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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MICROELECTRONICS MONITOR

No. 19 July-September 1986

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Dear Reader,

We have reported in earlier issues on the Latin American Regional Microelectronics Network (REMLAC) which was established with the help of UNIDO at a meeting held in Venezuela in 1985. A preparatory assistance project financed by the United Nations Development Programme has now been agreed upon between ECLAC, the UN Economic Commission for Latin America and the Caribbean, and UNIDO. International experts together with experts from REMLAC member countries will visit national focal points and discuss with Governments concerned their interest and actual participation in the REMLAC project. An effort will be made, in close co-operation with ECLAC, the Governments, agencies, enterprises, academic institutions and communications media to move to the formulation of the final programme.

UNIDO has also been assisting the Fundación Instituto de Ingeniería in Venezuela in upgrading their capabilities in microelectronics applications and strengthening their links with national and regional industry. At the request of the Government of Trinidad and Tobago we will assist in organizing a national workshop on microelectronics early in 1987.

A three-year effort of the UNIDO secretariat in building up software capabilities in developing countries has now reached a stage where international co-operation can be promoted. Software production in developing countries will be emphasized since it has become an industry that is an essential factor in the growth of the economies of developing countries.

I wish to thank again all readers who have reacted to our mailing list survey by commenting on the content and format of the Monitor; please be assured that each comment is considered and, if possible, taken into account, even if we cannot reply individually to our readers. One complaint we receive frequently is that the print is now too small; however, since we depend on the joint printing facilities of the Vienna International Centre and all documents are now created in the same format, this is beyond our control. One serious complaint is that the Monitor arrives with great delay at some overseas destinations since it is mailed by surface post. We will be looking, therefore, into the possibility of subscribers who wish to do so, making a contribution to pay for airmail and handling charges. We would be grateful for an early indication of interest from those wishing to participate in any such scheme.

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Compiled by the Technology Programme of UNIDO P.O. Box 300, A-1400 Vienna, Austria

A second reminder mailing list questionnaire is attached to this issue; addressees who are not confirmed will have to be removed from the mailing list.

Since this issue will reach you at the turn of the year, let me conclude by wishing you and your families a Happy New Year.

K. Venkataraman
Senior Technical Adviser
Department for Industrial Promotion,
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CONTENTS

Page

RECENT EVENTS 1

Symposium on cutting edge technologies 1
International symposium of fifth generation computer systems 1
International Informatics Access '87 Conference 1
IFIP held 10th World Computer Congress 1
IFIP Congress discusses CIM 1
UNU - computer training for DC's scientists 2

NEW DEVELOPMENTS 2

New developments in VLSI chips 2
Parallel processing 2
Practical use of parallel processing computer 3
The micro that thinks it's a mainframe 4
Differences are shrinking 4
Carbon aims to dethrone silicon 4
Building boards 5
Manufacturability of GaAs ICs improves 6
New technique for gallium arsenide single crystal production 7
Progress of the ROM compact disk 7

MARKET TRENDS AND COMPANY NEWS 7

US semiconductor market will pick up in 1987 7
Chip prices continue to climb 7
CAD, CAM, CAE news 7
Automation industry faces a shrinking market 8
Europe's elite 8
ATE-AI partnership 9
Bipolar comes alive again 9
Packaged software: a thriving market 10
Japan eyes the lead in 4-megabit memory chips 10
Siemens attacks new markets 11
Fairchild chips in 11
Motorola's latest 33-bit processor 11
AT&T teams with Honeywell 12
US-Japanese combine plans a joint venture in chips 12
32-bit war warms up 12
OSI firms team up 12

APPLICATIONS 12

World textiles dressed in informatics 12
British dairy farms are becoming computerized 13
Doctors call on computers to aid the disabled 13
Advanced image processing systems for research and practical applications 13
Managing energy electronically 14

ROBOTICS 15

Wanted: new jobs for sad robots 15
Robots build new markets 16
Automated handling 17

Page

FACTORY AUTOMATION 17

Factory automation reconsidered 17
Automated manufacturing research facility 18
Soviet factories are being automated 18
Factory of the future 18
Successful automation at aluminum works 19
CIM research in the Federal Republic of Germany 19
The retooling of America 20
CIM for the smaller firms 21

SOFTWARE 22

The "Greco" programme in France 22
Fourth generation languages 22
Are CAD systems innovative? 23

COMPUTER EDUCATION 23

Morocco: microcomputers in school 23
Electronic education covers Alaska's backwoods 24
Informatics in Spanish and Portuguese schools 25
The school micro situation in Europe 25

ARTIFICIAL INTELLIGENCE 25

Forum on artificial intelligence 25
AI research behind the laboratory door 26
AI research in the UK 28
Pro and contra LISP 29
LISP expert systems are more useful 29
LISP is not needed for expert systems 30

COUNTRY REPORTS 30

Brazil
How Brazil cornered its own small-computer market 30

EEC
European IC strategy gets Esprit boost 31
Esprit II is the last 31

France-Italy
Gallium arsenide in France and Italy 31

India
Gallium pilot plant goes into production 31
Bangalore becomes India's Silicon Valley 32

Ireland
Developing CIM software 32

Japan
R&D expenditure 'third' 33
Japan's X-ray route to superchips 33

	Page
Kenya	
Computer scene in Kenya	34
Latin America	
Overcoming incommunicado in Latin America	36
United Kingdom	
University chip design	36
Alvey launches Analyst Assist	36
UK takes leading expert role	37
USA	
Pittsburgh to get national supercomputing center	37
Zimbabwe	37
The computer industry comes on key	37
GOVERNMENT POLICIES	38
UK and new technologies	38
STANDARDS AND LEGISLATION	39
Microcode copyright	39
The Anglo-Saxon Trojan-European horse for M.A.P.	39
A common standard for Europe	39
ARSO-DISNET: an African network of information centres on standardization	40
SOCIO-ECONOMIC IMPLICATIONS	40
IT puts brain power at top of the class	40
A blueprint for the new homeworkers?	41
Computers close the gap between rich and poor	41
The Club of Rome and the future of industrial informatics	41
RECENT PUBLICATIONS	42
The employment effects of microelectronics in the UK service sector	42
Microcomputers and their applications for developing countries	43
The impact of industrial robots on the world of work	43
Impact of new and emerging technologies on trade and development	43
Information technology for development - an international journal	43
New journal to cover computerized translation	43
Cahiers du Centre de Developpement	43
Second reminder. Microelectronics Monitor reader survey	44
UNIDO mailing list questionnaire	45

RECENT EVENTS

Symposium on cutting edge technologies

The Board on Science and Technology (BOSTID) of the U.S. National Council of Research (Academy of Science) organized the third meeting in the series of symposia on microcomputers for developing countries (the first two were held in Sri Lanka in 1984 and Mexico in 1985, respectively). This year's symposium was held in Lisbon, Portugal, 30 September - 3 October 1986 and focused on cutting edge technologies such as artificial intelligence, expert systems and progress in hardware.

The symposium was well attended: participants from developing countries represented Brazil, India, Mexico, Portugal, Sri Lanka, Thailand as well as Zimbabwe. High-level experts from such prestigious institutes as MIT, National Institute of Health, University of California, Michigan State University, University of California, Hunter College and Northeastern University lectured on latest developments in the field. UNIDO was also represented by a staff member of the Transfer of Technology Division.

International symposium of fifth generation computer systems

The Committee on Science and Technology in Developing Countries (COSTED), headquarters at the Indian Institute of Technology, Madras and with regional secretariats in Kenya, Nigeria, Venezuela and Trinidad will organize the above symposium to be held in Madras on 25-27 February 1987. The conference will be preceded by two-day tutorials in expert systems robotics on 23-24 February 1987. It is planned to invite Professor E. Feigenbaum of Stanford University, the 'grey eminence' in robotics research, to be the keynote speaker. Further information may be obtained from Mr. T.V. Natarajan, Convener - 5G, 1 First Cross Street, Ramakrishna Nagar, Madras, 600 028, Tel. 416 333, cables: HITEK.

International Informatics Access '87 Conference

This international conference is scheduled to be held in Dallas, Texas, USA on 17-20 March 1987. It will provide a forum for policymakers, technical people and networkers to exchange ideas and develop plans of action for furthering informatics access. Preceding and following the conference the participants will be accessible via an international electronic network - ECONET, on which the Monitor has reported in earlier issues. The focus of the conference will not be theoretical but practical. People from developing countries can expect to learn from the experience of others how to gain access to electronics networks and databases, and technical experts can expect to learn the needs of current and potential users in developing countries. The main speakers will address four areas: the idea of informatics, international policies, technical concerns and users' considerations. It is planned to select 50 delegates (from the policy area; the technical area; and the network user area). Fifty per cent of the delegates will be chosen from developing countries. There will be no registration fee but delegates will be selected based on their degree of activity and knowledge in the field of informatics. For more detailed information write to Baylor Research Foundation, 3500 Gaston, Dallas, Texas, 75246, USA.

IFIP held 10th World Computer Congress

The International Federation of Information Processing (IFIP) held the tenth World Computer Congress, a triennial event, at Trinity College, Dublin, Ireland on 1-5 September 1986. The theme of this year's congress was "Informatics - A New Awareness". The technical programme contained four major streams: system design, component design, applications, and informatics for developing countries, covering ten technical areas. The session on informatics in a developing world discussed the following topics: the informatics sector in developing countries; information technology policy issues in the developing countries; innovative applications in support of developing countries; women, work and computerization; can developing countries compete in information technology? and non-Latin and non-alphabetic scripts.

The proceedings of the congress will be published by North Holland, P.O. Box 1991, 1000 BZ Amsterdam, The Netherlands.

IFIP Congress discusses CIM

Companies need a theory of computer-integrated manufacturing (CIM) before they can implement it. But with academics from Europe, Japan and the US falling out over what CIM is, such a theory seems a distant prospect.

Cultural bias crept into the definitions of CIM given during a session on Controversies in Computer Integrated Manufacturing at IFIP 86, in Dublin.

The pragmatic US view was expressed by Professor Theodore Williams of Purdue University, who sees CIM as a collection of flexible manufacturing systems. The Japanese view, expressed by Hiroyki Yoshikawa of Tokyo University, is that CIM is a strategy. More esoterically, Asbjorn Rolstadas of Trondheim University, Norway, believes CIM is a philosophy. Despite this divergence, the speakers all agreed that, although CIM systems should be fully automated, they had to include some provision for direct human involvement or intervention.

"Establishing rules for CIM is counter-productive," said Yoshikawa. "Too many rules will make manufacturing systems inflexible. If you build a system around too many procedures and rules, you can't change it quickly." Yoshikawa also suggested that some aspects of manufacturing could not be computerised. "For example, drawings by themselves are theoretically insufficient - operators need to be able to understand the designer's thinking to implement their designs," he contended. This means that transmitting design information electronically could impede the information flow. "In this respect CIM involves the automation of friendship," explained Yoshikawa.

Williams claimed that, while academics continued to debate the concept, CIM was already in widespread use, particularly in process industries like steel production and petrochemicals. He argued that every CIM system would have to be turnkey: "Systems will be customised to particular products and plants but they will be customised through the software." This would cut down the training requirements of implementing CIM systems.

Rolstadas disagreed that CIM would give rise to inflexibility. "The whole point about CIM systems is they will lower the cost of going to smaller batch sizes by increasing flexibility of manufacturing systems. If you accept CIM as a philosophy, you shouldn't lose any flexibility." He is also against the turnkey approach to installing CIM favoured by Williams. "CIM should be introduced step by step; you should start to integrate with the equipment you've got."

Finding skilled manpower was a major hurdle in every country, said Williams. Most US manufacturing companies did not have the engineering staff to go it alone on CIM installations. Skills shortages meant CIM would not benefit smaller companies at the moment, said Yoshikawa. "Users will need high level skills, and there will be a burden on smaller companies in attracting staff to maintain the systems."

But Rolstadas said countries like Norway could not afford to go along with this view. "In Norway 67 per cent of companies have less than 20 employees, and they need to apply CIM to stay competitive. As small companies cannot afford turnkey systems, they have to use existing resources and develop the system gradually. If you do that, then training is not such a problem." Williams argued that this type of evolutionary approach was wrong because problems would only show themselves when the system was complete. (Computer Weekly, 18 September 1986)

UNU - computer training for DC's scientists

Microprocessor technology is rapidly changing the economies of the industrialized nations; it now plays the basic role that steel and chemicals technology did in bringing about the industrial revolution of the last century. But state-of-the-art technology in this field is being developed only in a few industrialized countries - a fact that threatens to "lock out" the Third World even further from the benefits of the microelectronic revolution. The United Nations University (UNU) is attempting to answer this challenge with special training for scientists from developing countries in applications of microprocessor technology at centres of excellence in various parts of the world. One such centre is at Trinity College in Ireland.

Ireland, which underwent its own post-independence experience only a few decades before much of the Third World did so, claims a special affinity with the problems of developing countries. The financial support which the Irish Government is giving the UNU-Trinity College project represents a significant component of that nation's total annual development aid budget.

In the view of Professor F. G. Foster, chairman of the Systems Development Programme at Trinity College and project co-ordinator of the UNU training effort there, "information is the life-blood of the modern industrialized state. The systems supporting modern society are increasingly computer-based, and this is affecting the ways in which society is evolving".

There is, therefore, urgent need for the Third World to build up its own capabilities in this field and, in the process, to help develop a more pluralistic base for science and technology across the globe. Developing countries in particular need to overcome the prevalent opinion that only large-scale, centralized mainframe computers can do the job.

Computer technology has generally been transferred as "black boxes", complete packages with their secrets intact. The application of microprocessor technology, however, allows a more segmented transfer through mastery of the underlying scientific principles, and this understanding can be built on through experience with both hardware and software. The concept of "mastering" is fundamental; it does not mean "push-button" training for users of microcomputers but, rather, raising scientific and technological capabilities to the level necessary for understanding the technology, using it, and innovating with it.

This is what the microprocessor training project at Trinity College and other similar UNU activities in this field are trying to do. Obviously, before understanding of the latest advances in communications and information processing can permeate the scientific establishment of the Third World, it will require large-scale "in-country" training to meet projected needs. The UNU has chosen to put priority on "training the trainers" by educating the potential leaders and innovators from developing countries; it is also investigating the best methods of providing such training so there will be a "multiplier effect". ...

The Trinity College programme is one important component of the UNU's microprocessor training activities and also of the joint efforts to establish a microprocessor support unit at Addis Ababa University. Another important component is the co-operation with the International Centre for Theoretical Physics in Trieste, Italy, which has support from the Italian Government. This co-operation includes the organization of regional training colleges in the Third World. Three have been held so far: one in Colombo, Sri Lanka (1984), another in Bogotá, Colombia (1985), and a third in Heifei, China (September 1986). Further combined training and capacity-building activities have been initiated with universities in Africa and Latin America and an advanced joint research project in the use of microcomputer technology has been organized with the University of Malaysia and the Tunku Abdul Rahman College in Kuala Lumpur, Malaysia. (Development Forum, October 1986)

NEW DEVELOPMENTS

New developments in VLSI chips

Philips and its subsidiary Signetics introduced a range of new developments in the family of VLSI subsystem chips at the Philips/Signetics 68000 design seminar held recently in Dublin.

This latest development introduces a family of chips which are more complex than the CPU itself. Some of the chips contain more than 100,000 transistors, and range from data communications, memory management units, direct memory access, disk controllers and VME system interface chips. All are designed to meet future requirements in electronic data processing, telecommunications and data communications, industrial and process control, consumer products and military equipment.

In addition to S68000 peripheral chips, Philips/Signetics provides microcontrollers, CRT chip sets and VME board level products. ... (Electronics Report [Ireland], October 1986)

Parallel processing

It seems the 1980s are to be known as the decade of the parallel computer. Major advances in both chip and computer technology have opened the door to parallelism for performance at a modest cost in a wide range of computing systems. Before considering the various techniques used let us first understand why; for if, as is generally agreed, programming concurrent systems is more complex than programming sequential systems, the programmer certainly does not need it. So who does?

Systems designers need parallelism to improve systems performance in an era where the basic circuit technology speed can no longer give the increase in performance every five years that the user expects. Technologists have run up against some fundamental physical limitations, which mean that only diminishing returns in speed of operation may be expected from new generations of integrated circuits.

For example, consider the improvements in basic clock speed for a range of similar architectures designed by Seymour Cray. The CDC 7600 in the late 1960s had a clock of 27.5 nanoseconds, but the following generations of machines (Cray 1 and Cray 2, in 1975 and 1985 respectively) have failed even to double this clock rate every five years, as can be seen with the Cray 2, which is clocked with a four nanosecond cycle - about the time it takes for light to travel from one end of your desk to the other.

Depending on the transmission medium, electrical signals do rather worse. Although the trend has been to more compact implementations, and understandably so, there are also other physical and practical constraints, which limit this shrinking process, in areas such as fine line definition and power dissipation. The solution has been to use relatively slow but dense Very Large Scale Integration (VLSI) chips and to increase performance by processing in breadth. This use of fast "on chip" processing combined with great breadth, does lead to problems. In particular there is a loss of communication bandwidth between distant processors.

VLSI chip designers also need parallelism, to efficiently exploit the massive complexity that is to be found in these circuits. The gate, traditionally the measure of complexity of a system, is being replaced in VLSI circuits by the wire, which is adding both delay and area to integrated circuits. Parallelism provides some solutions to the problems facing silicon designers, by introducing regularity of structure and of interconnect.

Current VLSI circuits may contain around one million artefact and, in the near future, large highly parallel systems may well be constructed entirely in large single monolithic circuits. These circuits may well contain over one billion artefact, and without regular structure would be impossible to design.

There are only two fundamental techniques for exploiting parallelism. It is also likely that most parallel computer designs will exploit both. However, what determines the differences between parallel systems is the nature and implementation of the control structure of a given system. Within the limited scope of this article, we can only explore those concepts briefly. (More information can be found in Parallel Computers by Hockney and Jesshope, published by Adam Hilger.)

If it takes one man 10 days to build a house, how long would it take 10 men to build the same house? The naive answer of one day is an analogy of the use of replication in hardware. However, as with this example, the ideal may be impossible to achieve. To illustrate this, follow the analogy further and consider what happens if the 10 men are: a bricklayer, a plasterer, a carpenter, a plumber, an electrician, a painter and so on. Although some concurrency of operation may be possible, dependencies may limit some tasks to be performed in strict sequence. To complete the analogy, consider now what happens if the 10 are required to complete 10 houses. It seems unlikely that the 100 days could not be reduced to 10.

To summarise, replication is where multiple hardware units are applied to the task. These may be identical units working on different partitions of the problem, or specialised units sharing the various operations which make up the task.

The same analogy can illustrate the principle of pipelining. Consider the strict sequence of tasks of building walls, plastering and then painting them, with three specialists. The following is an optimal way of proceeding; the bricklayer builds the walls of the first house. While the plasterer is rendering these the bricklayer can proceed to house number two. Similarly, while the painter is decorating house number one, the bricklayer can start house number three. In this way, after an initial start-up period, the three specialists can work on three houses concurrently.

This principle is widely used in many areas of manufacture, including VLSI chips. It can be used where relatively complex operations can be broken down into a sequence of simpler operations. For example, floating point operations are often decomposed into their component parts and pipelined. It is this technique which has been exploited in the current generation of vector supercomputers, such as the Cray 1, the Cray XMP and Cray 2, and CDC Cyber 205. These machines use pipelining for fast throughput in floating point function units.

Data bandwidth is obtained using the same techniques on memory access, together with large register sets (four 256 Kbytes).

In a pipelined processor, the major requirements are that all sub-operations which make up a pipeline must take around an equal time and that partial or intermediate results must be buffered in pipeline registers. The major characteristic is that there is an initial start-up period in which no results are produced. Once the first result is produced, the pipeline is said to be full and subsequent results are produced much more quickly. (By Dr. Chris Jesshope, a lecturer in the Department of Electronics and Information Engineering, Southampton University, published in Computer Weekly, 18 September 1986)

Practical use of parallel processing computer

Thinking Machine of the U.S., which is developing artificial intelligence (AI), has developed a large-scale parallel processing computer called a connection machine. In this computer, about 65,000 computer devices are connected in parallel to be made to perform operation simultaneously. It is capable of performing 7 billion commands per second. The American company has delivered the first unit of this computer to the U.S. Department of Defense. The company is planning to deliver this computer also to the Massachusetts Institute of Technology (MIT) which has long had close relations with it.

In this computer, 65,536 of computer devices which have a 4 kbit memory capacity each and have an operation processing function are connected in parallel; these devices are controlled by another computer. Thus, high-speed operation is achieved. 16,000 data base keyword retrieval is possible in only 30 millisecond. The computer will be effective especially for image processing, design of VLSI and fluid calculation.

Thinking Machine will deliver the second unit also to the Department of Defense. Furthermore, it will supply two units to MIT, one to Yale University and one to Perkin-Elmer, an electronic machine manufacturer. A parallel processing computer, which resembles the nerve cells of the brain, is expected to lead to the development of articifical intelligence. (Chemical Economy & Engineering Review, Japan, June 1986)

The micro that thinks it's a mainframe

A new generation of desktop computers is about to hit the market. Based on Intel's 80386 microprocessor, they will have about 22 times the processing power of today's IBM PC. That is enough to run a small office, create complicated engineering graphics or crank through the tortuous reasoning of artificial intelligence. It is more power than computer makers know what to do with.

