborative skills will serve it particularly well as it positions itself for the more open EEC market planned after 1992. It has a better geographical balance of sales both world wide and within the EEC than do its European competitors. (Extracted from The Economist, 12 August 1989)

Intel works on faster version of 1860 micro

Intel says it is developing a much faster version of its 1860 microprocessor that will be available in mid 1990.

The new microprocessor will probably be called the 1870 and will feature over two million transistors and some elements of the 1960CA embedded microprocessor.

The 1860 has so far had few design wins and there have been reports that Intel will redesign the microprocessor and reposition it to gain greater sales. Intel says that the 1870 and 1860 will be offered as two members of the same family.

The 1870 will cost much more than the 1860 but it will have several vital functions that will make it into a strong competitor of the 1860. It will have cache management using a technique called bus snooping, making it easier to use in multiprocessing systems. Like the 1960, it will have a reduced instruction set computer core and may also use a superscalar architecture which can process more than one instruction per microprocessor cycle. (Source: Electronics Weekly, 27 September 1989)

Three firms come up with 32 Bit G Micro 100

Mitsubishi, Hitachi and Fujitsu plan to sample release 32-Bit G micro 100 microprocessors conforming to TRON specifications. The second series in the Micro Family following the G Micro 200 from Hitachi, the G Micro 100 is designed for small memories and as the core for ASICs with peripheral functions on the same chip. It features a clock frequency of 25MHz and average performance of about 7MIPS by the Drystone benchmark. By the 1.0 µm CMOS process, it integrates 330,000 transistors on a 11.47 x 8.89 mm chip. (Source: AEU No. 3/1989)

Office processor series geared for Asian market

Fujitsu Ltd., has begun marketing an office processor, the FACOM K 600 series, which features an operating system compatible with languages from eight Asian countries - Korea, Taiwan, Philippines, Thailand, Hong Kong, Singapore, Malaysia and China. The company also has set up an Application Support Centre wit its Philippine subsidiary to develop products for foreign markets. Last October the company released seven variations of the three high-end models - K-630, K-650 and K 670 series - in Japan. Sales of 1,500 units are targeted for the next two years. Office processor sales are scheduled to begin in Spain in mid 1990. (Source: AEU No. 3/1989)

LSI Logic

Unlike some market niches, those in high-technology seldom last. If a high-tech niche fails to grow, it is usually eroded away by still newer technology. If it thrives, large companies often muscle aside the start-up firm which pioneered the business Nowhere has this been truer than in chipmaking. Because of high capital costs, large economies of scale and the volatility of demand, it is usually more beautiful to be big than small in chips. But not always.

So far, LSI Logic, a small specialist chipmaker based in California, has bucked the trend. Despite growing competition from giant Japanese chipmakers such as Toshiba, NEC, Fujitsu and Hitachi, it continues to be the leading supplier of gate arrays.

In the nine years since it was formed by Mr. Wilfred Corrigan, LSI Logic has boosted its sales by about 60 per cent annually, reaching $379 million last year. Eager to banish its start up image, LSI is due to obtain a listing on the New York stock exchange in October. Its shares have been sold over the counter since 1983. At the same time, LSI knows that it has to diversify in order to fend off the big companies that are attacking its market. The company's future depends upon managing that diversification properly.

LSI produces ASICs (application specific integrated circuits), designed for particular customers to combine the functions of several standard chips in one piece of silicon. Equipment makers use ASICs because they are cheap, reliable and fast compared with the combination of standard chips they replace. Also, bright ideas are harder to copy if they are locked up in an ASIC rather than in a readily identifiable combination of standard parts.

LSI Logic has maintained its grip on gate arrays by investing heavily in R&D, even during the chip slump in the mid 1980s. Fortunately for the company, the manufacturing technology of gate arrays differs from that of the commodity memory chips churned out by big Japanese chipmakers. With production volumes much lower, economies of scale also count for less. (Extracted from The Economist, 9 September 1989)

Competition in the RISC microprocessor market

As competition in the RISC microprocessor market heats up with the entry of major companies such as Hewlett Packard and next generation SPARC designs from Cypress Semiconductor, software is becoming a key issue.

The success of a RISC microprocessor is increasingly dependant on what software applications will be available to run on work stations using that particular RISC microprocessor. The more software that is available, the greater the likelihood that customers will buy the RISC work station.

RISC manufacturers are using different strategies to ensure the success of their microprocessors. Office Equipment Manufacturers using Motorola's 88000 RISC microprocessor have formed the 88open Consortium to promote the 88000 and ensure that software produced for 88000 work stations is binary compatible so that it will run on 88000 based work stations from different manufacturers. 88open has published a set of binary software compatibility standards for the 88000 to guide software developers in porting their applications.

SPARC International, a group of licensees using Sun Microsystems' SPARC microprocessor is also encouraging binary compatibility among software for SPARC based work stations. SPARC International is close to publishing its binary software compatibility standards that will be distributed to software developers.

Other companies are taking a different strategy. MIPS Computer Systems is concentrating on ensuring that compilers for its RISC microprocessors are compatible, but it is not promoting binary compatibility. MIPS has customized its microprocessors for some of its largest customers which means that binary compatibility would be hard to guarantee. DEC has modified the MIPS microprocessor to ensure that it is more compatible with other DEC products. Silicon Graphics, another MIPS customer, has also customized the MIPS microprocessor so that it can better handle multiprocessing and three-dimensional graphics applications.

Hewlett Packard with its Precision Architecture RISC microprocessor, prefers to let its licensees handle software compatibility problems. This helps to discourage other companies from building compatible systems to its own, and Hewlett Packard believes that the size of its own customer base will be sufficient incentive for software developers to port their applications to its RISC work stations.

Both MIPS and Hewlett Packard are taking some risks in not encouraging binary compatibility standards. Porting software applications to a hardware platform involves considerable work and software developers must decide whether it is worth the effort. (Source: Electronics Weekly, 27 September 1989)

The price is right for embedded control

Microprocessor manufacturers have spent the weeks since the summer holidays announcing details of devices aimed at embedded control applications. These systems do not allow the user access to the processor, providing the chip with its data and interrupt requests from non keyboard sources.

At the moment the greatest demand is for 8 bit devices but the increasing sophistication of equipment in graphics and image processing, laser printers and communications systems is predicted to raise demand from about 240,000 units this year to over 4 million in 1992.

AMD has been releasing details of embedded control systems using its AM29000, now numbering about 170, since 1988 and Intel's 80960 architecture was first announced. Intel showed its whole family of devices to the press earlier this month. Motorola has based its 68300 family, described at a series of press conferences since last spring, on the 68000 core.

Inmos moved the Transputer into the market earlier this month by announcing a cut down 32 bit version of the device which will sell for $40 and Cypress followed with the CY7C601, a SPARC reduced instruction set computing (RISC) chip.

All the devices process millions of instructions per second and use cacheing techniques to store the most frequently used data and instructions. The companies have left off capabilities found on state of the art chips designed for computing, such as floating point units and graphic processors.

AMD can demonstrate a number of designs already using the device. A growing range of software has been written for the 29000, most of it by third parties.

The lack of available software may turn out to be the biggest handicap faced by the Transputer. Inmos's rivals also doubt the need for the array type of parallel processor in embedded control systems.

Cypress has based its strategy on a SPARC 32 bit RISC processor, the CY7C601, with separate floating point controller and processor chips. Its embedded control family also includes memory management, cache controller and cache memory devices.

A similar approach has been adopted by Intel with the crucial difference that it is trying to meet a range of applications with single chips. The present i960CA has three instructions execution units of which any two should be processing code at any one time at 66MIPS. The extensive use of cache memory and direct memory access controllers, together with a mixture of reduce and complex instruction sets, add to the device's effective processing power.

Addressing the specific needs of each embedded control application is also the basis of Motorola's strategy, but the company has abandoned the race for raw MIPS performance in favour of the huge software support for, and designer confidence in, its 68000 processor. The architecture, which is now over ten years old, forms the basis of its 68300 series.

Individual chips will soon be available to meet any 32 bit embedded control demands made by designers. Market share will be won by companies convincing their customers that their approach, their software and their price is right. (Source: Electronics Weekly, 27 September 1989)

Japanese 4M DRAM activity picking up

Semiconductor manufacturers Toshiba and Fujitsu are making solid moves into the 4M DRAM market.

Toshiba has reached 100,000 parts per month production levels at its Oita, Japan, manufacturing facility and expects to hit 1 million parts per month in 1990.

The Toshiba 4M DRAMs are fabricated using trench cell twin tub CMOS silicon gate technology. The n channel cell in the p-well design achieves high soft error immunity. Engineers at Toshiba say that they follow a "conservative" 0.8 μm design rule and plan a "prudent" shrink for the next generation.

The devices are constructed using an aluminium master slice technique; the same die is used with interconnect variations for each IC option - the circuit is available in two configurations, two speed (80 or 100 ns), several functional variations, and two package options. Amazingly, this memory can be packaged in a 350 mil 20 pin SOJ package.

The Fujitsu 4M DRAM, introduced in February 1989, is also fabricated in CMOS technology, using a high density three dimensional stacked

capacitor cell technology that permits higher cell packing density, reduced soft errors, and extends the time interval between memory refreshes.

In other DRAM news, Australian owned Ramtron, Colorado Springs, Colorado, has announced an agreement to co-develop a 4M DRAM with NMB Semiconductor in Japan - the fifth largest 256K DRAM supplier in the world. Under terms of the agreement, NMB Semiconductor has access to Ramtron's memory design expertise and advanced materials processing technology and Ramtron has access to NMB's semiconductor process development and automated high-volume manufacturing facilities.

Ramtron's advanced materials technology has a much higher linear dielectric constant than the silicon dioxide dielectrics commonly used in existing DRAMs, allowing memory cells to be made much smaller. Whereas most semiconductor manufacturers are developing nonplanar DRAM fabrication processes that use trench capacitors in an effort to provide adequate signal levels, DRAM cells fabricated with the high dielectric materials have significantly greater signal levels and therefore can be built without trenches. (Reprinted with permission from Semiconductor International Magazine. Copyright 1989 by Cahners Publishing Co., Des Plaines, Il., USA) (Semiconductor International, July 1989)

IV. APPLICATIONS

Hybrid PC systems

Personal computers could soon be supplemented with the capabilities of TV pictures and sound. Such hybrid systems could be used for training and education or for games. Desktop video or multimedia computing will change the concept of personal computing, according to R. Abel, a special effects expert who is creating computer video productions. The powerful new computer chips being developed could finally allow processing of the tremendous amounts of data required for TV like pictures, which could be frozen, manipulated or stored with the new technology.

Microsoft is spending $10 million per year on developing the new technology. IBM is developing mainframe computers for storing video information that could be used in networks of desktop computers. With Intel, IBM is developing technology for compressing video and other data for storage on CDs. Apple is also developing multimedia computers. IBM may introduce a machine by the end of 1990. Commodore and Amiga are also active in the field. US computer makers are pushing development of the technology to prevent it from falling under the control of Japanese electronics firms, which are developing HDTV. US media companies such as ABC, Newsweek, Time Warner and McGraw-Hill are all developing programming for multimedia computing. S. Alsop of PC Letter says IBM hopes to make multimedia computing more accessible by making the systems more like players (using prerecorded material) than like computers. Apple, however, is working on systems to let customers create their own productions. (Extracted from New York Times, 12 September 1989)

Desktop application for VGA on MS DOS

Autodesk has introduced Animator, a desktop multimedia application for real-time VGA animation on MS DOS. The only equipment needed to run the software is a VGA card, a monitor and a pointing device. Autodesk recommends using a 286-based system or better, although the program will run on IBM XTs. Animator can produce video images up to 4,000 frames and play them back at 70 frames per second from a hard disk, using compression. Graphic objects can transform from one shape to another and moving objects can be produced to have smooth movements. The software does not use windows and has difficulties integrating sound. Animator will accept still images from several microcomputer and peripherals as well as animation sequences from Amiga and Atari. Major distributors, not high end resellers, will feature the software. Ingram Micro D, Softsel Computer Products will market Animator to video professional and other uses. (Extracted from Computer Reseller, 7 August 1989)

Simulation frameworks

CAD/CAE firms are focusing on making EDA frameworks integrate different simulation tools at different stages of design and co ordinate several simulators on one run. Simulation frameworks have been specialized in the past: some were for simulator vendors, some for third party tool developers and some for in-house CAE/CAD integrators. However, comercial simulation framework technology is blossoming. Stable synchronization systems and overall experience are giving developers enough confidence to work on general simulators. Simulators by Viewlogic Systems (Marlboro, MA) and MicroSim (Laguna Hills, CA) were combined in order to handle mixed designs with analog and digital signals. Valid Logic Systems is treating the problem as one part of a larger whole. The user describes the circuit, making the type of interface unimportant. According to the VHDL Design Exchange Group, work is going on to create modeling standards. (Extracted from High Peformance Systems, June 1989)

First two inch floppy disk

Fuji Photo Film USA (Elmsford, NY) has released the first two inch floppy disks in the United States. Design for hand held computers, laptops, and multifunction telephones and fax machines, the new disks feature a 1 Mbyte storage capacity. (Extracted from PC Week, 27 July 1989)

"Disk arrays"

Development of "disk arrays" for storing and retrieving large volumes of data may phase out large, costly devices. The new devices are relatively cheap disk drives utilizing the 3.5 inch or 5.25 inch hard disks that can be found in several PCs. Gangs of disks, or "disk arrays", have the potential to be quicker, as well as cheaper, than the refrigerator size devices now used. Other features of the new development, still in the experimental stage, are that they use less electricity and take up a smaller amount of floor space. They may also have more reliability than the bigger devices. Major storage firms report, however, that disk arrays are several years away. (Extracted from Wall Street Journal, 19 July 1989)

Magneto optical memory uses

Magneto-optical memory is among several direct access secondary storage (DASS) allowing users to access off line historical data. The rewritable optical technique allows devices to address a smaller, physical area on a disk with the use of a laser, which leads to increased capacity, according to International Data (Framingham, MA). DASS products sales of 40,000-50,000 units/year to 1992 are predicted. Magneto optical disks store data in the form of a magnetic flux, which allows the disks to be written to and erased repeatedly without media wear or data degradation. Several companies,

including 3M, Ocean Microsystems, and Pinnacle Micro are developing systems using the technology. The increase in power available to users, along with networking capabilities, have caused a 20-25 per cent/year growth rate in the amount of storage required in a computer, according to Hewlett-Packard's Greeley Storage Division (Greeley, CO). The systems will address three application market segments: historical and archival storage, unattended backup, and document or image storage and retrieval. (Extracted from MIS Week, 10 July 1989)

Networking device

Photonics (Cambpell, CA) has announced a device that will allow users to connect themselves to a network with a quarter rather than cables. The 4.75-lb Photolink, delivering in September 1989, employs infrared (IR) light to transmit and receive signals from networked computers. It plugs into the rear of a computer and attaches to the top of a cubicle wall. Just one screw must be tightened and this can be done with a quarter. From its position, the device projects an unseen 7-ft. diameter infrared spot onto the ceiling. The reflected signal is picked up by other computers in the vicinity with their Photolinks. If the beam is obstructed or the units pushed out of alignment, a red signal indicates "down status". Data cannot be lost even when transmission ceases, thanks to a built-in detector. A Photolink network is limited only by the kind of network being employed. Learning of new command structures is not necessary since it works with current network protocols. (Extracted from Information World, 17 July 1989)

Silicon microstructures commercially produced

NovaSensor and IC Sensors are two firms that have produced commercial microstructures in silicon. Silicon micromachining, making micron-sized silicon equivalents of electromechanical components, has the potential to create novel products that are difficult for competitors to copy. Both firms are involved in developing product breakthroughs in silicon micromachines. NovaSensor makes commercial accelerometer chips (pressure sensors) for implantation in human hearts and IC Sensors has developed a chip with 40-micron channels for processing fluids that may enable the development of hand-held blood analysers. Other possible uses for the technology are fluidic computers that operate using fluids instead of electrical currents, machinery analysers, in-tyre pressure gauges and microphones directly located on musical instruments to prevent feedback. Micromachining research is also being conducted at Stanford University, University of California Berkeley and Bell Laboratories. (Extracted from Machine Design, 6 July 1989)

EISA logic chip set shipped

Intel has launched volume deliveries of the Extended Industry Standard Architecture (EISA) system logic chip set. The company says there are 33 North American system designs underway that will incorporate the 2 chip set. Products built around the bus specification are planned by board manufacturers Proteon and Adaptec. The chips will plug into the motherboards of machines that are almost finished. EISA supporters Compaq Computer and Hewlett Packard both hope to be the first supplier to debut a system. Intel is also shipping its 82350 line, a 2 chip motherboard set with the EISA bus. The 82350 is comprised of the 82357 Integrated System Peripheral using direct memory access control; timer/counter functions; interrupt regulation; bus arbitration, including bus master arbitration; and DRAM refresh. A 33 Mbyte/second direct memory access transfer rate is reported for the 1.5 micron CMOS product. Final samples of the 82350 chip can be obtained now. (Extracted from Computer Systems Network, 17 July 1989)

PC-based speech recognition system

Scott Instruments' (Denton, TX) new personal computer based speech recognition system is offered stand-alone or in a telephone version. The SIR Model 20 system, which recognizes 160 words from any speaker, includes a board for IBM Personal Computer XTs, ATs or compatibles; Speech Communication Manager software to create and edit vocabulary; and software that includes the firm's Coretechs speech recognition technology. The stand alone version allows a user to use voice commands to call up information from a personal computer. The telephone version consists of a PC equipped with a telephone line interface. Among the features of the SIR Model 20, it allows users to customize their vocabularies. (Extracted from Networking World, 17 July 1989)

Hard disk/tape storage machine

Fujitsu America (San Jose, CA) has introduced StorEdge, a combination hard disk/tape storage machine. It is designed and preformatted for stand-alone or NetWare 286 local area network environments. The machine can hold three 5.25 inch disks or tape drives from any manufacturer, although the host adapter is optimized for Fujitsu products. One hard disk will hold 320 Mbytes, while the tape back up system, supporting 0.5-inch cartridges, will hold 220 Mbytes. A Small Computer Systems Interface bus permits up to 7 hard disks per host adapter to be daisy chained together, resulting in a total of 2.24 Gbytes. In a hard disk mode, StorEdge has an access time of 18 milliseconds and a 1.5 Mbyte/second data transfer rate. The tape drive can back up 140 Mbytes in less than 15 minutes. According to Fujitsu, StorEdge is unique because it is expandable. (Extracted from PC Week, 3 July 1989)

Ferroelectric octal flip flop IC

Krysalis has introduced a ferroelectric octal flip flop IC, a first. The F74CF377 is an 8 bit flip flop which holds its states upon power down, and recalls them when power is restored. According to Krysalis, applications include terminal IDs, cellular telephone number storage, PC and radio memory configuration, engine control, and auto odometers. The device holds data at its inputs on all positive clock transitions, and outputs recalled data upon receiving a recall signal when power is restored. It is made via National's 2 micron silicon gate n well CMOS process integrating a thin film of ferroelectric ceramic. The device stores data for more than a year after 100 billion data changes. (Extracted from Electronic Engineering Times, 10 July 1989)

New chip technology makes RISC work station compatible with IBM's MCA

Bull Micral of America has developed a new chip technology which will make RISC work stations compatible with IBM's Micro Channel Architecture (MCA). The new technology uses Bull's Short Line Interface Kernel (SLIK) architecture which changes the interface between processor and memory. Thus any processor becomes compatible with an I/O since the bus is stabilized with a constant system design and common software. Micral implements SLIK with a chip set consisting of a memory/bus controller, a DMA controller, an address/data buffer, and a

peripheral support chip. SLIK is designed for 25-50 MHz functioning and handles Intel's 486 processor and the R3000 chip from Mips Computer Systems. Bull is working on implementing MCA to Intel's i860 RISC processor. Systems can be designed with SLIK for 32- or 64 bit data busses, a 32-bit address bus, extended DMA and concurrent I/O processing support, byte parity throughout the system, and multiport memory control. Other technology firms say that chip sets implementing MCA to a range of SPARC and Mips work stations will be offered within six months. (Extracted from Computer Reseller, 3 July 1989)

AI supporting chip developed

Sodima (France) has developed a knowledge based integrated machine (KIM), a microprocessor chip that supports artificial intelligence symbol manipulations. KIM has the complexity of 50,000 transistors but can execute symbol processing instructions at up to 20 mips with a 20 MHz clock speed. The device was developed for use in self-guided robots and similar control applications. (Extracted from Machine Design, 6 July 1989)

Micromechanics

Micromechanics is the technology to build incredibly small machines. Nozzles, springs, levers, valves and even motors can be built for a variety of applications, including medicine and biotechnology. Microdevices may be no larger than the thickness of a human hair. A National Science Foundation report has helped establish microdevices as a legitimate field of research. Micropositioners might control tiny mirrors in optical systems. Researchers at the University of Tokyo are working on a tiny robot that could travel in a person's vascular system to deliver drugs or tools to treat diseased tissues. Researchers are working to better understand the properties of materials at these small dimensions.

Microdevices are generally classed as either sensors or actuators. Sensors include silicon chips that can detect changes in pressure, humidity, motion or other factors. Micromotors are not yet able to do much, since they spin for only about a minute before the rotor sticks to the hub or silicon substrate. Nevertheless, the small motors enable researchers to study friction and materials at this tiny scale. In addition to silicon, researchers are studying metals and plastics in microdevices. Chemical vapour deposition is being used to deposit tungsten on silicon moulds. (Extracted from Science News, 1 July 1989)

Applications of micromachined sensors and integrated circuits

Micromachined sensors and integrated circuits are replacing electromechanical relays for industrial use. These new semiconductor chips are not designed for computing, but instead quantify machine vibration, the moving speed of process gas or liquid streams, detect pressure changes, etc. The price of micromachine silicon sensors has fallen an order of magnitude over the past 10 years, allowing their use in commercial and industrial applications. New micromachining technologies are being developed for silicon mechanical and electromechanical devices that have not, as yet, found applications. Leaders in the technology include AT&T, Bell Laboratories, Stanford University, Massachusetts Institute of Technology, NovaSensor, IC Sensors and SenSym. Others active in the technology are Honeywell, Emerson Electric and Foxboro. Micromachined silicon pressure sensors have become so popular that the market was worth $100 million in 1988, according to Frost & Sullivan (New York). (Extracted from High Technology Business, October 1989)

Double alphabet word processor

Conduct (Japan) will introduce a word processor in Spring 1990 that can handle the Roman and Cyrillic alphabets. It will cost less than ¥200,000 and will be able to handle Russian, English, German, Portuguese, Spanish and French individually or combined in a single document. Its spell check feature handles words written in Roman and Cyrillic letters. The word processor includes a printer, keyboard, disk drive and 9" CRT display screen. Conduct hopes sales in the USSR will total 1,000 units in the first year. (Extracted from Japan Economic Journal, 12 August 1989)

Supercomputing moves to commercial applications

Supercomputing is moving from the exclusive domain of scientists and engineers into conventional commercial applications, such as management of rental-car reservations, the development of financial models and processing transactions like credit card charges - all classic uses of large mainframe computers, which move and sort large volumes of data. Supercomputers perform mathematically intensive processing operations to quickly solve very complex problems, using parallel processing, which breaks down tasks and distributes them among multiple computer processors.

Tandem Computers, a pioneer in the use of multiple processors, has adapted some of its Non Stop SQL data base software to run in parallel. IBM is taking a similar tack to its DB-2 mainframe data base. Oracle recently announced it will write a version of its relational data base program, which can simultaneously find sets of related records. Its data base is used by thousands of companies in various industries. Most analysts say the machines most likely to capture commercial markets are the so called mini supercomputers, compared to the true supercomputers (e.g. Cray Research's). (Extracted from New York Times, 28 June 1989)

Cheap parallel processing computer

An inexpensive parallel processing computer that may possibly equal the capacities of the present most advanced supercomputers has been demonstrated successfully by NASA's Ames Research Center (Mountain View, CA) and the Defense Advanced Research Projects Agency. General Microelectronics (San Diego, CA), under a subcontract to Northrop, developed a system with hardware taking up 10.1 ft^3. Utilizing a standard computational fluid dynamics test, the system's sustained speed was gauged at 14 million floating point operations per second. (Extracted from Metalworking News, 19 June 1989)

New prototype super minicomputer developed

A new prototype supermini that uses 6 MIPS Computer Systems R2000 CPUs has been developed by the Industrial Technology Research Institute (Taiwan). The CPUs are linked over a 64 bit bus. The new MR 16 prototype features 32 Mbytes of common memory with error correction. Special R2000s are used for both communication and file processors. ITRI is currently looking for manufacturers to produce the parallel system in volume. ITRI is also working on the new MIPS R100 based MP 30 true symmetric multiprocessing system. (Extracted from Electronic Engineering Times, 29 August 1989)

Supercomputers put on speed

Use of supercomputers in the chemical industry is still rare, but the giant machines are making headway as industry learns what to make of them and as price/performance improves. Among recent developments is what NCUBE (Beaverton, OR) calls "the world's fastest supercomputer", and Evans & Sutherland (Salt Lake City) says it has breached the cost barrier with its new "moderately parallel" ES 1 model that uses scalar technology to "get a set of jobs done quickly". That contrasts with the older vector technology, which gets a single job done fast and moves on to the next.

Evans & Sutherland's unit differs from massively parallel computers such as NCUBE's model by using fewer processors to do the computations and sharing a single memory among them, rather than giving each processor its own. ES 1 is interactive, so a user running a molecular energy minimization program, for example, can watch the atoms as they move towards the lowest energy conformation. The user can also stop a program in mid execution to alter it.

ES 1 costs from $2.2 $8 million and the machine can support 10 to 400 users depending on the number of processors. Each processor contains 16 independent "computational units" that "can be used to support many users doing small things".

NCUBE 2, priced anywhere from $495,000 to about $20 million, supports "hundreds" of users. "Scalability" is a key feature of NCUBE 2. The buyer can start with a relatively modest investment on a single board, representing 64 processors, and by turning off the machine, plugging in more boards, and turning it back on, can upgrade it step by step to as many as 128 boards.