Nearly every company that now makes an IBM-compatible desktop computer seems to be developing a new machine using the 80386 chip. Many industry watchers think that Compaq will be first to market. IBM, as usual, will probably take its own sweet time in getting to market - leaving competitors waiting nervously to see what new, proprietory twists Big Blue puts into the technology. But the main problem facing companies building 80386 machines is to find uses for all the power there will be in their $10,000 packages.

The new chip should be able to run all the programs written for computers using Intel's 8086 or 80286 microprocessors, which include the IBM PC and compatible machines - but it will do so much faster. It can work through 4m instructions a second, roughly as many as Digital Equipment's VAX 8600 minicomputer. The 80386 can use much more memory than today's PCs. These work with one megabyte of memory in chunks of up to 64 kilobytes; the new chip will work with up to 4,000 megabytes.

Although a handful of number-crunching applications might require the chip's full attention, most of its power would simply be wasted on an office worker tapping away at his word processor or analysing accounts on his spreadsheet. One obvious way to use the power of computers built around the new chip is to share it out among several programs or several users. But that requires an operating system that can keep track of the various programs the machine is working on at any given time, and their data. "Windows", the latest enhancement offered by Microsoft to the DOS operating system standard for IBM-compatible computers, allows very limited "multi-tasking". But DOS can use only 640 kilobytes of memory; the new chip deserves a new operating system.

There are two candidates for the job. Various companies are converting AT&T's Unix operating system to run on the 80386. But the clever money is on Microsoft, which promises to unveil early in 1987 a beefed-up, multi-tasking version of DOS that should still allow users to run all of todays's popular programs. Although Unix promises to be more powerful - particularly in dealing with multiple users of the same machines - less software has been written for it.

A multi-tasking 80386 machine can be the focus of a network of personal computers, acting as administrator or data librarian for the less powerful colleagues. The market for such "work-group" computers is forecast to be one of the fastest-growing areas in business computing. But companies have also spotted two other fast-growing markets which require the new chip's power: graphics and artificial intelligence.

Graphics programs, like those used in computer-aided design, are hungry for processing power and memory to draw and manipulate the lines they put on the screen. Although much of this drawing work will in future be done by special graphics chips, engineers are loading other jobs on to graphics workstations - like calculating whether or not new products will stand up to the engineering stresses placed upon them.

Competition in the graphics work-station market is fierce. The young companies that now dominate the market, such as Sun and Apollo, have just announced low-cost $15,000 versions of their products. And Apple is also working on a high-powered version of its Macintosh computer (to be powered by Motorola's 68020 chip) which will compete for engineering workstation sales.

There is less entrenched competition in artificial-intelligence workstations. Boston's Symbolics sells computers tailored to run Lisp, America's leading artificial-intelligence language, and Xerox offers a low-cost version. But there is no standard - either for Lisp or for the machines designed to run it. And few companies use the Lisp machines. A recent survey by Schubert Associates of Boston found that only one in 40 companies experimenting with artificial intelligence plans to deliver its programs to customers on a Lisp machine.

Gold Hill, an American company which sells Lisp for microcomputers, has developed an 80386 board costing $7,000 which can be plugged into conventional PCs. It hopes to spur the development of artificial-intelligence programs using its software. But, however popular the new chip might prove to be among software developers, they make up a small market. And there are too few artificial intelligence programs in use to creat much demand for the powerful hardware they run on. Until such power-hungry programs do become popular, 80386-computers will remain ahead of their market, if not of their time. (The Economist, 23 August 1986)

Differences are shrinking

The differences between the most powerful of the 32-bit minicomputer ranges and central units of the mainframe type are diminishing with the increase in performance and storage capacity of the former due as much to technological factors as to increased commercial demand. This, the ever greater integration of integrated circuits and the utilization of specialized buses that can transmit tens and even a hundred million characters per second, makes it possible to satisfy the ever higher mips (millions of instructions per second) demand of a clientele which is using more and more integral office automation and distributed processing applications.

Something that illustrates this trend very well is that in 1977 IBM's fastest model, the 3033, was something like four times more powerful than the VAX 11/780, whereas at present the IBM 3090/200 is only three times as fast as the VAX 8800. (IBIPRESS Bulletin No. 89, 14 July 1986)

Carbon aims to dethrone silicon

A new kind of chemistry is out to dethrone silicon as king of the computer chip and put carbon in its place. It's called molecular electronics, and it aims to use organic molecules, including pigments, proteins and polymers, to carry out the tasks that silicon and metal now perform. Success, should it be achieved, may take 30 or more years, but the sales to the chemical industry could top $30 billion annually by 2020. Says Robert R. Birge, who heads the Center for Molecular Electronics at Carnegie-Mellon University (CMU), Pittsburgh: "It's only a matter of time, hard work and some luck before molecular electronics will have a noticeable impact."

Molecular electronics takes its name from its use of organic molecules to act as the wires and switches that make up the microelectronic components of computer chips. And although the idea of using molecules for such purposes may seem farfetched, nature does it every day. In fact, photosynthesis and electron transport, two of nature's most important energy conversion systems, says Phil Seiden, manager of molecular science at International Business Machines (IBM), Yorktown Heights, N.Y., are "real-world examples of what we're trying to do."

Two factors driving molecular electronics are the need for more speed and the reality that space is rapidly becoming less available.

Last year, for example, engineers at IBM made history when they built the megabyte chip, a memory chip with enough transistors to store 1 million bytes of information. It's likely that, sometime within the next decade, a 16-megabyte chip will be developed. But 16 megabytes may be the ultimate capacity for a silicon chip. For at that point, every usable bit of silicon will be covered with microscopic transistors, rectifiers and wires. Any further crowding of components would short-circuit them.

That's when organic chemistry may play a role and carbon may become the element of computers, replacing the inorganic semiconductors silicon and gallium arsenide. Memory chips, says Scott E. Rickert, head of the Polymer Microdevice Laboratory at Case Western Reserve University (Cleveland), may be developed that store "billions of bytes of information," and computers that are "thousands of times faster."

Even if molecular electronics does not revolutionize computer design, the research will surely pay dividends in organic chemistry. The concept will present "very challenging intellectual problems that could lead to remarkably interesting solutions," says Jonathan S. Lindsey, assistant professor of chemistry at CMU. Lindsey adds, moreover, that should the whole attempt fail, researchers will "still have learned a remarkable amount about organic compounds and their physical interactions."

Researchers are already plowing new ground. For instance, Lindsey is developing an automated system for synthesizing complex organic compounds - and the chemistry to go along with it. The system, he says, will be analogous to those now available for peptide and nucleotide syntheses. And Case Western's Rickert is using technology developed for molecular electronic applications to make gas sensors that are a thousand times faster and more sensitive than conventional sensors.

The chemical industry should also benefit. Technical Insights (Fort Lee, N.J.) says that supplying materials that make up the new computer chips will result in big payoffs. The company forecasts that by the year 2050, perhaps as early as 2020, sales of molecular electronic devices (MEDs) will account for 10 per cent of the total computer market. That translates into a market in excess of $30 billion/year for devices made with large amounts of organic chemicals.

Some companies are well aware of that potential. CMU's Center for Molecular Electronics has received several million dollars in funding from IBM, Westinghouse, Eastman Kodak, Harris Computer and Hughes Aircraft. And in a study issued last year, Gorham International estimates that research funding for molecular electronics, currently about $100 million year, could reach $1 billion/year by 1990. ...

Yet, researchers of molecular electronics do not expect to replace silicon and other inorganic semiconductors totally with MEDs. "Molecular electronics will not make silicon technology obsolete," says CMU's Birge. He does expect that MEDs will replace many devices now made with silicon and that the combination of the two technologies "should revolutionize computer design and function." (Chemical Week, 23 July 1986)

Building boards

When printed circuit boards (PCBs) first appeared over thirty years ago, they vastly changed the electronics world. Now, new kinds of circuit boards are poised to sweep the industry once again. The new boards, called molded circuit boards (MCBs) and extruded circuit boards (ECBs), have many of the same advantages over ordinary PCBs that PCBs have over hand wiring methods. MCBs and ECBs are proving to be more reliable and have superior electrical and mechanical properties. In many cases, the new boards are less expensive as well.

Making a PCB is a relatively time-consuming and labor intensive task. A typical board consists of a laminated composites of fiberglass and thermosetting resin. The board itself forms a substrate that must be plated, etched, drilled, and cut. Each of these tasks entails several steps or operations.

Once a standard board is complete, retainer clips, sockets, and standoffs must be added. The added steps and parts increase the final cost.

PCBs have another disadvantage: their production creates physical and chemical wastes. Drilling and cutting operations create plastic tailings that cannot be reused. And etching the boards produces used etchant containing large amounts of copper, which must either be recovered or safely disposed. In contrast, MCB fabrication has only two basic steps: molding and plating. Tabs, holes, standoffs, pockets, and other features are molded directly into the board, reducing component cost. In some cases, the circuits can be molded directly into a product enclosure, eliminating the need for a separate circuit board or wiring.

MCBs use a different type of plastic than standard boards. Consequently, they produce less waste because their scrap plastic can be reused. Copper is added to MCB rather than substracted (etched) from it, creating fewer chemical waste problems.

Extruded boards have more manufacturing steps than molded ones, but still have advantages over laminated boards. Board fabrication is simplified because large sheets of plastic are simply formed and then cut to size. Instead of drilling holes in the board, manufacturers often use a punch to reduce costs. Plastic scrap from ECBs can also be reused, and the boards have superior electrical and mechanical properties compared to those of laminated boards.

The manufacturing advantages of MCBs and ECBs translate into less expensive boards. One manufacturer predicts that bare molded boards will be 20 to 30 per cent cheaper than unclad conventional PCBs.

Besides being less expensive, MCBs also have better dimensional accuracies than standard boards. Hole location in most PCBs can vary by 0.003 in., but the steel molds used in MCB fabrication allow tolerances of ±0.001 in. Molded holes themselves are also superior to drilled holes because there is no chance of drilling debris becoming entrapped in the hole. In contrast, debris can prevent holes from plating properly in ordinary PCBs.

MCBs and ECBs have also solved a problem that plagues laminated boards: conductive anodic filament (CAF) growth. CAF is the formation of a conductive copper compound between the resin and glass or paper laminates found in standard boards. CAF causes a breakdown in board insulation. However, both molded and extruded boards are homogeneous and, thus, virtually immune to the problem.

MCBs and ECBs are more resistant to constant elevated temperatures and some hostile chemicals than conventional boards. For example, some manufacturers are using the boards in engine compartments, where temperatures can reach as high as 150°C, and there is constant exposure to gasoline and oil solvents. In addition, the plastics used have a high resistivity to electrical leakage, and are a low-loss dielectric at RF and microwave frequencies.

MCBs also facilitate the use of surface mount technology. Surface-mounted devices (SMDs) are miniature components that do not use traditional through-hole leads. SMD leads solder directly to the circuit trace. Often, glue or resin holds the SMD on the board until soldering is complete. But on a conventional PCB, the SMD rests several thousands of an inch above the substrate. The gap results in poor gluing and component loss.

MCB manufacturers solve this problem by molding recessed pads in the board for SMD terminations. As a result, the SMD is closer to the board and glue bonds are stronger. MCBs also offer fine trace widths and separations demanded by SMDs. Most manufacturers can easily produce boards with 0.01 in. traces and spaces; some processes have even finer resolutions. And using a molded board for an SMT circuit usually means far fewer bad boards because the molds guarantee high accurancy and repeatability. (Machine Design, 21 August 1986)

Manufacturability of GaAs ICs improves

A study done at GigaBit Logic Inc., reveals that gallium arsenide manufacturing technology now closely parallels that of silicon fabrication.

The study, carried out on large lots of GaAs ICs manufactuered by GigaBit, measured uniformity of Schottky gate lengths, pinchoff voltages, threshold voltages, transconductance, speed distribution, yield and reliability of devices.

The study revealed that manufacture of GaAs ICs is becoming stable, reproducible process. Wafer sort yields from IC lots manufactured by GigaBit were reported to have approached those of silicon manufacturing technology. "What we have shown is that we have a stable process that is manufacturable and will produce sufficient yields to make the products we are planning for the future", said Bryant Welch, vice president of manufacturing for GigaBit.

Using the results obtained through two years of commercial experience, Welch, Dr. David Nelson and Yie-Der Shen of GigaBit authored a paper titled "GaAs Integrated Circuit Technology Comes of Age", which was presented by Welch at IEEE Custom Integrated Circuits Conference in May 1986. Nelson, manager of device technology for GigaBit, believes the results prove that the door is open for future improvements in the design of GaAs ICs.

In the paper presented at the Custom Integrated Circuits Conference, the authors point out that early efforts at GaAs IC manufacturing technology could not be measured against traditional silicon standards. "GaAs wafer processing volumes were limited (10-20 wafers/week), yields were unpredicatable, reliability standards did not exist and industry standard manufacturing methodologies were not applicable", the authors wrote. "Since GaAs materials, processes and 1μm design rules were unlike silicon, early development efforts did not capitalize on early silicon IC approaches."

Nelson pointed to the jump to 3 in. GaAs wafers as one of the most important developments to aid manufacturing technology. "Several years ago, you had only 2 in. GaAs wafers", he said. "You just can't buy modern equipment anymore to handle 2 in. wafers. So, one of the biggest problems in the advancement of GaAs manufacturing technology has been equipment. As soon as we were able to design our processes around 3 in. wafer equipment, we were in much better shape."

Traditionally, GaAs IC manufacturing technology has had to deal with several unique problems among them, a repeatable capping technology and a lack of in-depth understanding of the semi-insulating material.

GigaBit's capping technology involves a thin sputtered Si_3N_4 film deposited immediately after cleaning, etching and dielectric deposition. The cap serves three purposes: (1) it prevents decomposition of GaAs during annealing (850°C); (2) it prevents formation of free surface states in the channel between the gate and drain or source; (3) it prevents performance degradation over long periods of time. Shen, manager of process engineering for GigaBit, states that the capping technology was a key development in obtaining a repeatable process.

Early on, material problems also had created difficulties and engineers were at a loss to determine whether limited device yields were due to material or process problems. Shen noted that engineers at GigaBit work closely with material vendors, providing timely feedback on what is acceptable quality and what materials are critical to device performance.

Another of the problems encountered in development of a repeatable GaAs IC manufacturing process was, very simply, the learning curve. Because commercial GaAs ICs were first introduced in 1984, and because fabrication techniques were often vastly different from those of silicon, the technology was still young and undeveloped.

GigaBit's report states that practical commercial production has been realized through the use of high quality 3 in. GaAs wafers, cassette-to-cassette process equipment, direct step wafer photolithography systems, dry processing techniques, parametric test equipment, automatic packaging equipment and custom GaAs high speed testing systems. The authors report that as day-to-day volume production of MSI circuits (~200 gates) reached levels of greater than 100 wafers/week, the process stabilized and yields improved.

GaAs device yields, as reported by the GigaBit engineers, have been surprisingly close to those of silicon devices. On devices approximately 2800 mil^2 in area, wafer sort yields up to 73 per cent were experienced, with 68 per cent yields on the best wafer. Yields were over 50 per cent on larger, more sophisticated (>200 gates) logic devices. Although those figures are below those of silicon, the authors point out that silicon IC yields are often based on 2-3μm geometries for mature fabrication technologies.

"For the maturity of the technology, we are doing very well", explained Welch. "We are far ahead of where silicon devices were at a comparable time. Of course, some of that is due to the equipment that is available today, as opposed to what was available for silicon ten years ago. But as we mature, our yields will continue to improve and we already have yields in excess of what most people expected." (Reprinted with permission from Semiconductor International Magazine, (July 1986). Copyright 1986 by Cahners Publishing Co., Des Plaines, Il. USA)

New technique for gallium arsenide single crystal production

Toshiba Corporation has developed a new technique to produce high-purity homogeneous gallium arsenide single crystals (3 inch in diameter). This process makes it possible to dispense with the addition of indium by lifting crystals from a melting furnace while applying incense magnetic force of 3,400 gauss. In the conventional process, indium has been added in order to reduce unevenness in composition. By the development of the new technique, it has become possible to improve the yield of gallium arsenide single crystals and to manufacture 50-60 wafers from a 3 kg single crystal. It has made possible mass production of gallium arsenide, which is a promising material for next-generation high-speed ICs. (Chemical Economy & Engineering Review, [Japan], June 1986)

Progress of the ROM compact disk

Despite the slow take-off of both professional and home sales, the popularity of the CD-ROM (read only memory) compact disk, capable of digitally recording sound, data and images, appears assured. There has been great progress in its standardization, IBM accepts the standards and has announced the forthcoming release of a reader that will cost US$1,600. It is already possible to use the same reader connected to audio and informatics systems. Moreover, such readers are a good alternative for locally distributed databases, as opposed to those accessed by telecommunications networks.

Standardization of the CD-ROM involves both the equipment and the organization of the information it contains, which means that microcomputers with different operating systems can use a common reader. Within the High Sierre group, a consortium created in October 1985 which groups the 13 major firms involved in CD-ROMs (among whom Apple, DEC, Hitachi, Microsoft, Philips, Sony and 3M), an agreement has been reached to standardize the disk's "index" format, the structure of the files and their distribution on the disk. The results have been submitted to the pertinent standardization bodies for approval.

Hitachi is already selling large numbers of a compatible reader for CD-audio and CD-ROM. Philips, the inventor of CD-ROM, and Sony are preparing a new generation of CD-interactive readers equipped with intelligent systems with a Motorola 68000 microprocessor, whose operating system is contained in a ROM and with special audio and video processors that can be connected to the television set or to a high-fidelity music chain.

Four hundred different products are now being offered in the USA supported on CD-ROMs: encyclopaedias, bibliographies, 8800 free computer programmes on a single disk and, databases that offer the user more complete guiding menus than those consulted via telecommunications and with better response times. The prices of such readers do not go as high as US$2,000. However the sector's bottleneck continues to be the high production cost per disk which is still making access to this form of distribution difficult for the modest purveyors of data: US$1,400 to US$14,000 to prepare the data US$4,400 to produce the master copy and, US$2.5 per copy printing costs with a minimum issue of 100 copies. (IBIPRESS Bulletin No. 95, 25 August 1986)

MARKET TRENDS AND COMPANY NEWS

US semiconductor market will pick up in 1987

US market bookings for semiconductors jumped more than 70 per cent between October 1985 and April 1986, getting the current industry recovery off to a strong start. Unfortunately, this rise was interrupted this spring when weakness in the overall US economy, and especially in the capital equipment markets, caused buyers to reevaluate their purchase requirements. Business is expected to remain relatively flat through the summer, before accelerating again in the fourth quarter. However, US semiconductor sales are expected to post an overall gain of 6.2 per cent to $8.6 billion for 1986, a welcome improvement from last year's 30.3 per cent decline. The market will climb steadily in 1987, for a follow-up gain of 19.7 per cent, and then grow nearly 30 per cent in 1988.

Chip prices continue to climb

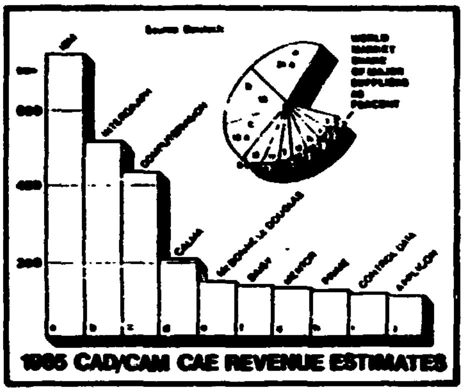
A price freefall in 1985 has given way to firming or rising prices in many segments of the semiconductor industry this year. Upward price pressures began to develop last fall when customer markets stepped up their purchase activity in order to replenish depleted inventories. Although demand slackened somewhat in mid-1986, orders should start to pick up again this fall and rise steadily during 1987. That will place additional upward pressure on prices. For example, digital bipolar IC prices, which have risen 6.9 per cent since spring 1985, are expected to climb 15-20 per cent more during the next 12 months. Prices for digital MOS ICs, which bottomed out last December, have risen 8 per cent to date and should hold firm for the next several quarters. Linear IC prices have just reached a low and are forecast to increase 7 per cent during the next 12 months. (Reprinted with permission from Semiconductor International Magazine, August 1986, (c) 1985 by Cahners Publishing Co., Des Plaines, Il., USA)

CAD, CAM, CAE news

In the latest survey of CAD/CAM, CAE systems and vendors by Daratech, Inc. (Cambridge, Massachusetts, USA), the market research company states that worldwide usage of CAD/CAM, CAE, driven principally by personal computer-based units costing as little as $5,000, is growing at an astounding rate of 10,000 units per month.

However, steeply declining unit prices and cautious capital spending, particularly for large system configurations, have slowed 1986 industry revenues, now forecast by Daratech to reach $4.3 billion, a growth of 22 per cent down from 24.6 per cent in 1985 and 55.6 per cent in 1984.

Daratech goes on to say that, "as sales of low-cost CAD continue to skyrocket, and more and more users find it advantageous to co-ordinate major CAD/CAM, CAE system purchases with requirements of their personal computer installations, leading CAD vendors are seeing their businesses increasingly influenced by requirements of personal computer-based systems supplied by third parties. Ultimately, if this trend continues, personal computer CAD software suppliers could find themselves in control of a major segment of the market." (Industrial World, August 1986)



(Financial Times, 17 April 1986)

Automation industry faces a shrinking market

General Motors Corp. is pulling back from its previously aggressive automation programme, and this is rocking an industry that at best was only staggering toward profitability. The retrenching at GM is expected to affect virtually all the players in the industry. Companies that are closely tied to automakers will be hit hardest, but those whose main business comes from other industries will be affected in the long term.