Cray Research (Minneapolis), which lays claim to two thirds of the supercomputer market overall, is making the deepest inroads into the chemical industry. It has units at Du Pont and Monsanto and orders from Eli Lilly and Sumitomo Chemical. (Source: Chemical/Week, 26 July 1989)

Neural network applications in chemistry

Predictions of product distributions from chemical reactions, frequencies of adverse drug reactions, and three dimensional structures of proteins from amino acid sequence are among chemical applications emerging from the little known but rapidly growing field of neurocomputing. According to speakers at a symposium on neural networks held by the Division of Computers in Chemistry, interest in the use of neural systems to solve chemical problems is beginning to increase.

Neural networks are computer based systems derived from a simplified concept of the brain in which a number of nodes, called processing elements, are interconnected in a netlike structure. A network is constructed with two or more levels of processing elements: input elements (analogous to nervous system receptors), output elements (similar to effector neurons), and often one or more levels of intermediate elements, also called hidden elements.

Each processing element receives input signals via one way connections from preceding elements, and each input is weighted by a variable connection strength. If the sum of weighted inputs to an element exceeds a certain threshold, the element will fire, sending a signal to another element in the network.

Although all current neural networks are [illegible] run on digital computers, there is no true neurocomputer as yet. Neural networks operate in a fundamentally different manner from conventional computers. In a conventional computer, a programmer must supply all the logic and rules (in the form of software or algorithms) that will be used to solve problems. The computer then operates on problems using serial computation, in which instructions are processed sequentially.

Unlike conventional computers, neural networks are parallel in their structure and in the way they process information. A network is set up so that its structure the number of levels and the distribution of processing elements among levels is appropriate for the problem under study. The network is then put through a training phase in which connection weights are modified recursively by a learning algorithm, based on a "training set" of known data, until the weights settle down into a fixed pattern. Assuming all has gone right, the network can then be used to answer new problems. Thus, unlike the centralized control and memory present in conventional computers, knowledge is represented in neural networks in a parallel fashion in the form of connection strengths distributed throughout the system.

Advantages of neural networks relative to conventional serial computers include their self learning feature and their ability to generalize. However, there are also a number of disadvantages. For example, neural networks are poor at mathematics and at processing algorithms. In addition, they sometimes fail to give correct answers. This can occur when they become trapped in a configuration of inappropriate weighting coefficients from which they cannot escape, or, more frequently, when they have been set up incorrectly. For example, there may be a mismatch between the number of processing elements in the network and the number of identifiable patterns in the data set. Another possible reason for failure is an insufficient number of trials (iterations) in the training phase.

An additional disadvantage of neural networks is that they cannot explain their predictions. Some theorists have tried to explain network predictions based on the state of hidden units and weights on the connections. But, as a general case, this is a difficult task.

Currently, most neural networks are implemented via software simulation on conventional computers. A number of commercial software packages are available, primarily for personal computers and work stations.

The next step up in sophistication involves use of neural network co processor units, which allow conventional programming and neural network processing to be combined, with the neural network running as a host called procedure on a digital computer. These units range from powerful co processor boards that slip into the backs of personal computers to co processors designed to be used on Digital Equipment Corp. VAX computers.

Speakers at the symposium discussed a number of chemical applications of neural networks that are beginning to develop. One of these involves use of neural networks to predict chemical reaction product distributions.

A chemical application of neural networks and one of great potential interest to pharmaceutical companies involves the neurocomputer based

prediction of adverse drug reactions, such as from use of nonsteroidal anti inflammatory drugs (NSAIDs). Neural networks also are being used to predict protein structure from data on amino acids. Neural network technology will not replace other forms of computing, but it promises to be a useful tool for approaching problems computationally that could not be well addressed by other methods. (Extracted from Chemical and Engineering News, 24 April 1989)

This is your captain speaking ... or a chip

Japan Airlines is now equipping its aircraft with a solid-state recording system that has no moving parts and gives instant access to up to 256 routine and emergency messages. Matsushita, which developed the system, demonstrated it to airlines at a conference in Basel.

Airlines currently use modified domestic video and audio tape recorders to inform and entertain passengers. Similar recording systems announce routine and emergency instructions, but the drawback is that it takes time to search out the appropriate announcement.

Matsushita calls its development the SSSV, for solid state stored voice system. Looking like a large domestic toaster, the SSSV contains two circuit boards, each carrying 60 1-megabit chips, which store the recordings.

Crew members simply enter instructions on a keypad for routine announcements. Additional memory stores five separate messages, lasting a total of 150 seconds, which override all other sound. Emergency announcements are triggered automatically by the plane's safety system.

Storing sound on chips is not new, but ordinary systems cannot handle data fast enough to produce any better than speech of moderate quality, known as "telephone quality". Even though the SSSV also has a low data rate, the quality of speech is virtually indistinguishable from taped announcements.

Another advantage is that the SSSV requires only a quarter of the storage capacity of ordinary systems. This system achieves this through clever coding to squeeze two hours of sound onto its chips. One trick that Matsushita uses is to encode only the changes of sound; it does not provide a fully accurate description of each spoken word. (This first appeared in "New Scientist", London, 14 October 1989, the weekly review of science and technology)

Mapping the future of fuzzy systems

At the third annual meeting of the International Fuzzy Systems Association (IFSA), one US company will show the world's first commercial microprocessor based on fuzzy logic, two Japanese companies will announce the availability of their fuzzy systems in the United States and a Chinese company will show the world's first on line programmable fuzzy processor.

Togai Infralogic Inc., which already has a C language precompiler that includes extensions for fuzzy logic, will announce its fuzzy logic microprocessor that can directly execute the fuzzy part of those extended C programs.

Togai was founded by Masaki Togai, who was an engineer at AT&T Bell Laboratories with Hiroyuki Watanabe in the early 1980s when the two built the first fuzzy system in the United States.

Today, Watanabe, on the faculty of the University of North Carolina at Chapel Hill, has built the only other fuzzy microprocessor available in the States. Announced in May 1988, it was fabricated by the Microelectronics Center of North Carolina at the nearby Research Triangle Park.

Two Japanese companies, Mycom Inc. and Omron Tateisi Electronics Co., both in Kyoto, will be offering dedicated controllers to the US market through their subsidiaries here.

Mycom's system is based on a proprietary read only memory (ROM) chip that works in conjunction with any standard microprocessor. The user specifies the rules to be used, and they are compiled into the special ROM that holds the proper fuzzy response, according to your rules, to any given input situation.

The various models of Omron's fuzzy peripheral, in contrast, use a mix of digital and analog components linked to a personal computer via a serial link.

To capitalize on fuzzy logic's inherent speed advantages, Apt Instruments Corp., which is based in Tokyo to avoid trade barriers, has designed a series of fuzzy processors that it is licensing to others for manufacture. They will be available in 1990.

These fuzzy products have, to date, been used in 80 successful applications in Japan, says Michio Sugeno, professor of engineering at Tokyo Institute of Technology. A subway system in Sendai is controlled by a fuzzy processor (in lieu of an engineer) and reportedly affords a smoother ride than any human conductor ever provided. Tokyo based Yamaichi Securities Co. Ltd. is using a fuzzy system to pick stocks for a special portfolio.

Other fuzzy expert systems under construction in Japan are designed to make management level business projections, control output from power stations, economize on automobile gas consumption and refine manufacturing process control.

Japan's Ministry of International Trade and Industry (MITI) has set up a consortium of 48 top Japanese companies to develop fuzzy systems called the Laboratory for International Fuzzy Engineering (LIFE), a name coined by Sugeno, who is a consultant to the laboratory. Its $ 6 million budget is coming from computer companies like Canon Inc., Fuji, Fujitsu Ltd., Hitachi Ltd., Honda, Minolta, NEC Corp., Nissan and 40 other top Japanese companies. (Reprinted with permission of DATAMATION® magazine©, 15 July 1989, copyright by Technical Publishing Company, a Dunn and Bradstreet Company, all rights reserved)

Helping the hearing impaired

People who are deaf in one or both ears can now use eyeglasses embedded with microelectronics to determine the direction of sounds.

This directional hearing aid, which works by flashing coloured lights to indicate the loudness and the direction of the sound, was devised by Murzy Jhabvala, an electrical engineer at the National Space and Aeronautics Administration's Goddard Space Flight Center, Greenbelt, Md., and Hung C. Lin, an electrical engineering professor at the University of Maryland, College Park.

The eyeglasses come equipped with microphones light emitting diode (LED) displays, a battery pack,

and an electronic package. The analog and digital circuits in the package are on one CMOS custom chip fabricated at Mosis (MOS Implementation System), a silicon foundry in Marina del Ray, near Los Angeles.

Sounds picked up by the two microphones, one on the left and the other on the right, are amplified and rectified. (An adjustable threshold for sound is included in the design.) The resulting dc signal goes into an analog-to-digital converter and an encoder, which gives a 3-bit binary output that represents the amplitude of the sound. Next, a digital comparator evaluates the outputs to determine which is louder. Logic circuits then convert the binary representation of amplitude into three levels of digital representation and activate the driver of the appropriate LED display. The red LED display represents loud noise; the green one, medium noise; and the yellow one, soft noise. The two sets of three LEDs are located at the top of each lens.

For instance, a loud noise coming from the right causes the red LED display on the right lens to light up, while a soft noise from the left triggers the yellow LED display on the left lens. But if the sound is coming from behind, then LED displays on both lenses light up. However, the design does not provide for sound coming from the front, because the engineers assume that the user can see a potentially dangerous situation ahead of him.

In addition, for people deaf in both ears, which is a more common condition than deafness in one ear, the researchers invented two other devices, a noise seeker unit and a stationary alarm. As the person holding the noise seeker aims it more accurately in the direction of the sound source, more and more LED lights flash. The stationary alarm unit flashes when there is noise above its set threshold, for example, a doorbell ringing.

Commercial prototypes of the three designs should be available early next year from DTI Engineering Inc., Oxon Hill, Md., the company that Jhabvala and Lin are working with. (Source: Spectrum, September 1989)

From defects in cars to defects in bones

A high-resolution imaging technology for detecting flaws inside automobile parts is being used to study microscopic bone structure at the University of Michigan, Ann Arbor. The Ford Motor Co., Dearborn, Michigan, originated the technique, which is called microcomputed tomography.

The university's team of orthopaedic researchers, led by Steven Goldstein, are using the approach to examine how aging changes bone structure, how biochemical variability like fluctuations in oestrogen levels after menopause can trigger such ailments as osteoporosis, how the sustained application of physical force to bone can lead to diseases such as arthritis, and how genetic defects produce bone disorders.

Moreover, they plan to use these studies to improve prosthetics by evaluating bone reaction to different types of repair and replacement. Because bone has the ability to alter itself according to the load on it, the geometry and materials of implants can affect how long the implant lasts before it becomes too loose mechanically to be of use. The results of second implants are never as good as the first ones, Goldstein said. Since current implants last about 15-20 years, younger patients face multiple implants and therefore need implants that can last a lifetime.

Microcomputed tomography uses sensors to measure X-rays that pass through a 1.30-square-centimetre bone sample. A range of intensities is digitized and recorded for the sample, which is rotated every 3 degrees until it has been turned a full circle. The images are then combined into a three-dimensional image of bone structure.

Digitization also yields precise measurements that quantify differences in bone structure for the first time. (Source: Spectrum, September 1989)

Computer advances streamline shipments

As a result of fine-tuning present programs and the development of new ones, the shipment of chemicals is becoming more efficient and centralized. With more advanced inventory control systems in place, the industry is able to transfer its information electronically without suffering the accustomed bottlenecks of paperwork.

Responding to the inherent difficulties in managing tank car traffic, chemical companies have been working for some time now with freight forwarders to develop a system of electronic data interchange (EDI), to speed the flow of documents and to allow chemical distributors and carriers to more effectively utilize their resources.

One carrier, Southern Pacific Railroad, has developed an EDI system tagged SP "Liberator". The system permits shippers to communicate directly with Southern Pacific's mainframe computers to transmit paperless bills of lading, trace shipments, release cars, obtain and negotiate rates and even send and receive electronic mail between the railroad, shipper and other facilities equipped with computers and modems.

SP "Liberator" allows customers to employ a PC to mainframe hookup with Southern Pacific.

There are three programs which fall under the SP "Liberator" umbrella: "initiator", electronic mail and "price master". The "initiator" program, used to send bills of lading, has been made generic, allowing shippers who use a number of railroads to transfer all information with the use of one simple program.

The electronic mail system, in addition to its rate request capabilities, can be used to order, divert and electronically release freight cars. The "price master" program helps shippers to calculate their companies' own personal freight rates, plus intermodal rates, special agreements and any fluctuating prices. All the information is up to the minute, and the system even alerts users to upcoming rate changes.

One recent development allows freight bills to be sent to the customers electronically, and in many cases payment is treated in the same way.

Mr. Odegaard estimates that the SP "Liberator" system is being used by 50 per cent of Southern Pacific's customers, with up to 800 customers sending shipping instructions electronically.

To reduce cost to the customer, Southern Pacific provides the software training and support needed to use the "Liberator" program. And the computer-to-computer communications help streamline Southern Pacific's own operations, thereby reducing costs while improving overall product, he adds.

Burlington Northern Railroad is also attempting to bring added organization to the arena of chemical

transportation. BN has been developing and testing a number of computer systems to help transport chemicals and other products. One system being tested is the "Advanced Railroad Electronics System" (ARES), a satellite tracking system developed in conjunction with Rockwell International.

Another computer development of BN's is a "Computerized Billing System" (CBS). This system, developed internally, has been in use for several years. It allows bill/rate clerks to enter waybill information into a computer and to send all copies electronically to the necessary locations.

Currently, the developers of CBS are finishing implementation of EDI with other railroads. The EDI system will let CBS communicate directly with other railroads, eliminating the need for manual transmission of information.

In addition to these two systems, BN has been developing an "Automatic Vehicle Identification" system (AVI). AVI will help further with the trafficking of freight cars as they are enroute. (Source: Chemical Marketing Reporter, 16 October 1989)

First system for commercially producing superconductors

The first system for commercially producing thin film high-temperature superconductors came on the market in April 1989, just two years after their discovery was announced. From Emcore Corp. in Somerset, NJ, the System 5000 is a modification of the metal-organic chemical vapour deposition (MOCVD) machine it developed for use with semiconductor wafers.

Until now, superconducting materials were usually grown by means of multistep, high-temperature processing equipment incompatible with manufacturing needs. Poor control over the processes and lack of flexibility degraded layer quality and yield. The System 5000, however, gives the same control over superconducting as over semiconductor materials.

The Emcore machine grows epitaxial layers of the superconducting materials on wafers of strontium titanate, sapphire, magnesium oxide, yttria-stabilized zirconia, and silicon. The system can handle multiple superconducting wafers up to 150 millimetres in diameter of materials having a critical temperature of about 90 K with the width of the temperature transition less than 2 K. (Source: Spectrum, July 1989)

New voltage-variable attenuator

Harris Microwave Semiconductor (Milpitas, CA) has introduced a Gallium Arsenide (GaAs) MMIC which attenuates rather than amplifies signals from DC to 18 GHz. The HMR-11000 is a voltage-variable attenuator with 15-dB linear attenuation minimum and up to 35-dB for low frequences. It can be ganged directly to 50 Ohm circuits but can also be used in non-50 Ohm circuits since it can set impedence via a voltage on its shunt control arm. The HMR-11000 is very small, measuring 390 by 450 microns. It uses three 1-micron planar GaAs MESFETs, and operates at high speed by switching from 10-90 per cent attenuation in less than 3 ns, typically. The HMR 11000 size and cascadability makes it suitable for amplitude modulation or gain-control applications in EW receivers and test equipment. (Extracted from MicroWaves, July 1989)

V. COMPUTER EDUCATION

Computing education groups merge

The International Council for Computers in Education and the International Association for Computing in Education have merged to form the International Society for Technology in Education. The merged organization and its geographic affiliates will include more than 40,000 members.

ISTE reportedly seeks to improve the quality of education through technology by providing support for computer-using educators, facilitating international sharing of information and resources, and encouraging research, innovation and organizations.

ISTE will publish The Computing Teacher journal, Update newsletter, The Journal of Research on Computing in Education and several other periodicals and monographs.

ISTE will maintain membership in the American Federation of Information Processing Societies and the Institute for Certification of Computer Professionals. It has also applied for category C membership in UNESCO.

ISTE can be reached at 1787 Agate Street, Eugene, OR 97403, phone (503) 686-4414. (Source: Computer, August 1989)

NSF report warns of education crisis

A report issued after a series of National Science Foundation-sponsored workshops warns of an impending crisis due to an alarming lack of attention to undergraduate education in the sciences, mathematics and engineering.

The Report on the National Science Foundation Disciplinary Workshops on Undergraduate Education cites a preoccupation by faculty with research rather than teaching. Workshop participants stressed the need for comparable support for innovative teaching.

One solution offered was the establishment of grants for outstanding teaching and curriculum, which the report recommended.

The report, publication No. NSF 89-03, is available from the Division of Undergraduate Science, Engineering, and Mathematics Education, Room 639, 1800 G. Street NW, Washington, DC 20550. (Source: Computer, August 1989)

Cornell takes on high school supercomputing programme

The Cornell National Supercomputing Facility has taken over the national SuperQuest competition from ETA Systems. The competition introduces high school students to supercomputing. Winning teams will conduct supercomputer studies of airplane wings, eye surgery, traffic lights, black holes, robots, medical X-rays, "brain-like" computers, colliding galaxies, advanced maps, concert halls, and island ecology. (Source: Computer, August 1989)

Computer Society Press offers new videotape series

The Computer Society Press is producing nine new videotapes that will be on sale soon. Materials should be available in September.

Based on state-of-the-art technology recently presented through lectures and visuals at IBM's US Education Center in Thornwood, New York, the tapes were made available for CS Press distribution through the generous assistance of IBM.

Ez Nahouraii of IBM, the editor-in-chief of CS Press, developed the program in collaboration with Frederick Petry of Tulane University, the newly appointed CS Press editor for media.

Running approximately 150 minutes, each tape provides a depth of treatment not usually found in typical one-hour presentations. A book of notes and visuals accompanies each tape.

The tapes cover a variety of topics. Topics and presenters include:

- Neural Networks - Current Applications and Directions, Bruce Shriver, University of Hawaii and editor-in-chief of Computer
- Parallel Processing - Architectures and Directions, William Dally, Massachusetts Institute of Technology
- Improving Software in a Measurable Way, Victor Basili, University of Maryland
- Software Risk Management, Barry Boehm, TRW
- Communications and Synchronization in Parallel Processing Systems, Harold Stone, IBM
- Distributed Software Engineering, Sol Shatz, University of Illinois
- SQL-2 Standards: ISO and ANSI, Philip Shaw, IBM
- Distributed Supercomputing Networks, Jordan Becker, IBM
- Software Reliability Measures: Guiding Software Development for Quality and Cost Effectiveness, John Musa, AT&T Bell Laboratories

Previews of the videos, screened in mid May at the International Conference on Software Engineering in Pittsburgh, prompted a great deal of positive reaction and on the-spot ordering. Other reviewers have seen the entire program and are equally enthusiastic.

The videos are in VHS format. Each is tentatively priced at $89 list and $69 for members and is accompanied by printed notes and visuals. For non-US prices, add 20 per cent. If the final prices are higher than those stated, all orders received through 30 September will be honoured at the above prices.

All tapes are sold with a full refund privilege if the user is dissatisfied in any way.

Order from Customer Service, Computer Society Press, 10662 Los Vaqueros Circle, Los Alamitos, CA 90720, phone (800) CS-BOOKS (in California, dial (714) 821-8380), fax (714) 821-4010.

The CS Press has other video projects under consideration and would welcome suggestions or advance copies of new tapes of good quality focusing on computer science and engineering. (Source: Computer, August 1989)

Interactive instruction

Students trained interactively retain 50 per cent more, in 25 per cent less time, than do those taught by traditional methods, according to the Instrument Society of America, whose series of interactive videodisc instruction programs are intended to benefit engineers and technicians in instrumentation and control.

INVOLVE, as the package is called, will consist of 12 series of about five programs each. They run on IBM Corp.'s Infowindow, a touch-screen monitor; an IBM-compatible personal computer; and a videodisc player.

The first series to be offered covers instrument calibration and standards, calibration pressure, differential pressure instruments, temperature instruments, level instruments, and flow instruments. Each of the five disks in the first series will cost $750, as an introductory offer. The other series are still in planning or production. Contact: Pam G. Hanlin, Instrument Society of America, 67 Alexander Drive, Box 12277, Research Triangle Park, NC 27709; 800-334-6391; (fax) 919-549-8288. (Source: Spectrum, August 1989)

Firms lend computers for ACS course

Some $250,000 worth of computer hardware was lent recently by Silicon Graphics, Evans & Sutherland, and Tripos Associates for use in a short course on molecular modelling offered by the American Chemical Society's department of continuing education. Hardware made available for use in the course included 20 Silicon Graphics Personal Iris work stations and four Evans & Sutherland PS 390 graphics terminals.

The four-day intensive course, held at the Laboratory for Molecular Modelling in the School of Pharmacy at the University of North Carolina, Chapel Hill, provided tutorials and laboratory sessions on molecular mechanics, quantum mechanics, molecular dynamics, graphics and other aspects of computational chemistry. Registrants learned how to run molecular modelling programs such as MM2, Sybyl, Model, and Ampac and how to interpret the results. Techniques on energy optimization, conformational searching and molecular graphics were presented. In addition, the issue of when to use computational methods in one's research and when not to was discussed.

The course was developed in response to increasing demand for scientists with expertise in molecular modelling, stemming from the rapidly growing use of these techniques for a wide range of applications in pharmaceutical and chemical research.

Future plans are to hold four sessions each year, with some of the courses providing an overview on molecular modelling and others focusing on specific areas such as macromolecular structure, polymers, and drug design. (Source, Chemical and Engineering News, 21 August 1989)

The university connection

Information systems suppliers, it is assumed, usually give equipment to universities to put their machines in front of students. But now they have graduated to a more important, long term goal. IS suppliers are sending their equipment to universities for the same reason that everyone else goes to college - to learn.

The schools, from junior colleges to big name universities, are accepting system donations not just because they are free but because they offer a chance to do what schools do best share information and perhaps influence the future.

IS suppliers are finding that the diverse computing environments on most higher education campuses are perfectly suited to testing advanced equipment. University research laboratories are also generating new ideas for product development. Meanwhile, educators are paying more attention to the role of computers as an educational tool in school curricula.

Suppliers do not deny the goal of influencing students, but more of their equipment donations now go into research environments than into higher visibility computer training laboratories. At the University of Utah, for instance, 75 per cent of the computer equipment on campus is used for research and 25 per cent for student use.

While almost every supplier follows Apple Computer Inc.'s lead in offering purchase discounts to universities, the amount of equipment they give away via grants or research partnerships does depend on the size and structure of the company. The conditions placed on these donations also vary from one supplier to another.

IBM, predictably, is the supplier with the largest grant and donation programmes for higher education, followed by Digital Equipment Corp., Hewlett-Packard Co. and a host of smaller manufacturers. HP last year distributed $40 million in cash and equipment for higher education, according to a company spokeswoman.

IBM's director of academic computing, Herbert Cotter, is quick to point out successes resulting from such mutually beneficial arrangements. "By listening to higher education two years ago, we were able to build world class TCP/IP [networking] products, which have been well accepted [not only] in the education market but also in manufacturing and other commercial areas," says Cotter.

The schools, too, are proud of their contributions. At MIT, Joel Moses, professor of computer science and engineering, emphasizes the school's role in developing windowing environments. Other universities have contributed to advances in computer networking and parallelism. But the research goes well beyond computer advancement. For instance, Cornell's School of Hotel Administration has a $1 million grant to study computer technology's role in hotel and restaurant management.

Grants range in size from a few thousand dollars for paying student researchers to well into the millions. At the University of Utah, where IBM contributed $13 million towards a supercomputing centre, research vice president Brophy estimates that donations typically fall in the $10,000 to $100,000 range. At MIT, corporate donations range from $1 million to $100 million.

Donations to a research programme may be intended to complement a supplier's own work, yet the advances that result are rarely owned by the supplier.

Like other well-known schools, Berkeley attracts gifts from suppliers around the world. The school's commitment to the Berkeley UNIX operating system is reflected in its computer research programme and it is illustrative of the autonomy that larger schools exert over suppliers.

While these donations may come in different forms and suit different goals, never do they attempt to direct research, say educators. Occasionally universities turn down donations of equipment that is out of date or incompatible with their needs. None, however, complain of suppliers misusing research or trying to steer research in a direction not compatible with university goals.

In part, this situation may reflect mutual goals of university and corporate researchers. Grants often are the product of long time relationships between faculty members and suppliers. Equipment donations are often earmarked for research outside the fields of computer science and engineering or for development of software for the education community.

Suppliers, for their part, are beginning to look at curriculum development as part of their sphere of influence.

A recent example is the Institute for Academic Technology now being established at the University of North Carolina at Chapel Hill. The institute will study computers in academia and act as a national clearinghouse for educational software. The institute will receive $3.5 million in equipment and cash over the next two years from IBM.

As a return on its investment, IBM will rest assured that the academic software getting high marks at Chapel Hill will be developed first on IBM machines - a strategy similar to the one that generated software support for its original PC.

Application packages that result from these joint efforts are usually made available through a software dissemination programme operated by the University of Wisconsin. Some suppliers, like Apple, will help the educator/developer find a third party distributor to market the software commercially, if warranted. The four-year-old software development grant programme at Apple focuses on curriculum programmes ranging from languages and business to engineering and computer science. The firm also tries to bring together researchers working on similar projects through an informal computer network.

IBM has its own approach to technology exchanges. The supplier has designated the Kansas-based Johnson County Community College as a Technology Transfer Center where the faculty of Midwestern institutions can attend seminars, witness software demonstrations and share information.

On a much larger scale, MIT, through Project Athena, has been studying the role of computers in a university curriculum since 1983. The $100 million project is being funded by Digital, IBM and other suppliers. Athena has inspired more than 100 faculty led projects and has produced eight thick books of material, but "no breakthroughs in educational software". (Reprinted with permission of DATAMATION® magazine©, 15 September 1989, copyright by Technical Publishing Company, a Dunn and Bradstreet company - all rights reserved)

IBM increases subsidies

IBM has raised the number of colleges and universities in its CIM in Higher Education Alliance to 57, by adding another nine, with the firm making the announcement at a recent alliance conference in Chattanooga, TN, of the educational institutions previously named to the group. It has also given responsibility to six colleges as regional education centres to aid faculty training in computer integrated manufacturing. (Extracted from Metalworking News, 19 June 1989)

VI. SOFTWARE

Parallel data bases

Data bases are being driven by two urgent requirements. They are bulging with more and more data, and more people want more access more quickly. Just as scientists have been turning to parallel processing to increase their crunching power for solving numeric problems, commercial uses of IT are resorting to parallelism to churn through data bases.

Most massively parallel processors rely on message passing of data and instructions between the locally distributed memory modules. Developing software for such architectures is much more difficult than for shared memory.

A local memory architecture presents some of the same data management problems as a distributed data base.

One of the problems is that mechanisms are needed to ensure that data is not locked up exclusively by some processors, preventing others from accessing it.

In June 1989 Oracle announced that it is porting its relational data base management system (rdbms) to the massively parallel NCube 2 computer. Oracle's Parallel Server Architecture is under development.

The latest NCube scales to over 8,000 processors with a possible peak performance, the company claims, of 60,000 millions of instructions per second (mips). This sort of power "will allow for infinite scalability. Parallel architectures are open and unlimited, and enable an escape from current hardware limitations.

Oracle is also working with transputer companies to port its rdbms to transputer systems. In September it announced that it is working with UK company Parsys to port Oracle to the Supernode transputer system. With 1,024 processors in use, the Supernode can support a 16-Gbyte data base.

Supernode runs a Unix based operating system, Trans-Idris, which, together with its rival Helios, is being used increasingly on transputer systems.

NCube also runs a version of Unix. Although Unix may not utilize transputer or other massively parallel architectures to their best advantage, it does make them far more attractive to commercial users and software developers.

Inmos, the manufacturer of the transputer, is also getting interested in the use of transputers outside science and engineering.

The company has selected data bases as a key area for the transputer, seeing its role mainly as that of a dedicated data base engine operating as an intelligent peripheral to a computer system.

UK transputer company White Cross Systems is already producing transputer-based data base engines, although it will not be launching them until the second quarter of 1990.

The move to develop a dedicated data base which takes advantage of parallel processing is not new. The most venerable, ICL's Content Addressable File Store (Cafs), exploits a low level parallelism for doing very fast hardware searches.

Cafs was originally a stand alone machine using expensive disc technology, but as discs speeded up it was integrated into ICL mainframes in 1985. It is now bundled with each node of the 3900 series, a move ICL sees as encouraging its users to take advantage of Cafs' capabilities. Extra Cafs engines can be added; ICL's longest users have around eight a node.

Cafs can handle complex queries with multiple search criteria, because each criterion (such as "age", "gender" etc.) is separately handled by the 14 processors in the Cafs engine. The next generation of Cafs, due out with ICL's long awaited Essex mainframe next year, will double the number of search channels.

Cafs will also be implemented in VLSI instead of the current board level implementation which will increase data transfer to around 10 Mbytes a second.

At the moment, Cafs only works with ICL's non relational data base, IDMS. An interface to Ingres, ICL's preferred relational data base, is still awaited and is unlikely before 1991.

Cafs' capacity to allow "fuzzy" searching is put to use at Reading Library. This means the public can enter partial or incorrectly remembered book titles and the Cafs system will still seek them out.

Cafs is a purely ICL accessory, but data base engines such as those from Teradata and Sharebase (the new name for Britton-Lee) can act as servers to other main vendors' mainframes and minis.

The Teradata DBC/1012 consists of multiple processors. Interface modules accept queries from the host computer and communicate over a high speed proprietary bus with the access module processors, each of which can access up to four discs.

The DBC/1012 scales to up to 500 access module processors.

A Sharebase engine runs the itemized billing system for the Hull telephone company Kingston Communications.

With large numbers of processors at your disposal, you can avoid having to resort to complex and time consuming indexing algorithms and simply stream the entire data base through the processors to extract the relevant records, within acceptable response times. (Extracted from Computer Weekly, 5 October 1989)

Object detection software

Noesis Vision and the French National Research Institute on Computers and Automation have jointly introduced a software package for object detection, particle counting, or shape and area analysis. The Visilog software package can work with any computer operating system that contains a C language compiler. The package can define various operations to be applied to a certain signal, launch a certain algorithm without more programming and transfer the algorithms to any industrial target system for which Visilog libraries are offered. More capacities for handling complicated word structure are recognition and positioning of overlapping 2D shapes utilizing edge characteristics, image segmentation, 3D vision, and reconstruction and display of 3D shapes from sequential slices through an object. (Extracted from Machine Design, 20 July 1989)

Package for PCs to operate in ISDNs

Vadis (Richardson, TX) has introduced a package which allows personal computers (PCs) to operate in integrated services digital networks. The PC2 Series

consists of a PC board and software for the XT/AT PC, the PS/2 Microchannel PC and for PC's used in LAN or RS-232 data communications connectivity. The first two versions let these PC's run in the ISDN Basic Rate Interface for voice and data transmission over one line at the same time. The initial PC2 Series is designed for ISDN lines running out of an AT&T 5ESS central office switch. Towards the end of summer 1989, the PC2 Series is expected to operate with Northern Telecom's DMS 100 central office switch. (Extracted from Communications Weekly, 3 July 1989)

"Walk" through 3 D design

Autodesk is preparing software and hardware that will enable users to "walk" through a 3 D design. The system requires the new Cyberspace virtual reality software. In co ordination with a headset consisting of two 3-inch television sets and a sensor equipped glove, the software creates the illusion of movement through an object such as a building. VPL Research (Redwood City, CA) is working with Autodesk on marketing the hardware and software. In addition, an animation program, Autodesk Animator, will provide graphic capabilities to users to shade and colour images from AutoCAD, and store animated sequences to a hard disk or videotape. The software will support OS/2's dynamic data exchange facility, allowing real-time data links, by the third quarter of 1989. According to Delta Process Management (Memphis, TN), this support will make many AutoCAD users turn to OS/2. (Extracted from PC Week, 3 July 1989)

"Lite" DOS software

Vendors of DOS software are offering new "lite" versions of their products. Because many DOS users are not switching to OS/2, but require more available RAM, 3270 emulation software developers are crunching their codes, in one case down to 35 Kbytes. Local-area networks are another cause for added RAM requirements for users unwilling to accept OS/2. ICOT, one of the first firms to crunch its codes, markets KSaver; the three host session emulator has only 75 Kbytes of RAM, according to ICOT (San Jose, CA). A poll the firm took shows that the proportion of its users concerned about RAM rose from 35 to 65 per cent in a nine month period. Other applications with crunched codes include Attachmate's Extra (91 Kbytes down to 44 Kbytes); IBM's PC/3270 (295 Kbytes to 146 Kbytes); and Digital Communications' E78 Lite (62 Kbytes). However, not all software firms believe code crunching is good. According to Helix Software (New York, NY), the process takes away too much flexibility, keyboard functions and application programming interfaces. It also forces single sessions. However, users will weigh the balance of functionality against memory. (Extracted from PC Week, 10 July 1989)

Software security key

Rainbow Technologies (Irvine, CA) has steadily increased earnings from its products for software security. Its main product is a small key that software publishers package with computer programs. The key fits into the back of a PC to receive coded electronic signals from the software and must be present in order for the software to operate. The company envisions big potential sales from software sold overseas, where many copyright laws are loosely enforced. Rainbow is also targeting computer users, a much bigger market than software publishers. It has modified its key so that individual users can shield their data files from unauthorized access. The Data Sentry product is sold through computer dealers. (Extracted from Business Week, 31 July 1989)

Insurance policy for computer viruses

Businesses can now buy insurance covering damage or loss of data caused by computer viruses. Allstate Insurance Co. of Northbrook, Ill., says it is the first to explicitly provide the coverage, which was added recently at no additional cost to owners of the company's standard electronic data protection policy. The current package limits virus damage coverage to $100,000. Although additional coverage may be purchased for an added premium, the company is not interested in writing really large scale coverage. (Source: Electronics, August 1989)

Optical character reader inputs directly into PC data file

NEC (Tokyo, Japan) has developed a software program that allows an optical character reader to input printed material to a personal computer data file, without requiring a special format. The software reads the data without the specified forms or mark sheets used with conventional systems so that the program is particularly well suited to creating data bases from published materials, such as books and magazines. The program is capable of encoding the copy layout of the source material and can read complicated layouts combining text, illustrations and graphs. The system takes five minutes to read an A4 sized page. (Extracted from New Technology Japan, July 1989)

Data compression up to 90 per cent

Dynatech Communications has developed SofCram/Net Version 4, which compresses data up to 90 per cent. Average compression is 75 80 per cent; average compression by other products is 35-40 per cent. The software is independent of any hardware because it compresses data before the communications application is run. Artificial intelligence in the software uses a decision making component to decide which knowledge base to use in compression. The knowledge bases are optimized for different types of data. SofCram runs on IBM mainframes and DOS-based microcomputers, and is used primarily for host to host and host to PC transmissions. It captures data in 2 Kbyte increments. Dynatech guarantees 100 per cent integrity and offers evaluation kits for testing. Prudential Bache uses SofCram in 260 offices; it has reduced transmission levels of its nightly data distribution by about 40 per cent. (Extracted from Networking World, 7 August 1989)

Network software handles remote sites

Unstaffed remote facilities can now be accessed for monitoring and testing with the DNE 2100 data network diagnostics system from Wandel & Goltermann GmbH. Besides remote diagnostics, the FRG company's SEP 120 network management software bolsters the system's multivendor connectivity with an interface to IBM Corp.'s NetView network management system. The IBM interface means that faulty network components can be restored automatically using NetView after alerts are received from DNE 2100 or any data network diagnostics system. The SEP 120 software also features multiline switching, analog and digital patching facilities, transparency to network protocols and the ability to store an

unlimited number of network configurations. Pricing depends on the importing country. (Source: Electronics, July 1989)

Easy to implement expert system AI

Several firms are developing easy to implement expert system artificial intelligence (AI) software rather than the more difficult neural network AI systems: including Arbor Intelligent System (Ann Arbor, MI), Texas Instruments, Westinghouse and IBM. Ford Motor company is following the neural network route, which will be widely used in 10 years, according to Ford Research Staff (Dearborn, MI). Arbor Intelligent Systems, a developer of expert system software for Apple Macintosh computers, is currently developing an expert system program for Dayton Power & Light that is scheduled for autumn 1990 completion. The software will allow utility operators to focus on important equipment status readout data, rather than having to determine important information out of a field of 6,000 input points unassisted. Expert system techniques can quickly produce simple to use, transparent programs that require very little user knowledge. (Extracted from Production, September 1989)

Computer unlocks the key to pianists' pain

A computer program can now help doctors to avoid and alleviate the hand pain that affects many musicians. The condition, called overuse syndrome, can seriously debilitate and endanger the careers of professional musicians.

Scientists at Purdue University at West Lafayette in Indiana have developed the Handy computer program to analyse the stress on each joint in the hand during repetitive tasks. They tested the prototype program using a piano and player because most of the playing motions is in two dimensions.

The scientists have found that a bad playing style can create four times the joint stress of a good style. They also found the finger position that causes the least stress.

People in other occupations, such as typists, could benefit from this program. Many jobs that involve repetitive movements can cause hand pain which is similar to that suffered by pianists. Another application is on the assembly line where overuse syndrome, or repetitive strain injury, can cost workers their health. (This first appeared in New Scientist, London, 9 September 1989, the weekly review of science and technology)

Object oriented Ada?

The Ada language has from the start had only a few functions that could be considered object oriented. Its support for generic operations, task typing, and subtyping, for instance, affords a limited version of inheritance (the ability to define a root class of software object that possesses certain traits, and then create higher level modules that inherit some of those traits).

Now the group that is working to produce Ada 9X, a modification of Ada for the 1990s, has to decide how many, if any, object oriented features should be added to the official language definition.

Fuller inheritance capabilities stand a good chance of success, according to Don Firesmith, consultant and president of Advanced Software Technology Specialists Co., Fort Wayne, Ind.

More problematic, he said, is dynamic binding: the ability to perform operations on classes of objects that are defined only as the program is run, rather than earlier on at compilation time. A SEND MAIL operation, for instance, might be applied to files, documents, or graphics. With dynamic binding, the system might only figure out which class of object it was sending as it actually did so. (Source: Spectrum, August 1989)

PostScript on the cheap

In less than five years, the PostScript page-description language from Adobe Systems Inc., Mountain View, California, has become the de facto standard for personal computer and work station graphics and moved rapidly into the typography market as well.

Until recently, users who wanted to use software that produced PostScript graphics had to buy laser printers with costly PostScript interpreters built in.

A $495 MS DOS utility program now lets them print PostScript images and fonts as graphics on cheaper printers without built-in interpreters. Freedom of Press, from Custom Applications Inc. (CAI), Billerica, Mass., converts in-line PostScript output from word processing packages into graphics commands (in two typefaces) for a choice of 45 ink-jet, laser and 24 wire dot matrix printers.

Printing takes somewhat longer, and of course the resolution is not as high as the latest PostScript-driven laser printers, which have 400 dots per inch (16 dots per millimetre), but it prints any PostScript graphic, including Adobe's famous spiral of type. A version is now being developed for the Apple Macintosh as well. (Source: Spectrum, August 1989)

"Industrial strength" C++ from AT&T

Programmers who wanted object oriented features in the C language now have a new option: AT&T Co., author of the object-oriented C++ variant, has just issued an updated version to developers. For the first time, AT&T is supporting the language with full documentation, in what it calls an industrial-strength release. The new version will be written into compilers and other products sold by several software companies.

Traditional languages treat data simply as information on which operations are to be performed, but object oriented programming adds procedures and instructions about how data should "behave" to that data.

Object oriented languages are well suited to writing Unix applications in windowing environments. Instead of defining a collection of graphic points to describe a window, for example, the programmer defines an object that has the characteristics of a window and thereafter simply calls up that object with specified parameters - without having to repeat the original programming.

C++ was originally offered to the academic community in 1984 as an experimental research product without support or documentation. It has C's traditional procedural approach to programming, but lets programmers throw in object oriented features at will.

The Release 2.0 version of C++ adds a feature that allows users to replicate existing object

features in new objects. Because of this multiple inheritance ability, for instance, a programmer who has defined three kinds of windows - moveable, scrollable and sizeable - would not need to write extra code to create new windows that incorporate these properties.

The first commercial implementation of Release 2.0, called HCR/C++, comes from Toronto's HCR Corp. To be shipped by the end of July for a $499 introductory price, it includes a debugger. Other implementations are sure to follow. (Source: Spectrum, August 1989)

Information data bases

Current Contents on Diskette (Institute for Scientific Information) provides access to contents pages of scientific journals on IBM PC and PS/2, Macintosh, and NEC 9800 series computers. The Physical, Chemical and Earth Sciences edition (annual subscription $345) covers some 800 publications, and the Agriculture, Biology and Environmental Sciences edition (annual subscription $345) includes contents from more than 1,000 journals. Both offer various search options including browsing, high speed scanning and customized search profiles. (Source: Chemical and Engineering News, 21 August 1989)

PAWS gives developers time to consider design

A software tool which enables system developers to model a system's performance during the design stage is being launched in the UK by SD, the defence and government arm of computing services group SD-Scicon.

The Performance Analysts Workbench System (PAWS) allows developers of real time complex systems to predict response times and performance using a graphical interface.

PAWS is for large systems using distributed processing or a communications network, making it very easy to put models together. The user draws up a representation of the system and specifies parameters on each node in it - like the speed of a line of a packet switching network node. The user presses a button and PAWS calculates how the system would perform in those conditions.

A prime cause of budget or time overruns in system design is the difficulty of accurately predicting system workloads or response times.

Despite major investment at the design stage, many civil and military systems fail to deliver the performance expected of them.

PAWS has been used by SD in half a dozen projects over the last two years, mostly for the Ministry of Defence. (Source: Computer Weekly, 21 September 1989)

Code and its efficiency

Suppliers of software productivity tools, accustomed to measuring software development in terms of thousands of lines of codes generated, are turning their attention to more realistic ways of appraising programmer output.

Ian Macleod, Managing Director of Marlow based Macleod Group, a Unix project management and development consultancy, says that certain productivity tools, if used properly, can make the difference between "writing 1,000 lines of code inefficiently or 100 lines efficiently".

The Macleod Group has signed a distribution agreement with Boston based Software Productivity Research to sell and support Checkmark, a productivity tool that looks at software projects not in terms of lines of code but in terms of function points, or key product facts.

Function points, devised by Al Albrecht at IBM in the US in the early 1980s, are the key to efficient software project development, Macleod claims.

The idea has created a paradox in software productivity circles, with many developers adhering to the belief that more functionality means more lines of code.

Checkmark allows developers to enter the number of files and interfaces in a project - for example, 319 in a 30,000 line project - which are its function points. The software then defines the amount of function to be delivered in a system, which can be checked against Checkmark's data base of 3,000 completed software projects' estimates. Developers can use these tools to record their measurements of software productivity and help forecast the likely duration of software projects.

Checkmark, which costs 15,000 pounds sterling for a one off licence, "will not transform the world, but it will improve DP managers' ability to control what is going on". (Source: Computer Weekly, 5 October 1989)

CASE versus 4GLs

The fate of fourth generation programming languages, it seems, has always been in question. Obituaries for these rapid development languages, developed out of frustration with application backlogs and slow systems development, have been written several times over.

Early on it was argued that fourth generation languages (4GLs) would never last. They were just not suitable for writing large, high volume transaction systems, claimed detractors. Later, it seemed that because they were closely coupled with out-of-favour data bases, their role could be transitory at best. But, despite these drawbacks, many companies, like Dallas based Kimberly Clark Corp., blithely amassed huge storehouses of 4GL applications.

Now some old doubts about the future of 4GLs are being raised anew.

In some ways, these challenges are not unexpected. For almost as long as 4GLs have existed, there has never been at shortage of critics willing to point out their flaws. Yet this time, even some long time 4GL supporters are saying the end is nigh.

These aged languages, say these critics, have simply outlived their usefulness. Unlike in the past, where their imminent passing was attributed to perceived technical shortcomings, today's prognosis has more to do with heightened competition from computer-aided software engineering (CASE) tools.

These languages, say the experts, can no longer claim a unique ability to rapidly produce new programs because CASE tools offer the same fast development capability. And CASE tools produce code in traditional languages such as COBOL. Moreover, as these tools generate code from programmers' specifications, the applications they produce are always true to original designs.

So, if 4GLs have any future role, these critics believe, it is for small, ad hoc reporting applications. (Reprinted with permission of DATAMATION® magazine™, 15 August 1989, copyright by Technical Publishing Company, A Dunn and Bradstreet Company all rights reserved)

The trends towards compromise that promises the best of both worlds

With the emergence and increasing use of fourth generation languages and applications generators, there is evidence that users may be finding a way of getting the best of both the custom and the packaged worlds.

These new systems combine much of the availability of packaged programs with the ability of custom applications to match the needs of the user. They allow programmers to meet user requirements more accurately than is possible with traditional bespoke development processes.

One of the major problems here, of course, is the inevitable changes in factors affecting the specification which users need to accommodate in an application.

With custom programs there is always the possibility of such changes being seen by users as having a higher priority than with a packaged solution, if only because the custom program is supposed to match all their needs.

This encapsulates the basic differences between the two. The packaged application is available off the shelf, is normally fairly well de bugged and usually cost effective.

It will, however, rarely cover all the aspects of a user's applications needs: the well known 80:20 rule will normally apply in such cases.

The bespoke custom package on the other hand, can be specifically tailored to meet the user's exact requirements, but this is normally achievable only at a high cost, over the development time cycle, and with a dependency on the users knowing exactly what they want from the application at the time of specifying perhaps two years in advance of delivery.

It is provisos such as this which are prompting companies to seek the compromise between packaged and bespoke applications that fourth generation languages and data base engines offer. (Extracted from Computer Weekly, 21 September 1989)

Kermit extension code to include other alphabets

Researchers at Columbia University are developing the Kermit Protocol Extension for International Character Sets to enable multi language computer transmissions. Kermit, a computer source code that translates a computing machine's particular text format into ASCII in its sending mode and converts ASCII into the recipient computer's text format in its receiving mode, is widely used in software designed to function in multi vendor computing environments. The present Kermit code works well for English and in a limited fashion for other languages easily translated into ASCII format, but will not support languages with different alphabets. The extension will add a layer of code based on the International Transfer Syntax and will accommodate any character set that is ISO registered. This includes Russian, Hebrew, Japanese and Greek. The software design is currently in draft form with a final design expected by August 1989. The non proprietary software will be available without charge in 6 12 months following the finalized draft. (Extracted from Data C, June 1989)

VII. COUNTRY REPORTS

Bangladesh

Prospects of electronics industry in Bangladesh

Electronics is one of the fastest growing industries in the 20th century. Whether on land, air or sea, electronics now plays a major role in nearly every aspect of our lives. Considering the importance of the electronics industry in the socio economic development of the country, the Government of Bangladesh emphasized this area and declared it as a "priority sector". The Government has reduced customs duty to 10 per cent on imported parts and components for assembling/manufacturing of electronics goods and the electronics subsector has also been placed in the "Free list", which means that no formal approval/permission is required for setting up an electronics concern if it is set up with its own financing.

Electronic goods assembled/produced in Bangladesh have a bright export potential for developed Western countries. Some Bangladesh companies are already exporting electronic items such as PCBs, VCPs, VCRs, light dimmers and antennas. To stimulate export, the Government has decided to consider the electronics industry as export oriented to provide it with incentives and facilities allowed other exporting business, assuming 50 per cent of the products are exported.

The availability of an inexpensive, trained and easily trainable labour force permits industrial production at a comparatively low cost. In view of a gradual increase of labour costs in many third world countries, Bangladesh still offers relatively low costs.

Advancement in the field of electronics science and technology is a continuous process. For exchange and transfer of this technology, the Government welcomes joint ventures in this sector. Recently the Government has liberalized joint venture policy to such an extent that projects costing up to Tk.100.00 million (US$3.33 million) and foreign equity within 49 per cent will not require formal approval and provides a package of incentives and facilities.

At present, engineering products worth US$7 million are exported. Exports valued at $90 million are targeted for 1989 90, which is expected to increase to $200 million by 1990 91.

Recently an Electronics Complex in the capital Dhaka was established which is regarded as a milestone for the rapid advancement of the electronics industry in Bangladesh. (Extracted from ABU No. 3/1989)

Canada

Currency reading device for the blind

A device that can read denominations of currency has been developed by the Science Technology Centre of Carleton University. The Bank of Canada prints $2, $5 and $10 bills with special codes that can be read by a scanner, which then speaks the denomination in French and English. The system should aid some 5,000 blind Canadians. The

pocket sized device will be produced by Brytech beginning later in 1989. (Extracted from New Scientist, 27 May 1989)

European Economic Community

CAD programme aims to avert VLSI engineer shortage

To combat a potential shortage of engineers and scientists skilled in the design and manufacture of VLSI circuits, the Commission of the European Communities is going to issue computer aided design work stations, test equipment, and software to a "kernel group" of 58 universities and polytechnic colleges in 14 European nations. In addition to the equipment, which will be procured centrally, members of the kernel group will receive funding for teaching posts and for advanced training for lecturers. Another 60 institutions, designated as associate members, will get equipment at reduced prices, and all 118 participants will be given access to silicon foundry services. The programme, projected to cost about $12.5 million, is expected to double the number of VLSI researchers and engineers trained during the next three years. (Source: Electronics, July 1989)

JESSI formally begins operations

The Joint European Sub micron Silicon Initiative (JESSI), a programme to develop integrated circuits and increase Europe's share in computer chip production, has formally started operations. The R&D initiative thus far involves SGS Thomson (France,Italy), Philips (the Netherlands), Siemens, Electrotech and Bosch (Federal Republic of Germany), and the Dutch research institute of STW. JESSI is part of a co ordinated research programme among European companies called EUREKA. The EC, although not involved in EUREKA, will fund 25 per cent of the first stage of JESSI to avoid duplication with EC programmes. JESSI aims to increase electron pathways on integrated circuits more than ten times the current density, while increasing chip size to 500 sq mm, compared to the current 200 sq mm. The number of memory elements and logic elements per chip would also increase. The programme goal is to be able to make the products as "commodity chips". The JESSI planning group aims for major European chip operations as it fears that the Japanese, for economic reasons, or the US, for security reasons, could stop chip sales to Europe. (Extracted from New Scientist, 1 July 1989)

Pan European ISDN trials to start

Look for pan European trials of 2 Mbit/s switched digital telecommunications service to begin now that a Memorandum of Understanding has been signed by 14 countries and 17 telecommunications operators belonging to the European Postal and Telecommunications Conference. The European Broadband Interconnection Trial will form a backbone network that will support pilot application services developed under the Commission of the European Communities' RACE (Research into Advanced Communications for Europe) programme. Still, work on a pan European integrated services digital network is three years behind schedule. Although full scale ISDNs have been launched in the Federal Republic of Germany and France, and trials are in progress in the UK, Belgium, Italy and the Netherlands, there are no standards that allow direct connections between networks. Plans set out by the Commission of the European Communities in 1986 called for the setting up of transcontinental ISDNs in time for the Single European Market by 1992. To reach that goal, standards have to be in place by the end of this year - a target that is unlikely to be met. (Source: Electronics, July 1989)

European Commission moves to update R&D for the 90s

The European Commission is expected to approve a new approach to research and development in Europe into the 1990s.

In June the Research Commissioner, Filippo Pandolfi, made a series of proposals aimed at widening the research topics and improving organization. He suggested three main subject areas: so-called "pervasive" technologies such as information technologies and telecoms; environmental and energy research to improve the quality of life, and improving research facilities to create "a Europe for researchers".

The EC's aim is to have a new framework in place before the five year term of the existing strategy runs out in 1991. This was to produce a "gliding" programme. The EC has set itself the target of the end of the French presidency to get agreement on both the concept and budget from the twelve partners. (Source: Electronics Weekly, 19 July 1989)

ESPRIT fails to halt IT slide

Europe's one billion pounds sterling ESPRIT computing research programme has failed "to reverse the $5 billion IT trade deficit with the US and Japan and in key areas Europe has slipped even further behind.

These are the conclusions of a gloomy report from the ESPRIT Review Board, which also criticizes the way the research projects have been organized.

The report says that although the overall European technology base has improved, "too much of the advance has been in niche areas with limited potential for future market exploitation".