The most prominent victim to date is GMFanuc Robotics Corp., Troy, Mich. After losing $88 million in GM business it had expected to ship in 1986 and 1987, the company announced this month that it intends to cut back its workforce by one-third by the end of the year. GMFanuc is a joint venture of GM and Fanuc Ltd of Japan. ...

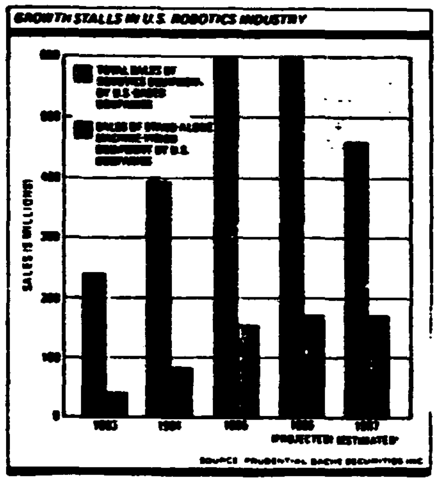
A number of companies almost certainly will go out of business. In the machine-vision segment of the industry, for example, some 100 companies are chasing business that will be worth about $180 million this year. By 1 January 1987, there will be only four or five pure vision companies that are in any position to do business for 1987.

The need for technological progress is underscored by the reasons for GM's pullback: apparently, automation turned out to be a lot more difficult than the automaker expected. Though GM will say only that "our plans on the rate of implementation are not as aggressive as they once were", other sources say the company took on too much, too soon. "GM greatly underestimated the amount of red ink, time and persistence required to make automation systems work", says one executive whose company has worked closely with GM. ...

Moreover, those systems that have been implemented have not paid off as well as expected. The cost differential between US and Japanese manufacturers does not appear to be reduced by automation.

Disappointment with the systems themselves is not the only factor in GM's pullback. Sluggish markets and a general cutback in capital spending also played a part. The bulk of these cutbacks are in the area of $1 million-plus contracts for new ventures. Less expensive projects have not been hit as hard - the market for retrofitting production lines with equipment costing $150,000 to $400,000 has remained fairly steady. (Reprinted from Electronics Week, 21 August 1986, (c) 1986, McGraw Hill Inc., all rights reserved)

Growth stall in US robotics industry



(Electronics, 21 August 1986)

Europe's elite

The top 25 companies in the European market last year had revenues totaling $34.5 billion, up 21 per cent in dollars over the year before.

As usual, the revenue range between the first- and last-place firms is very broad. Top-ranked IBM pulled in a staggering $13.4 billion, while bottom-rung Atlantic Computers chalked up $219.5 million in 1985 European computer sales. As was the case in our 1984 survey, Big Blue's European dp sales represented 39 per cent of the combined revenue total.

The European dp market, which has always experienced more modest but steadier growth than the US, suffered much less in 1985 from the so-called slump in the computer business. This is reflected in the healthy 21 per cent jump in combined revenues of the top 25 companies. Recent market surveys indicate that the European dp business grew by more than 15 per cent last year to well over $40 billion: the combined revenues of the top European 25 account for 86 per cent of the European computer business.

One area that did especially well was software and services. According to the European Computer Services Association (ECSA), the European computer services and software business in 1985 was worth $15.4 billion, up 22 per cent over the previous year. Breaking this down, packaged software soared 32 per cent, custom software and consultancy grew 23 per cent, and processing services inched up a modest 10 per cent.

The Federal Republic of Germany spent the most on data processing during 1985, followed by the other major markets in the UK, France and Italy.

The strong market in the Federal Republic of Germany helped the country's leading dp company, Siemens, hold on to the number two position in the 1985 ranking, with revenues of $2.8 billion. At the bottom of the chart, the names of the members may have changed, but the $219.5 million revenue threshold for membership in the top 25 club stayed almost the same as in 1984.

Leading European dp companies

	Company	Country	World-wide DP rev ($ mill)	% CHG actual acctg. curr.
1	Siemens AG	FRG	3 265.0	20.8
2	Ing.C.Olivetti & Co. S.P.A.	Italy	2 637.7	42.4
3	Groupe Bull	France	1 794.5	18.5
4	N.V. Philips	Netherlands	1 365.6	13.4
5	Nixdorf Computer AG	FRG	1 339.9	20.5
6	STC plc	UK	1 330.8	10.0
7	L.M. Ericsson	Sweden	1 232.8	14.1
8	Compagnie Générale d'Electricité	France	479.0	10.3
9	British Telecom plc	UK	455.1	NA
10	Volkswagen AG	FRG	452.9	19.7
11	Racal Electronics plc	UK	380.8	-14.7
12	BASF	FRG	357.1	23.5
13	Mannesmann AG	FRG	355.7	7.0
14	Ferranti plc	UK	282.1	10.3
15	Rank Xerox	UK	270.0	13.4
16	Plessey Co. plc	UK	250.0	10.3
17	Cap Gemini Sogeti	France	245.1	22.2
18	Atlantic Computers plc	UK	224.4	94.4
19	Norsk Data AS	Norway	219.8	38.8
20	Nokia Corp.	Finland	217.6	24.2

IBM Europe's major markets

Country	1985 total rev ($ mil)	% change in acc*	Inter-co. transfer ($ mil)	Local sales rev ($ mil)	1985 net income ($ mil)
France	4 183.4	13	1 920.2	2 263.2	322.1
FRG	4 500.0	17	1 693.5	2 806.5	289.8
Italy	2 241.5	17	707.0	1 534.5	250.3
Netherlands	1 032.5	26	356.3	676.2	100.6
Spain	1 128.9	38	519.9	609.0	128.8
Sweden	846.4	25	354.1	492.3	66.2
UK	3 901.3	30	2 028.2	1 873.1	394.9

All figures include typewriter sales, which have been deducted from Datamation European 25 chart.

* Actual accounting currency.

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Methodology

For this survey, Europe includes Austria, Belgium, Denmark, Finland, France, Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden and the UK.

Dp-related revenue is defined as general purpose dp products and services generated by one or more of the following categories of equipment: mainframes, minicomputers, office systems, data communications, peripherals and terminals, software and services, and maintenance and repair. Excluded are data transmission or "basic" services revenues from specialized common carriers, standalone electronic and mag card typewriters and standalone electronic cash registers, instrumentation, semiconductors, printed circuit boards, automated test equipment, and dp supplies, with the exception of magnetic media for disk and tape drives. All peripherals that attach to a system are included. For computer-based manufacturing systems, such as computer-controlled machine tools, only computer and hardcopy output devices are included and not the tools themselves.

All revenue and earnings figures have been adjusted to calendar year calculations. All European company figures were converted to US dollars, using OECD exchange rates.

ATE-AI partnership

Artificial intelligence is widening its role in the world of testing. Manufacturers of automatic test equipment are moving beyond such first steps as the establishment of knowledge bases, and they are now fashioning practical automatic test equipment (ATE) expert systems.

AI functions such as designing and building testability into very large-scale integrated circuits, establishing expert systems and using them to pinpoint faults, and creating diagnostic routines to sniff out failures in test equipment are being expanded and refined far beyond their first incarnations in testing equipment. New applications, among them automatically configuring test systems to perform specific tasks, are being developed. And some of the new approaches are getting set to move out of the lab and into the marketplace. ... (Electronics, 4 September 1986)

Bipolar comes alive again

Bipolar technology is on the move again, advancing rapidly into VLSI now that it has overcome many of the scaling problems that continue to bedevil MOS. One good indicator of the increasing momentum is the number of new processes being moved to production.

Another measure of this resurgence is the resurrection of the Bipolar Circuits and Technology Meeting, a gathering of bipolar technical specialists that has been missing from the calendar since the mid-1960s. Sponsored by the Institute of Electrical and Electronics Engineers, it was held in Minneapolis in September.

The innovations and solutions that researchers will describe are the new guideposts for the technology, which is increasingly finding its greatest number of applications in the high-density, high-performance end of the market: precision analog and very high-speed digital circuits. And this strength is building even as bipolar's share of the total integrated circuit market diminishes.

According to conference chairman John Shier, device engineering manager at VTC Inc., Bloomington, Minn., "Overall, bipolar is a shrinking fraction of all IC shipments, dropping from 44 per cent of the IC total in 1985 to about 35 per cent in 1990. But viewed by itself, bipolar is an industry with $8.4 billion in revenue and a compound annual growth rate of 12.7 per cent." This growth would be impressive, he says, by almost any standard except that of the MOS market, which is increasing by 22 per cent a year. ... (Reprinted from Electronics Week, 4 September 1986, (c) 1986, McGraw Hill Inc., all rights reserved.

Packaged software: a thriving market

The computer software packages industry is flourishing, and its growth is the proof that businesses will bend to accommodate "alien" ways of working, no matter how unique they believe themselves to be. If, that is, the economics are right. When computers were large, cumbersome and expensive and therefore used only by the larger corporations, those companies had software written to suit their every little quirk. As a method of developing business software, it resulted in satisfied customers (eventually), but at a high cost both in cash and time.

As the cost of hardware fell with the introduction of minicomputers - cheaper, simpler but with many of the capabilities of mainframes - it became obvious that the economics of software production would have to change. The mini itself might cost £100,000 or less; a custom-built program suite of some complexity might easily cost the same.

So there was an irresistible logic in creating generalized software programs which could be applied to a number of different companies for tasks such as payroll, accounts receivable and so on with only a minimum of alteration to suit the quirks of the individual company. With the introduction of the low-cost business microcomputer, the package came into its own. There was simply no logic in spending $10,000 to have written a specific piece of software when, produced as a package and sold to hundreds of customers, the same software might cost only $500.

Today, three categories of software package are generally distinguished. First, sytems and utilities. These packages include operating systems (the complex programs which direct the internal workings of a computer and determine its relationship with the outside world) and compilers and assemblers (programs which translate between high level or English-like languages understood by programmers and the stark patterns of pulses of electricity understood by the computer).

Second applications, tools, software. This includes all those programs which make it possible for the computer to handle applications effectively - data management software, for example.

Third, application software, programs which carry out the task - or one of the tasks - for which the customer bought the computer.

Packages of all three kinds are built by hardware manufacturers, by systems houses and by software houses. They are built for all sizes of machines. A major financial package for a big company to run on a mainframe might cost $100,000.

A package written to run on the IBM Personal Computer or one of its "clones" (designed and built by another manufacturer to run the same programs as the IBM original) will almost certainly cost less than $500.

In Western Europe, figures from the consultancy International Data Corporation suggest that the market for packaged software was $5.2 bn in 1985 and that it will grow by between 28 and 30 per cent every year up to 1991 when its total value will be $24 bn. ... (Financial Times, 27 June 1986)

Western European Market Forecast

The packaged software market by country with values in $m

Country	1985	% share	1991	% share
Federal Republic of Germany	1 157	22	5 492	23
France	860	16	3 769	16
UK	1 142	22	4 769	20
Italy	579	11	2 708	11
Western Europe	5 224		24 117	

Source: IDC

(Financial Times, 27 June 1986)

Japan eyes the lead in 4-megabit memory chips

Although sample shipments of 1-megabit memory chips have only just begun, Japanese semiconductor makers are already jockeying for position in the 4-megabit sweepstakes. The competition is stiff and the race is close: "All the big Japanese makers are at about the same level technologically", says Shiro Horiuchi, director of Matsushita Electric's Advanced Devices Laboratory. Probably the only clear winner in this intense rivalry will be memory buyers as prices for megabit chips tumble in the face of fierce competition.

Much of the technology needed for 4-Mb dynamic random-access memories (DRAMs) is already known so success will most likely come from refining existing designs and improving production processes. Two Japanese companies, NEC and Toshiba, have already built experimental devices and presented papers on them at the 1986 International Solid-State Circuits Conference. The rest are not conceding anything, though: "Any time the others start producing 4-Mb chips, we'll be ready to start", says Matsushita's Horiuchi.

Nonetheless, the technology of the 4-Mb DRAMs is still far from routine. Most critical is the capacitor used in the memory cells to store the electric charges representing bits of data. The flat, or "planar", capacitors in early, low-density integrated-circuit memories required a substantial amount of the chip's surface area. As the number of memory cells increased, capacitor size and circuit line width had to be decreased. One problem with this approach was that as the capacitors shrank, they were no longer able to store sufficient charge. And as circuit lines became narrower, they became increasingly difficult to etch on the chip surface.

One solution, favoured by Fujitsu, is to create capacitors in silicon layers deposited on top of some of the current-carrying lines, rather than on the chip's surface. These "stacked" capacitors do not compete directly for space with the circuitry, yet they are big enough to store the necessary charge.

In the second approach, favoured by NEC, tiny holes, or "trenches", a few millionths of an inch deep are etched into the silicon substrate, then filled with another silicon layer. The area of contact between substrate and deposited layer - which is where the stored charge gathers - is thus increased while the chip surface used remains small.

Though the trench capacitor will undoubtedly offer the highest density, some designers question the need for it. "We made a prototype 1-Mb chip using trench capacitors", says Hitachi Central Laboratory's Hideo Sunami, one of the pioneers of the technique, "but when a larger chip size was proposed, we found we didn't need it". Hitachi's prototype was based on a 16-pin package, but the industry standard was eventually set at 18 pins to permit an extra address line. Thus the company took the conservative route and stayed with planar capacitors. Toshiba and Matsushita are also using the planar approach at this level; NEC is the only company to have developed a trench-type 1-Mb device.

But trench capacitors will probably be necessary at the 4-Mb level. NEC's prototype 4-Mb DRAM uses a unique structure in which the charge is stored on the inside of the trench rather than in the substrate, thus reducing vulnerability to so-called soft errors. These random errors are caused by impacts from high-energy alpha particles in the earth's background radiation, which cause charge depletion in the minuscule memory cells.

The other major technical challenge, that of etching and depositing narrower lines on the chip's surface, is also being addressed in a variety of ways. For 1-Mb chips, lines as narrow as 1.2 microns are needed, while the 4-Mb variety requires 0.8-micron lines. But submicron distances begin to approach the wavelength of light, so precise control of line width becomes impossible with conventional lithographic techniques.

A possible solution is to use light with a shorter wavelength or direct-writing electron beam machines. The electron beam technique offers far more precision, but the entire surface of the chip cannot be exposed at once. Instead, the narrow beam must "write" the pattern on the surface line by line, guided by a computer. "The method is going to be too slow for mass production," claims Matsushita's Horiuchi. Electron beam machines are used, however, to make photomasks - the original patterns, corresponding to a photographic negative, that are etched on coated glass or quartz and then projected on the chip's surface during the production process.

X-ray lithography holds more potential for mass production, since it offers fine line resolution and permits an entire wafer to be exposed at once. Special photomasks, with patterns formed of materials such as gold, are necessary, and synchronous orbital resonance (SOR) machines are being built to produce the powerful radiation needed. One of the most promising new techniques, electron cyclotron resonance, allows ions to etch at lower temperatures and pressures, reducing the effect on surrounding areas. But the equipment is expensive: "An SOR machine is 10 times the cost of an E-beam machine", says Matsushita's Horiuchi.

These new manufacturing methods will significantly raise fabrication costs for coming generations of memory chips. Thus, when Hitachi set up an ultra large-scale integration lab within its Central Research Laboratory near Tokyo, an impressive target was needed to get management approval of the massive budget required, according to Sunami. The target they chose was impressive indeed: the creation of a 64-megabit DRAM. (High Technology, July 1986)

Siemens attacks new markets

Two announcements were made a few days ago that fall within the framework of the expansion policy being followed lately by the German Siemens. One concerns the negotiations in progress with the Dutch Philips and the French Thomson in the electronic components field, and the other the attack launched by the German group on the British computer market.

Siemens and its French and Dutch partners are confident that, through pooled financing, they may arrive at the creation of a European consortium to develop research in the microelectronics sector. Such activity is in fact becoming ever more expensive and therefore more and more difficult for individual firms to engage in. Thus it is necessary, as never before, for European groups to collaborate in order to be able to confront the increasingly aggressive attacks by US and Japanese firms. We recall that Siemens has sustained considerable financial efforts in recent years in the integrated circuits sector, in particular in the research and development of chips having from one to four megabit memories.

Siemens has also announced that it intends to become the fourth ranking computer supplier on the British market within four years. It has therefore decided to launch a campaign in Great Britain for the sale of computers covering the entire range, from mainframes (produced by the Japanese Fuji) down to the minis and personals. Siemens has also just opened a new software development centre, again in Britain which, within the next two years, is to employ 220 persons, including engineers and experts of the sector.

For the future the German group is aiming at becoming competitive at international level in sectors considered to be of primary importance, such as: telecommunications, production automation, office automation and microelectronics.

Its takeover of the British Northern Telecommunications, which occupies itself with telephone equipment and particularly with PABXs (private automatic branch exchange), early this year, is to be seen in this light. Moreover, the German house made a proposal a few days ago for the acquisition of the French CGCT, as a European counter-proposal to the ITT bid to absorb CGE. (IBIPRESS Bulletin No. 90, 21 July 1986)

Fairchild chips in

Fairchild Semiconductor is on the verge of making chips in both Japan and Europe as well as in the US, according to Robert Walesnik, the company's new European marketing manager for microprocessors.

He said that a wafer fabrication plant at Nagasaki in Japan was slated to come on line some time in 1987 in the absence of a further downturn in the market. It would be making 6 in. wafers that use CMOS technology with 2μm drawn lines which have an effective width of 1.3μm.

"We've had an assembly and test facility in Nagasaki for several years. The building is built and the facility is completed; they have been running wafers, but bringing the full line in is dependent on business conditions", said Walesnik. The European fab is at Wasserburg am Inn in the Federal Republic of Germany. (Electronics Weekly, 10 September 1986)

Motorola's latest 33-bit processor

The successor to one of the brightest stars of the 32-bit microprocessor world is more than a year away from volume production, but Motorola Inc. is ready to disclose details of its upcoming MC68030. An advance look reveals that the chip maker will add such features as a data cache and on-chip memory management that will at least double the performance of the existing 68020.

Parallel functions are also being expanded to help speed up the company's latest chip. Added functions include twin parallel buses for on-board data and instruction caches, the capability of filling the caches with data from external memory as the central processing unit simultaneously executes instructions, and the capability of sending addresses to a memory-management unit to begin searching external memory while the buses search on-board caches.

The 128-pin CMOS chip - which will be fully source-code compatible with the 68020 - should be operational late in the first quarter of 1987. Samples are slated for early next summer, with volume production beginning around October. The 68030 is targeted not only at engineering work stations but also at the personal computer market, a stronghold of Intel Corp.'s iAPX 86 processor family since IBM Corp. selected the 8088 for its Personal Computer.

Motorola is also planning to introduce next year a new 68-pin floating-point processor, designated the MC68882. The 20-MHz coprocessor will be pin-for-pin compatible with the existing MC68881, but its enhanced parallel architecture is expected to boost performance two to four times. ... (Excerpted from Electronics, 18 September 1986)

AT&T teams with Honeywell

Honeywell and AT&T are teaming up in the US to provide integrated systems to control commercial buildings. The agreement calls for each company to conclude separate contracts with customers, but they will work together to provide an integrated solution. Honeywell has been striving to marry its skills in computers and environmental control systems to promote the idea of intelligent buildings.

For such applications it will be using the Premises Distribution System developed by AT&T to support voice, data, graphics and video communication through a universal wall jack. Honeywell's integrated building architecture brings together subsystems which control heating, ventilating, air conditioning, lighting, fire and security equipment. (Electronics Weekly, 13 August 1986)

US-Japanese combine plans a joint venture in chips

Executives of a US maker of chip sets for IBM PC clones were scheduled to head for Japan on Labour Day to nail down details of a partnership with one of Japan's largest software companies. The two firms, Chips & Technologies Inc. of Milpitas, Calif., and Ascii Corp. of Tokyo, are putting together a company to enter new worldwide markets, particularly in communications protocols such as those for the integrated services digital network. Plans are still tentative - the new firm does not even have a name yet - but the idea is to use Chips & Technologies' computer-aided-engineering system for design work and have the products manufactured by major Japanese chipmakers working at silicon foundries. The two companies will each hold an equal share of the majority interest in the new venture. Minority investors will include general trading company Mitsui Bussan, component and equipment manufacturer Kyocera, and perhaps others, including diversified manufacturer Nippon Gakki. (Electronics, 4 September 1986)

32-bit war warms up

Hitachi is preparing to launch its own 32-bit microprocessor following the failure to obtain an agreement with Motorola to second source its 68020 32-bit microprocessor.

Hitachi's new 32-bit microprocessor device will be launched next year and will be compatible with Motorola's 6800 microprocessor architecture. Industry sources report that the similar architecture may lead to a dispute between Hitachi and Motorola like the dispute between NEC and Intel over alleged microcode copyright infringement.

Hitachi produced working samples of its 32-bit microprocessor in December 1984. At the time the company said it had no plans for commercial production of the device and was still hoping to obtain a second source agreement for Motorola's 68020 microprocessor.

Hitachi is a major second source for the 16-bit Motorola 68000 microprocessor and will continue to produce the device. The company is working on a wide number of support chips for its own 32-bit chip that include a memory management unit, a floating point unit, and a graphics processor.

Motorola has granted only Thomson CSF permission to manufacture the 68020. The company has been insisting that it obtain second source rights to comparable worth products before it will grant other second source agreements.

Matsushita Electrical Industrial Co. has disclosed the development of a 32-bit microprocessor and will start selling it before the end of this year. (Electronics Weekly, 9 July 1986)

OSI firms team up

Eight of the 12 members of the European group of companies dedicated to the promotion of open systems interconnect (OSI), including ICL, have set up a commercial company to produce OSI validation equipment.