The report also says the European position in the peripherals market is a matter of serious concern, and the position in microelectronics is weak. Europe's share of the world wide semiconductor market declined from 15 per cent in 1980 to around 11 per cent in 1987, and it has not seriously challenged US dominance in package software.

Europe represents a third of an estimated $2,500 billion world IT market but only produced 13 per cent of the total.

The report criticizes aspects of ESPRIT I, such as the way contracts were negotiated and the speed of payments to participants. It is also critical of the large number of partners in some projects, a trend it says is repeated in ESPRIT II and gives cause for concern. No project should have more than six members, it says.

ESPRIT I was dominated by the so called big 12 firms AEG, Bull, CGE, ICL, GEC, Nixdorf, Olivetti, Philips, Plessey, Siemens, Stet and Thomson which got half the budget and took part in 70 per cent of the projects. Small to medium enterprises (ones with less than 500 staff) on the other hand took part in 65 per cent of the projects and only got 14 per cent of the funding.

ESPRIT II, the follow up, has already begun with a budget of 2 billion pounds sterling. "The way in which ESPRIT II has evolved towards a

stronger application orientation involving users to help pull technology through into the marketplace is a change in the right direction but further evolution is needed", the report says. (Source: Computer Weekly, 5 October 1989)

Research firms plan image lift

Leading IT research and information companies have joined forces to set industry standards and improve their professional image.

The Information Suppliers Group has 10 members, including IDC, Dataquest, Datapro and Romtec.

The group's formation is an attempt to improve the image and visibility of the industry and to set professional standards for analysis and reporting.

If the US connection materializes, it is hoped to unify standards across Europe and the US, possibly with Australasia and South East Asia joining as well. (Source: Computer Weekly, 28 September 1989)

France

Electronic library for France

The President of France has given his endorsement to an ambitious computerization scheme for the nation's overstretched library network. Faced with the dual problem of an overloaded Bibliothèque nationale in Paris - which, with an estimated 12,000,000 books, is running out of space - and an endemic shortage of basics such as books, periodicals and qualified staff in university libraries, the French Government is to begin work on the creation of a new Library of France.

Far from just a physical building, the project, estimated to cost up to $786 million, and scheduled for completion by 1995, would integrate the Bibliothèque nationale into a nationwide network of provincial and university libraries, giving users electronic access to the resources of the entire collection.

The Government's proposal calls for complete computer cataloguing of the Bibliothèque nationale's collection as well as the electronic consolidation of the catalogues of every provincial and university library in France - some 1,300 institutions in all. The actual contents of the Bibliothèque nationale and other libraries' collections would be scanned on to optical disks.

Ultimately, a user anywhere in France should be able to locate desired material in any collection included in the catalogue network and have access to Bibliothèque nationale materials by computer. Additional high technology help is promised for bibliophiles who prefer to visit the new Library of France in person; current plans call for special robots to fetch and reshelve books on demand. (Source: Time, 1 May 1989)

Democratic Republic of Germany

Microelectronics programme

Microelectronics in particular is getting top attention, as witnessed by the Government earmarking about $7.6 billion for this industry over the past several years. Under Honecker's directives, the party's Central Committee decided in 1976 to launch a massive microelectronics research and development programme. Although the results of the country's efforts do not match those of the West, they are impressive, particularly because the nation has no access to US or Japanese technology. Testifying to its success are a handful of star products: 1 Mbit dynamic random access memories using 1.0 um CMOS, 16 bit microprocessors running 2 million instructions/s, and gate arrays with up to 100,000 transistor functions. Such products demonstrate the industry's engineering know how and hint at the country's technological standing in the Soviet bloc.

Electronics production is done mainly at State owned enterprises, so called Kombinate, or combines, each concentrating on a specific sector communications, production equipment, components, consumer, and so on. A typical example is the Kombinat Nachrichtenelektronik, which lumps virtually all the country's activities in communications into an organization comprising 18 production centres and one research institute.

Among the heaviest contributors to the country's electronics output is the Kombinat Robotron. The Dresden based combine employs 69,000 workers in 21 production centres, one software institute, an export import organization, and a number of support facilities. Sales last year came to $6.1 billion.

Among Robotron's top products is a 32 bit engineering work station, the K1840. Representing designs on a monitor in three dimensions, it is intended for computer aided design and manufacturing, as well as for simulating complex processes and solving scientific and technical problems. For now, the machine is not for export.

The country's weak spots, Western analysts say, are low productivity, slow transfer of products from design to fabrication, and a quality standard that leaves much to be desired. But things are beginning to change as top executives in electronics realize that a move to world markets is a must. The first steps have already been taken. The industry has struck co-operative deals with companies in Greece and Belgium and has made first contacts with Siemens AG, the Swedish/Swiss Asea Brown Boveri group, and other Western European companies about joint projects in third countries. (Extracted from Electronics, July 1989)

Federal Republic of Germany

Internal optical bus system replaces circuit boards

Researchers at the University of Duisburg have developed an internal optical bus system that replaces printed circuit boards to enable faster operation in complex circuitry. The system transmits optical signals through a thin (several millimetres) metal clad flat glass plate and then picks up those signals through windows. The researchers feel 2 Gbit/s data rates should be feasible with the new technology and they believe that the technology is close to commercial exploitation. (Extracted from Electronic Engineering Times, 24 July 1989)

Former rivals join to form alliance

Announcements of new strategic alliances have become fairly routine in Europe's electronics industry. But the joint venture between Siemens AG of Munich and the Matsushita Electric Industrial Co. of Osaka, Japan, is raising more than a few eyebrows. Set to be launched in October, the venture brings together two giants and former rivals in the passive components market. Analysts

expect the alliance to yield a formidable competitor on world markets for a broad range of devices.

The deal gives Siemens access to the Matsushita's manufacturing know how, which, along with the greater economies of scale, should translate to lower operating costs.

The alliance, to be based in Munich, provides Matsushita with a European beachhead for its components activities. Such a base inside the European Community is vital in the light of the potentially higher barriers to Japanese imports that could emerge when Europe's single market becomes a reality by 1992. By using components made in Europe, Matsushita will also meet local content requirements for the equipment it assembles in the EC.

Siemens will undertake the joint venture with Matsushita Electronic Components Co., a wholly owned subsidiary of Matsushita Electric. The new firm, to be called Siemens Matsushita Components GmbH & CHC for short must still get the go ahead from the German Cartel Office in West Berlin. (Extracted from Electronics, August 1989)

India

Indo Soviet venture for PC production

India and the Soviet Union are to form a joint venture that will lead to the production of 10,000 personal computers and 20,000 printers a year in Tashkent, USSR.

A Memorandum of Understanding has already been signed by Usha Rectifier Corporation (India) Ltd., and the USSR State Committee for Computer Systems and Informatics.

The total sales of the joint venture in the first five years are envisaged at approximately 3,500 million rupees and will earn an operating profit of about 300 million rupees, according to sources.

The invested equity capital of 40 million rupees is expected to be increased seven fold to 280 million rupees in the form of dividends and retained profits over a period of five years.

Under the joint venture, Usha Rectifier will furnish complete know how and technical assistance as well as train Soviet experts in India and in Tashkent. Usha will also assign its technical experts to the joint venture for the initial period of two to three years to supervize smooth running of the plant and to achieve the targeted capacities, some Indian newspapers reported.

This venture will be the first project of its kind in the Soviet Union for computers and printers and will pave the way for further co operation with the Soviet Union. (Source: Electronics Weekly, 27 September 1989)

Ireland

Expert lithography system

Development work at the National Institute for Higher Education in Limerick, Ireland, has resulted in an expert system for ASIC lithography.

The expert system is particularly applicable for processing ASIC wafers that require different exposure and development process times.

Features include the ability to provide detailed information on all aspects of processes and equipment; this is stored in help files. A "notebook" file is provided for every operator.

The programme operates through a combination of vertical and horizontal pull down menus; a user can choose to enter a laboratory notebook editing mode or a process mode. Job, machine and operator data is stored in a dynamic data base and is simulated by finding an optimum assignment.

In the process mode, the programme caters to the needs of three types of users: beginners who can access detailed descriptions of wafer processing for training, specialists who can check on work-in-progress (this is the expert advisory function of the programme), and supervisors and engineers who need help in optimizing a process run. The information in the data base is available for on line consultation. (Reprinted with permission from Semiconductor International Magazine, July 1989. Copyright 1987 by Cahners Publishing Co., Des Plaines, IL, USA)

Japan

Agreement on chip prices with EEC

Makers of electronic components for semiconductors have signed an agreement with EEC officials on a fixed price for the sale of their chips in Europe for the next five years. This agreement has to be sanctioned by Brussels, which should not cause any problem as the Japanese accepted all the proposed conditions. The Japanese companies involved in the signing of this agreement were Hitachi, Toshiba, NEC and the Japanese subsidiary of Texas Instruments. They have been selling their dynamic memory components for at least 8.9 per cent above their cost price. (Extracted from Le Monde, 21 August 1989)

Open systems

In Japan, where computer systems have historically been designed to be incompatible, the concept of open systems is still very much an open question. The pervasiveness of the PC, however, has forced the island nation to take a fresh look at software and reopened the whole open systems question for Japanese IS users.

Opting for personal computers from their vendor of choice, NEC, Japanese users soon found that software for their low end machines was in short supply. Moreover, the packages that were available just did not do what they were supposed to do. And custom software, they discovered, was simply too expensive to be a viable alternative. Hoping to alleviate this software crisis, which had spread throughout the entire IS spectrum, Japan's Ministry of International Trade & Industry (MITI) launched the Software Industrial Generalization and Maintenance Aids (SIGMA) project in 1985.

Working with MITI on this five year, $175 million (¥25 billion) effort to strengthen Japan's software industry are all the major Japanese IS vendors and of foreign investors including AT&T UNIX Pacific, Data General Corp., Digital Equipment Corp., NCR Corp., Nihon Unisys, Olivetti and Yokagawa Hewlett Packard. AT&T's participation is particularly significant as one of SIGMA's key goals is to create UNIX based networks, software libraries, development tools and work stations that can be used to develop application as well as system software. The underlying belief is that UNIX

development platforms will help ease the nation's eventual programmer shortage.

Since SIGMA is allied with AT&T, it was not surprising that UNIX System V with 4.2 BSD enhancements was selected as the development language. Work stations based on SIGMA standards are being manufactured by four Japanese companies: Fujitsu Ltd., Hitachi Ltd., NEC and Tateishi. The work stations currently being produced are being tested and evaluated at 30 user sites.

Most Japanese users and vendors feel that a single UNIX standard would be very beneficial. Standardization in a general sense could also help the Japanese fuel both their off-shore production operations and their hardware export campaign. (Reprinted with permission of DATAMATION[r] magazine[c], 1 August 1989, copyright by Technical Publishing Company, a Dunn and Bradstreet Company, all rights reserved)

The Netherlands

CD ROM aids development

A project aimed at enhancing self sufficiency in agricultural and rural development with the use of CD ROMs has been started by the Information and Documentation Department of the Royal Tropical Institute in Amsterdam, the Netherlands. CD ROM equipment is being installed at 11 sites in eight countries in the Caribbean, the Pacific and Africa.

Along with CD ROM work stations, a number of data bases in CD ROM format will be installed, such as Agricola, produced by the United States Department of Agriculture, and the Maize Germplasm Bank of the Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT). Also provided will be an operational kit, supporting devices and training. Document delivery will also be available.

Other aims of the project, which was commissioned by the Technical Centre for Agricultural and Rural Co-operation (CTE) in the Netherlands, are to stimulate and initiate the introduction of computer technology in information centres in these countries. (Source: ACCIS Newsletter, 7(2), July 1989)

Nigeria

NCR leads computer market

National Cash Register Nigeria (NCR) leads the Nigerian computer market, and claims to be seeing continued expansion. The company supplies hardware, software and training programmes, with the hardware programme including the "Tower" series for industry. In mid-1989, NCR employed 229 people and had 16 subsidiary operations. It has 72 technicians for service and installation work across the country. It is the only computer company which is listed on the Nigerian stock exchange. In 1987, it saw a turnover of Naira 39 million. It mainly supplies the financial sector, followed by government institutions, business houses and hotels. Growth is also being seen by Commercial & Scientific Computing Nigeria (CSC), with some 40 per cent of production going to the financial sector. Data Processing Maintenance & Services is representative for IBM products. According to a market study, sales of hardware in 1987 and 1988 brought a turnover of Naira 150 million and Naira 180 million respectively, set to reach Naira 215 million in 1989. Hardware business represents around 40 per cent of total turnover, with 30 per cent through consulting services and the rest through training, maintenance and software. (Extracted from Ausenhandel, 7 August 1989)

Norway

Norwegian firm hits on easier connection

Prototype silicon for a revolutionary technology to replace bus backplanes will be available late next year from a Norwegian company, a development which could see computers around the world much more easily connected.

Dolphin Server Technology in Oslo expects to have ECL devices to serve the scalable coherent interface (SCI) technology, which is widely seen as the successor to current backplane techniques. SCI performs beyond the limitations of traditional backplanes and consists of a series of nodes linked together by two Gbyte serial paths, solving propagation delays encountered by signals on current backplanes.

Apple Computer and Hewlett Packard are working with Dolphin to develop SCI chips and the company expects product to be available by 1992.

The main advantage of SCI is that it allows many users to access the same information at once in ring or complex switch networks. (Source: Electronics Weekly, 6 September 1989)

Pakistan

Progress slow in acquiring electronic technology

During its eight years of existence, Pakistan's National Institute of Electronics has taken steps to realize the role it is expected to play in research and development in electronics. The Institute has established well equipped laboratories and support facilities. Concurrently, it has attracted engineers and scientists with suitable qualifications. It also has trained its scientists and engineers in Pakistan and abroad in areas suited to its requirements. It is true that the institute during its formative years worked on rather low technology projects but this was done for two reasons: a lack of modern test and development equipment and people to train the fresh blood.

Presently the institute is engaged in some high technology projects of national importance in the areas of microelectronics, systems development, industrial electronics, digital communications, computers and informatics. Despite financial and manpower constraints, the Institute can now design complex digital circuits. With its well equipped laboratories, the Microelectronics Division is capable of undertaking miniaturization of system level designs, logic conversion of discrete designs to gate array macros, logic minimization and design analysis, physical layout for IC fabrication, test programme generation and semiconductor foundry interface. The Institute has already completed studies on Schottky diode surfaces and has fabricated such diodes.

The Microelectronics Division has designed a digital dialer chip, which was to be used to train our engineers and scientists in the design of complex circuits. However, the main criteria for the selection of this chip was that the Pakistan Telegraph and Telephone Department imports this chip from Siemens in significant number. The dialer chip designed by the Institute will replace the imported chip and will cost one third as much. The chip is under fabrication abroad.

For the future, the Institute is attempting to acquire the:

- Capability to process bipolar integrated circuits by the end of 1989;

- Capability to fabricate (mass production) bipolar ICs and discrete transistors by 1992;

- Capability to undertake production of CMOS ICs by 1991;

- Capability to undertake production of application specific ICs by 1994.

In the field of industrial electronics, the institute has designed and developed a 20 kW invertor. When completed the secondary batteries will be charged through solar cells; DC will then be converted to three phase AC. This will have very useful application in rural electrification. The product is being handed over to UNDP for installation and trials in Baluchistan. Some time back a demonstration model of an industrial controller was completed. The controller can be adopted to automate industrial processes. Feasibility studies of an application specific Computer Controlled Security System for large installations has also been undertaken.

Three years ago, the institute developed a 250 line electronics telephone exchange (PABX). A prototype with 6 40 lines capacity was used in the institute. The design has since undergone a number of changes. Presently, the product is being strengthened and documentation is being finalized. When completed, it will be possible to multiplex two such exchanges.

In the area of optical fibre communications, a 2M bit laboratory prototype link is being upgraded to 34M bit optical link that will carry both data and speech. Potentially the link will be able to accommodate 480 voice channels.

Technically advanced countries have developed and introduced supercomputers that compute at superspeeds. Normally three techniques are used in high speed computers. Advanced countries are very reluctant to transfer this technology. Realizing these difficulties, it was decided to develop a computer architecture with parallel processing. The main idea was to train a group of engineers and scientists in house in the development of this technique. Despite difficulties in the procurement of high speed microchips and sophisticated test equipment because of the embargo on their export placed by the advanced countries, the project is progressing at a satisfactory pace.

To achieve precision and better efficiency CAD/CAE this sytem was procured as a design and engineering tool. Using a PCAD CAE 2 package, the system is capable of providing services like creating electronics circuits concepts, circuit modelling, static and dynamic circuit characteristics analysis. It has the capability to create data bases for components lists and net lists. The CAD system uses a PCAD PCB 3 software package. This facility can be used for printed circuit board designs schematics and PCB layout can be routed to the pen plotter, photoplotter and NC drilling. It can be expanded for PCB testing.

As R&D work progressed plans were made to establish an Electronics Industries Promotion Centre (EIPC). The Government has since approved the proposal. EIPC will convert laboratory prototypes into production prototypes with complete documentation, find a market for the products and undertake limited production if required. It will be an interface with the electronics industry, which it also will promote. Another important scheme is to establish hi tech townships in Islamabad along the lines of the ones in Singapore and Korea. The Government has approved this proposal in principle. This will have a marked impact on the progress of the electronics industry in Pakistan. (Extracted from AEU No. 3 1989)

Switzerland

Swiss firm boosts USSR ASIC capability

Switzerland's Lasarray SA, the Biel based company, has started its first ASIC factory in the Soviet Union. The $5 million Leningrad facility will soon be followed by a similar plant in Moscow. Lasarray says the plants, which the Academy of Sciences of the USSR will administer, fill a gap in the USSR's electronics industry. According to the company, a top academy official conceded in the spirit of glasnost that sluggish sales of equipment to Western countries stem from inadequate technology and hardware. Now, with Swiss help, equipment can be individualized and ICs made to order. (Source: Electronics, August 1989)

Taiwan, Province of China

Computer industry trends

The computer industry experienced growth pains and success simultaneously in 1988. The country produced 25 per cent of the world's personal computer market and 30 per cent of IBM PC compatibles. However, the information industry growth rate was at 30 per cent compared to 80 per cent in 1987. Three problems plagued the computer industry: shortage of certain components, particularly dynamic random access memory chips (DRAMs); rising labour costs; and sharp appreciation of the New Taiwanese Dollar. Manufacturers had to pay 5 8 times more for DRAMs in 1988 compared to 1987. According to the Taipei Computer Association, the lack of a Taiwanese DRAM manufacturer is a "lurking danger" and may cause severe disadvantage in competition with South Korea.

Labour costs may be alleviated with off shore moves to the Philippines, Malaysia, Thailand and China, according to the Taiwan Computer Users' Group. Other problems may be caused by short sighted corporate vision. Most of the computer market is based on XT and AT based clones. Only 10 per cent of PC exports were 80386 based clones. Taiwanese computer firms are well entrenched in Europe and ready for the single European market of 1992. China may probably enter the Taiwanese picture supplying labour and buying products. In 1988, 60 per cent of PCs sold in China came from Taiwan, while 40 per cent of PC boards printed for PCs made in China came from Taiwan. (Extracted from Computer Reseller, 19 June 1989)

Semiconductor intentions

Semiconductor makers aim to supply 4 per cent of world demand by 1992 via six plants built for a combined $1.2 billion. Meeting the goal would make Taiwan the No. 4 chip supplier in the world, behind Japan, the US and Korea. Until mid 1988, Taiwan had only two wafer fabrication plants, but two others became operational in the second half of 1988 and two others were added in 1989. Over the next couple of years, an additional four wafer fabrication facilities will be built. Dataquest believes Taiwan's chip sales could reach $3.1 billion in 1992.

However, a downturn in the industry could endanger the survival of some of the plants, particularly those that branch out into the mass market for computer memory chips, whose price falls fast during slumps. Firms taking part in Taiwan's chip production boom include United Microelectronics, Hualon Microelectronics, Taiwan Semiconductor Manufacturing, Winbond Electronics and a joint venture of Texas Instruments and Acer. (Extracted from Business Week, 14 August 1989)

Electronic firms prepare for post 1992 EC market

Taiwan's electrical appliance and electronic manufacturers are setting up factories and sales networks in Europe in anticipation of unification of European markets.

Tatung Co., Sampo Corp., and Great Electronics Corp., are readying themselves for 1992, when the European Community becomes the world's largest market.

Tatung has established plants in Austria, the UK and the Federal Republic of Germany and personal computers and televisions have carved a niche for themselves in the UK market. (Extracted from AEU No. 3/1989)

United Kingdom

NEDO in UK initiative

A campaign to boost the competitiveness of the UK components industry is being spearheaded by the National Economic Development Office (NEDO).

Driving NEDO's initiative is a powerful threat to Britain's competitive position now that over half the components purchased in the UK come from abroad and with the Japanese rapidly expanding their production base within the UK.

The campaign has been put together by the electronics components and technology group of NEDO.

The group has targeted the customer/supplier interface as the key area where UK components companies can sharpen up their act. Within that area are the disciplines involved for efficiently handling communications, responsiveness to customers, delivery systems, technical support, the design of new products, paperwork and product keeping.

NEDO's campaign is backed by the Electronics Components Industry Federation (ECIF), the Institute of Purchase and Supply (IPS) and the Printed Circuit Interconnection Federation (PCIF). (Extracted from Electronics Weekly, 19 July 1989)

Universities earn eight ESPRIT projects

UK universities have won eight of the 55 software projects awarded in the 3.1 million ECU (2.31 million pounds sterling) Parallel Computing Action programme of Europe's IT research initiative, ESPRIT. Up to 100 per cent of the hardware costs will be met by ESPRIT.

Most of the projects are based on Inmos's transputer and will concentrate on developing run time environments, processing tools and applications.

Among the UK universities selected are Bristol, Reading and University College London.

Reading will be acquiring either a Parsys or a Meiko transputer system to network to other parallel machines in a mixed architecture.

University College London's project will concentrate on developing software to allow parallel computers to communicate at high speed across an FDDI (fibre distributed data interface) network.

The Department of Computer Science already has one 32 node machine from Parsys, and the project will fund a second transputer system. (Source: Computer Weekly, 31 August 1989)

Commercial rule worries researchers

Stringent commercial conditions and red tape are threatening the future of the UK's national IT research.

A year after the deadline for project proposals there are still no projects under way in the first 42.9 million pounds sterling round of the Information Engineering Advanced Technology Programme.

The Department of Trade and Industry has sent contracts to only 20 of the 105 consortia who had proposals approved this year, but the contracts call for commercial exploitation of the project within two years of its completion or the money to be refunded.

The DTI also wants lead contractors to assume financial responsibility for all industrial sub-contractors.

Industrialists and academics are frustrated at the delay in getting first call projects off the ground, although the Science and Engineering Research Council (SERC) partners the DTI in co ordinating IEATP. (Extracted from Computer Weekly, 17 August 1989)

The Scottish electronics market

The Scottish electronics industry is concentrated in an area which stretches from Dundee in the North East to Ayr in the South West, which is often referred to as Silicon Glen. This is not only where 4 million of Scotland's 5.1 million inhabitants live, but also where most of the country's 300 electronics firms are based. Scotland has one of the largest concentrations of electronics manufacturing plants in Europe. Almost every type of electronic product is made in Scotland - from microprocessors (Scotland produces more chips per head of population than any other country in the world) to personal computers and specialist equipment.

Many of the world's largest electronic manufacturers have locations in Scotland. IBM makes its PS/2 range and NCR makes ATMs for the financial community. Motorola, Nat Semi and Burr Brown - three of the leading US micro chip manufacturers also operate in Scotland as does their Japanese rival NEC. Compaq Computer Manufacturing, said to be the fastest growing company in history, recently began producing personal computers at a brand new facility just outside Glasgow. The biggest British manufacturer, and the largest single electronics employer in Scotland, Ferranti, employs 8,500 people in several plants, mainly in the defence field. The Scottish electronics industry actually began with Ferranti, which during the second world war, set up a gun sight plant in Edinburgh in order to escape German bombs in the South of England.

The first US multinationals, IBM and NCR moved in in the late 1940s and early '50s, attracted by the ease of operating in an English speaking country in Europe. The 1960s saw the semiconductor revolution, with Motorola and National Semiconductor setting up shop in Scotland. The '70s and '80s saw even

greater change with old mechanical engineering firms moving to incorporate new technologies into their equipment and working methods. The imminent arrival of the single European market in 1992 is being preceded by a new wave of investment in the '80s, with DEC, Compaq, NEC, Sun, Oki and JBC moving in.

The Scottish electronics industry employs about 46,000 people and accounts for 15 per cent of Scotland's manufacturing output which is worth about 3.5 billion pounds sterling. The SDA, which regularly competes with the IDA, has played a pivotal role in stimulating the growth of the Scottish economy over the past 15 years. Over one billion pounds sterling has been spent by the agency, and it is Scotland's biggest industrial landlord.

Although Silicon Glen is a very successful manufacturing base, the area is not self-sufficient in terms of components. Recent figures from the SDA show that Scottish based companies account for only 15 per cent of all the components consumed in Silicon Glen, despite the fact that a massive 2.4 billion pounds sterling is spent annually by Scottish electronics OEMs. This money goes on equipment, components and sub-assemblies.

Major supply opportunities for the Scottish market have been identified, and the following list is in order of priority.

- PCBs;
- Plastic mouldings;
- Metal work;
- PCB assemblies;
- Power supplies;
- Laminates;
- Connectors;
- Monitors.

(Extracted from AMT, August/September 1989)

United States of America

Results of superconductor survey

Most US firms are reluctant to commit themselves to producing high temperature superconductors until the technology is more firmly established, according to a Defense Advanced Research Projects Agency (DARPA) survey of 48 firms involved in high temperature superconductivity research. Firms such as DuPont, Hewlett Packard, IBM and AT&T do not plan to produce these superconductors in the near future, although they have well-developed research programmes. Only smaller start-up firms appear to be planning to begin production over the near term. Some 94 per cent of the firms surveyed would consider entering into a government sponsored consortium on superconductivity. DARPA would be the government sponsor preferred by 64 per cent of the respondents, followed by the Department of Commerce (22 per cent), Department of Energy (18 per cent) and the National Science Foundation (12 per cent). Some 71 per cent of the respondents think that it is too soon to consider establishing an industrial base. (Extracted from Chemical and Engineering News, 7 August 1989)

Pentagon joins the race to build a brain

The US Department of Defense is about to award $33 million to researchers who are trying to teach computers to think like the human brain. Its Defense Advance Research Project Agency (DARPA) will make grants to projects investigating the use of artificial neural networks by the US armed forces. The programme will double the American Government's funding for this technology.

Half of DARPA's money will go for experiments to compare how neural networks and traditional computing techniques solve particular problems. Neural networks will be used to recognize spoken commands, detect the noise of submarines in the ocean, analyse the seismic echo from nuclear tests and identify military targets, such as tanks. If neural networks perform best, the Pentagon will put more money their way.

The remainder of DARPA's programme will go to improving scientists' knowledge of how neural networks function. The programme will also aim to develop more appropriate hardware for neural computing.

The Pentagon hopes that neural networks will be able to handle problems that have defeated traditional techniques of artificial intelligence. Despite decades of research, computers still cannot accomplish tasks that a child carries out easily, such as recognizing faces or understanding speech.

Security staff are using neural networks to detect plastic explosives in luggage at John F. Kennedy airport in New York. The apparatus bombards luggage with low energy neutrons. When the neutrons strike concentrated nitrogen, which is a component of explosives, gamma rays are produced. A sensor measures the pattern of gamma radiation, and a neural network decides whether it is likely to have come from an explosive.

Unfortunately, other substances also contain nitrogen. For example, German sausages contain a lot of nitrogen. The network would have to be retrained if it were used in Munich.

The appeal of neural networks currently rests more on their promise than on their performance. People have used them to solve relatively simple problems, which traditional methods of computing can handle almost as well. (This first appeared in New Scientist, London, 8 July 1989, the weekly review of science and technology)

USSR

Opportunities for Western IT companies

Plunging into the information technology market in the Soviet Union may land the uninformed in a veritable minefield, but British businessmen are queueing up to take advantage of the pervading spirit of perestroika.

According to the UK Department for Trade and Industry, the Soviet computer industry is probably the sector most critical to the plan to modernize the economy because so many other areas - robotics, computer numerical controlled machine tools, telecommunications and CAD/CAM - depend on it.

The Soviet leadership wants to boost its installed base of personal computers from the current 30,000 to 1.1 million by 1990, and to 5 million for schools and colleges alone by the year 2000.

To help firms negotiate obstacles successfully, a variety of "help" options are available, most of them coming from the DTI.

The UK Government is prepared to subsidize up to 50 per cent of the cost of exploratory trips to

Moscow, for example, and IT firms are seen to be treated to their own exhibitions.

But there is some criticism that the UK Government's assistance does not match support levels of other countries dealing with the USSR. The Government of the Federal Republic of Germany, for example, offers its industry far more funding. It has put up a DM 3 billion line of credit that the USSR is using to help with projects such as the construction of a German trade centre in Moscow.

The Federal Republic now commands 21.2 per cent of all western exports to the Soviet Union, compared with 3.9 per cent for the UK. Back in 1970 the respective figures were 15.9 per cent and 9.2 per cent. Italy has a 10.7 per cent share and France 8.5 per cent.

Joint efforts, between western companies and Soviet co operatives, are mushrooming. Each foreign visit by Gorbachev and each business exhibition in Moscow seem to spawn new ones. (Extracted from Computing, 17 August 1989)

VIII. FACTORY AUTOMATION

Robots see a way out of the factory door

Joseph Engleberger, the inventor of industrial robots, said that robots are on the verge of making their long awaited escape from factories into everyday life. Their impact in many other occupations, such as farming, construction and helping the aged and handicapped, continues to grow.

Engleberger was speaking at the 20th International Symposium on Industrial Robots, held in Japan, the country with the world's largest population of robots. The Japan Industrial Robot Association predicts the market in industrial robots will be worth as much as 430 billion yen (1.8 billion pounds sterling) this year.

According to a survey carried out by the association, the most important reason for Japanese companies to invest in robots is the need to diversify - to build factories capable of making many different products. Five years ago the main reason for investing in robots was to cut costs. One area needing technological development is the robot's sensors. Scientists must improve the way robots detect and interpret images of the world around them so they can cope with environments outside factories.

Several groups of Japanese researchers told the symposium about efforts to tackle some of the problems of making robots capable of recognizing three dimensional objects. One group, at Niigata University, is building a system which relies on the doppler effect using ultrasound to keep a robot paint sprayer, for example, the correct distance from the surface it is working on. The advantage of ultrasound over optical methods, says Shinichi Nakajima of Niigata, is that it works regardless of the texture or colour of the surface it is measuring.

Ultrasound has also been chosen by a team at the electronics company NEC. The group, under Noburaki Takanashi, is developing arrays of solid state devices which send and receive ultrasound. Takanashi said his goal is to produce an array which is small enought and fast enough to act as the "eyes" of a mobile robot. The prototype, however, takes 3.5 seconds to build up an image of 128 by 128 pixels.

A rival team at Mitsubishi Heavy Industries believes that laser light is better for the job. The group is working on mobile robots to inspect and maintain nuclear reactors. These machines will need fast and accurate ways of identifying objects inside radioactive areas. The prototype laser rangefinder takes 14 seconds to measure the distance to and the size of an object, transfer and process the data and display the resulting histogram on a screen. This is then matched with a pattern of what should be there that is stored in the robot's memory. The team is now trying to reduce the time to four seconds. (This first appeared in New Scientist, London, 14 October 1989, the weekly review of science and technology)

New centre for automation technology

A centre for automation technology to unite the many disciplines involved in production technology is being built at Drexel University (Philadelphia, PA), with completion expected to be in early 1991. Financing for the centre will come from a $12 million grant from the US Department of Energy. The centre will have automation laboratories for instruction and research in CAD/CAM, robotics, integrated systems, artificial intelligence, materials and chemical processing, ultrasonic non destructive evaluation and sensor technology. The laboratories will be employed by Drexel s newly created Intelligent Manufacturing, Processing and Quality Technologies (IMPAQT) Center, which is an industrial consortium with research and education programmes targeted at revitalizing production. IMPAQT will carry out interdisciplinary research on enhancing such production technologies as increasing materials quality, raising productivity and cutting production costs. A goal is to utilize new technologies to help firms move towards no defect output. (Extracted from Metalworking News, 17 July 1989)

New robotic arm developed

A robotic arm, wrist and hand that nearly immediately mimics a human's movements has been developed by C. Engler, a Lehigh University mechanical engineering graduate student. The robotic hand does not need calculations for each movement. As an operator moves his gloved hand, an analog controller stores the voltage signal from potentiometers, which correlate with the hand movement and alter voltage signals to correspond to new positions. The data are converted into signals that run the motors at 1,400 electronic pulses/s. Engler geared the mechanical arm for low voltage levels like those carried by muscles so that it may be utilized to help amputees. Motors in a mechanical arm simulates muscles. (Extracted from Mechanical Engineering, July 1989)

Automated riveting system

Monforte Robotics and Gesipa Fasteners USA (Trenton, NJ) have jointly introduced a new automated riveting system. Monforte's robots accommodated the need for speed and precision. A greater power to weight ratio of pneumatic systems was necessary because the gun alone on Gesipa's automatic blind riveting unit weighs 4 lb. The rivet feeding hose and a power line bring that above the 5 lb. limit of numerous electrically actuated arms. Gesipa said a prototype blind riveting work cell allowed the output of one airbag with eight rivets every 20 seconds. The machine has passed plant testing, and the two firms are looking at uses in such industries as aerospace and electronics. Monforte is a Multivisions (W. Trenton, NJ) subsidiary and Gesipa Fasteners is a Gesipa Blindniettechnik (Frankfurt, FRG) subsidiary. (Extracted from Metalworking News, 12 June 1989)

Robots in horticulture

Mitsubishi Heavy Industries and Waseda University have developed a robot to produce virus-free lily bulbs. The robot peels scales off lily bulbs via centrifugal force and then plants the bulb in culture medium. The work was done in co-operation with a laboratory on Okinoerabu Island, which is the world's largest source of white trumpet lilies. (Extracted from Japan Chemistry, 11 May 1989)

Automated handling in pharmaceutical plant

SmithKline & French is using a $2.5 million FATA Automation (Turin, Italy) handling system at its 25,000 sq. ft. pharmaceutical plant near Milan, Italy. It is the first pharmaceutical plant to use computer integrated manufacturing extensively. The material handling system, which was completed in late 1986, includes an automated guided vehicle system, an automatic storage and retrieval system, and interfaces. The key to the handling system's success was FATA's willingness to work on a partnership basis and to totally understand the business in applying automatic handling to pharmaceutical output. The handling system links the $14.6 million plant's production, packaging and warehousing sections together horizontally and vertically. SmithKline & French is a SmithKline Beckman (US) unit. (Extracted from Material Handling, May 1989)

IX. STANDARDIZATION AND LEGISLATION

Standardization

Standards for modems

Standards for 2,400 bps modems are in a state of flux, according to E. Beck and J. Devlin of Armadillo Association. As a result, modems bought today may be obsolete quickly due to the V.42bis standard established by the CCITT, an international data-communications standards organization. Formal approval should occur by early 1990. The V.42bis standard defines methods ensuring data is not corrupted during transmission. Hayes Microcomputer Products (Norcross, GA) is the first vendor with a V.42 compliant product. According to S. Porter, marketing director of Racal Vadic (Milpitas, CA), a successful modem business must offer corporate standards such as V.22bis, 212, 300, AT Autodialer and error control at MNP Class 2-4. Two incompatible error detection standards - Link Access Procedure for Modems and MNP Classes 1-4 - are both found on the V.42bis. The latter is used as a back up to the former.

According to M. Arafa, BT Datacom (Chantilly, VA), MNP has a large installed base, but users will eventually have to choose between it and LAPM. A clause in the V.42bis language allows MNP to be dropped. Such a move, according to D. McNamara, of Codex (Canton, MA), would orphan many users. This has not yet happened. However, MNP Class 5, the leading compression scheme, is not incorporated into V.42bis; instead, a data compression scheme, called Lempel Ziv or BLTZ, was chosen. Lempel Ziv is supported by BT Datacom, AT&T and IBM, according to Arafa. G. Petty of Hayes advises that buyers do not purchase equipment that does not support V.42bis. (Extracted from PC Week, 10 July 1989)

Standards for digital audio tapes

Two sides are battling over the standards for 4 mm helical-scan digital audio tapes. One side, led by Hewlett Packard and Sony, are pushing the digital data storage standard. They are joined by Alwa, Alliance Technologies, Alps America and Mitsumi Technology. Expected to join are Digital Equipment, Sun Microsystems and Novell, according to R. Vermeulen, product marketing manager of HP (Bristol, UK). The other side of the standards battle is the Data/DAT Group, led by Hitachi America and Sharp Electronics. This group already has format documentation that has been approved by the American National Standards Institute; this is the first step towards full certification. GigaTrend (Carlsbad, CA) has shipped its 1230 line of DAT tape drives, which conform to 80-90 per cent of the Data/DAT standard. According to H. Steinmetz, of GigaTrend, the company will have full conformity by the end of 1989. Steinmetz does not think the two standards are incompatible: he sees DDS as a subset of Data/DAT and believes drives will be made to run both systems.

According to I. Flizer, of Data Storage Concepts (Santa Barbara, CA), DDS is limited to high performance streaming; Data/DAT is an umbrella architecture that has a random access format and a high performance streaming format. The random-access format will require two hours of formatting, but will permit the user to write over old files; DDS requires no formatting, but will not allow overwriting old files. According to J. M. Casey, of InfoCorp (Santa Clara, CA), Data/DAT will require more RAM because of its stronger error correction code. (Extracted from PC Week, 3 July 1989)

Graphical user interface standard

CAD/CAM vendors are developing their own graphical user interfaces (GUIs) in the hopes of becoming the industry standard. An Autodesk spokesperson said that GUIs, whether Unix or DOS, will be more like multi user windows or OS/2. So far the following GUIs have been introduced: IBM's Presentation Manager, Sun Microsystems' Open Look, Digital Equipment's GEM, Open Software Foundation's Motif, Microsoft's Windows and X Windows. According to J. Dunkle, of Workgroup Technologies, one standard will not evolve for some time, however, he expects Macintosh, Presentation Manager, Motif and Open Look to be among the most popular. A standard GUI will benefit developers by freeing them of designing the GUI and increasing the hardware base. Users benefit from an easy to learn GUI and improved portability between applications from different developers. (Extracted from Computer Reseller, 14 August 1989)

Boundary scan architecture standard

The IEEE is going ahead with its plan to introduce a boundary scan architecture standard for testing dense assembled printed circuit boards. The P1149.1 standard is going to vote in August 1989. At least 75 per cent of a group of 240 design, product and diagnostic engineers must approve the standard. However, according to R. Tulloss, of the Standards Working Group, suggestions by dissenters will be implemented in order to get full consensus. A final decision will not be made until the second quarter of 1990. Already several firms have announced products offering boundary scan. AT&T will supply a test suite to manufacturers to certify their products with the standard. Systems and chip manufacturers will have to certify their own products. (Extracted from High Performance Systems, August 1989)

Proposed standard for image processing

Wang Laboratories has presented its proposed standard for image processing across all platforms. Concurrently, it introduced a new toolkit for its

new image architecture. Wang's Open/Image standard defines the management, storage and distribution of images regardless of applications, hardware, communications environments or storage media. The technology is available to other vendors. Already Oracle, Gupta Technologies and Information Builders are planning to integrate Wang imaging technology into their offerings. Five other companies have signed licensing agreements with Wang for Open/Image windows. According to T. Bajarin, of Creative Strategies Research International, many more vendors will have to adopt the standard for it to work. The toolkit will have programming tools for integrating the capture, storage, retrieval and display of images. According to K. Olisa, of Wang, Open/Image offers a wide range of entry points to firms needing image processing. It has 175 Application Programming Interfaces, using TIFF to store and exchange images. Freestyle, Wang's graphical information management system, supports operating systems from Banyan Systems, Novell, 3Com and IBM. (Extracted from Computer Reseller, 26 June 1989)

CASE standards

Standards for integrating computer aided software engineering tools are slowly developing. According to E. Chikofsky, director of research and technology, Index Technology (Cambridge, MA), about 19 standards efforts on CASE exist. They range from government work to ad hoc committees. These efforts are concentrating on five topics: data exchange, tool integration, portability, openness and development of standard CASE repositories. The last topic is especially important. A data base holding all vital project information, and accessible by all tools, is the best solution.

One standard has been created; the Integrated Resource Directory System provides repository specifications. IBM, a member of the IRDS committee, will add the CASE repository to its Application Development/System Application Architecture, probably in late 1990. According to A. Rin, of the Gartner Group, IBM's clout should make AD/SAA the CASE integration standard for commercial software. However, he warns that the standard will probably evolve through the mid-1990s and that many vendors would have to undergo major retooling to use AD/SAA. Sage Software (Rockville, MD) is following the new standard. The CASE Integration Services ad hoc committee, formed by Digital Equipment and Atherton Technology, is working on a standard based on Atherton's Software Back Plane. (Extracted from Computer Reseller, 19 June 1989)

Adding fibre to modern networks

Networks are the established means of delivering information technology services to users. To be competitive, businesses have to formulate and implement a future proof strategy for the networking of information.

A key element in such a strategy will have to be a new standard for high-speed networking - the Fibre Distributed Data Interface (FDDI).

This is likely to become the dominant standard for high speed networks in the 1990s. It is supported by all the leading suppliers of information technology and will eventually become an international standard published by the International Standards Organisation.

Since FDDI is based on networking data at 100 Mbits per second it offers a quantum leap forward in networking performance over current methods based on Ethernet (10 Mbits per second) or token ring (four or 16 Mbps).

One of the most compelling reasons for anticipating the use of FDDI is that it unites the IBM and DEC worlds. Both companies are backing the standard and an FDDI backbone network will be able to route traffic between Ethernet and token ring local networks.

As the number of network users increases and graphics based applications become more common, organizations will require more bandwidth than current local area networks can provide.

Nearly all of FDDI's 100 Mbits per second bandwidth will be available, thanks to its append token protocol. Typically this could mean between a 12- to 20-fold increase in throughput.

Further benefits come from FDDI's resilient design, which makes it able to survive cable breaks and failures of single nodes, and its ability to extend the reach of networks up to 100 kilometres.

The standard is being developed by a committee (X3T9.5) of the American National Standards Institute for the International Standards Organisation. The committee has completed three parts of the work, which have already become ISO draft standards, and should complete the last part early next year.

The last part, covering station management, is by far the most complex and important section. It deals with network configuration and control and is still some way from completion.

The standard specifies a 100 Mbits per second network working over fibre optic cabling. The topology is a dual contra rotating ring. Data travels one way round a primary ring and the other way round a secondary ring, which is how it can survive component failures.

Multimode fibre optic cable allows a total fibre length of 200 km, which is normally expressed as a dual ring of 100 km. Up to 500 nodes can be connected to both rings (dual attached) or 1,000 nodes connected to a single ring (single attached). The maximum distance supported by multimode fibre is 2 km.

FDDI will not be a revolution but an evolution. Most current users will be connected to the corporate network via local networks such as Ethernet or token ring. Local network traffic will be contained within departments. However, the growth of corporate services, accessed by all departments, will lead to the introduction of higher speed FDDI backbones.

The next development of FDDI backbone networks, probably starting in 1991, will include direct connection of mainframes and high speed servers. But the cost of connecting to FDDI will be high and most users will continue to be connected to the local networks. (Extracted from Computer Weekly, 31 August 1989)

What is FDDI?

The Fibre Distributed Data Interface (FDDI) is a standard for high-speed networking over fibre optic cable. It is being developed by a committee (X3T9.5) of the American National Standards Institute, authorized by the International Standards Organisation.

FDDI is a fibre optic token ring network. It uses light emitting diode transmitters over multimode fibre to achieve 100 Mbits per second over links up to two kilometres. It uses a dual contra break or node failure.

There are four major sections to the standard. Three are already draft ISO standards.

The fourth section, on station management, is the most complex and important and should be finalized early next year.

Physical medium dependent sublayer (PMD)

This specifies the optical signals and waveforms on the fibre cable as well as the connectors and fibre cable plant.

Physical layer protocol (PHY)

This has two main functions - clocking and the coding and decoding of signals.

Coding has been designed to maximize the signalling rate with a scheme called four of five code. This is 80 per cent efficient and reduces the signalling rate down to 125 Mbits per second. The Manchester encoding scheme, used in Ethernet and token ring, has only 50 per cent efficiency and would require 200 Mbits per second signalling if it were to be used for FDDI.

FDDI does not require a ring monitor station controlling clocking, as token ring does, but implements a distributed clocking function. This imposes no limit on the size of the FDDI ring but does lead to a maximum frame size of 9,000 code symbols (4,500 bytes).

Media access control (MAC)

This schedules and transfers data on to and off the ring. It handles packet framing, station address recognition, token passing and the generation and verification of frame check sequences.

Station management (SMT)

The main functions are initial ring configuration, bit error monitoring of the line, reconfiguration to bypass failures and provision of management services during normal ring operation. (Source: Computer Weekly, 31 August 1989)

Europe polarized over EMC regulations

Everyone agrees that electromagnetic compatibility (EMC) is a desirable feature to have in a component or a piece of equipment. But the implementation of the EEC directive (89/336/EEC) on the subject is far from clear in the run up to 1992.

While there is no disagreement over the assumption that the public network has to be protected against the effects of electromagnetic interference, there has not been universal acceptance among EEC members that all equipment has to be tested by a third party.

Manufacturers of information technology (IT) and telecommunications equipment know that they face added costs in getting their equipment screened so as to reduce interference levels. They also know that certification will enable them to sell across EEC borders.

Manufacturers making telecommunications and radio equipment are offered the choice of manufacturing "in accordance with specified European standards which will be published in the UK as identically worded British standards". Or they can keep a technical construction file on their equipment. It will contain a certificate from a third party test house, to the effect that the equipment conforms to national or international standards.

The Electromagnetic Compatibility Directive applies to all types of equipment connected either directly, or indirectly to the public telecommunications network, for sending, processing or receiving information.

Harmonization of the different national and international standards has yet to be agreed upon. For example, CENELEC has a mandate from the European Commission to deal with EMC standards for IT equipment. But the UK has questioned how to treat such equipment when it incorporates radio transmitters. The UK also has problems over cellular radio in the frequency range 900 905MHz.

It was against UK wishes that an extra certification procedure should be imposed upon telecommunications terminals, compared with IT equipment. But the UK was outvoted, and the directive was adopted.

One area yet to be resolved is that of sub assemblies. Often the EMC of a system can differ from that of its constituent parts. A one off piece of capital equipment is difficult to test for EMI, before it is put together on the customer's premises. Nevertheless, investment by UK test houses has been substantial.

For companies seeking EMC advice and support, Radio Frequency Investigation offers test facilities to meet most national and international standards - for example, VDE 0871, BS800, and 6527, CISPR, EN55022 and MPT 1300 series.

The military department at Leatherhead determines compliance with defence standards and MIL specifications, as well as carrying out work on the compatibility problems in ships and military vehicles. The aircraft department is concerned with more onerous EMC problems in military and civil aircraft, and has a comprehensive mobile test facility for computer-controlled, low level, swept frequency, coupling investigations.

The impact of the Brussels directive is going to mean a lot of aggravation for UK manufacturers when it comes into force. The results of a DTI funded study suggest that companies are going to suffer delays and costs. The smaller ones may not be able to market their products, unless additional test facilities are available. (Source: Electronics Weekly, 30 August 1989)

How connectivity standards help

An effective connectivity solution sets a company apart from its competitors, and it keeps the focus on customers. The optimum connectivity solution also allows evolution from distributed systems to newer technologies. And it permits both integrated sets of products and single product offerings to operate within the same environment. Helping companies recruit customers and save money in achieving these objectives are certifiable connectivity standards such as the Open Systems Interconnection (OSI) model and the Integrated Services Digital Network (ISDN).

Ever since the first computers were built, connectivity has presented both opportunities and problems. As technology marches steadily onward, whole new product lines have gradually become available to users. New services have flourished in the 1980s thanks to the advent of PCs, advanced work stations and specialized superminicomputers.

All of which means that companies trying to keep up with their market rivals in the 1990s will continue to spread their technology mixes across many competing IS vendors' product lines. This certainly was not the case in the past, when a single vendor could maintain its strength in all facets of the technology. But now, by buying products that conform through certification to international standards, users can help ensure a seamless link up across networks. At the same time, they can also free themselves from the higher cost, single supplier approach.

ISDN and X.25, the two well known standards for public connectivity, are implementations of the third layer in the seven-layer OSI model, the so-called network layer. In the ISDN trials that are currently taking place around the world, home subscribers to the voice/data service receive a pair of 64-kilobit per-second data channels (B channels) that may operate over the same twisted pair wire as a voice line. They also get a D channel that carries routing and other administrative information.

The D channel will also carry data packets over the public network in the same way a local area network (LAN) carries them within a company. Another D channel advantage is that it enables companies to automate the handling of incoming calls based upon the caller's telephone number. Since ISDN is digital, it also gives carriers the chance to reoffer special cost features that flopped in the past.

One dilemma is that, in order to implement ISDN, sophisticated digital switches are required. Already making the conversion to these new generation switches, the European Community will be ready to roll out ISDN by 1992. In the United States, things will take a little longer, primarily because the carriers will have to cost justify these technology expenditures.

Instead of the paltry two data channels for residential customers, corporate users will be able to take advantage of 23 data channels for a grand total of 1.5 megabytes of capacity.

This means that companies will be able to get much more variety on these primary hook-ups than just 23 fixed voice sessions. Those options sound appealing to an increasing number of US businesses. Some are replacing their in house PBX systems with ISDN switches that will enable them to internally mimic the telephone company's service.

Network products must pass stringent tests to win certification. At the Corporation for Open Systems (COS), the western hemisphere's primary network standards conformance checker, certification is a methodical process. After an international standard is adopted and an industry workshop produces conformance guidelines, then COS builds or buys testing software for the standard. Next, it tests the network products for conformance to the standard. And finally it awards a COS mark to wares that pass its tests. Periodically, COS spot-checks already certified products. It can also help resolve interoperability issues that arise between two products.

This year, a preliminary COS mark was granted to X.400 (the international standard for electronic mail) and to LANs that conform to the Institute of Electrical and Electronics Engineers' (IEEE) standards for Ethernet (802.3) and token bus (802.4). Token ring (802.5) products will get COS certification by 1990.

Interoperable electronic mail systems provide connectivity outside the walls of a company. Employees will be able to send, receive and edit mail from colleagues, customers and competitors alike. Another standard in the process of being certified is X.25, the packet switching precursor to ISDN.

In 1990 we will also see conformance testing for electronic data interchange (EDI) and file transfer access and management (FTAM) standards. In addition, a limited set of standard virtual terminal capabilities will also be tested. Virtual terminal capabilities will be welcome because they will enable users to buy different devices for different purposes from different vendors secure in the knowledge that the products will have certain capabilities in common and will be communicated correctly from one vendor's screen to another vendor's screen.

The biggest potential cost savings for users, however, could come from office document architecture (ODA) which promises to save many dollars and make users' lives a whole lot easier by facilitating the exchange of documents between systems so that they can be edited. In this context, documents include such things as graphics and special characters.

The International Standard Organization's (ISO) transaction processing standard is critical to airlines, as well as to banks, brokerage houses and other financial institutions. Transaction processing highlights two issues that are central to the whole standards movement - efficiency and installed plant.

Conformance to standards may exact a price in terms of efficiency. Non OSI message formats can be more efficient since they can remove generally useful pieces of data that are irrelevant to a particular application. Last year, a COS survey showed that customers would be willing to pay an average of 7 per cent more for products that adhered to standards. But that does not mean they would be willing to pay that premium for devices that process only half the information in a given period of time.

Contending with an installed plant that is not based on international standards is another sore spot. Even though some networks do not conform to OSI protocols, users must sometimes accommodate them to do business.

There are also some installed plant issues to delay with in terms of ISDN implementation in the United States. While ISDN could be conformance tested as early as 1992, it is not expected to go into widespread use until some time after that. That is because the United States, as opposed to Europe, still has a vast non electronic plant in place that must be converted to digital equipment before ISDN can go in.

It may be well after ISDN product certification that products will be tested according to an international network management standard. The delay is unfortunate because such a standard is vitally needed. So much so that last year the new OSI Network Management Forum was established to try to accelerate the development of an international standard for network management.