The Standards Promotion and Applications Group - SPAG as it is lovingly known - was set up in 1983 to promote OSI and counter the dominance of the IBM network standard Systems Network Architecture (SNA). The 12 companies involved are GEC, ICL, Plessey, Bull, CGE, Thomson, AEG, Nixdorf, Siemens, Olivetti, STET and Philips.

The new company, SPAG Services, will not include Plessey, GEC, AEG or CGE. The company is jointly financed by the other eight firms, and is headquartered in Brussels. It will be run along the lines of an ordinary commercial company - unlike SPAG itself, which is just a voluntary grouping. (Electronics Weekly, 8 October 1986)

APPLICATIONS

World textiles dressed in informatics

Experiments and studies on the possibilities of introducing the new informatics technologies into the textile sector's production cycle are being carried out all over the place, in Japan, France, Germany, Italy and the USA. They range from the training of managers to computer-assisted creation and to the final sewing of the model.

A project has been started in Japan which calls for the construction before the end of 1989 of an automated workshop for the sewing of suits and garments. The number of companies in Germany that produce machinery for the textile industry and that invest large amounts of capital in research and development for automation is increasing. Also in Italy numerous initiatives in this direction are being taken by individual companies. In northern Italy, courses are being held in co-operation with the University of New York for programming, production and administration managers of textile firms in order to provide them with an updated picture of the possibilities offered to the sector by the new informatics technologies.

At another locality in northern Italy that is deeply involved in the fashion sector, innovative technologies based on informatics, electronics and robotics are very shortly to be introduced in order to improve yarn production, particularly that from natural silk, the dyeing process, weaving, etc. Moreover, local administrations and private companies are to be linked by a telematics system for purposes of keeping both the businessmen of the sector and local governments informed on the region's textile situation.

In addition, the EEC seems to be extremely interested in and ready for co-operation in a project developed by a number of industries in the vicinity of Brescia (Italy). The latter are using a system known as tex-cim for the production of models, for the computerized cutting of suits, the study of cuts and the design on video terminals of new styles and fashion lines. (IBIPRESS Bulletin No. 95, 25 August 1986)

British dairy farms are becoming computerized

A new service called MMB Dairyfax has been set up for milk producers in England and Wales. The system, developed by Prestel, gives milk farmers in these two regions the opportunity of having direct access to an information service concerning their market.

By means of this system, a farmer may directly enter all the information on his milk production, such as weight, price, output, etc. From this information, the system is able to tell him his situation immediately, be it as on that day or for the entire year. This makes it possible for him to make assessments, comparisons, etc. In this way the farmer is able to obtain a view of the whole on the results of milk production in his entire region or even on other regions.

Dairyfax is a veritable information service which allows farmers not only to consult it but also to pose questions, to send messages and even to send out orders.

The integrated memory the computer has, makes it possible to save information when the computer is disconnected. If the user desires a paper copy, a printer may be incorporated into the unit.

The introduction of the new system gives the farmer the opportunity to be more efficient and to improve his productivity by avoiding certain problems through the possibility of being able to dialogue interactively and to obtain information fast.

In addition to savings in time and money, direct access to this service lets him obtain other information concerning his sector or not, such as financial information and the latest results of laboratory tests made on cattle, etc. (IBIPRESS Bulletin No. 95, 25 August 1986)

Doctors call on computers to aid the disabled

Treatment of people with spinal injuries involves up to a year in hospital, but very often the largest hurdle that disabled people face is the struggle to find work once their initial stay in hospital is over. For the past three years Julia Schofield, herself blind, and fellow consultant Bill Butler, have worked on a project at the Stoke Mandeville and Odstock hospitals (UK) to develop computer systems that help patients to adjust to their injuries. The computers also serve as teaching aids for new skills. So far, more than 100 people have learnt how to use the hardware and software developed by Schofield's company, Julia Schofield Consultants. Schofield and Butler did their work with the aid of £280,000 in grants from the EEC and the Department of Trade and Industry. Forty of the people who worked with the hardware and software during its development now have full-time jobs, from farm accounting to running a garden centre. Only one person has gone into computing.

At the Stoke Mandeville and Odstock hospitals, disabled patients are offered the chance to learn about computers almost as soon as they are able to manipulate the equipment. The Musgrave Park Hospital in Northern Ireland also provides patients with the computers, which provide paraplegic patients with a basis for occupational therapy. Schofield has designed a gantry device for microcomputers which holds the screens and keyboards over the patients' beds. The screens are 10-volt models, which are safer to operate than the normal 240-volt variety.

Patients unable to operate a computer keyboard control their computers with a mouth stick which converts their puffing and sucking into computer commands. Programs for the computers are held on floppy disks, but Schofield hopes to switch to sealed hard disks which do not have to be pushed into slots in the machines.

Initially, patients, who are often only able to watch television, use their machines to play games (some designed to help them learn about the treatment of their injuries) and to find out about computing. Later, Schofield Consultants will assemble a package of software for each patient which can be used for work. The consultancy has a library of some 200 programs, many of which are commercial programmes that have had teaching elements added to them.

Computers have allowed some people to continue in their old jobs. Others, such as the building apprentice who started an estimating service for builders and plumbers, have learnt new skills. The scheme, pioneered at the first two hospitals, has now been taken up by five others in Britain. Schofield has also worked in Australia, where she says she is better known than here. But funds dry up in December and the future of the project is in doubt.

So far, the Department of Health and Social Security (DHSS) has declined to buy any of the purpose-built gantries. "The DHSS could be more active", says Schofield. Although people leaving hospital can get grants of up to £6,000 from the Manpower Services Commission for equipment to use in their work, hospitals have to rely on the health service for funds. (This first appeared in New Scientist, London, 24 July 1986, the weekly review of science and technology)

Advanced image processing systems for research and practical applications

A family of advanced image processing systems, based on technology developed during 10 years of research at the Institute of Technology in Linköping, Sweden, has been introduced onto the market by Contextvision AB of the same city.

The company describes its systems as offering a new method of handling contextual and structural aspects of image processing. Rather than processing pictorial information in the form of isolated information points, the Contextvision systems contain a special algorithmic structure which handles symbol and syntax properties simultaneously during computation, so that the image at each point can modify and be modified by its context. This method makes possible the rapid classification of large areas without massive data processing. It also enables the system to detect structures that are practically invisible to the naked eye as well as to other image processing systems, the company says.

The systems are applicable for a number of different uses within the areas of image creation and handling. They are available with advanced graphics and document handling capacity. Iterative processing for image improvement is for instance a useful tool in fingerprint identification. In cartography, the systems can be used to rapidly identify structural features such as housing areas, roads or intersections as well as for image clarification and labelling. The processing of X-ray and microscope images in medical diagnosis and bio-medical research is an area to which the systems are particularly well suited, according to the company. The image data compression techniques incorporated in the systems can be used for efficient image transmission and storage.

A set of simple general image processing operations are used as building blocks in a system structure where the hardware, the General Operator Processor (GOP), is specifically designed to implement this structure. The system implements operations within a four-level hierarchical structure. An operation with a particular size neighbourhood produces a transformed image at the next level. A further operation uses this transformed image to produce a higher level transform, and so on.

The systems can be programmed in a Pascal-like computer language, but also offer the option of interactive training. Areas or objects to be categorized are pointed out in the displayed image and the system itself determines the characteristics particular to them. According to the company, this training procedure makes it possible to handle complex object descriptions which would be impossible to incorporate into conventional programmes.

Contextvision offers three different processing systems and a range of options and accessory units. The most advanced system, the GOP-300, was introduced in 1985, and is currently in use at the Karolinska Institute in Stockholm and the Linköping Regional Hospital. Contextvision also offers a variety of educational and support services. (Science & Technology, Swedish International Press Bureau, September 1986.

Managing energy electronically

With the increase in energy costs over the past decade came the recognition that as a raw material resource, energy was as susceptible as other factors to modern management techniques. In order to control, it is necessary to monitor. However, as energy use is generally so widespread and diverse, until recently one could monitor and measure its consumption economically only where use was concentrated, such as in heavy process industry. Today, the availability of relatively cheap and reliable transducers means that it is possible to measure energy use economically and accurately.

Microcomputers allow the necessary analysis of consumption and monitoring of equipment to be achieved in a manner approaching the simplicity of monitoring just one large industrial process. Now, one factory or indeed any number of factories, becomes manageable in energy terms.

By monitoring energy consumption and by relating its use to certain key parameters - for example, floor area, number of items produced, degree days - it is possible to determine the efficiency of energy use in a factory, to plan for future energy targets, and to monitor the progress of energy saving programmes continuously so that energy wasting faults can be identified quickly. Eventually the level of energy use falls.

The full potential of such a system is not simply limited to energy use. Combining fire and intruder alarms with a system's energy management functions is technically possible. Indeed building automation systems, installed abroad, often include both energy and security functions. Therefore, this extra capability should be given serious consideration at an early stage: including additional non-energy functions will greatly enhance the usefulness of the system, by making it a total management information system. Also, the inclusion of these extra functions is likely to have little impact on the overall cost of the project while shortening its effective payback period and increasing its financial attractiveness.

One can distinguish two major types of energy management system:

Dedicated system. Such a system monitors/controls just one energy service or function such as lighting, space heating or electrical maximum demand control. It is analogous to a dedicated burglar alarm system.

Comprehensive energy management system. This monitors/controls a range of energy functions. Also, it usually can analyse energy consumption off-line along with energy related events and alarm conditions. Thus it can produce management reports on energy use and, with the inclusion of non-energy functions, provide the reporting necessary for a total building management information system.

A comprehensive system can be centralized or distributed.

With a centralized system, all essential computing operations are carried out at a central station which is usually hard wired or at least has continuous connection to its non-intelligent outstations. The outstations take all control instructions from the central processing unit.

In a distributed setup, however, the outstations are likely to be remotely positioned and are, therefore, not in continuous contact with the central station. Instead, they periodically communicate essential summaries of information at certain fixed intervals and, perhaps, alarm conditions as they arise through, for example, auto-diallers working into the public switched telephone network.

The outstations are intelligent: they can store information feedback from their locally positioned transducers, raise an alarm if necessary, and provide simple control routines such as maximum demand control or heating optimization. Effectively they are standalone units. However, all off-line computing and display of current conditions on VDU mimics and management reporting will still be done at the central station.

The market is young. While the technology is basically similar to telemetry monitoring/control equipment, its application to energy management only started properly in the last 10 years. Hundreds of companies worldwide now claim to supply energy management systems.

In the UK, many distributed systems have been installed in areas as diverse as supermarkets, hospitals, hotels, commercial office buildings and factories.

Electronic energy management systems and techniques are well developed now. The declining real cost of transducers, microprocessor and computer technology, combined with long-term increases in energy costs at slightly over 3 per cent per annum until the end of the century will make systems increasingly attractive. ... (Technology Ireland, May 1986)

ROBOTICS

Wanted: new jobs for sad robots

If robots are taking over where men once worked (as union leaders fear), then surely the men who make the robots must be doing good business? They aren't. Instead of big sales, the machines have chalked up big losses. Growth in the American robot market has slowed to a snail's pace. Companies are still struggling to find the formula that will transform todays's rusty tin men into gleaming knights. Latest to try is Japan's Toshiba, which this week signed a robot-marketing joint venture with FRG's Messerschmitt-Bölkow-Blohm (MBB).

Eager to diversify from its roots in aerospace. MBB will market Toshiba's robots in the Federal Republic of Germany, Switzerland and Austria. Japanese robots have gone down relatively well in FRG's engineering industry. Sales grew by around 50 per cent last year, to 541 (including the unprogrammable pick-and-place machines which only Japanese statisticians count as robots). But competition for robot sales everywhere is tough, especially in the large American robot market where a lot of apparently well-laid plans have recently gone badly wrong.

In 1985, Americans spent about $595m on robots and the software needed to make them work - about half as much again as they spent in 1984. This year, stockbrokers Prudential Bache expect robot sales to grow by only about 5 per cent, to $625m. Because many robot companies were suffering even during last year's boom, the slowdown will hurt.

Some of the saddest faces are at the electrical giant Westinghouse. In 1983, Westinghouse paid $107m for Unimation, then the world's leading robot maker. Unimation has disintegrated in Westinghouse's hands. Its share of the American robot market has shrunk from nearly a third in 1982 to less than one-tenth today, and its place in the American robot-maker's league has slipped from first to fourth. Westinghouse has invested heavily to beef up the Unimation robots, but so far it has little to show for its effort and money.

General Electric has fared little better. In 1980, GE predicted that, by 1990, it would hold around a fifth of a factory-automation market worth $25 billion a year. Instead, it has chalked up losses of over $120m, and it still does not even rank among America's top ten robot companies.

Number of industrial robots ...

...in:	end 1984
Japan	67,300
United States	14,500
FRG	6,600
France	3,380
Italy	2,700
Britain	2,623
Sweden	2,400
Belgium	859
Canada	700
Spain	516

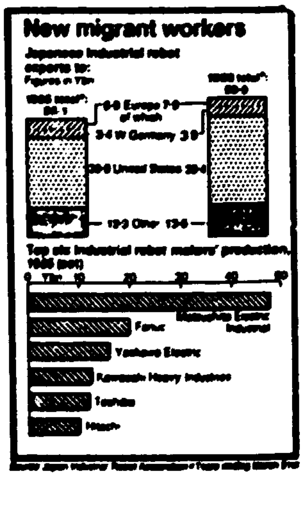
Source: Japan Industrial Robot Association

Most embarrassing of all, success in robot markets has proved little more profitable than failure. The second-ranking and third-ranking firms in the American robot market - machine-tool maker Cincinnati Milacron and Sweden's ASEA - are not much richer for all their years of robot production. The firm now making most money out of the American robot market is GMF Robotics, a joint venture between the American carmaker General Motors and the big Japanese robot company Fanuc. And GMF Robotics made only $10m on sales of $187m in 1985. Around two-thirds of those sales went to GM itself, and this year GM has cancelled about $80m-worth of its robot orders.

The robot makers' problem is that selling automata is not as simple as winding them up in the morning and sending them out to do a real person's work. They require complex software to do even the simplest tasks. And robots must be taught to communicate with the other machines working beside them on the shop floor. Creating that software and those communication links is expensive. So are the service people needed to ensure that they keep working.

So far, carmakers have been by far the best buyers of industrial robots. For them, the cost of robots forms only a small part of the price of a new production line. Because the whole line is usually built at once, car firms have an easier job ensuring that the robots will talk to their fellow machines than companies that have to integrate the creatures with existing equipment. Painting, welding and all the other jobs on car production lines can employ a lot of robots. GM alone plans to install some 20,000 by 1990. But the really big markets for robots should lie elsewhere: in "assembly" tasks like putting circuit boards into computers, assembling electric motors or packing chocolates in boxes. Until now, demand for such assembly-robots has lagged well behind robot makers' expectations.

One of the dampers on demand for assembly-robots is now being lifted. Led by GM, robot consumers have created standard communications protocols, called MAP, which should ensure that any manufacturer's robots can work side-by-side with any other's. But equally galling problems remain. Market analysts had expected the first big wave of assembly-robot orders to come from the electronics industry - which has lots of the repetitive kind of work that robots can do, and enough technical expertise to teach the machines how to do it. But stagnation in electronics and computer markets has forced manufacturers to cut their previous investment plans. And IBM, which has been installing robots regardless, has been building its own. (The Economist, 26 July 1986)



(The Economist, 26 July 1986)

Robots build new markets

The British Robot Association's analysis of robot applications for 1985 suggests that assembly is now one of the fastest-growing application areas for robots. Of the 300-odd assembly robots now in use in the UK, about 100 were installed last year, making assembly second only to injection-moulding machine loading as the most popular application for new robots in 1985.

Two main factors control the pace of robotic assembly systems development; robots speed and machine vision. General Motors estimates that by 1900 it will have 14,000 robots, and about half of these will have vision. Lucas Industries has a continuing programme to automate the assembly of small parts, and is now looking at the robotic assembly of headlamps in a flexible system which will cope with around 12 product variants. Since a headlamp is a cosmetic item as well as a functional product, it is likely to have quite a short product life, so a flexible assembly system is a must.

With Imperial College, the Lucas Research Centre worked on a programme to find out whether vision could be used to assist headlamp assembly. The programme's results were presented last year at an IEE conference Robots and Automated Manufacture. The vision system used at Lucas comprised a Vidicon closed-circuit television camera with monitor, an Eltime Image III digital frame store, and a microcomputer with one floppy disc drive and 256 kbytes of RAM. If performed successfully on trial, teaching Lucas much about how to design a vision system able to cope with extremely reflective surfaces. A similar vision system will be used to check that the correct main components - body, headlamp and lens - are being fed to Lucas' headlamp assembly cell, which is now under development.

But even with reliable vision systems, there is still a need to pick the right robot for assembly work. High accuracy and repeatability, and the ability to control the movement of quite heavy loads, can allow an assembly robot to compete with dedicated automatic systems or manual labour for some mechanical and electronics assembly tasks.

At GEC Research in Leicester, a new type of robot has been developed which should be more accurate, easier to control and stiffer than conventional designs, making it suitable for fast, precise operations like product assembly. Called the Tetrabot (for tetrahedral robot), the new design is made up of a central limb, positioned in space by three linear actuators. These form a truly triangulated structure which, says GEC, is light and stiff, so allowing the robot to achieve high acceleration rates. A three axis wrist unit gives the Tetrabot a total of six degrees of freedom. ...

The flexibility that even advanced assembly robots offer to some manufacturing processes could be restricted, in the case of low-volume production runs, by the need to stop and programme the machine for each new task as it arises. Many robot installations are now expected to operate on a three-shift basis to be cost-effective, and there are three factors which are likely to be vital if assembly robots are to be kept working efficiently:

- Programming languages which are interactive and allow fast, accurate program generation;

- Recovery strategies to minimise down-time after, for example, in correct handling or insertion operations; and

- Off-line programming, to cut out time-consuming robot teaching sessions.

Conventional teach and repeat methods can occupy much of the robot's time, especially if it is assembling a range of short-run products. It is here that off-line programming comes into its own, but if this can be done through the company's computer-aided design (CAD) system, the production engineer can re-use the geometric information about the product which has already been defined by the designer, saving on both time and errors, and bringing about productivity gains as high as 15:1.

Using Unimation and Computervision products, a development cell was set up which has demonstrated many of the advantages to be gained from the technique. These include better robot cell design using simulation techniques, as well as the faster and more accurate programming of robots.

One important factor likely to limit the application of CAD in off-line robot programming, however, is the lack of standard robot languages. Without a standard language, CAD vendors will not be able to design software to exploit all the robot's facilities.

In the longer term, many of the applications for which robots may eventually be used will lie outside the controlled environment of the factory. Shipbuilding, mining, construction, and specialised activities like the decommissioning of nuclear reactors are all areas where a robot which could transport itself over rough surfaces, or even climb stairs, could be a valuable production tool.

Although tracked or wheeled vehicles could do some of this work, there is much to be said in favour of a machine which could walk, coping with difficult terrain by feeling its way and only transferring its weight when it has tested its footing, as humans and animals do. A team at Portsmouth Polytechnic, led by professor of robotics John Billingsley, is developing such a walking machine, which will use pneumatic power to drive its six legs. Previous approaches to walking machines, says the Portsmouth team, have approached the problem by devising large, powerful machines which, at any point in their stride, form a rigid structure adopting a stable position as it rests on the surface. The Portsmouth approach will be to use a compliant, adaptive mechanism of jointed limbs powered by compressed air to achieve a smooth, fluid motion over uneven terrain. How would such a machine actually move?

There are several different gaits the machine could adopt, the simplest of which is a 'prowl', where the machine's centre of gravity is not allowed to move out of the area enclosed by the points at which its feet touch the ground. In this mode, the machine should be moving slowly enough to stop at any point in a stable state. The next, and slightly faster, gait is a 'scurry' where the centre of gravity is still within the ground contact area, but the machine might need one or more paces to come to a halt. In both these gaits, the body can move smoothly in a horizontal line, without any angular movement.

Faster gaits must allow the centre of gravity to move, temporarily, outside the leg base. The movement of the foot relative to the body will decide how much vertical, horizontal or rotational movement is produced. The resulting gaits would be a 'canter', with some rotational movement of the body, a 'lope', similar to a human walk, and a 'trot'.

Finally, the robot could 'gallop' in emergencies. In this case, the feet would spend much of their cycle time off the ground, and the machine would need gyroscopes to stabilise the body during these faster movements. There are a variety of ways of steering such a machine, including lengthening or shortening its stride, and rotating the legs in a similar way to the steering wheels on a car. (Engineering, July/August 1986)

Automated handling

Materials handling accounts for between 30 and 70 per cent of production costs in UK manufacturing companies. The use of advanced handling systems, says a new NEDO report,* can produce massive reductions in these figures with great improvements in productivity as a result.

About £23,000 million is tied up by UK manufacturing industry in the form of inventory, according to a recent estimate by Kearney Consultants. One way to cut this figure is to introduce advanced handling systems (AHS) - mechanical handling hardware controlled by computers. These systems can be made up of automated guided vehicles (AGVs), conveyors, cranes, and automated storage and retrieval systems.

A report on this whole subject, entitled Advanced Handling Systems - Exploiting the Opportunities, was published recently by the National Economic Development Office (NEDO) on behalf of the Mechanical Handling Economic Development Committee. The report says that the scope for improving handling efficiency in industry is enormous. Materials handling, it claims, is a major expense for companies, accounting for 30 to 70 per cent of production costs. Despite this, it is one of the least considered functions in the majority of businesses. The difficulties that arise in materials handling are often seen as isolated problems of stock control or production scheduling, rather than as symptoms of poor materials flow management. ...