Anyone who has used a product such as IBM's Netview can readily see the advantage of having a common information base that can be easily exchanged among network management wares from different vendors. If network management advocates have their way, products could roll into the testing blocks as early as 1992.

Slow as network standards were in coming, it took even longer for practical efforts to begin on security issues. An appendix to the basic document outlining OSI (ISO 7498) deals with security. But the thing that really sparked awareness of the need for some sort of security standard was the virus attack on ARPANET, the US Government's Advanced Research Projects Agency Network. Nevertheless, OSI testing of security products probably will not happen quickly because the standards setters are only just now asking users what they need.

The years that have gone into product testing have already paid off for users. Certified conformance to network standards facilitates true competition among vendors, which in turn leads to lower priced products. By guaranteeing interoperability, standards enable users to pick the best products from each OSI vendor, thus allowing them to optimize their connectivity solutions. Also, as more certified OSI products become available, the cost differential will decrease between wares that carry the standard mark and those that do not. That is chiefly because testing costs can be spread over more hardware and software.

Despite the cost savings, there are still drawbacks to pursuing a full OSI implementation. One way to overcome these hurdles may be to simply use protocol converters when non OSI barriers cannot be avoided. Nevertheless, OSI generally will be good for tearing down such barriers between computers, networks and even individual applications. This is crucial because companies today use a diverse mix of networking products from a plethora of vendors. Assuring product interoperability through OSI standards will help companies realize the full promise of connectivity. (Reprinted with permission of DATAMATION® magazine©, 15 September 1989, copyright by Technical Publishing Company, a Dunn and Bradstreet Company - all rights reserved)

A vast maze of standards bodies

The world of standards-setting organizations is a 3-D maze that makes the seven layer model for the Open Systems Interconnection (OSI) seem a confection of pure simplicity. There are international standards setting bodies, national standards setting bodies, not to mention national and international standards implementation bodies. There are government bodies that seek to influence standards. There are organizations that aim to implement standards before they have become official standards, reinforcing the de jure with the de facto, so to speak. There are ad hoc committees that seek influence on specific, narrow issues.

Take, for example, the players in the OSI arena. The Consultative Committee on International Telephone and Telegraph (CCITT), based in Geneva, fields Study Group VII on data communications networks. The International Standards Organization, also in Geneva, fields a joint technical committee with the International Electrotechnical Commission called ISO/IEC JTC 1, which works with the American National Standards Institute (ANSI). Serving on X3, the ANSI blessed committee that oversees US information technology standards, are representatives of the Institute of Electrical and Electronics Engineers Inc. (IEEE), the National Institute of Standards and Technology (NIST), the American Library Association (ALA) and the American Nuclear Society (ANS). And each of these groups is a standards setter in its own right. Also involved at this level is the Computer and Business Equipment Manufacturers Association (CBEMA), which handles administration for the activities of X3. Once an OSI standard nears completion in the United States, the OSI Network Management Forum kicks in, seeking to give vendors and users a head start so that equipment can be built and bought that will meet a standard once it becomes official.

And, finally, the job of the Corporation for Open Systems is likened by Carl Cargill, vice-chairman of ANSI's X3 Planning Committee, to that of a political action committee. COS takes the consensus created standards and attempts to rally grass roots support. (Reprinted with permission of DATAMATION® magazine©, 1 September 1989, copyright by Technical Publishing Company, a Dunn and Bradstreet Company - All rights reserved)

Legislation

Copyrights for creative work

The software industry is closely examining a Supreme Court ruling limiting a firm's possession of contractors' work. The ruling amends the Copyright Act of 1976 in such a way that a creator retains rights to a creative work. Copyrights for creative works that are not made for hire are retained by the creator. The software industry is looking for legislation stating that software is "work made for hire". Such a clause would give possession of the software to the person or group that paid for it. The Computer & Business Equipment Manufacturers Association has filed a brief with the Court stating that problems could arise if software vendors have to share ownership with independent contractors. (Extracted from Communications Systems Networks, 19 June 1989)

Computer spreadsheet patent

Refac Technology Development (New York), a patent licensing concern, has laid claim to a patent that could have a major impact on the computer spreadsheet industry. In 1983, two Canadian developers obtained a patent on a computerized technique for tracking formulas within a body of information. Refac purchased the patent not long ago and considers it to be "pioneer" patent, covering know how that has since been incorporated in several spreadsheets. (Apparently, the patent was not defended by the Canadian pair.) Pioneering patents cover breakthroughs, not enhancements to existing products. Before 1983, the US Patent Office did not issue patents for software inventions, and may have been unaware of similar inventions. Refac says it will alert vendors and others that it considers to be violating its patent, and request licensing fees. It is aiming for 5 per cent of the total spreadsheet industry's revenues - or about $25 million - because of the patent. D. Siegal, a computer attorney in Palo Alto, CA, says that if the patent is upheld, Refac may be entitled to revenues for future sales. But considering the time that has passed since the patent was filed, he said it is improbable that Refac could prohibit Lotus or other firms from selling their wares. (Extracted from Information World, 31 July 1989)

Draft ?R: entity position paper on software vandalism

The Institute of Electrical and Electronics Engineers (IEEE) sustains a code of ethics that respects the rights and property of others and that fosters the safety and well being of the public at large. The creation and dissemination of computer viruses for unauthorized purposes, a form of software vandalism, violates this code of ethics and is therefore labelled as an unethical, unprofessional and criminal act.

The IEEE Computer Society, the largest of 33 technical societies in the IEEE, has a membership of more than 100,000 computer professionals in academic, industrial, and government positions worldwide. Their members design, build, program, test, and manage the computers and computer networks so pervasive in today's culture. Through their special roles in the computer industry, IEEE Computer Society members are often involved in the design of the critical functions a computer virus must exploit in order to sabotage a computer system's operation.

In recognition of these professional responsibilities, this position paper serves three functions:

(1) It examines the problem posed by computer viruses.

(2) It clarifies the relationship of computer viruses to professional conduct.

(3) It proposes meaningful practices for professional, industrial, educational, and government organizations to adopt.

The essential principle to be first established is that all rights of property and privacy should be extended to the ownership of computer systems. This encompasses their application, the programs and data stored and used within them, and the communications networks that interlink them.

A computer provides services to its users. These services are defined by the programs and data available in the computer. Coupled with authorized activities of authorized users, these applications bound a computer system's intended operations. Each computer system and all data and programs performing these services have recognized owners, lessees, or authorized users.

When a computer owner is not the exclusive user, permission to use or access some or all of the available services, or to extend specific rights of ownership, is granted by the computer owner (or his agents) to specific users.

Usually a computer system contains an access control mechanism to prevent unauthorized use. Any deliberate effort to thwart a computer's access control mechanism amounts to attempted breaking and entering and should be treated as such under law. Successful penetration of such security features is equivalent to trespassing as well as breaking and entering.

The deliberate unauthorized use of computer services by any person constitutes theft of service and should be treated as such under law.

Any deliberate unauthorized addition, deletion, or change to (or introduction of new) programs and/or data in a computer system is an act of vandalism and should be treated as such under law.

A software vandal uses a program to facilitate the wrongdoing. The program employs features of a class of programs deliberately designed to bypass or elude a computer's security or integrity. These programs are called "trap doors", "time bombs", "Trojan Horses", "worms", and "viruses" (see below for definitions).

Computer professionals performing computer virus research are expected to follow good laboratory practice; viz., they must ensure that the experiment does not become contaminated, and that the experiment does not contaminate or spread to anything outside the laboratory environment.

Deliberate tampering with another's data or programs, however clever the method, is unprofessional, unethical, irresponsible, and criminal. Often, such acts have been rationalized as efforts to understand the inner workings of computer systems. However, one must recognize the difference between penetrating one's own computer and penetrating another computer, or a network that belongs to others.

In order to address the software vandalism problem, the following actions are recommended:

(1) The Board of Governors of the IEEE Computer Society should publicize the fact that software vandalism constitutes unethical, unprofessional, and criminal behaviour.

(2) The academic accrediting agencies, such as the Computing Sciences Accreditation Board (CSAB) and the Accreditation Board for Engineering and Technology (ABET), will be urged to ensure that their standards provide for appropriate coverage of ethical and professional conduct in university computer science and computer engineering curricula.

(3) Employers will be advised to emphasize to their current and potential employees that they do not condone software vandalism.

(4) Governments will be urged to update or enact laws to recognize the seriousness of computer crimes. The IEEE Computer Society will be prepared to provide expert assistance to government bodies, if requested.

(5) Members of the society will be reminded to adhere to the following professional obligations:

- Respect the property and privacy of others;
- Support programs to improve the security of computer systems;
- Notify the owner of a computing service in case a weakness in the security mechanism or an actual security breach is discovered;
- Support and participate in activities geared to educating the public about software vandalism and its ramifications.

Definitions

A "trap door" provides a hidden software (or hardware) mechanism that permits computer system protection mechanisms to be circumvented.

A "time bomb" is a trap door that is activated by a particular set of circumstances, usually occurring over time.

A "Trojan Horse" is a program with an apparently or actually useful function, but that also performs an unexpected (deleterious) function.

A "worm" is a program that replicates itself throughout a computer system or network through its own exclusive efforts. In the process, it overlays or erases other programs or data, making them useless.

There are two types of computer viruses:

A "computer virus A" infection occurs when a Trojan Horse program is allowed to spread to (and is therefore said to "infect") another computer. The virus requires human intervention (usually inadvertently) to spread to another computer. Transmission may occur by copying the Trojan Horse

from a computer bulletin board or a "contaminated" removable disk to another computer system.

A "computer virus B" infection is far more insidious. This is a program that can modify the executable code of another program and add the malicious instructions that now cause the other program to become a Trojan Horse. The other program is now said to be infected. Contamination of additional computer systems occurs in the computer virus A manner.

This statement is a draft prepared by the Subcommittee on Computer Ethics of the IEEE Computer Society Committee on Public Policy and approved by the society's Membership and Information Board, 2 March 1989. It has not been approved by the Board of Governors of the IEEE Computer Society and is not an official position of the Computer Society.

Ralph J. Preiss, the acting chair of the Committee on Public Policy, invites comments about the draft to him at 12 Colburn Drive, Poughkeepsie, NY 12603; Compmail : r.preiss. (Source: Computer, July 1989)

Battle against bootleggers

Senior executives and lawyers from western computer companies met their counterparts in the Soviet bloc to discuss laws to stamp out the "bootlegging" of software, which is widespread in the Soviet Union. Alfred Ai Amazyan, the director of the Programs Systems Institute in Pereslavl Zalessky near Moscow, described the problem as "technical terrorism".

No such laws exist at present in the Soviet Union. This means that computer operators throughout the Soviet hierarchy copy software routinely and with impunity even if it originated in the West. The scale of the problem has discouraged western firms from trading software with the USSR. Soviet programmers also resist developing novel software for fear of it being bootlegged. The 90 or so delegates issued a declaration which urged the Soviet Government to bring computer programs under the protection of law. (This first appeared in New Scientist London, 8 July 1989, the weekly review of science and technology)

Who will weather the gathering storm in the courts?

Major changes in the way the electronics industry will conduct business in the 1990s are being forged not in the marketplace but in the courtroom. The aim of the companies that are filing suits pushing the boundaries of copyright and patent law is to expand the definition of what can be legally protected and licensed for fees and royalties. If they succeed, the intense competition to develop smaller, faster, cheaper products that has characterized the industry for the past three decades may give way to a new strategy: nailing down legal monopolies. But even if they do not succeed, their attempts seem likely to change the way hardware and software advances are perceived. Many key cases have yet to be decided, so the ramifications of this legal movement remain unclear. Indeed, the drama unfolding in federal courts nationwide has no historical parallel. And it is perplexing the legal community, which is being forced to confront slippery questions of what constitutes intellectual property using patent and copyright laws that were developed for machines and works of art, not software and microcode.

The most celebrated - and most critical - suits involve copyright protection of software. In their so called "look and feel" suits, Apple Computer, Lotus, and Ashton Tate are seeking control beyond the actual code itself to include file structures, command names, and the images that the code causes to be displayed on a screen. Although most legal scholars and technical consultants familiar with litigation are not impressed by look and feel arguments, some early rulings have gone in their favour.

On another front, AT&T Company's success in patenting an algorithm has opened a new, some say perilous, avenue for protection of intellectual property. Xerox Corporation further muddies the waters by attempting to license its windowing environment, sidestepping the look and feel suits altogether.

Legal battle lines are also being drawn on the hardware front. Intel Corporation's successful patent infringement suit concerning its erasable programmable read only memory established that a design house could not piggyback on a technology licence held by a foundry. Meanwhile, Brooktree Corporation of San Diego has brought suit against Advanced Micro Devices Inc. of Sunnyvale, California, alleging infringement of mask works for a special static random-access memory design. Such litigation is not uncommon in recent years, but all cases have been settled out of court. If a court rules in the Brooktree AMD case, it will set the first mask-work case law on several major points.

Some observers fear that if the envelope of protectable intellectual property extends much beyond its present limits, the US will become even less competitive in global markets.

Companies seeking to expand protection counter that they should not be forced to stand by while less innovative competitors freely pluck the fruits of their labour.

Legal observers view the aggressive trend in litigation as a sign that the computer industry has matured.

Copyright and patents provide limited monopolies - patents for 14 years and copyrights for 75. Patent protection is much more easily enforced. The first company to patent a technology has exclusive rights to its use. In contrast, a viable defence against a copyright infringement action can be built by proving that the defendant's product was developed without detailed knowledge of the plaintiff's product and how it works.

Copyright case law regarding software is in greatest disarray regarding the argument that a program's "look and feel" and its "structure, sequence and organization" are protected under existing copyright law. Cases like Apple's action against Microsoft Corporation and Hewlett Packard Company over the windowing environment focus primarily on one of the criteria for copyright infringement: that a defendant's program is "substantially similar" to the plaintiff's.

Similarity is only one criterion for copyright protection; another is that the plaintiff's work be novel and creative. In a 1988 case involving video games Data East USA Inc. v. Epyx Inc. the US Court of Appeals of the Ninth Circuit ruled that because functionality dictated the look and feel of both games' screens, anyone writing such a program would come up with substantially the same result. Since that result was thus neither novel nor creative, it could not be copyrighted, the court decided.

While Apple contends that its "unique audiovisual display" - windows, icons, and screen arrangements - is protected, Lotus Development Corporation pushes the envelope a little further. The Cambridge, Mass., software house contends that not only the screen display but also the command names and the sequence and range of choices offered in its 1-2-3 spreadsheet are protected by copyright. It has filed suit against Mosaic Software Inc., also of Cambridge, to win that protection.

Ashton-Tate Company's suit against Fox Software Inc. of Perrysville, Ohio, adds another twist. The Torrance, California, company is seeking copyright protection of the intermediate file structure of its dBase data base management system. A ruling in Ashton-Tate's favour would mean that any company that markets a dBase compatible product would have to license the file structure.

Despite all the activity, it will be a while before precedent making decisions are made.

Observers believe that look and feel is not going to fly. Functionality is critical in the arguments against look and feel.

Look and feel has become an important enough issue to prompt law scholars to meet in February 1989 in Arizona.

Clinton of the University of Iowa thinks the look and feel argument will fail for a simple legal reason: the copyright act makes a distinction between literary works and pictorial, graphical, and sculptural works. There is a specific exclusion from copyright protection for pictorial, graphical, and sculptural works, he says, adding that copyrights cannot be legally granted on these expressions unless they are separate from utilitarian functions of the work. Regarding software, he argues, it is clear that utility and expression cannot be separated.

The look-and-feel issue may well be settled out of court. Xerox, which invented the windowing environment at its Palo Alto (Calif.) Research Centre, has jumped into the picture not with a suit, but by offering licences to what it considers its intellectual property. Xerox's move, observers say, may undercut the look-and-feel suits.

Hardware cases have not generated as much comment as look and feel, but a few have made news - particularly Intel's suit against NEC Corporation of Tokyo for copyright infringement of the microcode for the Intel 8088 and 8086 microprocessors. Although the case went generally in NEC's favour the court decided NEC did not copy the microcode - Intel won a big point when the court ruled that microcode can be copyrighted. If it holds up, the ruling will give microcode developers the chance to seek the 25 year protection of copyright law.

After the Intel/NEC ruling, IBM Corp. decided to copyright all the microcode for its mainframe computers and now licenses the microcode in the machine. A more obvious fallout is that Intel and other firms with microprocessor designs have now protected themselves with both patents and copyrights.

In a more recent case involving Intel, a US International Trade Commission decision keeps independent design houses from arguing that a licence held by a foundry for some basic circuit in this case EPROMS - acts as an umbrella over all devices manufactured in the foundry. Atmel Corporation of San Diego had included EPROM circuitry and had the circuit manufactured in an offshore foundry that holds an Intel EPROM licence. Intel's victory makes independent design houses tread more softly - and adds to Intel's licensing revenues.

Because the case was not decided by a federal court, Intel's victory is limited to keeping the chips from being imported into the US. The final step - endorsement of the decision by President Bush - was set for September 1989. Although the ITC is not a federal court, its decision can be cited as precedent in US courts. (Source: Electronics, August 1989)

X. RECENT PUBLICATIONS

International Standardisation Organisation (ISO) produces handbook on documentation and information

Information and documentation have increased in volume at both the national and international levels. Thus, the need for standardization of documents is becoming more urgent: documents must be compatible with each other and understandable to users. Now international standards have been developed in the field of documentation and information.

The third edition of ISO Handbook 1 contains all ISO standards for continuous and systematic collection and processing of recorded information, for the purpose of information storage, retrieval, utilization or transmission (except electronic data processing which is the subject of ISO Handbook 9).

Part 1 of the handbook contains standards for terms and definitions in the fields of documentation, information, document reproduction and terminology. Standards in Part 2 deal with the creation, compilation and co-ordination of terminologies. Part 3 contains standard conversions of systems of writing, e.g. transliteration of Slavic Cyrillic characters. And Part 4 is devoted to standards relating to libraries, documentation and information centres, indexing and abstracting services, archives, information science and publishing. Standards on documents and representation of data used for information exchange in administration, commerce and industry appear in Part 5 and standards involving microforms are included in Part 6.

For further information on this publication, contact ISO, Case postale 56, CH 1211 Geneva 20, Switzerland.

Directory of development research and training institutes in Arab countries and Register of development research projects in Arab countries

These two publications, published in 1988 by the Organisation for Economic Co-operation and Development (OECD), provide detailed information on 210 research and training institutes and units, located in 20 Arab countries, and on 689 research projects recently undertaken in these countries. Selective information retrieval is possible from the computerized data base using the terms from the Macrothesaurus (published by the UN in 1985).

The Directory is available at FF 145, 17.50 pounds sterling, $US 32 or DM 63. The Register is available at FF 310, 36.50 pounds sterling, $US 68.50 or DM 134. For further details, contact the Organisation for Economic Co-operation and Development (OECD), Publications Service, 2 rue André Pascal, 75775 Paris, Cedex 16, France.

Directory on marine environmental centres

The Regional Co ordinating Unit (RCU) of the Caribbean Environment Programme, through its information network CEPNET, is in the process of expanding and updating the Directory of Marine Environmental Centres in the Wider Caribbean published by UNEP in co-operation with FAO. The information will be incorporated into a computerized data base which will be updated on an ongoing basis in order to support the networking functions of CEPNET. For further information, contact: UNEP RCU, 14-20 Port Royal Street, Kingston, Jamaica.

Technology for information in development

Technology for information in development is the title given to the proceedings of the sixth conference of the International and Comparative Librarianship Group of the UK's Library Association. The conference, which was held from 21-23 August 1987 in Brighton, UK, attracted over 50 participants from more than a dozen countries throughout the world, and from United Nations system and other international organizations including ACCIS, to discuss the general theme of technology for information in development from a number of angles.

The majority of papers given at the conference and reprinted here in edited form make specific reference to particular developing countries and regions. Two describe facilities offered by organizations which are of benefit to the third world, and a further paper discusses the need for and provision of agricultural information in less developed countries. The management of computerized data bases is, furthermore, considered by the authors of several papers, as are other issues, such as difficulties in the implementation of information technology in the third world.

Published in 1988, this 88 page publication (ISBN 0 906905 04 8) is available, price 8.50 pounds sterling, from the publishers, the International and Comparative Librarianship Group of the Library Association, 25 Bromford Gardens, Westfield Road, Edgbaston, Birmingham, B15 3XD, UK.

Toward an ethics and etiquette for electronic mail

The medium of electronic mail is in its infancy, and about to undergo an explosive expansion, say the authors of this Rand Corporation report, which begins from the premise that electronic mail is a fundamentally new medium, very different from telephone calls, interoffice memos, letters, and face-to face conversations.

The report addresses both the ethics and the etiquette of electronic communications: ethics because certain behaviour in dealing with electronic mail can have useful or adverse effects on society as a whole and its members; etiquette because certain standard social norms must be reinterpreted and extended to cover this quite novel social medium.

The report explores how electronic mail is different, and gives guidelines on its appropriate use. In doing so it looks at aspects unique to the medium, such as "flaming" a word coined to represent expressions of emotion in (and often caused by) electronic mail.

Written by Norman Z. Shapiro and Robert H. Anderson, Toward an ethics and etiquette for electronic mail was prepared by the Rand Corporation for the US National Science Foundation. The report (ISBN 0 8330 0669 X) is available (price $US 4) from the Rand Corporation, 1700 Main Street, P.O. Box 2138, Santa Monica, CA 90406 2138, USA.

ARISNET proceedings

Proceedings of the first technical meeting on the Arab Information System (ARISNET), organized in Tunis, Tunisia, by the Arab League Documentation Centre (ALDOC) from 8-12 June 1987, are now available.

The meeting's theme, "Information for Development in the Arab World", was covered in these four plenary sessions: ARISNET: Concepts and Planning; Information Networks - International Experience; Information Networks: Specific Aspects; Manpower Training and Development, and by six working groups, which considered: Networks Planning and Implementation Mechanism; Systems, Standards and Guidelines; Manpower Training and Development; Data Base and Data Bank Development; Telecommunications Networks and Systems, and User Services and Information Marketing Systems.

The proceedings, which contain over 40 papers, are available (in Arabic), priced $US 75, from: Arab League Documentation and Information Centre (ALDOC), 17 Khereddine Pacha Street, Tunis, Tunisia.

Directory of fertilizer related projects in Asia and the Pacific

The ESCAP/FAO/UNIDO Fertilizer Advisory, Information and Development Network for Asia and the Pacific (FADINAP) has published a Directory of fertilizer related projects in Asia and the Pacific. This first edition lists 120 development projects which were either begun, ongoing or completed during 1988, or planned to commence during 1989. Supported by a variety of bilateral and multilateral donors, the projects address a range of concerns, including policy making, investigation of raw materials, construction of fertilizer plants, improving fertilizer distribution, and training of dealers and extension staff. Also included are agricultural development and irrigation projects with a fertilizer component.

FADINAP intends to update the Directory every two years. For further information, please contact: Ms. Marianne Vespry, Information/Documentation Co ordinator, FADINAP, ESCAP Agriculture and Rural Development Division, Rajadamnern Avenue, Bangkok 10200, Thailand.

Information systems for the next decade

For the next decade, the main management problems concerning telecommunications and computers will relate to people, not technology, says author Peter G. W. Keen in Roles and skills for the organization of tomorrow, an International Center for Information Technologies (ICIT) briefing paper.

In today's information systems world, the paper claims, machines are often better looked after than personnel. Technical professionals are a valuable capital resource which needs to be maintained in order to avoid depreciation. The paper identifies a number of challenges facing organizations in the next decade, and advocates greater integration of information systems and telecommunications, to create an information services organization which is poised to provide integrated thinking about increasingly integrated technology.

The 19 page paper costs $US 10 and is available from: International Center for Information Technologies, 2000 M Street, NW, Washington, DC 20036, USA.

REPRINTED ARTICLES

Conversing with computers - naturally

by Professor Marcel Tatham, Department of Language and Linguistics, University of Essex.
(This article is reprinted from Spectrum/8, No. 220, 1989)

For the past 20 to 23 years a great deal of research has been aimed at enabling users of computers to communicate with their machines by voice only, instead of by keyboards and visual display units. What at first appeared to be relatively easy, getting a computer to talk with a human-like voice and making it able to respond appropriately when spoken to, has turned out to be extremely difficult. It is so difficult that we can now confidently predict that it will be several decades before fully natural, free flowing conversation can take place between people and machines. Only now are we beginning to develop systems that perform the task in an acceptable way, though in certain restricted areas conversation with computers is, of course, already with us.

The scenario of a conversational system with a machine requires us to picture using a computer to replace one of a pair of human beings speaking to one another; that is, using the machine to simulate the behaviour involved in carrying out one side of the conversation. So we can begin by examining in general terms what it is that a person does during the communication process.

On the surface, what happens looks simple enough: when someone is spoken to, the immediate response is to speak back, enabling information to flow back and forth between the two speakers. We can model this behaviour as consisting of three separate components:

(1) Hearing the message or question;

(2) Thinking about how to respond;

(3) Speaking the response.

Hearing is in fact a two-stage process. The speech signal enters the ear and almost immediately a complex acoustic analysis takes place in the inner ear. This is a passive process involving no thought on the part of the listener. The results of the analysis are sent to the brain where, in a second stage, cognitive processing takes place to further refine the analysis and to "label" the data as particular speech sounds or words.

Before any response to the perceived signal can be generated, cognitive processes must take place which result in the listener's understanding of what has just been heard. Only when the message has been understood can the listener compose a suitable response.

Two stages are involved in speaking the response. First, the message needs to be encoded linguistically: thought is turned into language as preparations are made to adjust the speech organs to produce the appropriate acoustic signal. Second, a quite complex process of neuromuscular control is brought into play to make sure that lungs, vocal cords, tongue, lips and so forth are organized to produce the right sounds at the right time.

These processes are repeated over and over by each participant in the conversation as the exchange of information unrolls.

Simulating conversation

The basic idea of replacing one human being by a machine is simple enough: programs replace in turn the three stages of the human process being simulated. The first stage is parallel to the hearing process. A microphone picks up the speech signal and a program simulates the ear's analysis of the acoustic signal. The results of this analysis are processed by a second program which conducts the labelling task: the acoustic signal is identified as containing particular speech sounds which in combination represent individual words. The stage is usually called "automatic speech recognition".

The next stage in the simulation is to copy the human process of understanding the message content of the speech just received. We call this "speech understanding", and it is by far the most difficult part of the system in which to achieve satisfactory results. People understand speech in the context of their accumulated experience of the world. Obviously, to put such knowledge into a computer is a vast, if not impossible, task. In practice ways are found of getting around the problem, usually by restricting the area of conversation as much as possible so that the contexts the computer must know to interpret the information are narrowed down to a manageable size. The processes involved are studied within the field of artificial intelligence, which here means simulating the cognitive behaviour of people.

Once the computer has understood what has been said to it, it is able to formulate a response which must then be spoken. Speech synthesis forms the final stage of the process. A program takes the linguistically encoded response and, mimicking the way a human being produces an acoustic signal, produces speech through a loudspeaker.

Experience and labelling

The most difficult part of getting computers to hold conversations with people is the simulation of the cognitive processing involved in understanding what the person has said and in formulating an appropriate response. The reason for this is that speech signals do not contain within themselves all the information needed for their understanding. Take the simple sentence "it's warm today". Spoken during the winter this might mean that the temperature has risen to 10 degrees, but spoken at the height of summer it might well mean that the temperature has reached 25 degrees. Human beings talking to one another know whether it is winter or summer; the computer does not. All of us have spent our lifetimes acquiring such information which we use every time we interpret what is said to us. The problem is how to give the computer just the right "experience" to be able to put what it hears into context and reach an understanding of the message.

But even if we are able to limit the topic of conversation in such a way that the computer stands some chance of understanding what is said to it, there is also the difficult task of converting the sound it hears into the sentences it must understand. The first illustration shows the acoustic signal of the spoken sentence "it's a black cat". In the waveform, time runs from left to right

and it is easy to spot, by looking at the way in which the amplitude of the tracing changes, the individual words in the sentence. Labelling this signal is not at all difficult because it is naturally segmented. It consists of alternating consonants (without loud vocal cord vibration) and vowels (with loud vocal cord vibration). It is the alternation which results in the widening and narrowing of the trace. The second illustration shows the acoustic analysis the computer performs on the same sentence, producing a kind of map of the inner details of the signal. Once again the boundaries between the words are easily detected.

Sentences are rarely this easy to segment, however. In the third picture we see the waveform of the sentence "How are you?". Although in the spelling of this sentence we see orthographic consonants and vowels alternating, the particular consonants here (w, r, y) are spoken in much the same way as we speak vowels. The result is a blurring together of the words, making it almost impossible to spot the boundaries between them. If we look at the final illustration, which is the analysed version of the same sentence, we can see that the segmentation of the individual sounds and words that make up the phrase is by no means obvious.

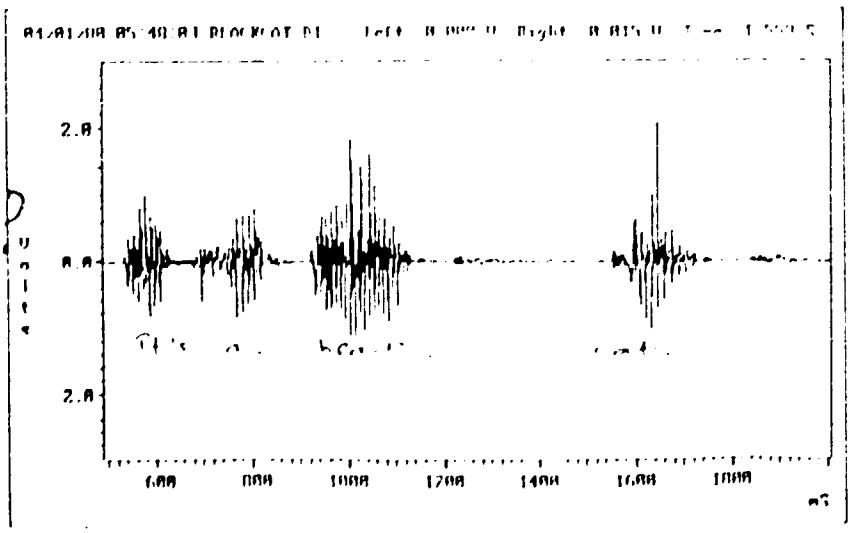
Synthesizing the response

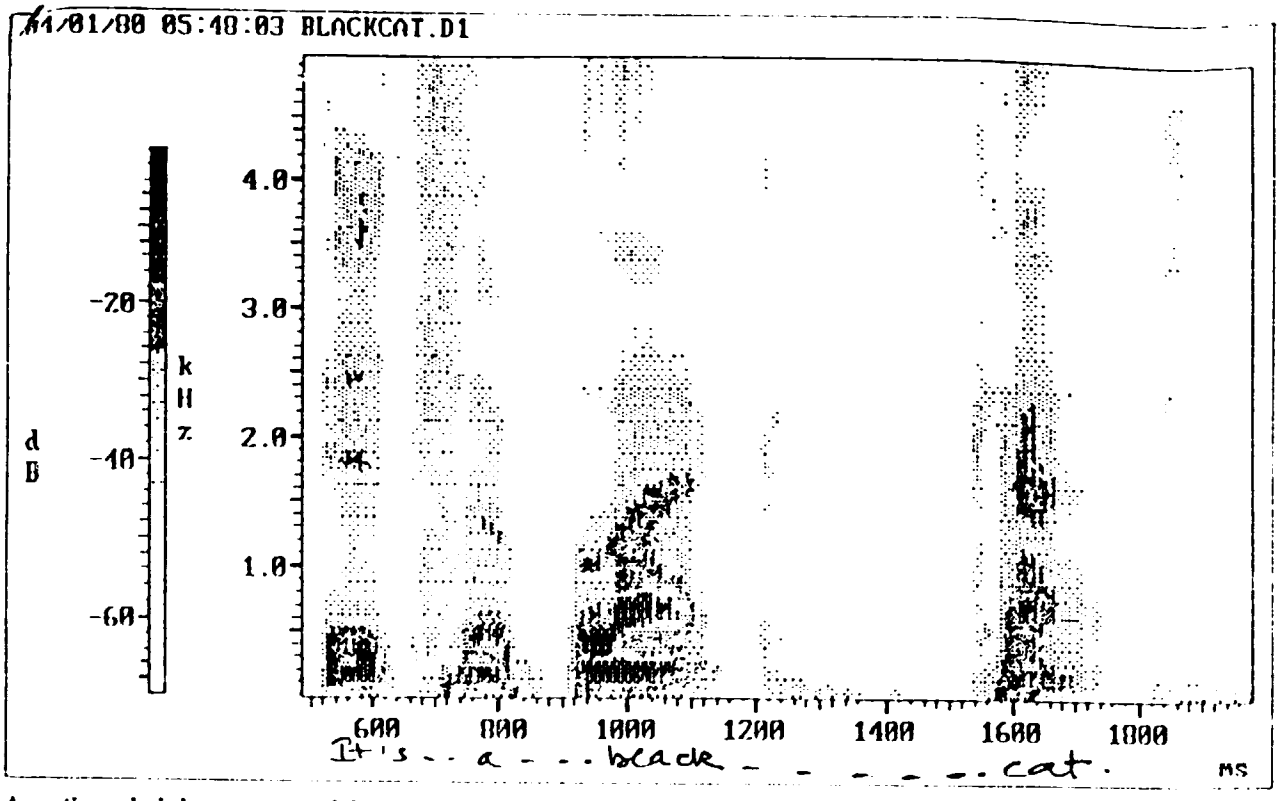
The easiest component of the system is the synthesis of the message the computer has generated in response to what it has heard. Assuming the problems of the earlier stages have been overcome and that the computer has formulated what it wants to say, the response must now be spoken. In some sense the task here is the opposite of the labelling one: the computer has generated the right labels and arranged the words to form a sentence, and now the acoustic signal has to be generated. The building blocks used to form the spoken sentence are individual sounds but, as we saw above, people do not speak sequences of isolated sounds. They run them together. Blurring the boundaries between speech segments forms the basis of good speech synthesis, and success depends accurately generating the different types of blurring, as shown by the first and third illustrations.

Conversations with computers will be a success only when everything is as natural as between two human beings. Each of the stages described above can now be accomplished with varying degrees of success, and we have complete systems in operation in the laboratory. But they are unnatural in that, for example, the computer cannot detect the subtleties hidden within human speech nor reproduce them when it speaks. These subtleties largely communicate peoples' attitudes, feelings or emotions. We can say the simple word "hello" in such a way that it communicates how pleased we are to see someone; or how relieved we are they have shown up; or how angry we are; or how surprised, and so on. Research is well under way to determine just how a person communicates such emotive subtleties in speech, and how these can be detected and reproduced by the computer. Preliminary results of incorporating this research into our conversational simulations show naturalness to be considerably improved.

It will be some time before holding what seems a quite natural conversation with a computer will be a common everyday occurrence. But already computers that understand us and can respond by speaking back are beginning to make their appearance. In certain restricted areas, such as information services available over the telephone, experimental systems are already in use. Banking transactions and airline time table services are the first of such systems becoming available, and as we improve the conversational abilities of the computer we shall see a rapid expansion of interaction between human beings and computers, not using keyboards and screens but natural sounding speech. (Published by the Central Office of Information, Hercules Road, London SE1 7DU and obtainable through any British Embassy, High Commission or Consulate. Printed in the UK for HMSO Dd. 8932107R1266.)

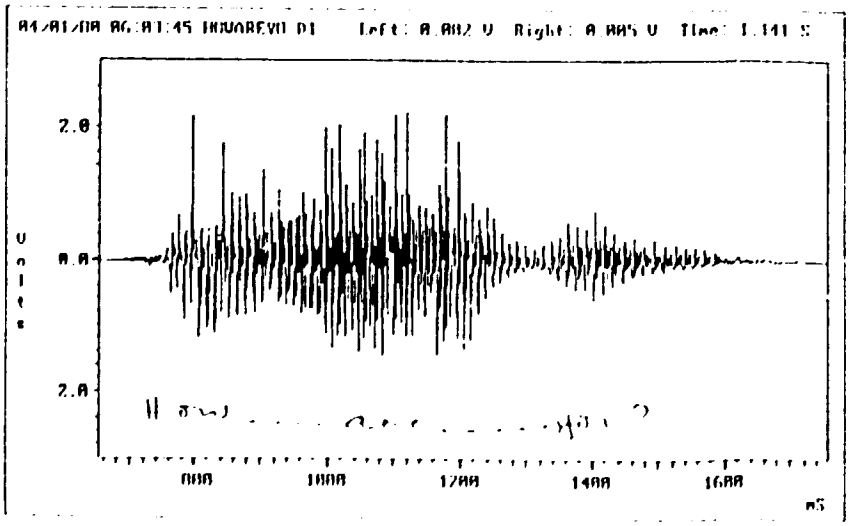
Acoustic signal of the sentence "it's a black cat." It is easy to spot the individual words

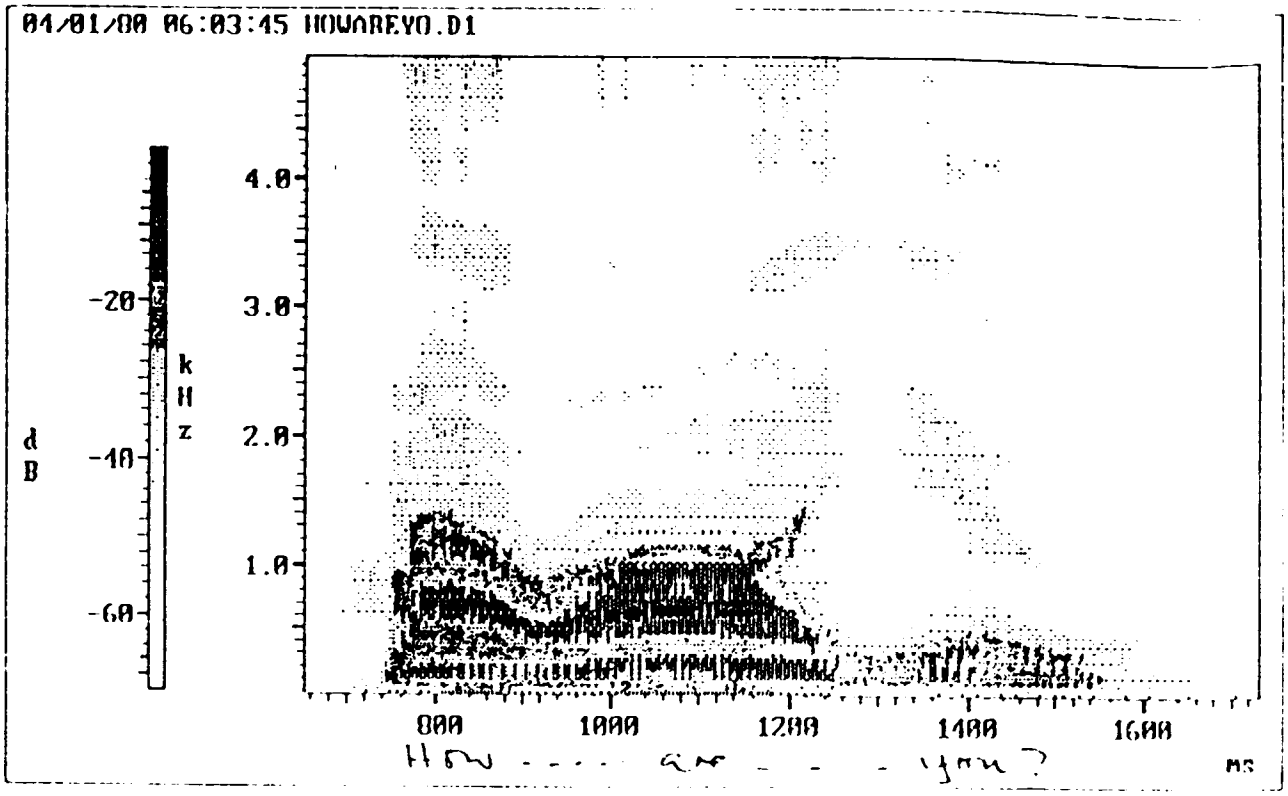




Acoustic analysis by computers of the sentence in the first illustration. In this, a kind of map of the inner details of the signal, the boundaries between the words are still easily detected.

Waveform of the sentence "How are you?" Because the consonants are spoken in much the same way as we speak vowels, the words are blurred together.





Analysed version of the waveform in the previous illustration. For this phrase the segmentation of individual sounds and words is by no means obvious.

Manning the unmanned factory

Karl-H. EBEL*

There is a growing body of opinion, supported by case studies and research, that industry is at the threshold of a new era in manufacturing. Many believe that computer-integrated manufacturing (CIM) will transform the world of work beyond recognition. However, there is also much evidence of failures following the introduction of this new technology - even though companies seldom care to advertise their failures. Has the CIM concept the potential for introducing far-reaching qualitative changes in manufacturing? And what can we reasonably expect to happen to the men and women employed there? A preliminary answer to these questions, emphasizing the key role of the human factor in the application of the new technology, is attempted here.

The CIM concept 1/ seems rational and sensible, and appeals to the tidy mind. It satisfies the quest of the engineer to create order out of chaos. It is reassuring to the manager looking for efficient means of controlling the production process. Why is it then that the realization of projects runs into so much difficulty in practice? Are expectations set too high? Even allowing for the fact that CIM can be introduced only step by step, that it requires considerable computing power and the mastering of complex system architectures and software developments, and that different production processes need different CIM systems (i.e., they must be tailor-made), it is obvious by now that the practical results achieved so far have not lived up to the initial optimism of many automation equipment and system suppliers, engineering researchers and management strategists. The "factory of the future" described by CIM advocates in the engineering profession remains largely a figment of the imagination, despite a few science-fiction-type realizations. And even staunch technocrats readily admit that industry is a long way from realizing the full potential of CIM, although partial solutions such as flexible manufacturing systems, automatic materials handling, computer-aided design, and computer numerical control (CNC) of machine tools have made much promising headway. "Islands of automation" have thus been created in many plants, but linking them together is clearly not an easy task. Some CIM systems set up as demonstration or pilot projects illustrate this new approach to manufacturing, but they are usually very costly and isolated experiments removed from the real world of production. The installation of operational CIM systems in industry is in inverse proportion to the talk about it. Should we, therefore, regard CIM as a dead-end, a fading fad or a technocrat's pipe dream of the manufacturing paradise?

The socio-economic perspective

The CIM concept has evolved in the highly industrialized countries characterized by significant capital accumulation, high labour costs, a solid and wide scientific and technological base, and a well-developed social and economic infrastructure. It owes its birth to rapid advances in computer and information technology. Pilot projects and accompanying research to put the concept into practice in manufacturing have been concentrated in Japan, the United States and some industrially advanced European countries. However,

---

* International Labour Office.

there are considerable differences in the approaches adopted, which tend to be a response to the specific socio economic situation, the industrial traditions and the factor endowment of the country or enterprise concerned.

The human centred versus the technocentric approach

The different approaches may be broken down essentially into two: the "technocentric" approach and the "human centred" approach. No industrial society has a monopoly of one or the other, and they frequently exist side by side, though one or the other may tend to predominate. The following analysis of the main features of these approaches, which does not go into their historical roots, should be seen in this perspective.

In the United States the so-called technocentric approach is found in its purest form. It has often served as a model for enterprises in other countries. 2/ It constitutes an attempt gradually to reduce human intervention in the production process to a minimum and to design systems flexible enough to react rapidly to changing market demand for high-quality products. Workers and technicians on the shop floor are typically seen as unpredictable, troublesome and unreliable elements capable of disturbing the production and information flow, which is best controlled centrally through computers. The "unmanned factory" is the ultimate goal. Only a residual role is assigned to workers, whose skills are supposed to be incorporated gradually and progressively into the machines. The technocentric approach, it is hoped, will halt the continuing erosion of American manufacturing know how and help industry to regain its lost superiority and competitiveness in world markets. Investment in capital intensive and sophisticated technology (some have dubbed this the "moonshot" approach) is thus expected to overcome a deep seated structural problem. Since American manufacturers produce for a vast and homogeneous home market, they can concentrate on large volume products and fairly big batches in component manufacturing. The resulting production process is relatively inflexible even when flexible manufacturing systems and machining cells are used. The central engineering challenge is said to consist in arriving at continuous flow production of large varieties of products and components without much work in progress, i.e., without idling capital; this would ensure high productivity and adequate returns. Human skills play a minor role in this scenario. Such "scientific management" would be carrying Taylorism or Fordism - originally based on the principle of using vast pools of unskilled and semi skilled labour - to its ultimate extreme since the increasingly sophisticated machinery is supposed to make human skills dispensable. Traditionally adversarial industrial relations and a low level of worker commitment and loyalty reinforce this attitude. The technical office manned by professional engineers and technicians increasingly becomes the repository of production know how to the detriment of production workers.

Carried to its extreme this approach has proved not to work very well or to function satisfactorily only at excessively high cost. For instance, it has been found that flexible manufacturing systems installed in the United States have often performed worse than conventional technology. The relevance of the technocentric approach for the future of manufacturing therefore seems questionable. 3/ It may prove to be a dead end because of an essential flaw: there is mounting evidence that proper and continuous operation of the type of flexible automation that is central to CIM systems can be ensured only by highly qualified and motivated workers able to cope with the relatively frequent breakdowns of such complex and sophisticated equipment and with software problems - and there are persistent complaints that the specific skills needed for "high tech" manufacturing are scarce or simply not available. At any rate, there is generally a long learning and running in period, with uncertain future returns as a result of excessive reliance on unproven technology.

The Japanese approach to CIM is based on a different rationale. Companies introducing advanced and flexible automation systems can rely on a highly qualified, versatile and loyal workforce. Instead of progressing in the technological field by giant leaps they prefer to make gradual improvements in the production process and in quality, frequently initiated by motivated engineers, technicians and workers on the shop floor. The wide adoption of the quality circle movement is only one manifestation of this. Emphasis is on product quality and production scheduling (i.e., just-in-time production and electronic ordering of materials and components). Compared with the outstanding manufacturing skills evident in the extensive application of industrial robots, the integration of the information flow through computers is less developed owing to gaps and difficulties in software development. The most flexible element in the system is, in fact, the people who make it work. Moreover, most companies operating such systems tend to serve large local and export markets and therefore produce fairly large series, although the flexibility of the equipment is more fully utilized than in American manufacturing thanks to a highly qualified workforce. The strength of this approach, which is facilitated by a co operative industrial relations climate, is apparent in diversified high quality mass production.

Manufacturers catering for relatively small, heterogeneous or specialized domestic or export markets demanding high-quality components and customized products, as is largely the case in Europe, have been inclined to rely on another strategy in introducing CIM. Owing to the high investments required and the often limited capital base, they usually opt for a cautious, pragmatic and gradual approach rather than adopting the whole panoply of CIM at once. The centrepiece of manufacturing has remained, by and large, the skilled and highly skilled craftsman and technician. Although Taylorism made some inroads in European manufacturing, particularly in the automobile and consumer durables industries, it never replaced skill based production in medium and small-scale enterprises in the capital goods sector where an extreme division of labour is not feasible. Enterprises competing in narrow markets have always had to be flexible and innovative to survive. The new computerized flexible and integrated automation equipment is primarily seen as an improved tool in the hands of a skilled and versatile workforce serving to enhance existing know how and to permit greater flexibility, higher productivity, better product quality and shorter delivery times. It is not regarded as a solution for all production problems, but as an effective prop in gaining a market share. Such enterprises also tend to make a sustained effort to retrain their staff. Moreover, the lesser emphasis on division of work allows them to assign broader responsibilities to the workers according to their qualifications and consequently permits more flexible forms of managerial control and work organization, including teamwork and imaginative applications of CIM using available skills. 4/

Impact on employment

There is encouraging evidence that by and large the aggregate level of employment in industrial societies is not greatly affected by the introduction of new technologies. The long-term trend of declining manufacturing employment observed in industrialized countries is certainly continuing, owing partly to technological innovations that eliminate unskilled work (and may also accentuate labour market segmentation). However, on the whole, job displacement and redeployment of workers in the innovation and rationalization process appear to balance out, and where technological change is accompanied by strong economic growth, expanding markets and new investments, it even tends to induce positive employment effects through the revitalization of the economy. Japan's technology drive and growth pattern are a case in point. However, it would certainly be vain to pin exaggerated hopes on the spin off effects of CIM and other advanced technologies in creating employment. "Reindustrialization through high technology" is certainly a misleading concept. 5/ Only a very small proportion of the labour force in the highly industrialized countries - roughly 2 to 5 per cent - are engaged in this advanced sector and, if past trends and experience are any guide, the proportion will rise only slowly in future, if at all.

The managerial and organizational perspective

CIM: The end of chaos or its beginning?

Management attitudes about how to cope with CIM vary. In part they mirror the national idiosyncracies and different industrial backgrounds evoked above. Thus the technocentric approach results in management strategies that neglect or underrate the human factor in production. This tendency is frequently aggravated by short term profit considerations, which are one of the major stumbling blocks to sound technology planning and management. The introduction of CIM requires long term strategic thinking. From the managerial point of view it is essentially an organizational quandary: how to create order out of potential chaos. Equipment needs to be carefully selected and compatibility ensured. However, the fundamental problem is how to reshape existing production processes, alter organizational boundaries and make them permeable. This requires redesigning the information and data flow to foster decentralized decision making. The difficulties involved in accomplishing this in existing organizations should not be underestimated.

At the same time, the introduction of CIM may well act as an antidote to poor management practices. This is where the human factor comes in. Industrial case studies and experience accumulated so far clearly indicate that a pragmatic management approach that advances step by step, builds up the skills, responsibility and motivation of the workforce, invests in the people who are to operate the system and relies on the human factor to make it flexible, has consistently paid off best.

The conviction that this is really the case seems to be lacking in many management circles, otherwise a more systematic and consistent effort would be made to enhance the human factor. At all events, it has been found that in general CIM is not introduced primarily to "humanize" work. The motives and expectations of management have to do mostly with inventory reduction, greater transparency of the organization, reduction of lead time, closer adherence to deadlines, saving of personnel, greater marketing flexibility, increased capacity use, higher product quality or the need to keep up with technological developments - all leading to higher productivity. Better working conditions tend to be a secondary consideration and to be regarded as a rather accidental by-product. 6/ In fact, working conditions may even be neglected or grow worse, particularly where automated machinery is used to impose an accelerated pace of work, where only residual tasks are entrusted to workers or where the new tasks created by computerization involve a higher degree of stress.

A new management style

A management style that allows production personnel greater autonomy may well mean a break with established principles and thus be seen as a threat to vested interests and the power structure in an organization. Although it is not surprising that as a rule everything is done to avoid such clashes, it is in fact possible to switch to new technology without making fundamental organizational changes, and to keep established divisions and hierarchies in place. However, information technologies can also be used, where vested interests oppose restructuring, to institutionalize and even reinforce ineffective and counterproductive management practices such as excessive centralization of decision making or abusive monitoring of individuals. This is, of course, costly and leads to mediocre results while prolonging the life of organizational dinosaurs.

The successful introduction of CIM requires a clear strategy that has the backing of both senior management and the rank and file. Obviously nothing much can be done without the consistent support of top management; however, the stumbling block may prove to be middle management who stand to lose part of their influence when established hierarchies are dismantled and all needed information is available directly "on line" to all participants in the production process. This shows the need for top level technology management, a function frequently neglected because legal, financial and marketing aspects tend to dominate decision-making at the top. It is not enough to let middle management acquire new technology and then to resort to crisis management at the top when bottlenecks occur in the organization or the middle managers lack the necessary skills for handling the technology.

Some commentators have in fact traced existing problems to the lack of managerial competence. 7/ Managers' knowledge of advanced manufacturing systems is frequently limited even when they have received a technical education or are professional engineers. Owing to the fast advances being made in manufacturing technology, and especially information technology, the professional knowledge and experience that managers have acquired rapidly become obsolete unless they are constantly exposed to shop floor experience. Consequently, potential users of automation equipment, often fearing that they will not be able to muster and constantly update the know how needed for operating the equipment, fall back on outside consultants and equipment suppliers. They naturally tread carefully in unknown territory and avoid incalculable risks.