The NEDO report concludes that worldwide investment in AHS will grow by 12 to 15 per cent annually from the £1,400 million of two years ago to £2,500 million by 1990. However, the UK market, although relatively underdeveloped, is expanding at an even faster rate and is expected to reach a value of over £250 million in 1990, an average annual growth rate of 20 per cent.

NEDO also says that major opportunities exist for UK users of AHS to improve their competitiveness, if they invest in storage and warehousing - a substantial market worldwide but one in which the UK has been slow to adopt the latest technology. Automated handling in manufacturing assembly also has much to offer in sectors with reasonable volume throughputs, especially electro-mechanical goods, consumer products and computers.

The report recommends that all companies should carry out an audit of their handling costs and needs, and that they should adopt AHS to ensure their long-term future in terms of:

- Increased control over materials flow through the business as a whole;
- More efficient use of labour;
- Reduced capital employed as a result of lower inventory;
- Increased product quality; and
- Reduced lead times and greater flexibility.

Another important recommendation in the report is that chief executives should appoint a powerful technical voice at board level - a strategic thinker with in-depth experience of modern production and design technologies. It is also suggested that technical staff should receive training at the national Materials Handling Centre, Cranfield and/or a local university, technical college or polytechnic.

A strong recommendation for the Government is that it should mount a further substantial awareness campaign based on a unified approach to computerised automation. Also, that it should undertake a major review of technical training facilities for AHS, and that there should be direct-grant support in crucial product development areas. The Government agencies could provide their support by giving preference to suppliers already using AHS.

Lastly, the report endorses the setting up of a unified, financially and technically strong organization to span all the product and market areas of AHS, with the objectives of promoting the need for optimum automation and showing how AHS can help achieve its goals. ... (Engineering, July/August 1986)

FACTORY AUTOMATION

Factory automation reconsidered

"A few years ago, the factory of the future - with robots and other automated machinery effortlessly turning out products from A to Z - seemed to be just around the corner. Today we know better. Flexible manufacturing systems, which are flexible only within limits, are now being installed more thoughtfully, one step at a time. The robot has traded its headliner status for a strong supporting role. And factory communications standards like General Motors' MAP, essential for smooth operation, are finally emerging."

"Formerly hailed as a panacea for the ills of American industry - and prescribed in heavy doses - flexible manufacturing is now being scaled down. Because highly sophisticated systems are expensive and often incompatible with a company's other manufacturing operations, users of flexible automation have begun taking a step-by-step approach, starting with basic building blocks that can eventually be linked into larger systems.

"This new conservatism is a backlash against the rapid push for sophisticated automation in the 1970s and early 1980s. Squeezed between maturing markets and low-priced foreign competition, basic metal-goods producers like automobile, machinery, and farm equipment companies eagerly embraced flexible automation to improve efficiency and cut costs. But a combination of poor planning, neglect of basic shop-floor management, and unrealistic expectations scotched many of these efforts."

The above is quoted from the introductory paragraphs of a well-researched article by J. Zygmont, senior editor of High Technology, in which he looks at performance and promises of FMS based on examples of American industry. He concludes that:

"Recognizing that manufacturers aren't willing to pay too high a price, automation vendors are quick to point out that FMS is not the panacea it was once held to be. Rather than going for all-out flexibility, some are pushing "appropriate flexibility". For a German automaker buying a machining line for four-cylinder engines, appropriate flexibility means the option to add an inch to engine-block height if future markets demand larger

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* Advanced Handling Systems - Exploiting the Opportunities is available from the NEDO Book Shop, Millbank Tower, Millbank, London SW1P 4QX, price £3.50.

engines. Otherwise, the new line is a conventional fixed system.

"Fixed (nonflexible) automation will remain an important aspect of future manufacturing. However, even such dedicated lines - when combined with an appropriate combination of manufacturing cells and FMSs in a single plant - will eventually provide flexible production; computer-integrated manufacturing will tie together "islands of automation" under a single, co-ordinating computer that can efficiently handle product variations. But even as flexible automation expands and improves, manufacturers will remain cautious." (High Technology, October 1986)

Automated manufacturing research facility

Three years ago, the National Academy of Engineering in the US discovered a peculiarity. Large companies involved in mass production are more likely to automate their factories than small companies producing batches of 50 parts or fewer at a time. The problem, the academy discovered, is that batch manufacturers tend not to integrate computers into their factories because it costs too much to persuade machines from different sources to co-operate with each other. Big business can afford to build automated factories from scratch and to customise machines and computers of different makes. ...

Big companies such as General Motors or Boeing can afford to assemble a new factory like a hi-fi system or to customise every machine to communicate in the same way. But even General Motors is still crawling: only 15 per cent of its 40,000 programmable devices can communicate outside their own processes. Resolving that mechanical misanthropy, according to the chairman of General Motors, takes up almost half the company's budget for automation.

Batch manufacturers add equipment one or two pieces at a time. They need to buy from different suppliers but they cannot afford to tailor each machine's software and hardware. Yet these companies need the most flexible form of automation, as they frequently switch from making one small lot of parts to another. The problem is more than academic. About 90 per cent, or 100,000, of the companies in the US that make parts for other companies are batch manufacturers. Discrete parts account for about 75 per cent of the trade in manufactured goods in the US. If big companies are the only ones that can afford to automate, they will eventually swallow up the small operators. This is why, in 1981, the National Bureau of Standards (NBS), in Maryland, set out to design an automated machine shop "as easy to hook together as a home music system."

The NBS is a quietly industrious research centre, run by the government, that most people think just measures things. Now a team of about 130 researchers at the bureau has set up a sparkling new machine shop called the Automated Manufacturing Research Facility (AMRF). Philip Nanzetta, the manager, points out that the AMRF is not a prototype factory or simply a source of innovative equipment. It is a laboratory for experiments. An economic analysis for the NBS, by the Management Collaborative Group, calculated that the AMRF's work could eventually reduce machining costs by 25 per cent. This represents an annual saving of tens of billions of dollars in the US. So far, 19 universities have sent researchers to study at the AMRF, and about 35 companies actively participate in its work by offering people, equipment or cash.

Computer scientists and engineers sit at the terminals attempting to string the machines and their robots into a single, automated entity that produces parts. Eventually, they hope to accomplish two goals. The first is to devise new ways to machine parts so precisely that they conform to national standards of measurement. Their second goal is to provide enough information to design a standard interface for industrial machinery. Eventually, the NBS will use the AMRF to develop manufacturing systems that incorporate artificial intelligence.

When the AMRF has achieved its immediate goals, it will have developed what is known generically as computer-integrated manufacturing (CIM). A CIM system, besides working untouched by human hands, must be flexible enough to respond immediately to changes in the market-place. An engineer must be able to throw an alteration or new design into the computer at the top of a CIM system and have its machine tools cut a modified or new part immediately. ...

The NBS aims to create an electronic hierachy that shares labour out, writes a common database and sets rules to decide how decisions must be made. The bureau must also decide what information you need to run a factory and how to get it. This explains its preoccupation with sensors. The aim at the AMRF is to set a data standard that can deal with events, such as the motion of a robot's arm, as they happen. MAP, on the other hand, is concerned with static events, such as delivering a tally of parts for clients. The NBS will not write the new standard for manufacturing industry, that job belongs to an independent body, the International Standards Organisation (ISO). What Simpson is trying to do is to write the electronic equivalent of a better law and then to persuade the ISO to enforce it in the lawless land of computers. (This first appeared in New Scientist, London, 4 September 1986, the weekly review of science and technology.)

Soviet factories are being automated

A computerized system worth US$6 million for the automation of the production process of a factory that produces the largest gearboxes for harvesting machines is about to be completed by a British firm and sent to the Soviet Union.

After the new system has been applied the factory will be able to produce a unit every 49 seconds. The parts to be assembled will be conveyed by mobile platforms through 15 stations controlled by computer. The engineers assigned to product control will be able to obtain on a screen, after making selections from menus for the purpose, all the information regarding the product at the individual stations of the production cycle, as well as a diagram providing a complete overview of production.

By selecting a particular workstation, they will be able as well to take individual machines, or parts of the same, into examination and to obtain information coming from diagnostic monitoring devices applied to the machines.

Even if the system will not be completely automated, the production line will not in fact be controlled totally by the computer inasmuch as the parts will be loaded and unloaded manually, it nevertheless represents one of the most advanced automation systems present in factories in the Soviet Union. The entire project, which took over 20 months to develop, is expected to go into operation at Taganrog at the end of the current year. (IBIPRESS Bulletin No. 92, 4 August 1986)

Factory of the future

The factory of the future will be successful if sensing devices can effectively predict tool failure. Users and planners of machining cells and systems need sensors that can detect broken and worn tools. A promising development in tool condition sensing has been demonstrated by Kennametal. Its Tool Condition Sensor System for turning machines can detect when a cutting tool breaks and stops the spindle in less than a single revolution of the workpiece. The system's operation is based upon the direct measurement of radial, axial, and tangential forces that are measured in a special tool block and processed in a special computer. As a result, the system is immune to the 6 common tool wear mechanisms: crater wear, flank wear, chipping of the insert or cutting edge, depth-of-cut notching, microscopic breakage, and thermal deformation of the insert. In sensor research efforts, NBS has developed a laboratory module of an 'ultrasound' probe to automatically monitor the surface finish of a part during machining. The probe has been successfully tested on both flat and curved stationary objects with average surface roughness values of 25-1,000 microinches. (Iron Age, 15 August 1986)

Successful automation at aluminum works

Kaiser Aluminum and Chemical Works, located in Erie, Pennsylvania, USA, is making an impressive push toward what it has termed Computer-Integrated Organizational Automation.

The Erie Works, as the plant is called, specializes in the manufacture of aluminum forging dies. Both the corporation and the plant realized that modernization was required to reduce costs and lead times, improve accuracy and repeatability, and, through these advances, increase competitiveness and the chance for survival.

The modernization began with a study of CAD/CAM in 1979, culminating with a 1984 installation of a system from McDonell Douglas running on Data General hardware. Next, in February 1985, Kaiser/Erie added three Rambaudi (Italy) vertical CNC machine tools for die machining. To reduce data entry times at the CNCs, a Masterlink DNC system to connect the machine tools to the CAD/CAM system (via an intermediate Data General computer) was installed.

In a parallel activity, the Erie Works installed a Data General ECLIPSE MV/1000 to off-load computer information from the corporate network at the firm's headquarters in Oakland, California. When fully implemented this summer, the system will handle all the accounting, purchasing, work-in-process tracking, pay-roll, and shop-floor-control requirements of the plant. Tying together all the various programmable devices at the Erie Works is a MAP-compatible broadband communications network from Concord Data Systems. Called Token/Net, the network was installed in August 1985, and includes some 36 interface modules - plans are to install over 150 eventually - to connect 86 different devices throughout the 26-building complex. (Industrial World, August 1986)

CIM research in the Federal Republic of Germany

At the METAV '86 Exhibition in Dusseldorf in June, the importance of CIM and of new engineering materials to the small and middle sized industry was strongly emphasised. This is one of the biggest shows in the metal-working industry in Europe and included a total of 948 exhibitors from 26 countries.

One of the main features of the exhibition was the special shows for new engineering materials and for computer integrated manufacturing, reflecting clearly the two important areas where industrially significant R & D is taking place.

This article attempts to highlight the main features of the special CIM show and to summarise some of the most significant developments in the FRG in recent times and in particular since the EMO-Exhibition in Hanover last September.

The CIM-special show encompassed an area of over 1,400 m^2. Five of the leading German CIM R & D institutes in conjunction with computer and production engineering industries were on display. A number of the systems exhibited island solutions to the problems of CIM. The broad spectrum of prototype solutions indicate clearly the complexity of the problems associated with the development of CIM systems for small to medium sized industry.

Considerable resources are being pumped into production planning, designing, work preparation and manufacturing technology by both German industry and research foundations. The effects of this could be seen at the special CIM show where the linkage between the various departments of a company was being demonstrated and where specialists were available to discuss the detailed problems associated with interface development.

The Machine Tool Laboratory of the Higher Education Institute at Aachen demonstrated a complete information flow system from the design department right through to manufacturing using a CNC-sawing and turning cell to produce rotationally symmetrical components. The Traub company was showing its fully automatic flexible turning centre, TNA 480-FHS2, which with the aid of a flexible materials handling device had the facility of changing the workpiece, cutting tools and chuck jaws fully automatically. Linked to the turning cell was a sawing centre SSZ 140 k from the Kasto company. The CNC circular saw PKS 140 was supplied with bar from the multiprogram magazine. An NC sorting system was capable of sorting sawn workpieces into the respective bins. For the data transmission, a Prime computer installation which was capable of undertaking the functions of production planning (PS-systemtechnik) the design (Prime-medusa) and the NC-program generation (Prime-GNC) could be seen.

A most interesting presentation of CIM came from the Institute of Production Systems and Design Technology of Berlin in conjunction with Digital and Maho. In a 40 minute demonstration the unquestionable suitability of CIM in the small to medium size manufacturing plant where a versatile product range is demanded was shown.

In a model factory, the company showed the visitor the standard range of products normally available, selected a guest and asked him/her to suggest a modification to one of the basic items on the product menu. The entire procedure from customer order of a standard part with modification (a typical case in the small/medium sized manufacturing plant) right the way through each department of the factory was then demonstrated.

The order was entered on computer, given an order number and a brief description of the modification. This information was passed with the aid of electronic post to the design department. The designer called up the particular item from the menu and proceeded to modify the item as per instruction. In a remarkably short time, and making use of the EUCLID system, he completed the modification. After checking that it was in accordance with specification, he produced - also with the aid of the EUCLID system - a complete NC-program for component manufacture of the CNC machining centre and then checked this program using the graphics simulation facility.

The data were then transferred, again by electronic post, to the production planning and control as well as to the job shop scheduling departments. The job-shop scheduling package in the CIM-Strip demonstrated was being developed by the Fraunhofer Institute for Production Systems and Design Technology (IPK), Berlin. In the paperless activity the data were evaluated quickly by each department and clearance given to go ahead with manufacture. The completed item was handed to the 'customer,' along with the necessary documents.

The Institute of Production Systems and Automation (IPA) of Stuttgart, working with Krupp-Atlas and DEC, showed a computerised solution for the areas of production planning, machine loading, diagnostic techniques, manufacturing control and cost analysis. Two different systems were being demonstrated, one using the robot as a machine tool in a CIM-System and the second showing a flexible QC cell.

Making use of off-line programming, it was shown that the use of robots as machine tools can be undertaken more efficiently. The mini-computer plays a very important role here. On one hand it may be used in the CAD/CAM system and for robotic control; on the other, it can be used to realise relatively time independent, non-critical general functions which are necessary for many robot applications.

The software systems currently being developed by the IPA in Stuttgart, aimed mainly at the manipulation of tools using robots, have the following functions:

- User programmable interpolation,
- The generation of patterns,
- The generation of programs without control of the industrial robot,
- Off-line part-program correction,
- Flexible documentation and storage,
- Recording of programs for different robot types and
- Fast programme changing on robot switch over.

The winter semester, 1986/87, at the Institute of Manufacturing Technology and Machine Tools of the Technical University, Hanover, will see the start-up of a new CIM-laboratory, the first of its kind designed for educational purposes in the FRG. The concept was demonstrated at the METAV '86 show.

The system comprises a CAD work station for design and NC-program generation. A PC network for the direct conveyance of the NC-program (DNC) and CNC-machine tools for the manufacture of the computer designed components.

On the other integrated PCs the CAD-software from the work station can be used in 2-D form, having a menu architecture identical to that of the work station. The PC-CAD Software is said to be very suitable for the educational environment. A computer based work planning system (A VOPLAN) and its linkage to the CAD-System in addition to a computer controlled tool management system are also being developed at Hanover.

The fifth institute demonstrating CIM-systems was the Nuclear Research Centre of Karlsruhe. It demonstrated a CIM-model assembly factory with a flexible assembly cell using an industrial robot RRM 15 from the Reis Company. A typical industrial component being assembled and disassembled was on demonstration. Coupled to the assembly cell was a real time PPS-system from the Herber Company. The PPS-System was well demonstrated by the use of six terminals for the different departments including sales, design/calculation, work preparation and materials economics.

The working environment of all personnel not directly concerned with controlling tasks can be separated from the actual production process due to information networks in connection with data based management systems, simplified man-machine communications and intelligent computer operations.

Considerable development has taken place in the development of prototype CIM-systems in the FRG over the last year. It is evident from these prototype systems that CIM has much to offer to the small to medium size manufacturing company. However, there are many teething problems associated with the development and installation of industrial systems. These lie mainly in the following areas:

- Interface development,
- Communication standards,
- Function and system integration,
- Machine intelligence,
- Decentralised closed loop controls,
- Diagnostic systems and
- Staff qualification.

Still, both industrialists and educationalists have no choice but to become involved with CIM and to develop strategies for the evaluation of systems on offer. Although much has been achieved, there is no limit to the amount of R & D needed before fully automated manufacturing can be realised. (Technology Ireland, September 1986)

The retooling of America

Flexible make-anything factories are beginning to sprout across America, bringing back jobs that had slipped offshore.

American companies began pouring big money into high-tech manufacturing around 1980. All told, firms in the United States spent less than $7 billion that year on computerised automation. Today they are spending annually $16 billion, mostly on more sophisticated CIM equipment. By 1990, investment in computer-integrated manufacturing will have doubled to $30 billion or more, forecasts Dataquest of San José, California.

General Motors has spent no less than $40 billion over the past five years on factories of the future. Even its suppliers are being hooked into GM's vast computerised information net, allowing them to swap data with the giant motor maker as a first step towards integrating them wholly within its CIM environment. IBM has been spending $3 billion a year on computerising its manufacturing processes. In so doing, it has been able to bring numerous jobs, previously done offshore, back into the United States. Pleased with the results so far, IBM has raised its investment in CIM to an annual $4 billion.

The heart of a CIM plant is a flexible manufacturing shop which can run 24 hours a day, but which is capable of being retooled in minutes rather than days, and able to turn out hundreds of different products instead of being dedicated to just one line. The difference between the best of traditional automation and the best of new style CIM plants is that the former automates just the flow of material through the factory, while the latter automates the total flow of information needed for managing the enterprise - from ordering the materials to paying the wages and shipping the finished goods out of the front door.

The aim of CIM is not simply to reduce the amount of direct labour involved in manufacturing a product (only 5-15 per cent of the cost). The real savings come instead from applying strict computer and communications controls to slash the amount of waste (typically 30 per cent of the cost) through having up-to-the-minute information on tool wear, while minimising the handling, management and overhead charges (rarely less than 40 per cent) by knowing precisely where items are at any instant during the manufacturing process. The net result is that a CIM factory has a much lower break even point than a highly automated conventional plant. The majority of the CIM plants now on stream in the United States break even at half the level of a conventional plant (typically 65-70 per cent of full capacity). And because it does not have to operate flat out from the start to be efficient, a CIM plant makes it earier and cheaper to launch new products. That spells shorter life cycles - and hence more frequent (and more attractive) model updates.

Pressure from other parts of Washington is also helping to usher high-tech manufacturing into American factories. To government gurus like Dr. Bruce Merrifield, the attraction of these flexible manufacturing plants is that they are ideal not just for industrial giants like General Electric, Westinghouse or IBM, but even more so for the tens of thousands of tiny workshops across the country. While Japan has two-thirds of its industrial output within the grasp of broad-based keiretsu manufacturing groups. American industry by contrast has always relied heavily on its 100.000 or so independent subcontracting firms. In metal working, for instance, 75 per cent of the parts made in the United States are manufactured by small independent workshops in batches of 50 or less.

The American Commerce Department sees no antitrust reasons why smaller firms should not band together to share a flexible manufacturing centre, making spindles for washing machines one minute, wheel bearings the next, then switching to precision mounts for a microscope maker, crankshafts for diesel engines, microwave cavities for radar equipment, nose-cones for missiles and so on. This would reduce the investment risk for the individual firms, while providing a higher return for the CIM plant as a whole. It could also help rebuild much of the industrial base of rustbowl America. (The Economist, 23 August 1986)

CIM for the smaller firms

Computer Integrated Manufacture is one of those phrases that spells trouble for a lot of engineering companies. Rather than being the promised land it is seen as the land of broken promises. Production companies are cautious - and rightly so. But with decent computer systems for manufacturing companies costing up to £250,000, a financial or quality return simply must be got. With good management, a realistic budget and a suitable supplier that return is possible.

Good management systems are the first step. It has long been clear that the first building block of computerisation must be in place long before any computer hardware comes into the production department. Unless the business operates in an integrated way with good paperwork systems, a computer will just be a further burden on a disorganised staff. Computerisation of bad management systems leads to more chaos and more costs.

Because of the impact it can have on any engineering business, production control is usually the first part of the manufacturing management system to be computerised. The potential is enormous. But turning potential into performance is the key element. There is no simple plug-in solution. Signing a £200,000 cheque to CIM Ltd. and expecting a box delivered that controls production is simply not realistic. A typical medium sized Irish engineering company can expect to spend two or three years getting the system up, running and running well. It is nothing less than a tough slog requiring total management commitment, a disciplined approach and clearly defined objectives. Where failure occurs (and there have been plenty) and results do not meet expectations, it is usually more to do with management weakness than any inherent system fault.

In Ireland and the UK, batch produced products have an average lead time of eight weeks. Yet the average time spent making the product is only eight hours. It takes little imagination to see that while faster machine tools can cut down the eight hours, they make no impact on the eight week lead time. This lead time is only reduced by much better control of the production resources. Resources in this case are stock, machines, people and ultimately money. Good systems, and then good computerised systems are, all about getting the best use out of the resources you have. ...