Managers are also under pressure to justify the high capital expenditure required for implementing CIM. By the standards of a short term return on investment (ROI) approach, the financial feasibility of most CIM projects is doubtful despite the hypothetical long term economic advantages outlined above. In fact, there are no generally agreed methods for making reliable cost-benefit analyses of

CIM, and the cost of full scale CIM implementation is often considered to be prohibitive, especially when the cost of tailoring the system to the enterprise's specific uses is added to the cost of the equipment. It is also feared that CIM will be inefficient to use and expensive to maintain because technical change will constantly require the replacement of parts of the system, by definition not an easy job in an integrated package. To this should be added that in present flexible manufacturing systems fixed costs constitute about 70 per cent of the total outlay. This is one indication of the high risks that management takes when installing CIM.

There is, of course, the other side of the coin: the risks are balanced by opportunities if the expected economic benefits of CIM materialize. Moreover, in the years ahead the capital outlay required is bound to decrease as cheaper systems come on the market. It has also been estimated that CIM plants could break even at 30 to 35 per cent of capacity utilization as against 65 to 70 per cent in the case of conventional plants.

Introducing CIM: A strategic decision

Costs are not the only element to be considered in making the strategic decision to introduce CIM. A responsible and forward looking management may well conclude that the company cannot afford to be left behind in the technology race and that it must meet research and development expenditures for process technology and investment in CIM in order to remain competitive in the long run. Clearly, much depends on the specific situation of the enterprise. If it is decided to introduce CIM, management's essential task in implementing the system is to overcome organizational resistance to the change, from the shop floor up through all layers of the organization. To streamline an organization and make it suitable for CIM may be a considerable challenge but may well be worth the effort. The findings of a number of surveys concur on this point: manufacturers who have introduced advanced manufacturing systems attribute between 40 and 70 per cent of the total improvement achieved to organizational changes. In other words, the main benefit does not necessarily stem from sophisticated and integrated technology itself but from the reform of management and production practices and from a more transparent and efficient organization. 8/

The human and social perspective

The indispensable human factor

If we accept that a technocentric approach to CIM would be inefficient and counterproductive it follows that we must recognize the key role of the human factor. The difficult part is to assign a really effective function to the people involved, to help them master the production process and utilize to the full their knowledge, capabilities and skills.

It is important to look at the potential weaknesses and strengths of the human factor in a CIM environment. Human beings involved in the production process are apt to make mistakes, particularly when they are under physical or psychological stress. Noise or bad lighting can lead to fatigue. The rate of error also grows with information overload. Survey findings show that 70 to 90 per cent of the failures of technical systems are due to faulty human intervention or system design. Human beings do not always concentrate fully on their works they sometimes come to wrong conclusions or fail to act when they should. Their behaviour at work can be unpredictable. Should the human being therefore be banished from the production process?

There is clearly a wide range of tasks and functions that are best done by machines, industrial robots and computers. The improvement of sensors and actuators makes robots and other production equipment more versatile, rapid and exact than human beings. Some jobs can be done far more efficiently and reliably by information systems and computers. This is particularly the case of routine functions such as data collection and statistical analysis as well as many surveying and control functions that serve as the basis for automatic process and quality control in production. Hence the execution of an increasing number of specialized functions can no doubt be transferred to machines and computers. We are therefore faced with a growing complexity of such technical systems.

As such systems become more complex, however, they also tend to be less fail safe. In fact, they break down frequently, and the cost of such breakdowns is high. They can be perfected or repaired but this requires skilled human intervention and means that the workers responsible for the operation have to make choices and decisions that no technical system can make for them. Quick intervention based on experience and a knowledge of the system's limits is often required. Despite their shortcomings, human beings are thus indispensable for an optimal and efficient use of automated equipment. The qualified, motivated and experienced worker familiar with the system can cope with uncertainty and assess situations, find and interpret faults rapidly and correct them. Judgement backed up by technical knowledge and experience, understanding of the system and common sense is a human quality that cannot be replaced by computers or artificial intelligence in the foreseeable future. In CIM systems machines and computers may well take over most routine and physical tasks but they do not relieve the people involved from thinking, critical decision making and responsibility.

The design of CIM systems

Since the human factor cannot be replaced it is essential to design and plan CIM systems in such a way that those working on them can do their job in the best possible conditions and can effectively apply their empirical knowledge. This means, first of all, that they must not be made totally and helplessly dependent on the system. Such dependence could have serious consequences when system errors cannot be corrected in good time. It also limits initiative, improvization and creativity, and fosters blind reliance on routine which in turn makes the systems, and consequently the enterprise, vulnerable. Overdependence on systems and machines has not only caused disasters in nuclear and chemical industries but has also produced perhaps less spectacular, but none the less very costly, failures in automated production. Workers employed in "human centred" CIM systems should be able to intervene in the production process in order to optimize it. This means that the system must allow shop floor programming of CNC equipment on the basis of indications provided by and discussed with the design office. The implementation of such organizational principles presupposes the availability of appropriate man/machine interfaces and software. An example is a portable electronic sketch pad which designers can use to discuss their ideas with shop floor personnel, thus helping to overcome their notorious divorce - accentuated by computer aided design - from the realities and constraints of the production process. 9/

Another problem that has to be borne in mind is that there tends to be a greater physical distance between the personnel operating or supervising the equipment and the production process itself. Much visual and manual control has been replaced by sensors that transmit data to screens and data bases. The worker has before him control data at his work station, but loses direct touch with the production process which often can only be monitored from a control room. It has been found that such distances from the process may make quick reaction and the correction or compensation of system faults more difficult because warnings emitted by the system can be misinterpreted or neglected and workers lose the "feeling" for the process. This means that the process must be designed transparently so that it is comprehensible and sufficiently accessible to the worker, without creating hazards, to allow him to make the required intervention. Some research conducted on the empirical knowledge of machines and materials that experienced skilled workers possess indicates that they develop a feeling, almost a sixth sense, that tells them what is wrong with a machine and how it works best. This capacity is precious and its importance for the smooth running of advanced manufacturing systems should not be underestimated. 10/

In the technocentric approach to CIM there is clearly a tendency to incorporate most production knowledge into the computer and expert systems without giving workers sufficient opportunity to exercise skills - skills that may then waste away from lack of use. This can make production systems very unwieldy and vulnerable. It can also erode the human knowledge base of the enterprise to such an extent as to put its future in jeopardy.

Moreover, there are signs that the technocentric approach may lead to the disaffection of the workforce. Research findings in the United States suggest that workers in high technology industries are less satisfied than other manufacturing workers because of more rigid rules, stricter discipline and closer supervision and monitoring. 11/ Such disaffection has been noted particularly in the case of production workers who feel threatened by de-skilling. Management frequently tends to leave the trouble shooting and maintenance and repair of advanced systems to specialized services and not to the operators of the equipment, and this neglect of shop floor skills has led to a great increase in production down time. 12/ The obvious solution is to entrust as much responsibility for maintenance as possible to suitably qualified workers on the shop floor.

The practical problems of taking all these aspects into account in designing CIM systems and of making optimal use of the human factor must not be underestimated even where such human centred systems are recognized as superior. Though by no means easy to organize, a multidisciplinary approach is needed: managers and engineers responsible for designing the system should associate ergonomists, training specialists and social scientists in the work. There are few tried methods of proceeding since the technocentric approach, which neglects ergonomics and social concerns, has prevailed up to now. Moreover, engineers and ergonomists often tend to be at cross purposes. This is certainly a field that requires further study. 13/

Skill requirements for CIM

The foregoing observations imply that there should be a rise in the level of skills of shop-floor workers, despite the fact that some of their present skills will become obsolete and trends towards the division of labour will be reversed. CIM requires versatile craftsmen and technicians, computer and software experts, mechanical and communications engineers and, in general, people who understand production methods and the system and are capable of handling a great deal of technical information and of taking decisions on the spot. These requirements go far beyond simple machine tending. There is little room in CIM for unskilled workers such as assemblers, labourers, machine loaders and transport workers. CIM also renders redundant clerical workers engaged in ordering parts and materials and scheduling the workload of machines.

Middle level managerial jobs are also bound to decrease or undergo changes in CIM systems because of the general dissemination and free flow of information. There tend to be fewer hierarchical levels and demarcation lines, and fewer co-ordinating tasks. The emphasis is on planning, anticipating problems, less formal communications, teamwork and interaction, and much less on giving instructions. Excessive monitoring of workers (which is technically possible) is best avoided because it can antagonize the very people needed to man the systems. There is a new world for team leadership in CIM which requires from managers a subtle combination of human, conceptual and technical skills. 14/

New types of work organization

As many specialized jobs are abolished because of the reduced division of labour, work organization tends towards the group pattern. Relatively autonomous groups are organized and their members perform complementary tasks; they must be versatile enough to handle a variety of jobs in order to keep the system running smoothly, and have the ability to co-operate and to communicate beyond narrow technical boundaries. They are given some autonomy in the choice of tasks and in planning their work. In this way existing qualifications can be used more efficiently and mutual coaching takes place. Such teamwork, if properly organized, results in greater job satisfaction.

However, this sort of participative work organization is by no means an automatic outcome of introducing CIM. Management must consciously seek to overcome outdated, demotivating and unsuitable hierarchical forms of organization, and this means shedding old power relationships, which is often a painful process fraught with pitfalls. Those who have a vested interest in maintaining the status quo are usually in a strong position. However, it should be some comfort to management deciding to base CIM on group technology that this type of production is usually less capital intensive than full scale CIM since it is less computerized and requires less costly software; the fact that many decisions are taken on the shop floor also helps to make it flexible. Moreover, existing qualifications of the workforce can normally be used and few new ones are required. There is also a reduction of throughput time. 15/

Hazards in the new working environment

Although the new job requirements in CIM systems are gradually becoming better known, there is still much uncertainty about the new occupational safety and health hazards they may pose. It stands to reason that physical risks are diminished because fewer workers are in direct contact with production equipment and most production takes place without direct human intervention. On the other hand, the

pace of work is usually faster and the amount of shift work greater, both factors that tend to increase fatigue and the risk of accidents. It has been found that work at computer terminals can be very stressful, particularly in the case of computer aided design. There also tends to be more social isolation, with all of its detrimental effects.

A potentially very serious problem is that an increasing number of psychosomatic disorders appear to be caused by work with the new automated systems. Workers confronted with the expensive and complex equipment often do not feel up to the task assigned to them and have a sense of being powerless to intervene in the production process though they are responsible for running it. The combination of great responsibility and insufficient qualifications to master the job at hand or to intervene can be extremely stressful. The stress may be aggravated by frequent breakdowns which have to be repaired quickly. A state of constant stress can lead to nervous and physical disorders and is said to affect a disproportionate number of workers in advanced manufacturing systems. While training and ergonomically designed workplaces may help to solve the problem, it can be averted more easily if system designers ensure from the outset that excessive demands are not placed on system users and maintenance staff. At the same time, however, they should not go to the opposite extreme and make jobs undemanding and monotonous, a factor that also causes stress.

Another cause for concern is the fact that work with CIM is more sedentary than traditional production work and requires more brainpower than muscle. As machines and robots take over materials and components handling, physical activity is greatly reduced and this too can be a serious threat to health. Countermeasures may well be needed.

A further cause of fatigue and stress is the poor design of much computer software. Much of it is not user friendly and is ill adapted to actual workplace requirements. This can make man-machine interaction very difficult. "Cognitive" ergonomics addresses these problems. However, this is a relatively new science and improvements in software design that take into account research findings are only slowly forthcoming.

System designers, who usually have an exclusively technical or scientific background, tend to overlook such considerations when planning the installations. However, it is then that preventive measures must be taken. The increase this implies in planning and investment costs is insignificant compared with the cost of rectifying ergonomic mistakes once a system is installed. 16/ The principal objective here should be the creation of humane working conditions, for only workers who are treated first and foremost as responsible human beings will be prepared to commit themselves to company goals. A definition of humane work that is apposite to the new technology is the following:

> Work is called humane if it does not damage the psycho physical health of the worker, does not ... impair his psycho social well being, meets his requirements and qualifications, allows him to exercise individual and/or collective control over working conditions and systems of work, and is able to contribute to the development of his personality in activating his potential and furthering his competences. 17/

The preparation of the workforce for CIM

If people are the key to successful CIM, obviously much hinges on their preparation for the new systems. In all industrialized countries there is a shortage of professional, technical and managerial personnel able and qualified to mastermind the implementation of CIM. There is no easy solution to the problem. But one way of tackling it is through the systematic training and further training of the workforce based on a strategy specifically designed for the purpose and endorsed by management and workers' representatives. Such training needs to be carried out mainly by the enterprises themselves in co-operation with system suppliers, since CIM systems are tailor made to the particular requirements of enterprises and training institutes rarely have the necessary expertise in leading edge technology.

Another path lies in the widest possible use of expert advice at the planning stage of CIM and an open discussion of alternatives among all those concerned - including the workers' representatives who far too often at present find themselves faced with a fait accompli. A thorough discussion of the economic, technical, organizational, and manpower requirements and of the objectives of a proposed innovation would facilitate an informed assessment of the social consequences and the negotiation of working conditions. In introducing CIM both management and the workforce are usually moving into uncharted territory and ought to recognize the fact.

The impact of CIM on industrial relations

In the real world the transition to CIM systems, even when they are well planned and prepared, will rarely be accomplished without creating tension or conflict. The workforce has good reason to be worried since there is ample evidence to show that its interests may not be taken sufficiently into account or may simply be neglected. Far too often technology is placed before people to cope with as they can, without having been properly trained to handle it or given a say in its choice. Small wonder that systems fail. Workers fear pay losses as a result of reduced overtime, redundancy, fewer promotion prospects and lower manning levels, de-skilling, greater stress, more intensive shift work, individual performance monitoring by the computer system, and the strain of having to adjust to unfamiliar working patterns.

By applying a strategy that puts people first and seeks genuine consultation at all levels, such fears can be overcome. The positive aspects of introducing advanced systems and the new opportunities they offer will be more readily accepted: these include safer and physically less taxing jobs, enhanced learning and training opportunities, greater responsibility and more interesting assignments, better remuneration, generally better working conditions or greater job security in a more competitive enterprise. The use of new systems can also bring down the rate of absenteeism. Innovations can, in fact, exert a beneficial influence on industrial relations if more emphasis is placed on consultation at all levels and less play is given to "the arrogant expertise of technologists".

The positive aspects can carry the day only in an atmosphere of social dialogue and good will at the enterprise level. Adversarial industrial relations might easily spell the failure of CIM projects. Their success presupposes reconciling the interests of management and workers and introducing

flexibility in work rules. Dialogue between the social partners is thus essential for achieving product and process innovation and higher productivity and flexibility in manufacturing. There is evidence that in an adversarial climate of industrial relations management tends to resort to an excessive division of labour as a means of restricting the influence of unions. In such circumstances management avoids entrusting blue collar workers with more autonomy and control (e.g., the programming of NC tools) in order to circumvent rules in collective bargaining agreements providing for the upgrading of workers who are assigned greater responsibilities. This situation has the perverse effect that unionization - whenever it leads to restrictive and inflexible work rules inhibits skill acquisition by blue collar workers and their upgrading. 18/

A large degree of consensus and co operation is indeed necessary if CIM systems are to work smoothly, though this does not exclude a resolute defence of the workers' rights and interests. It must not be forgotten that highly skilled workers and technicians in integrated manufacturing are in a strong position and cannot easily be replaced. Enterprises installing CIM depend on the quality and commitment of their workforce: qualified personnel are needed to maintain the complex and costly equipment and keep the system working. Moreover, advanced manufacturing systems are vulnerable to strikes by a small proportion of the workforce, and responsible management will therefore be well advised to seek the social dialogue and collective agreements needed to provide a proper framework for their operation. An unorganized workforce kept in check by management prerogatives and arbitrariness, subdued by authoritarian supervision and anti union policies, could easily jeopardize the success of CIM. Industrial relations based on mutual confidence and respect will be far more conducive to success. 19/

However, it should also be borne in mind that as hierarchical structures change and as middle management is threatened by CIM the role of unions and workers' representatives in enterprises may be weakened. Autonomous groups of highly qualified staff may be able to exert a more direct influence on the determination of their working conditions and thus feel less in need of union representation and intermediaries in their dealings with management.

In enterprises introducing a CIM system, social dialogue obviously cannot be limited to questions of remuneration and benefits. At any rate, payment-by-results systems may well have to be redesigned since the success of the CIM system and higher productivity depend essentially on the reduction of down time of the automated equipment and not on the output of individual machine operators. The dialogue will have to embrace questions related to the implementation of the new technology, such as more flexible working time arrangements, adjusting working conditions to teamwork and redeployment.

Outlook

At present there is little chance of reconciling divergent views on CIM. Many of its advantages or faults are in the eye of the beholder. However, it is definitely not the panacea that some seem to see in it for all problems encountered in production. The promised land of total manufacturing integration is still far away, although an increasing number of enterprises appear to be engaged in an evolutionary process towards it.

At all events, the introduction of CIM is a risky undertaking. If it is to be successful the firm's manufacturing organization and product range have to be reviewed and rationalized. The pace of transition will depend on the knowledge, qualifications and abilities of the planning and operating staff.

CIM is a leading edge technology and its introduction requires long term strategies, much research and development and, possibly, forgoing immediate financial benefits. The most essential element in such a strategy is the preparation of the workforce for the impending changes. This requires consultation at all levels and a systematic training effort. To neglect the further training of staff is inevitably very costly in terms of machine down-time and scrap production.

All experience gained so far speaks in favour of a cautious and gradual approach in order not to overstretch the assimilating and learning capacity of the workforce with the negative results which that implies. The fact remains that the trend towards more manufacturing integration is bound to continue and scientific advances will continue to offer solutions to outstanding technical problems. CIM is most likely to fail where it tries to supplant essential human qualities. The subjugation of people to machines and technical systems is proving more and more counterproductive. Instead, a type of work organization is needed that enables and motivates people to use their theoretical and empirical knowledge and skills in mastering advanced means of production and operating them efficiently. CIM will be only as good as the people in charge of it.

Are we heading in the wrong direction? Evidence suggests that the difficulties and complexities of introducing CIM on a large scale were initially underestimated. The technocentric approach aiming at the "unmanned factory" is now questioned for a very good reason: so far it has failed to produce the expected results. This is having a sobering effect on the unconditional technocrats. There is probably not just one type of "factory of the future" but many alternative solutions to manufacturing problems.

Will CIM really spell the end of Taylorism? It is definitely too early to pronounce its methods dead and buried. Taylorism will continue to subsist in mass production alongside dedicated automation and machinery and so will the corresponding hierarchical structures. However, mass production and market dominance of mass produced goods are declining in many manufacturing activities. The markets demand differentiated, diversified and customized products, entailing a need for small batch production. The flexible automation offered by CIM can, if properly conceived, do the job.

Integrated manufacturing systems are very vulnerable to disruption. Running them efficiently and, so far as possible, round the clock presupposes harmonious industrial relations, since work stoppages, go slows or other types of resistance stemming from demotivating working conditions can cause major losses. The success of CIM, therefore, presupposes mutual understanding and co operation between management and the workforce and its representatives. While the introduction of even well designed CIM systems is bound to cause tensions, it also offers new opportunities for enhancing dialogue and breaking down barriers between the social partners - a chance not to be missed.

References

1 There is no generally accepted definition of CIM. It usually denotes computer control of the entire production process from design and manufacturing to product delivery. It comprises computer aided design (CAD), computer aided planning (CAP), computer aided manufacturing (CAM) and computer aided quality assurance (CAQ). These functions and the subfunctions in each area are parts of a system, are fully integrated through computer networks and have access to a unified data base. CIM is thus essentially a means of organizing and controlling the manufacture of components and assemblies as logically and flexibly as possible and of mastering and co-ordinating the corresponding flow of data and information. It aims at optimizing the use of equipment, reducing lead time and inventories, and ensuring high product quality and lower unit costs. The synergies created through integration are expected to lead to cost reductions, higher productivity, and rapid adjustment of product quantity and quality, product variations and delivery times to demand in competitive national and international markets. It appears to offer an opportunity to compensate for short product life cycles and to eliminate much waste.

2/ W. Wobbe: "Technology, work and employment - New trends in the structural change of society", in Vocational Training Bulletin (Berlin (west), European Centre for the Development of Vocational Training), 1987, No. 1; P. Brödner: "Towards an anthropocentric approach in European manufacturing", ibid., loc. cit.

3/ S. S. Cohen and J. Zysman: "US competitiveness suffers: The emergence of a manufacturing gap", in Transatlantic Perspectives (Washington, DC), autumn 1988.

4/ H. J. Warnecke: CIM in Europe (Stuttgart, 1987), unpublished manuscript.

5/ Wobbe, op. cit.; K. H. Ebel and E. Ulrich: The computer in design and manufacturing - servant or master? Social and labour effects of computer aided design/computer aided manufacturing (CAD/CAM) (Geneva, ILO, 1987), Sectoral Activities Programme working paper, pp. 19 ff.

6/ Ebel and Ulrich, op. cit., pp. 51-57.

7/ R. Hodson and J. Hagan: "Skills and job commitment in high technology industries in the US", in New Technology, Work and Employment (Oxford), autumn 1988.

8/ R. Haywood and J. Bessant: The integration of production processes at firm level, Brighton Polytechnic research paper (Brighton, 1987).

9/ Paper presented by M. Cooley to a conference on vocational training as an investment in the future, Essen, 2-3 May 1988, cited in BFZ Info (Essen), 1988 No. 3, pp. 4-5.

10 F. Böhle and B. Milkau: Vom Handrad zum Bildschirm - Eine Untersuchung zur sinnlichen Erfahrung im Arbeitsprozess (Munich, Campus Verlag, forthcoming).

11 Hodson and Hagan, op. cit.

12 P. Chabert and P. Laperrousaz: "Modernisation - Attention aux idées reçues!", in L'Usine nouvelle (Paris), 21 January 1988.

13 J. M. Corbett: "Human centred advanced manufacturing systems: From rhetoric to reality", in INFO Pack No. 4 (Karlsruhe, Committee on Social Effects of Automation, International Federation of Automatic Control), March 1989.

14 O. L. Crocker and R. Guelker: "The effects of robotics on the workplace", in Personnel (New York), September 1984.

15 Brödner, op. cit.

16 Wobbe, op. cit.

17 T. Martin, E. Ulrich and H. J. Warnecke: "Appropriate automation for flexible manufacture", in R. Isermann (ed.): Preprints, 10th World Congress on Automatic Control, Munich, July 1987 (Laxenburg, Austria, International Federation of Automatic Control, 1987), Vol. 5, pp. 291-305.

18 M. R. Kelly: "Unionization and job design under programmable automation", in Industrial Relations (Berkeley), spring 1989.

19 F. J. Kador: "Das Soziale in High tech Unternehmen", in Der Arbeitgeber (Cologne), 1988, No. 3/40.

(Readers' views on the ideas expressed in this or any other Review article will be welcome. They will be communicated to the author and may be published in full or in part, at the Editor's discretion, in a future issue. Please write to: The Editor, International Labour Review, International Labour Office, CH-1211 Geneva 22, Switzerland.)

(This article is reprinted from International Labour Review, Vol. 128, 1989, No. 5)

For new subscribers only

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO MAILING LIST QUESTIONNAIRE

(Se... 82)

The UNIDO Newsletter is sent free of charge to an approved list of readers.

To be considered for inclusion on the UNIDO Newsletter mailing list, please complete this questionnaire and return it to:

UNIDO MAILING LIST, INDUSTRIAL INFORMATION SECTION,
P.O. BOX 300, A-1400 VIENNA, AUSTRIA

	Type or print clearly (one letter per box) and leave a space between each word
NAME (underline family name)	
TITLE OR POSITION	
ORGANIZATION	
STREET AND No. (or P.O. Box)	
CITY AND STATE OR PROVINCE	
COUNTRY	

PLEASE DO NOT WRITE IN THESE SPACES

S.A.	DISP. CODE	COUNTRY	
CITY			

T TYPE OF ORGANIZATION. Identify below the type of organization to which you belong, checking the box(es) as appropriate (e.g. for a research centre at a university, boxes 20 and 23 would be applicable).

01	UN, specialized agency or other UN body	12	Trade centre or association	23	Research centre, laboratory
02	Other intergovernmental organization	13	Professional association, learned society	24	Library, documentation centre
03	International non-governmental organization	14	Bank or financial institution	25	Information centre
04	UNIDO National Committee	15	Industrial enterprise	26	Publisher
05	Embassy or Mission to UNIDO	16	Public utility	27	Bookseller
06	Government body for development aid	17	Trading concern	28	News agency, press
07	Ministry for industry	18	Engineering organization	29	Radio and television
08	Other governmental department	19	Consultant		
09	Non-governmental aid agency	20	University		
10	Chamber of industry or commerce	21	Vocational or technical institute/school		
11	Manufacturers' association	22	Industrial training or productivity centre		

F FIELD OF INTEREST. Check the appropriate box(es) which reflect your main field(s) of interest.

MANUFACTURING INDUSTRIES - PLANTS, PROCESSES AND PRODUCTS

001	Food processing	017	Electrical machinery	030	Industrial legislation
002	Beverages	018	Transport equipment	031	Industrial property
003	Tobacco	019	Precision instruments	032	Transfer of technology (licensing)
004	Textile and garment	020	Agricultural machinery	033	Industrial research and development
005	Leather			034	Standardization
006	Wood processing	NON-MANUFACTURING INDUSTRIES AND PROJECTS		035	Industrial organization and administration
007	Pulp and paper			036	Industrial co-operatives
008	Petrochemical and plastics	021	Mining and quarrying	037	Industrial information and documentation
009	Industrial chemicals and fertilizers	022	Utilities (including power plants)	038	Industrial promotion
010	Pharmaceuticals and other chemical products	023	Public services (transport, communications, tourism)	039	Industrial training
011	Rubber	024	Construction (civil engineering) projects	040	Industrial management
012	Non-metallic mineral products and building materials	SUPPORTING INDUSTRIAL ACTIVITIES		041	Industrial consulting services
013	Iron and steel	025	Industrial planning and programming	042	Development of small scale industries
014	Non-ferrous metal	026	Industrial policies	043	Industrial estates
015	Fabricated metal products	027	Industrial financing and investment promotion	044	Appropriate technology
016	Machinery	028	Promotion of export-oriented industries		
		029	Industrial development surveys		

LANGUAGE. Indicate below in which language you wish to receive the NEWSLETTER.

ENGLISH [ ] FRENCH [ ] SPANISH [ ] RUSSIAN [ ]

UNIDO Form IPR.1 (12.85)