Use of Computers in UK Engineering Companies

	% of Cos using this module
Stock Control	33%
Job Costing	30%
Purchase Ordering	24%
Materials Requirements Planning	20%
Master Production Scheduling	15%
Capacity Planning	13%
Total Sample:	18,206

Source: Engineering Computer Survey, UK, November 1985.

Unlike many other sectors where computers are used, production control systems rank as one of the most stable areas. Small micro based systems with limited capability are available to help standard production set-ups, from £5,000 up. Very few engineering companies of over 100 employees however will get by with less than a mini computer based system running a well developed interactive suite of software modules. Such a system can easily cost £60,000 by the time it is actually in full use. For larger companies requiring custom designed software to match their specific production system, the bill can top £250,000. Such a system would usually run on a powerful mini computer such as a DEC VAX 750 with many shopfloor terminals feeding into it.

Unlike some of the other new technologies, computerised production control is now very well established with genuine financial, quality and delivery benefits making systems viable even in quite small operations.

SOFTWARE

The "Greco" programme in France

Over 30 teams with a total of 250 researchers dedicated to filling the gap in currently available software are in operation under the direction of Professor Cori of the University of Bordeaux. This is the result of a year of Greco programming work. Greco is the joint project of CNRS (Centre National de Recherche Scientifique) with universities, institutes and groups of French industrialists, including IBM. France, the country acknowledged internationally as being the cradle of the Ada language adopted by the US Defense department for the standardization of traditional programming applications, as well as the Prolog language adopted by Japan to nucleate its fifth generation, is making an important effort to expand this creative effort in software, one of the key aspects of the future in informatics.

The Greco research themes include artificial intelligence, databases, advance programming hardware, man-machine interfaces, relationships of informatics with mathematics and linguistics, co-operation, competition and communication. Greco is being aimed at several ambitious objectives, from improving researcher knowledge to lifting programming above its artisanal level by preparing the theoretical basis for its elevation to industrial level, going by way of the creation of software prototypes, the training of professional software persons and the transfer of the results and knowhow among the teams and to industry.

Greco, open to co-operation with the centres of many countries (Berkeley, Edinburgh, York, MIT, Stanford), has provided access, through European and American scientific data networks, to its research and products to anyone interested. (IBIPRESS Bulletin No. 96, 1 September 1986)

Fourth generation languages

The rate of development of fourth generation languages shows no evidence of slowing down. If anything, the rate of change is increasing. New products are emerging, and existing products are being enhanced in micro, mini and mainframe environments. This kind of situation will always pose the question, do we invest now or do we wait for something better to come along? This question has caused sleepless nights for many managers, not least in the world of data processing.

Have fourth generation languages been a success or have they failed to deliver what they have promised? Firstly, let's dismiss the claims by some that fourth generation languages are a sales hype put about by software vendors. If that were really true, the data processing managers of the world have all been taken in by smooth talking software salesmen. A claim that is patently untrue and also offensive to software vendors. Secondly, the volume of sales of products claiming to be fourth generation languages has been an outstanding success.

It's not easy to define precisely what a fourth generation language is. This is partly because it is an evolving product area, and also because the label is attached to a wide range of products which have differing origins. However, it does help to look back at the origins of these products.

The story started in the timesharing industry, with products from Tymshare, Geisco, ADP, Comshare, NCSS, etc. These products found a niche in the market place to provide computing facilities for company managers who could not wait for the data processing deparment to write systems for them, and who were not prepared to become "programmers". These companies offered products that we all now recognize, such as Focus, Nomad and Ramis. All of these products have been available since the mid-1970s.

But it was only in the late 1970s, and early 1980s that these products became generally available for in-house systems, as software from IBM, such as TSO and VM/CMS, became more widely used.

Initially, these products were report generators, with limited file handling capability, keyboard data entry, etc. As they began to spread into in-house sites, the demand for features such as greater file handling facilities and screen based transaction processing capability gave them greater value to data processing professionals as development tools. Initially, this was for simple systems, but increasingly these tools are being used for complex full "production" applications.

While fourth generation languages were developing primarily for the end user, application development products, like UFO and Mantis, were extending their functionality by trying to be more user friendly. This gave rise to products such as Natural and On-Line English.

Later, but essentially following the same process, the personal computer world began to deliver user friendly products such as dBase II and Lotus 1-2-3, using the excellent "instant" screen facilities of this type of hardware. In turn, the suppliers of this type of hardware are now attempting to move their products up the hardware range, while the suppliers of mainframe software are doing the reverse. Integration is also becoming increasingly important, so that links between mainframe, mini and personal computer hardware, via software provided by the fourth generation vendors, is another element of their offerings. The consequence of the outburst of developments is a spectrum of products ranging from the "friendliest" of user friendly systems costing a few pounds to "heavy" Cobol application generators costing hundreds of thousands, with all combinations in between.

This historical perspective is important since fourth generation languages are seen by different people to do different things. Sometimes they are seen as report generators, sometimes as information centre products, sometimes as application development tools, and sometimes as prototyping tools. This confusing image has allowed other products to claim to be fourth generation languages even though they fail to meet most of the objective tests that define them.

So have fourth generation languages been a success or failure?

Their objective is quite simple - it is to increase the productivity of users of data processing facilities. As a by-product, fourth generation languages will replace Cobol. There are a number of Focus sites that only have Focus and Fortran installed as languages.

But has this "productivity increase" taken place?

Fourth generation languages have primarily had an impact on the "programmer" and hardly any impact in the areas of data analysis, database design, etc. The next phase of fourth generation languages is the arrival of expert systems. These will enable non-DP staff to do their own data analysis and database design, using the expertise built into such software. Such systems, while they have a high penetration into many large corporations, appear to be primarily used for evaluating their potential with the organization. It is unlikely that they will be widely adopted until well into the 1990s. The future, I suppose, is towards fifth generation languages.

At present, I can envisage these as the combination of today's fourth generation languages with expert system capabilities, available on a wide range of hardware, with full transparency. The user or the developer need not be aware of which hardware system they are or will be using, or where the data resides. Clearly this scenario will require significant developments in the areas of operating systems and communications. (By Peter Scaven, managing director of Information Builders (UK) Ltd., published in Computer Weekly)

Are CAD systems innovative?

Professor Hiroyuki Yoshikawa of Tokyo University in an interview asserts that even the most advanced CAD systems are still really little more than draughting aids.

All designers are familiar with the stop-start thinking patterns of creative work ... the train of thought which is fruitful but which suddenly comes to a stop, for no apparent reason. And then, the equally inexplicable moment at which a solution to the problem suddenly and mysteriously 'appears', and creativity starts to flow again.

Man has invented various labels for these patterns, such as 'brain wave', or 'breakthrough', or 'block', or 'hang-up', but has little if any understanding of the actual processes involved.

It is a detailed examination of man's thought processes which Professor Yoshikawa - one of the gurus initially leading Japan's 'unmanned manufacturing' research project (MUM) - is now working on and which he believes to be essential if CAD (computer-aided design) is to move forward from its present position as a sophisticated draughting aid to the point where it can be of genuine assistance to man's creative and innovative design potentials.

Yoshikawa suggest that one of the most crucial factors in man's ability for creative design is his intuitive understanding of the importance of 'function', by which is meant the 'intention' he has in mind when he sets out to create any new product. Indeed, function is invariably the starting point for any design exercise, and its corallary 'fitness for purpose' is axiomatic for all designers.

The present generation of CAD systems, Yoshikawa says, are almost exclusively concerned with manipulating 'shapes', activity at which they are exceptionally competent. But their shortcoming is that they do not incorporate any understanding of function, or fitness for purpose, so cannot give the designer help in those vital areas. If a CAD system could comprehend the intention of the designer, then it could probably also carry that understanding forward to CAM (computer-aided manufacture).

Yoshikawa sees the work of those currently engaged on artificial intelligence (AI) as probably the key which will eventually unlock the door to the next generation of CAD, and integrated CAD/CAM systems.

To capture designers' experience in an AI system is valuable, but is not in itself enough, Yoshikawa believes. The processes involved in 'intuition' must also be understood. Yoshikawa proposes that the first step should be to establish some axioms for the process of design, and from them to deduce some theorems. The latter would then be analysed to see if any patterns are present.

Yoshikawa also told Machinery that Japan's national research project MUM (unmanned manufacturing systems), has been closed down. The first stage of the project reached the completed hardware point and some working trials on components for pumps and for agricultural machinery were successfully completed. The second step was obviously a major assault on developing further the software required.

Reading between the lines, it appears that MUM was simply overtaken by events. The machine tool industry in Japan, in collaboration with its customers, has been (and still is) so vigorous in the development and application of flexible manufacturing cells, systems and minimally and unmanned systems in general, that 'private enterprise' in fact got further, faster and 'for real', quicker than MUM and its committee-approach could manage.

But there is no question mark over support for Japan's Institute for a New Generation of Computer Technology, which is charged with developing the country's fifth generation of machines. Started in 1981, the project is planned as a 10- to 12-year exercise. The first phase was completed in 1985 and its fruits are now being applied, in the second phase, to machine tools and CAD/CAM. The group working on this project comprises representation from machine tool and computer industries.

'The fifth generation computers,' Yoshikawa told Machinery, 'will be very different from those we have today, with much improved concepts of architecture and profiting from the advances already made by workers in the field of artificial intelligence.' (Machinery and production engineering, 1 October 1986)

COMPUTER EDUCATION

Morocco: microcomputers in school

This article is the paper read at Toulouse by Mr. Rachid Benmokhtar Benabdellah, it treats an analysis of an experiment in the promotion of human resources by the introduction of the microcomputers into teaching establishments in the Kingdom of Morocco. Among the key factors in Morocco's socioeconomic situation involved by the project, it is well to mention education. This is a subject of constant preoccupation which determines the country's socioeconomic future and which, in view of its cost, is a very important effort being made by the state.

Informatics in education was limited at the beginning of the project almost to the university alone and to the colleges of university level such as those for engineering which had available equipment used for both research and informatics training, and to a number of technical teaching establishments (mainly accounting). On the other hand, informatics was absent in elementary and secondary education. This is why the Ministry of Education, aware of the probable impact of informatics in the education field, sponsored the first national seminar on informatics and education in 1981.

The seminar made it possible to determine the status of the ideas and to examine the experiments made in the West and established the main heads for reflections on the subject. This later led to the emergence of at least three projects, namely the introduction of microcomputers into technical schools, a Logo-using experiment in an elementary school and the idea of a human-resource promotion project by the introduction of microcomputers in teaching establishments. The last project, initiated by Association Marocaine de Prospective (AMP), obtained the consent of the Ministry of Education and of the Inter-Governmental Bureau for Informatics, which agreed to finance it.

It is important to stress the project's characteristics because they reveal its originality:

- The project is informal i.e., there is no organized computer-handling or programming being taught, no computer-assisted teaching or specific software. A micro-computer has merely been made available in an open space at the disposal of students, teachers, administrative personnel and any interested parents;

- The environment around the computer has been organized thanks to the training of moderators selected among the establishment volunteer teachers and software and equipment maintenance technicians;

- The project is independent in the sense that a project committee which includes those in charge of education from IBI and from AMP is charged with its follow-up and evaluation;

- Financing of the project is assured, as far as the equipment is concerned, by an IBI loan, and as far as the operation is concerned, by the Ministry of Education.

Evaluation of the project is made at four levels:

- At student level, to be noted generally speaking is an improvement in participation and in a spirit of innovation; new relationships with teachers; a new attitude to technology with fewer myths and complexes; curiosity and a constructive attitude;

- At teacher level, attitudes have varied from rejection to enthralment; a strong demand for information and training arose; interesting discussions on program adequacy and the new tools became established;

- At education policy level, informatics will henceforth be considered as deserving of consideration in any future education system;

- At the socioeconomic level, a number of practical applications have seen the light in the schools, among which some that go beyond the school environment - new initiatives have been taken by the Ministry of Education (vacation camp and microinformatics), by Association Marocaine de Prospective (creation of young science clubs among high school students). Founding of private schools oriented towards the training of young people and the development of research and in the field of the two-alphabet computer.

On the whole the project has been an enriching experience in a sensitive field, it represents a different approach from those used in numerous developed countries, in the sense that its aim is to learn in order to better perceive an integral education policy on vanguard technologies.

In view of the results it is now possible to envisage the project's extension. The project committee, after having examined the first results, has recommended the extension of the project to 360 schools in six years. This represents the purchase of 3,500 microcomputers and the training of 1,000 moderators, 700 group leaders, 34 teachers and 187 maintenance technicians. The project's specifications have been drawn up and its financing is currently under study. (<u>IBIPRESS Bulletin</u>, No. 100, 1 October 1986)

<u>Electronic education covers Alaska's backwoods</u>

In an isolated village far above the Arctic Circle, a young Eskimo intently studies a computer screen filled with data, part of a University of Alaska (UA) business course delivered entirely by videotex. When she finishes the lesson, the student takes a test that is scored within seconds by a computer 1,000 miles away in Anchorage. When she needs to do library research, she turns to an electronic card catalog - covering the UA library's entire collection - to find and order the books she needs. She also has access to the latest issues of professional and general-interest magazines delivered via one-way teletext, and to educational software sent to the local school's Apple II via low-powered TV signals.

That's the vision shaping up for "LearnAlaska", the world's most technically advanced and geographically extensive electronic educational system. By the time she graduates, this student will earn a degree in business from UA without ever leaving her community, and might then stay on to administer her village's financial interests. Another student might study to be a nurse-practitioner, bringing modern medicine to the village for the first time.

Along with hundreds of other high school and college students in remote villages scattered over a territory a fifth the size of the entire "lower 48," they will take most of their courses via interactive videotex and telephone conference calls, supplemented by one-way television lectures and class discussions delivered by satellite from "LearnAlaska's" Anchorage studio.

Run jointly by UA and the state Department of Education, "LearnAlaska" is a response to the challenge of educating a scattered rural population. While almost 90 per cent of Alaska's 400,000 residents live in the Anchorage-Fairbanks-Juneau triangle, the rest, mostly Indians and Eskimos, live in 365 communities scattered over 586,000 square miles of rugged terrain. About 85 per cent of these communities are reachable only by water or air - and they are in need of nurse-practionioners, business managers, and other professionals.

"LearnAlaska's" heart is the world's largest teleconferencing network; during the 1984-85 school year, it handled 5,782 conference calls involving a total of 38,400 users. Many of these calls were classes, but they also included administrative meetings, a statewide elementary-school contest resembling TV's <u>College Bowl</u>, an original radio-type play with student actors (and the audience) located at a variety of sites, and labor negotiations between the state and widely scattered unions.

With 4,500 Apple IIs in classrooms and the nation's highest percentage of computers to students, Alaska is intensely interested in videotex, teletext and software teledelivery. Videotex, which will operate over long-distance telephone lines between the remote sites and "LearnAlaska's" host computer, is beginning to deliver interactive training modules. UA officials expect videotex to quickly become an important adjunct to the "LearnAlaska" system, providing complete courses and supplemental material, electronic textbooks, and interactive testing for courses taught via audio conferencing.

Teletext and teledelivery of software, which got their start with "LearnAlaska" two years ago, are moving more slowly. Both programs use the vertical blanking interval (VBI) - the blank bar transmitted between frames of conventional TV signals - to send data over the educational TV network. The teletext and teledelivery signals are more sensitive to noise than are regular TV picture signals, so each of the state's rebroadcast stations must be tested and adjusted separately to deliver them properly.

In spite of these problems, "LearnAlaska" remains interested in both systems, because they promise inexpensive channels for one-way delivery of large amounts of information. Operations manager Charles S. Hickman says several ambitious proposals such as the UA card catalog - which will be one of the largest teletext projects ever undertaken in terms of data delivered - have already been submitted to the state legislature for funding. In the meantime, the VBI has been used to deliver teletext editions of popular magazines and samples of educational software to several remote sites in the "LearnAlaska" network.

"LearnAlaska" also makes heavy use of two electronic mail systems: one is based at the University of Alaska, and the other, run by the Department of Education, connects the state's 52 school districts. These networks have almost completely replaced voice telephone for administrative communications, mainly because their store-and-forward capability allows users to receive and send messages at their convenience - a vital feature in a state that spans four time zones. (High Technology, July 1986)

Informatics in Spanish and Portuguese schools

Just as numerous other European countries where informatics systems are gradually being installed in schools, Spain and Portugal, who recently joined the European Community, have also taken a turn in this direction.

As far as Spain is concerned, the introduction of informatics in schools falls midway between the German and French models. The Spanish model recalls the German system by the decentralization of certain of its projects, that are being carried out at regional level. One could mention among them the Catalonian region which signed a contract with Bull and Thomson for the purchase of 1,000 nano-networks for secondary education, and which is also negotiating with French editors for the transfer of software.

The Spanish Ministry of Education and Sciences, after the French model, last year launched the Atenea project, an experimental plan for the introduction of new information technologies in primary and secondary schools. Drawn up to cover a five year period, this project already covers 30 primary and 30 secondary schools and 56 centres where teachers are being trained. Five personal computers with respective colour monitor and 2 disk drives have been installed in each of these establishments.

For the moment, the creation and distribution of educational programmes and teaching units, as called for by the Atenea project, have been halted by the high cost of quality programme production and by the drawbacks connected with the translation of the existing programmes.

As for Portugal, a number of innovations have appeared. This country, which has a tradition of national plans in which everything is centralized, has begun the implementation of its informatics projects in schools with completely decentralized programmes. The introduction of informatics into non-university teaching has, until now, gone forward upon the initiative of five universities. After a discussion period that lasted two years, concrete plans were made in 1985 to obtain results in 1988, even if there is as yet no definitive agreement with regard to equipment, utilization strategy and teacher training. (IBIPRESS Bulletin, No. 96, 1 September 1986)

The school micro situation in Europe

According to extremely painstaking statistical studies carried out by Intelligent Electronic Europe, the installed microcomputer population in European education systems (primary, secondary and university) amounts to around a million units. The introduction of informatics into the school has been done differently in each country.

Going by this study, France heads the list with 27.6 of the total, followed by Great Britain (25.3), then by FRG (13.8), Italy, Spain, etc. The forecasts for 1990 are that there will then be approximately three million units.

Great Britain pioneered the introduction of computers in schools. Three consecutive plans were subsidized in 1981, 1982 and 1984 by the Department of Trade and Industry (DTI) to encourage schools to equip themselves. In each plan, each school was authorized to choose its equipment from that offered by three British manufacturers.

In fact, the main problem associated with these plans was precisely the choice of the domestic product. In an environment of rapid technological evolution this equipment very soon became obsolete so that, today, it is very expensive to replace this apparatus, considering the numerous investments already made with regard to software, networks and training.

In France, on the other hand, the informatics plan for all, launched at the end of January 1985, which calls for the delivery of 120,000 micro-computers to schools, high schools and colleges in France, was carried out within a one-year period and 110,000 teachers have been trained, moreover, the school or university rooms in which the informatics equipment is installed are accessible to all adults; 50,000 informatics shops have gradually been opened to the public. Nevertheless, certain problems have arisen with regard to software because of the limited choice of software available at the time the plan was launched.

In the Federal Republic of Germany, computerization levels vary from region to region because the educational system is very decentralized. In fact, there is no federal plan or budget for education, each of the Länder is free to draw up its own informatics plan. Since 1980, the teaching of informatics is being introduced into each land in various forms and a standard informatics examination was established in 1981. (IBIPRESS Bulletin, No. 94, 18 August 1986)

ARTIFICIAL INTELLIGENCE

Forum on artificial intelligence

About 50,000 people assembled in June 1986 at one of the largest conferences ever held to discuss artificial intelligence. About 40,000 delegates from the US and 10,000 from Europe were linked by satellite for what was described as the first Transatlantic Satellite Symposium.

Sponsored by the US chip maker Texas Instruments, it linked up artificial intelligence researchers on both sides of the Atlantic. Speakers included Ed Feigenbaum, from Stanford University, John McDermott, from the Carnegie Group, and Harry Tenant, of Texas Instruments.

The formidable list of speakers and the sheer size of the event should indicate the importance now attached to artificial intelligence. Expert systems will be high on the agenda. The notion of capturing the human skills and knowledge in a computer system, turning it into a set of rules and presenting it to non-experts is an attractive one.

Over the past two years there has been a boom in development tools ranging from proprietary "shells" to standard programming language compilers designed for artificial intelligence applications. This boom suggest that a lot of development activity is taking place.

Texas instruments held a European-based satellite conference on artificial intelligence last November, when it surveyed the delegates to measure how much development activity there is. From 3,000 replies it found that 47 per cent of the delegates, from across industry and commerce, intended to spend money soon on artificial intelligence developments. Expert systems have thus moved out of the research laboratory and into the real world.

The big commercial computer manufacturers declared their commitment to artificial intelligence and expert systems last summer when large numbers of products were announced. Xerox, Hewlett Packard, Tektronix, DEC, Data General, Texas Instruments, Acorn and Commodore all launched Lisp language compilers to work with their computers last year. Lisp is the favoured language in the US for building artificial intelligence applications and a requirement for US Department of Defence projects in artificial intelligence. Such projects figure strongly in the computer part of the Strategic Defence Initiative research effort by the US military.

IBM also put its first artificial intelligence products on to the market last summer. Its commitment to new directions, by announcing products, often becomes a reference point in the future: its move into the business computer market in the early 1960s with the announcement of the IBM 360, its announcement of the IBM personal computer in 1981 and the recent move into local area networking. In the past year IBM has made significant expert system product announcements, suggesting that this area of development is set to expand. These announcements culminated in April this year when IBM announced an expert system designed for its important mainframe customers.

There has also been progress in applying expert systems in the computer industry itself and manufacturers are using them to help fault diagnosis in computer systems.

Texas Instruments, for example, uses an expert system for finding faults in circuit boards and one of ISI's clients in the insurance business is using an expert system to help to find faults in a computer network. DEC has been using an expert system to help configure its computer systems for some years. These applications are relatively easy to build because in every case there is a strong body of formal knowledge. So the rules needed to define the "expertise" were well-established. Examples of expert systems in use in commerce, where the knowledge needed to build a system is not so well-defined, are still rare, however.

Perhaps the most significant recent development has been the inclusion of artificial intelligence techniques in popular software products. Ansa Software's Paradox database and the Q and A database from Symantec are two products aimed at the personal computer software market which have adopted this approach. These two products, both developed in the US, have used artificial intelligence ideas to help make them easier to use. Symantec, for example, has built a "natural" language front-end to its database product. The large number of personal computers now in use promises to be a strong market for these products. It is also the area where people are likely to get their first glimpse of expert systems in practice. (Financial Times, 30 June 1986)

AI research behind the laboratory door

The bright lights that shine on AI are focused almost exclusively on commercial expert systems. But an important community of human AI experts is hidden from public view. Theirs is the seldom examined world of AI research, where the technology on which the field's future depends is now being developed. Research efforts behind the laboratory door - in key areas like expert system knowledge representation and problem solving, connectionist systems, and natural language - will determine whether commercial AI has a future or whether expert systems will mark the end of AI dreams.

According to the Massachusetts Institute of Technology's Patrick Winston, a leading advocate of AI technology, "Today's expert systems are idiot savants - their knowledge is very thin." Both the quantity and breadth of the information that can be stored in an expert system's knowledge base is limited. Consequently, researchers are paying increased attention to the problems of how to represent knowledge and program it into knowledge bases.

To date, nearly all expert systems have attempted to solve problems using the rule-based approach. That's because it's still not easy to pin down a live expert, convert his or her meandering discourses into specific if-then rules, and get it all up and running on a Lisp machine. But it's desirable to reach beyond rules because, according to Winston, "It's often the case that in order to deal with a problem you have to look at it from different perspectives." So researchers are also planning to add a variety of problem solving strategies to make it possible for expert systems to tackle more perplexing puzzles.

Ohio State University Professor B. Chandrasekaran is one AI researcher who has attempted to define the multitude of solution techniques that complex problems require. Generic tasks is the term he has coined for these; they include classification, hypothesis building, and precompiled problem solving plans. Classification, he says, is perhaps the most universally applied generic task. By classifying, an expert relates a single situation to a larger group of like cases.

Beyond simple classification come classification hierarchies. A classification hierarchy uses a tree-like pruning process to build the hypothesis that best explains the problem. Large groups of probable solutions are whittled down to smaller sets, and eventually to individual elements. Often, though, several different hypotheses may result, with each explaining a different portion of the problem. Another generic task, called abductive reasoning by Chandrasekaran, attempts to merge the different possibilities into a single, composite hypothesis.

A precompiled problem solving plan is another commonly used tactic. Here, the expert begins with a broad plan of attack. Once into the problem, the solution strategy is refined along the way, as per the peculiarities of the different components of the situation. Chandrasekaran built a medical diagnosis expert system called MDX to help refine his ideas on classification hierarchies. He is currently at work on MDX 2. This expert system, he hopes, will serve as a testing ground for generic task research on reasoning and precompiled problem solving plans. As the ideas develop further, they should migrate over to commercial expert systems.

On the knowledge base front, researcher Lawrence S. Lefkowitz, at the University of Massachusetts, Amherst, is one of those professionals trying to bring method to the currently haphazard process of building and upgrading the mass of domain-specific information - a synonym for knowledge base - stored along with each expert system. To this end, he has built a prototype matcher for knowledge acquisition. Currently, most knowledge bases are built by interviewing experts, analyzing written transcripts of these interviews and attempting to form rules, and then trying to program those rules into the system. Lefkowitz's system is an attempt to help formalize this seat-of-the-pants approach. "[It] sticks with the same general scenario of a domain expert trying to get information into the system through an intermediary and simply automates the intermediary," he says.

Developing such standard methodologies may be a start towards cracking the tough problem of building reusable knowledge bases. Right now, knowledge bases are like the custom-fitted machines made in the early days of the industrial revolution. Although an existing knowledge base might cover the domain of an expert system under construction, that knowledge base is so deeply intertwined with its host that it is impossible to disentangle and transfer useful information over to the new system, however similar it might be. Reusability will become particularly important as today's relatively small expert systems and knowledge bases grow. Lefkowitz's matcher works in three steps. The user generates a rough formal representation of the information that is to be incorporated into the knowledge base. The matcher takes the information contained in that representation and analyzes it, grouping it into different categories. The matcher then compares it against the existing knowledge base and generates expectations.

This expectation generation is the key to the matcher's utility. The expectations - so called because they are pieces of knowledge that the matcher expected to find within the representation based on its analysis - are used to alert the expert system designer to the missing details needed to fill out the knowledge base.

In expert systems more than in any other AI research area, the dividing line between the laboratory and the market place is often blurred. Large corporations looking for help with complex manufacturing and design problems are funding expert systems development projects. Often, these projects lead to advances in underlying expert systems technology. Mark Fox, a Carnegie-Mellon University professor and co-founder of the Carnegie Group, a commercial expert systems house, is one researcher with a foot in commercial expert systems development.

To help design an expert system for Westinghouse, Fox, who is director of Carnegie-Mellon's Intelligent Systems Laboratory, went with CMU researchers into factories to observe and analyze human schedulers on the job. There they studied the semantics of manufacturing in an attempt to model the activities that go on in a manufacturing environment.

"That led to the juggler theory of how human schedulers make decisions," says Fox. "They were on the phone all day, speaking to people in different parts of the factory." The conversations were to collect inputs from planning, marketing, tooling, and production department. Fox's observations led to the theory of constraint-directed reasoning. It is used to smooth out work flow, to avoid the industrial mayhem that can result if parts shortages, quality defects, and rush orders disrupt a manufacturing operation. The theory was applied in several expert systems, starting with ISIS. Begun in 1980, the Intelligent Scheduling and Information System has since been delivered to Westinghouse and successfully used to smooth work flow at a turbine manufacturing plant. CMU also applied the theory to Callisto. Funded by Digital Equipment Corp., this expert system schedules and manages the activities surrounding computer design projects.

But when truly intelligent systems arrive, they probably won't run on the single-processor computers that are home to most of today's primitive AI experts. Instead, researchers are looking toward massive parallelism to divide up problems and conquer the sequential computing bottleneck. Today's massively parallel - thousands of processors - AI designs exist mostly in the minds of their creators as connectionist systems. Connectionist systems is an important but arcane and little known AI research area, so named to emphasize that the multiple communications links between processors are the key to their computing power. ...

With their myriad message paths, connectionist systems are often likened to the human brain and nervous system. This has lately become a hackneyed analogy - no one really knows much about how the brain computes. But that's one of the things researchers are hoping to learn more about by studying this, the brain's electronic counterpart.

Division of labor is the key to how connectionist networks compute. They execute algorithms that have thousands of minute, specialized functions. Each function runs in a separate processor; the processors communicate with each other over the vast network. Taken as a whole, the combined action of these thousands of individual processes results in learning and other intelligent activity.

"The [connectionist] systems are extremely uniform and homogeneous. There is just one kind of unit that communicates with other kinds of units in a very stereotyped fashion - it isn't as if you have lots of special cases," says Richard Sutton, a researcher at GTE Laboratories, Waltham, Mass. "So you can think up learning methods that will apply to that one unit and then, however they're [re]connected, whatever they're doing, that one rule will [still] apply.

Specifically, Sutton is trying to learn how to implement learning rules in computers. ("Learning rules" is a subset of, not a synonym for, intelligent activity.) As part of his research, he simulated a simple system that tried to learn how to balance a simulated broomstick on a simulated hand.

At the University of Rochester, Feldman and company are pursuing a slightly different tack in modeling systems with intelligent function. Unlike Sutton's empty vessels, Feldman's systems start out with lots of structure or a priori information. For example, a Feldman version of the broom-balancing experiment might give the computer information about hand movements and centers of gravity. In practice, this added structure allows them to attempt to simulate intelligent activitiy in situations of greater complexity than can be handled with Sutton's approach.

Yale University Professor Roger Schank is also studying how humans learn, looking at what he calls a "theory of creativity." Schank developed the idea of explanation patterns. Like a standard script, an explanation pattern is a reflex-like response that seeks to fit a reason to an event. But sometimes standard explanations - e.g., event: a car's fender is crushed; explanation; it's been in an accident - won't do.

Along with his theory, Schank has written an anomalous-events explainer program for a computer. It uses a standard set of explanation patterns and tries to apply them to various situations. The hope is that the program, like a creative human, will apply the explanations in ways that can't be anticipated ahead of time.

Marvin Minsky, one of the founding fathers of AI, no longer carries out experiments, but works as a broad-brush thinker instead. Lately he has been thinking about the Society of Mind system, a theoretical attempt to construct a general intelligence. It is also based on massive parallelism. The Society system links together several thousand experts (in the form of processors). But unlike conventional computer programs, they communicate with each other via end results, rather than sending out intermediate data and commands.

As envisioned, each processor represents a different expert. (The clearest analogy is to think of each expert as an expert system. But, the term "expert system" is eschewed by AI academics because of its association with today's primitive rule-based commercial offerings.) All would be loosely connected with one another, with interexpert communications co-ordinated by a black box that knows what each expert is good at, but doesn't know or care how each works.

The main problem in realizing a practical Society of Mind system lies in developing this "weak" theory of communication to link the processors, says Minsky. He believes that a prototype is at least 10 years off.

While the Society of Mind is closely linked with connectionist research, Minsky says that, strictly speaking, its part of the AI research area called common sense reasoning. Minsky is now finishing a book, called The Society of Mind, detailing his theories. (It will be published by Simon & Schuster later this year.)

If today's AI applications are ever to gain widespread acceptance in the workaday world, they must speak a language their users can understand. The majority of those users will not be engineers and programmers; they're not going to learn computerese. Instead, the AI applications must learn English. To this end, natural language researchers are trying to develop ways for machines to understand spoken and written input.

A long-sought goal is to build a system that will be able to read text, convert it into a database filled with information about that text, and use the database to answer questions and write essays about it. "[Today] we can do it in the small, but it'll be a long time before those are really practical systems," says Robert F. Simmons, a leading natural language researcher and professor of computer science and psychology at the University of Texas at Austin.

Although Simmons refuses to speculate on exactly how long that may be, his efforts illustrate the extraordinary complexity of the undertaking. "I've been working on that for about 25, 30 years, with small progress," he says. But over that quarter-century, the combined efforts of natural language researchers like Simmons have not been in vain. Their work has provided a solid foundation for the field.

Simmons drew on that base for his latest project. For the past four years, he has been working to get his system to understand a bible of sorts. His book, however, is The Handbook of Artificial Intelligence (three volumes, edited by Cohen and Feigenbaum; William Kaufmann Inc., 1982). This highly technical tome is widely recognized as the definitive guide to artificial intelligence.

Because of its mathematical bent, Simmons felt it would be ideal as a test text for his natural language software. He is trying to represent that text in logic, to write grammars that will translate the text into that logic, and to get the system to answer questions on the text. "So far, we have a grammar that is very well behaved for about 20 pages of that text. And we have question-answering capabilities, but in the questions that it can answer, it's not very powerful [today]," he says. Simmons continues to improve his expository text processing systems, however.

In contrast to the in-depth understanding approach of Simmons, Yale University's Schank built FRUMP. The Fast Reading and Understanding Memory Program took stories off the UPI newswires, skimmed them, and produced a brief summary of the key points. "Now what we're doing is reworking [FRUMP] to read news and produce questions - to come up with hypotheses about why things are happening, the way they're happening, and use those hypotheses to go into future stories," says Schank.

A major limitation of today's natural language systems is that they work best when handling a single domain or field. According to Schank, "The problem that you have in natural language is one of multiple domains. So if you ask a program to read the newspaper you have thousands of domains. You have to put an awful lot of information in there - that's very hard. The problem [with] answering questions and wondering isn't directly a problem of natural language, its a problem of the nature of thought and wondering. That problem remains to be solved, and is certainly significantly part of the natural language problem in principle."

That solution process, according to the University of Texas's Simmons, will be as interesting as the problem itself. "One of the beautiful things that has come out of our concern with artificial intelligence and natural language in computer science is that the psychologists are looking at learning differently, they're looking at language differently."

But even as science increases its understanding of intelligence, the definition of exactly what intelligence is will likely remain a moving target. "I see it [intelligence] as the ways we solve problems that we don't understand yet. Because once you know how to solve a problem, you don't regard it as requiring intelligence," says MIT's Minsky. (Reprinted with permission of DATAMATION magazine, 1 August 1986, copyright by Technical Publishing Company, A. Dunn and Bradstreet Company, - all rights reserved.)

AI research in the UK

Artificial intelligence is now of such national strategic and economic value that the free exchange of ideas among scientists is being restricted. The danger is that the UK, already lagging behind the US in developing artificial intelligence, will be excluded from the latest research and fall irretrievably behind in the race to exploit the technology.

Professor Roger Needham, head of the Cambridge University Computer Laboratory, says that barriers are coming down on free trade in academic research in the subject. He claims that fellow academics in the US are no long so forthcoming about their work because of its strategic importance. Needham, who argues that the UK must be more self-reliant in artificial intelligence, has been instrumental in setting up a research centre in Cambridge. The centre will be run by one of the world's leading experts, the US firm SRI International.

The Cambridge centre, which has backing from British Aerospace, British Telecom, Hewlett-Packard, ICL, Olivetti, Philips and Shell Research, as well as the UK Alvey programme for advanced information technology research, will be headed by SRI's Bob Moore, an American, who says that while restrictions on moving expertise across national boundaries has not had an effect on basic research yet, the danger is that it will soon.

The centre will be able to draw on the expertise of SRI, which is said to employ a fifth of all US artificial intelligence scientist. The centre will work closely with its industry collaborators, each of which will contribute £75,000. SRI director Gordon England believes that the quality of software will effect the performance of national economies: "Artificial intelligence is becoming a major strategic resource which won't be traded across frontiers. It is, therefore, vital to have leading edge research in Europe."

The centre's first project will be in natural language processing (NLP), with the aim of producing a core natural language engine. The engine will be used to create interfaces to interactive computer systems. Natural language processing gives a computer the ability to understand the system and grammar of English language.

UK industry has been "slow and reluctant" to fund NLP research, says David Shorter, director of Alvey's Intelligent Knowledge Based Systems programme. There is very little academic research in this area: a recent survey found only 30 industry-based NLP researchers in the UK compared with over 800 industrial laboratories in the US. NLP is also the odd-one-out in the Alvey programme. All other areas of research are 70 per cent funded by industry, but in NLP only 30 per cent of the money has come from industry. Shorter says this means there is little prospect of any technology transfer in NLP, despite its economic potential. Tony Weaver, of Philips, who will chair the NLP project group, says that the opportunity to try out real code developed as part of the programme will give the industrial partners "a major edge in terms of time". The NLP project will take three years. Moore says the aim is to produce a core natural language engine that can be used to create interfaces to any interactive computer system.

The potential of artificial intelligence is "almost frightening", and companies which ignore or resist this potential do so at their own risk. This warning was sounded by Bryan Nicholson, chairman of the Manpower Services Commission, speaking at the AI – Industrial and Commercial Applications Conference in London recently. He told delegates that "it will be easy to get left behind" in the rush to commercialise artificial intelligence research. (Computer Weekly, 25 September 1986)

Pro and contra LISP

LISP expert systems are more useful*

Lisp continues to be the language of choice for artificial-intelligence research. But the question is, should Lisp programs be translated into conventional languages for the commercial world?

The answer is simple: no. The path from the laboratory to the field is smoothest when both worlds use the same programming language.

Lisp has unique features that are not only difficult to develop and use in other languages, but that are fundamental to writing expert systems. Expert systems in Lisp can be more functional, flexible, and useful than what can be achieved using other languages.

A Lisp system can extend itself by writing, compiling, and dynamically linking code. Another feature is that functions (programs) can be created, passed as arguments, and returned as values. A third feature, dynamic storage allocation, means the programmer need not directly manage memory allocation and deallocation and he is not limited to stack-like allocation schemes.

Because of these features, a Lisp-based expert system can be flexible and respond to the situation in the field, even reconfiguring itself to meet changing needs. Translating an AI application from Lisp to another language for delivery to a targeted market cannot be justified if the Lisp version is fast enough, integrated with the commercial environment, and small enough to fit on the computers that are to be used.

One misperception of Lisp is that it is inherently slow because it is simply an interpreted language. But in fact, all Lisp systems in serious use since 1959 have had compilers.

Another misperception is that Lisp must do type checking at run time. Again, for several years, Lisp systems have had declaration facilities that enable a programmer to direct the compiler to avoid run-time type checking.

Yet another notion clouding Lisp's reputation is that garbage collection must be done during the execution of any application program. This is not necessarily so. Explicit memory-management techniques can be and frequently are used.

C is occasionally mentioned as an alternative to Lisp for expert-system delivery, and its performance is cited as a major attraction. But Lisp is not necessarily slower than C. Lisp and C have similar performances on problems for which both languages are appropriate. Benchmarks for three such problems rated Lisp from 20 per cent slower than C to 30 per cent faster. These benchmarks do not represent a wide range of applications.

Expert systems must also integrate with commercial computing. Current Common Lisp systems interact with other systems by invoking non-Lisp code. In many systems, the foreign code can also call Lisp code as if it were a subroutine. Protocols for foreign function calls have minimally adequate functionality at present but are certain to improve rapidly.

Size is another major factor in the delivery of expert systems. Lisp-based expert systems have many megabytes of code and data, with a significant proportion being the underlying Lisp system. Expert systems delivered on run-time Lisp systems that include just those functions needed for deployment are often small enough.

Before very long, even personal computers will be large enough and powerful enough to run today's complex expert systems easily. And then, better expert systems – ones using the full power of Lisp development environment – can be delivered on personal computers.

AI is a field whose fruits can make a significant contribution to the efficiency and

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* By R. P. Gabriel, originator of Common Lisp.

usefulness of computers in the business and commercial world. As with any scientific field that has practical applications, a continuous flow of techniques from the research laboratories into the commercial world is critical to the heath of both the scientific field and the commercial enterprises that can benefit from the techniques.

There is simply no good reason to deliver AI in anything but its natural language - Lisp.

LISP is not needed for expert systems*

The commercialization of expert systems requires that the technology be delivered in traditional procedural languages. The importance of languages other than Lisp for delivery of expert systems stems from a number of sources, one of which is the fact that these systems will run more efficiently (require less memory and run faster) in these languages than they will in Lisp when installed on mainstream computers.

Run-time efficiency is fundamental to the economic deployment of computer applications. It is advantageous, for this reason alone, to provide expert-system technology in traditional languages as one of the primary steps towards commercialization.

Expert-system technology is packaged and used in the form of software tools, such as Inference's Automated Reasoning Tool (ART), that are designed to support the interactive process of knowledge engineering and to provide the inferencing capability at the heart of successful expert systems. Most of these tools have been, and continue to be, written in Lisp - and rightfully so, since Lisp is the language of choice for artificial-intelligence research and development.

However, those who use these tools to build expert systems are developing applications, not performing AI R&D. For these people, the language of choice is the particular tool that they use to build their application. These tools are not tied to Lisp; their underlying AI technology can be delivered in traditional languages without loss of functionality, robustness, or power.

No one has yet created a version of Lisp that has its full range of benefits as a development language without suffering significantly degraded efficiency at run time. Because the power and flexibility of Lisp for exploratory development is not needed when using expert-system development tools, its cost in run-time efficiency can therefore be avoided by not using Lisp.

Moreover, garbage collection, which is so valuable in exploratory development, can be particularly burdensome at run time for a practical application. Batch garbage collection leads to randomly occurring, oftentimes lengthy pauses in the operation of an application at run time. The alternative, incremental garbage collection, avoids many of these pauses but leads to a general reduction in run-time efficiency.

Traditional languages, on the other hand, have less of the power and flexibility of Lisp for development, but are optimized to run software efficiently. Moreover, most existing software applications are written in traditional programming languages. Therefore, it is easier and more efficient to interface expert systems written in non-Lisp languages to existing applications software.

Finally, there are situations in which it may not be permissible to deliver an expert system in Lisp. The most obvious examples are defense installations that require Ada.

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* By A. D. Jacobson, President, Inference.

The conversion of a tool like ART to a traditional language can be done without loss of AI functionality and will neither destabilize the product nor bar its users from programming the procedural part of their expert system in Lisp if they choose to do so, because all major versions of Lisp now or soon will support calling to and from other procedural languages. The advantages of run-time efficiency, interfaceability, programming-language doctrine, and conventional acceptability dictate that such tools be deliverable in non-Lisp languages to take advantage of such important benefits. Given these considerable advantages of delivering expert systems in non-Lisp languages, there is no compelling reason not to do so.

All of the foregoing delineates the reasoning behind Inference's decision to support non-Lisp versions of its product. Put simply, it reduces to this: non-Lisp language implementation delivers full-power expert-system technology in the traditional commercial form that business and industry have come to expect. (Reprinted from Electronics Week, 7 August 1986 (c) 1986, McGraw Hill Inc., all rights reserved)

COUNTRY REPORTS

Brazil

How Brazil cornered its own small-computer market

Edson Fregni and Polish-born Josef Manasterski are the Steve Jobs and Steven Wozniak of Brazil. Jobs and Wozniak founded Apple Computer Inc. in a San Jose (California) garage. Fregni and Manasterski started Scopus Tecnologia in a little house near the University of Sao Paulo. On a chancy $10,000 investment a decade ago, the small computer-design company has become Brazil's third-largest manufacturer and marketer of micros, peripherals, and software, with annual sales of $75 million. What's more, the two 39-year-old engineers have become leaders in Brazil's nationalistic drive to compete in computer technology.

Much of their success is the result of Brazil's "informatics" law, which is straining relations between the U.S. and Brazil. The law restricts imports into Brazil of micros and minicomputers and advanced industrial equipment. It also regulates joint ventures with foreign companies. That's how Brazilian companies in effect have roped off for themselves a computer market worth $1.3 billion and growing fast.

The government and Brazil's computer makers say the law is essential to economic development and national security. But increasingly, even Brazil's manufacturers complain that the policy prevents them from modernizing fast enough because it limits choices in technology.

Manasterski concedes that without the informatics policy, Scopus wouldn't be where it is today: "It was good timing that we started out when the ideas of the policy were germinating." Every month, the publicly held company's 1,300 employees churn out 1,000 IBM-compatible 16-bit Nexus 2600 computers and smaller Apple-compatible Spectrums at a new Sao Paulo plant.

In all, the law has helped spawn 18 national computer makers, 80 to 90 peripheral producers, and 150 or so service companies that offer jobs to some 6,000 computer engineers. Adds Fregni: "In a couple of years there should be a pool of some 20,000 specialists in the computer field in Brazil."

Some foreign companies just grin and bear it. General Electric Co. recently agreed to a deal that permits a local company to market GE computer-aided design technology and systems.

International Business Machines Corp. and Burroughs Corp. can sell mainframes, a $1.3 billion-a-year market. But they cannot compete at all on smaller machines. Because of that, Burroughs has shut down production of micros and has reduced its operations in Brazil by more than half in recent years.

Brazil will probably open up more for foreign computer makers only when its voracious appetite for growth demands new investment. In the meantime, Fregni and Mamasterski will keep trying to duplicate Apple's success, Brazilian style. (Business Week, 11 August 1986)

EEC

European IC strategy gets Esprit boost

Microelectronics is to get a lion's share of the Esprit II $7bn budget. Proposals include plans for a "one-month silicon" project for the rapid design and prototyping of gallium arsenide, bipolar and CMOS devices. The intention is to make Europe dominant in the application specific IC (ASIC) market. According to Jean-Marie Cadiou, director for Information Technologies within Esprit, the aim is to be able to design and prototype one million transistor complexity chips within one month by the early 1990s - a process that he said now takes about one year.

Cadiou sees no one company or country building a market lead. He feels it is a business Europe can dominate as long as it develops the basic processing capabilities. Cadiou said that the Commission believes that ASICs will account for 30 per cent of the total IC market in the next decade. Overall, he added, microelectronics will be around one third of the Esprit II spend. Although firm decisions on Esprit II have yet to be taken, the belief is that another 30,000 man-years of effort are needed to achieve the original 10-year aim, of Europe developing the enabling technologies, which will make it industrially competitive in the 1990s.

In the microelectronics arena, Cadiou stressed that with less and less second source licences on micro-processor devices being granted, it is essential that Europe gets absolute control of its own microprocessor industry.

Proposals to go before the Council of Ministers state the work in the microelectronics sector should include: high density integrated circuits - the provision of random logic ICs with up to four million gates; and high-speed integrated circuits for real-time applications such as telecoms front-end processors.

The target performance here will be operation between 5GHz and 10GHz clock frequency or gate delays less than 50 picoseconds and complexity greater than 10,000 gates. Towards this end, the main activities will be the development of fast process technologies in silicon bipolar and GaAs FET technologies, and development of special CAD tools to optimise circuit speed, and development of special packaging techniques. (Electronics Weekly, 8 October 1986)

Esprit II is the last

There will be no Esprit III. Although plans are currently on the table for the second phase of the European 10-year programme, Esprit Information Technologies director, Jean-Marie Cadiou said last week: "There will not be an Esprit III, so what we achieve we must achieve in the second phase." But even in Esprit II, there is some contention over both financing and the definition of what can and can't be called pre-competitive.

Draft plans for the entire European high-technology framework programme (of which Esprit is just one part) propose funding levels of 7.73bn ECUs, but it is known that some major member states are going for a lower figure. (Electronics Weekly, 8 October 1986)

France - Italy

Gallium arsenide in France and Italy

The national microelectronics programme in Italy and the laboratories of Philips of Holland in France are carrying out research on the development of semiconductors in which gallium arsenide replaces silicon.

In one of the five subprojects making up the Italian national microelectronics programme, the one dealing with materials and devices for microwaves and optoelectronics, the high speed of the free charges in GaAs and its light-emitting properties are used to generate transmissions and receptions of signals in the frequency bands of microwaves, infrared waves and visible light.

In France, Philips' electronics and applied physics laboratories have announced the forthcoming sale of integrated circuits made of this material. In practice, the finishing touches are being made to the components of the future Cray-3 supercomputer pursuant to the terms of a contract made with the Cray research firm in 1985.

The market for semiconductors derived from GaAs amounted in 1984 to only US$76 million. Its faster growth than the rest of the semiconductor industry leads to the forecast that in 1990 it will reach US$7,000 million of which over US$1,000 million refer to Europe.

The laboratories of the Plessey firm in Great Britain, those of Thomson in France and those of Siemens in the FRG are developing devices incorporating this technology. Esprit, for its part, is developing its application in a project dedicated to the development of fast circuits as part of that European research programme.

This technology is being studied in the rest of the world as well. In Japan the public telecommunications operator firm, Nippon Telephone and Telegraph, is working on a 16kbit ram memory. In the USA, the McDonnel Douglas firm has developed, tested and manufactured a 4-bit microprocessor and is now working in the final stages of developing one with 32-bit capacity.

Despite all this progress over a sufficiently long time span, the economic aspects continue to favour the silicon technology. Its production is cheaper and the conversion costs of existing integrated production installations, not fully amortized, would be excessive. Technical factors also exist which favour the utilization of silicon. A report by Bell Laboratories indicates that as the levels of integration of GaAs integrated circuits increases, speed decreases and winds up by being the same or inferior to that of components based on silicon. It thus appears that the use of GaAs may remain focused on products of low and medium scale integration. (IBIPRESS Bulletin No. 93, 11 August 1986)

India

Gallium pilot plant goes into production

The pilot plant for the production of gallium, established by Madras Aluminium Company at Mettur based on the Central Electrochemical Research

Institute (CECRI), went into production in April 1986. The intermetallic compounds of gallium with arsenic and antimony find useful application in semiconductor and photovoltaic devices. Super fast computers depend on gallium intermetallics.

Gallium is present in bauxite to the extent of 20-80 g/tonne. In the aluminium industries, bauxite is leached in caustic soda to give the Bayer liquor, and when aluminium hydroxide is precipitated out, the remaining solution contains gallium with concentration ranging from 100 to 250 ppm.

CECRI developed a technology for the production of gallium from Bayer liquor from aluminium industries in the country and established a unit of capacity 50 g/day, at CECRI. The metal produced by CECRI was analyzed by the Nuclear Fuel Complex, Hyderabad and found to be acceptable for further purification to electronic grade. With a view to collecting additional data and assessing the feasibility of the technology, the Madras Aluminium Company, jointly with the National Research Development Corporation of India, has put up a pilot plant at Mettur (capacity 100 g/day). The results of test runs were encouraging. The experience in the operation of pilot plant and the data obtained would help in establishing gallium production units at other aluminium companies in India also. The metal has good export potential as well. (<u>CSIR [INDIA] News</u>, 30 June 1986)

<u>Bangalore becomes India's Silicon Valley</u>

Like many Silicon Valley whiz kids, software designer V.K. Ravindran dreamed of striking out on his own.

But instead of setting up shop south of San Francisco where he was working, Mr. Ravindran returned to his native India. In 1974, he settled in Bangalore, a city then known primarily for its mild climate and easy-going citizens. Three years later, Mr. Ravindran, who holds a Ph.D. from California's Stanford University, was making computers. "In those days, there were no computer manufacturers here," he recalls.

How times have changed. An increasing number of Indians who have been working in California's Silicon Valley are returning home - and in many cases are choosing to live in Bangalore. Now, high-tech graduates here have dozens of companies from which to choose. Bangalore has not only attracted domestic computer and electronics manufacturers, but European and U.S.-based multinationals, too.

Texas Instruments Inc. later this month will begin exporting computer software manufactured in the city. An Indian company here will begin to manufacture Hewlett-Packard Co. computers next year. And a number of foreign companies are awaiting New Delhi's approval to set up in Bangalore-based operations.

According to the Karnataka State Electronics Department Corp. (Bangalore is the capital of Karnataka), the following companies are waiting for government clearance to operate in Bangalore: the U.S.'s Data General Corp. to make computers, N.V. Philips of the Netherlands to assemble video recorders, Sweden's Telefon AB L.M. Ericsson to manufacture telephones, and Japan's Yokogawa Hokushin Electric Corp. to make industrial instruments.

Bangalore is India's fastest growing major city, with a population of about 3.5 million. By the year 2000 it will have six million people according to estimates by demographers at the Bangalore-based Institute of Social and Economic Change.

Nevertheless, it isn't a surprise that Bangalore should house India's Silicon Valley. The Indian Institute of Science has been widely considered the country's premier scientific university for decades. Karnataka state also boasts more than a third of the country's engineering colleges. ... (<u>Wall Street Journal</u>, 9 September 1986)

<u>Ireland</u>

<u>Developing CIM software</u>

Associated with computer integrated manufacture (CIM) are large banks of costly, capital equipment. Yet what largely distinguishes high quality production equipment is the quality of the software which drives it. And this factors gives Irish researchers with relatively constrained budgets a fighting chance in the new field of computerised factory operation.

Dr. Jim Browne of the Department of Electronic Engineering at University of Cork (UCC) explains that investing in state-of-the-art robotics development laboratories is not a viable proposition for Irish institutions. The capital outlay would be prohibitive - just one quality robotic system can cost up to £40,000. For researchers, such equipment has a limited life. Serious, competitive research would require replacements at one or two year intervals - again at huge cost. However, fuelled by industrial sponsorship and ESPRIT contracts, UCC has established a CIM research centre, which currently employs 12 researchers.

The UCC centre concentrates on software and the development of computerised design tools for the factory of the future. The centre features a fully configured VAX 11/780 system with 16MB of core memory and a dozen colour graphics terminals, presented by DEC, for which the centre carries out some substantial joint research.

This resource has grown over the past five years. Dr. Browne acknowledges that without support of ESPRIT, and the backing of Irish based manufacturers - especially DEC - the current level of work would not have been possible.

This first ESPRIT project is valued at £12 million and involves 92 man years of research, 10 years of which are being carried out at UCC over a five year period. The project, ESPRIT No. 623, falls into three portions.

- Implicit robotic programming - a method whereby a robot is programmed for comparatively broad, task-oriented commands which it will analyse and break into individual movements. This is a high level, artificial intelligence based form of programming.

- Explicit robotic programming - herre the programmer has to specify precisely each movement that a robot will make as it carries out a job. The machine has little knowledge of the environment.

- Technological planning - today's robots are single-station machines, but as they become multi-station units, which is essential for tasks like assembly, the business of designing factories and production lines is going to become far more complex. Engineers will have to concern themselves with issues as basic as preventing robots from colliding with each other and missing feeders. Production lines will have to be designed with a precision unnecessary for human workers. This means that the technological planner will have to process a vast amount of data, and will need the support of a computer system.

It is in the area of technological planning that UCC is making its contribution. The CIM Research Unit is developing an expert system (software based on artifical intelligence principles) for planning flexible assembly systems. It is known by its acronym, ESPFAS.

Technological planning in a discrete parts, batch manufacturing industry involves translating product design specifications from an engineering drawing into manufacturing or assembly operation instructions. Planners use stand-alone systems in large companies now; the aim is to integrate these facilities into an overall CIM environment.

ESPFAS concentrates on assembly. 'Assembly is an art rather than a science', explains Jim Browne. Unlike, say, machining, there is little hard scientific information which can be used to govern it. So ESPFAS uses an artificial intelligence rather than a conventional programming language.

ESPFAS takes an artificial intelligence approach, capturing knowledge from people already doing the job, says Jim Browne. The idea is that a user presents the system with a bill of materials, a list of assembly tools (robots, grippers etc.) and other data. The system then suggests a sequence of assembly operations using robotics and other assembly techniques (it points out which jobs cannot be done by robotic means). It asks questions - acts as a checklist - and will modify its proposals, coming up with alternatives if required. The rerearchers are already studying a variety of products from local manufacturers, and incorporating this knowledge into the system.

'We're not artificial intelligence experts - we're engineers who use AI. It's simply a tool; we're computer users', insists Dr. Browne.

The system is designed to show a feasible but not necessarily optimum way of assembling a product. Postgraduate researchers are working on a computer model using simulation techniques to predict how ESPFAS output would work in practice, thus allowing planners to fine hone a proposed solution. ... (Technology Ireland, September 1986)

Japan

R&D expenditure 'third'

The just released fourth edition of Japanese Electronics R&D Centers ranks Japan third, after the US and the USSR, in total R&D expenditure. The ranking is based on a 1985 survey of 112,100 private companies, 1,300 non-profit and public laboratories and 2,000 universities, all in Japan. According to the data compiled in the survey, the total Japanese R&D expenditure for 1984 (the fiscal year ending 31 March 1985) was $43.8 billion. This amount is 9.9 per cent greater than that spent in 1983.

The survey also revealed that in Japan, the private sector (spending 65.1 per cent of the total R&D dollars) was more aggressive than the public sector (34.9 per cent). Top R&D spenders were in the telecommunications and electronics industries - a subtotal of over $6.1 billion.

Japanese Electronics R&D Centers outlines the major R&D centers in Japan, detailing R&D budgets, size of laboratories, number of researchers, fields of activity and the results of recent R&D. From the report, examples of the newest microelectronics R&D efforts in Japan include:

- The Matsushita Electric Industrial Semiconductor Research Laboratory in Osaka plans to recruit researchers from Japan and overseas in a major effort into VLSI development.
- Matsushita's Kyoto Research Laboratory, established in 1985, is developing submicron processing and computer aided design techniques. The R&D budget for 1985 was $70.5 million.
- Sanyo Electric's Tsukuba Research Center is conducting R&D of future high technologies such as three-dimensional devices, new materials and "biochips". (Reprinted with permission from Semiconductor International Magazine, July 1986. Copyright 1986 by Cahners Publishing Co., Des Plaines, Il. USA)

Japan's X-ray route to superchips

Japanese companies are turning their research efforts to new ways of making microchips that carry many more components than do today's chips. Some time within the next few years, the optical equipment that manufacture use to transfer circuit patterns onto wafers is going to reach its physical limits. Then manufacturers will have to switch to other, probably X-ray based, equipment.

The timing of this change depends on how much further optical technology can be pushed. The question is of particular importance to the Japanese. Memory chips, the type of chip where the space between components is shrinking fastest, account for more than half of the Japanese semiconductor industry's total production.

Currently, circuit patterns are transferred to wafers by two different types of machines, aligners or steppers. An aligner scans a slit of light across the pattern mask, which is a stencil that defines the position of components on the chip. The result is that an image, which is the same size as the mask, is projected onto the wafer.

A stepper works by shining a light from an ultraviolet source through an enlarged section of a pattern mask called a reticle. The enlarged pattern is projected through a lens, which reduces it in size, onto the wafer's surface. After exposure, the table on which the wafer sits is mechanically moved - "stepped" - to the next site on the wafer, and the procedure is repeated until the entire wafer is exposed.

Aligners are faster, steppers offer better resolution. Most chipmakers use a combination of the two, with aligners exposing the lower layers where resolution is not so important, steppers the more precise upper layers.

In memory chips, steppers predominate, because line widths between components are so narrow. In the latest generation, one megabit chips, component separation is 1.2 micrometres. In the next generation, four megabit chips, which will start appearing towards the end of next year, it will be just 0.8 micrometres.

A few years ago, engineers thought it was impossible that optical technology could go that far. The idea was that electron-beam machines, which could write patterns line by line directly onto the wafer, would take over from steppers. This has not happened, for several reasons. For all their precision electron-beams are slow, capable at best of processing a dozen wafers an hour, compared with a stepper's 60, or an aligner's 120. They are also as much as five times more expensive, take up lots of space and need special resists. Today, electron-beams are mainly used to make masks rather than chips.

Optical lithography has kept pace with the semiconductor industry's needs. In particular, lenses for stepper machines are of much higher quality. Nippon Kogaku - a company better known by its brand name, Nikon - makes not only its own lenses, but also its own glass. This is one reason why the company currently dominates the Japanese market, with a share of 60 per cent. Nippon Kogaku's most recent stepper has a lens which can resolve 0.8 micrometres; another, capable of 0.6 micrometres, will be available soon.

By the 1990s, advanced microchips - such as 16-megabit memories - will require a component separation of as little as 0.5 micrometres. Although optical technology is theoretically capable of the required resolution - just - there are several reasons why it will not be suitable for application to the production line.

One is that working at the limit leaves optical machines no margin for errors caused by light diffracting and scattering. A second is that as the wavelength of the light source decreases, sensitivity to dust and defects in the mask increases markedly. At 0.5-micrometres separation, the limit on particle size will be 0.05 micrometres, or 10 times tinier than the current limit in clean rooms.

Replacing ultraviolet light with X-rays solves both these problems. Short-wavelength X-rays produce the required resolution. The wavelength of X-rays is too small to be diffracted and scattered by dust particles. There are three ways to make chips with X-rays. The first uses a conventional X-ray source such as a rotary anode. Steppers equipped with such sources are already available. Nippon Kogaku has sold three to Nippon Telegraph & Telephone (NTT).

The trouble with conventional X-ray sources, however, is that they are not very powerful. This means exposure times must be long, which in turn means that the production rate would be low. Plasma sources offer a brighter alternative, but researchers have not yet been able to make them reliable.

The third and most promising method is to use beams produced by a synchrotron, a racetrack-shaped ring in which electrons are accelerated by magnets to speeds close to that of light. X-rays from a synchrotron are as much as a thousand times more powerful than those from a conventional source.

The first company to attempt to make chips with a synchrotron was IBM, at Brookhaven Research Laboratories, in 1980. The following year, NTT started experiments with a beam at the Photon Factory at the Institute for High-Energy Physics in Tsukuba.

IBM has succeeded in producing devices with components separated by 0.5 micrometres. In September 1983, NTT announced that it had reduced line width to 0.2 micrometres, in theory, sufficient to produce a 64-megabit memory. Encouraged by this success, the company is now constructing a synchrotron of its own, at its Atsugi laboratory. The synchrotron is scheduled to begin operation in 1988. Its ring will cost £28 million and have a diameter of 15 metres.

This price is too high for large commercial semiconductor makers to contemplate. The aim is therefore to build cheaper, more compact synchrotrons. The first, made by an NKG company called COSY Micro Tec, should be on the market by 1988. It will cost about £8 million and will drive eight steppers.

The Ministry of International Trade & Industry is supervising two synchrotron projects. The main difference between them is that one uses ordinary magnets to accelerate the electrons, the other, a superconductor.

A third project may turn out in the long run to be the most significant, because it is a consortium consisting of 13 chip and equipment-making companies. It will run for 10 years. (This first appeared in New Scientist, London, 19 June 1986, the weekly review of science and technology)

Kenya

Computer scene in Kenya

The computer marketplace for the traditional mini and mainframe computers is dominated in Kenya by five main computer vendors, IBM, NCR, ICL, CAL (Wang) and BML (Olivetti). There is a notable absence of some of the big names in the world market who, for strategic and other reasons, have adopted a low profile in the East African marketplace; names such as DEC, Hewlett-Packard, Honeywell and Prime are rare, or completely absent.

Among the vendors currently competing for business there is a generally increasing awareness of the need to provide for the demands of a rapidly changing market. Increasingly, as fast developing computer technology erodes the old mainframe/mini/micro distinctions and processing power is slashed in price, vendors in East Africa are being forced to re-examine marketing product strategies.

Computers are classified in various ways. Probably the most commonly used classification is micro-computer (micro), minicomputer (mini) and mainframe. Conceptually, these machines perform identical internal computer functions, but on different scales. Peripheral equipment such as disk devices, printers and video screens are also conceptually the same. Distinctions among various sizes of input/output operation and volume of transactions, size of files, sophistication of software, environment requirements (for example, air conditioning), portability, memory size - both internal and external, and segregation of duties (operator, programming and user functions are often combined in smaller systems but are usually separate in mainframe computer environments).

Basically, the bigger machines can do more tasks faster, have a greater depth of manufacture support and generally can accommodate a larger number of users at the same time. Microcomputers have less capacity and are relatively inexpensive. The power and price of minis fall somewhere between that of micros and mainframes. The border between high-end microcomputers and low-end minicomputers is blurred, as is the border between the more powerful minis and mainframes. The borders promise to become even more blurred, and the emerging technology necessary to link various sizes of computers promises to bring even more dramatic changes to the computer landscape.

Of the 17 or so Kenyan vendors, all of whom represent at least one overseas supplier, five could be said to occupy principally the mainframe category, four the mini category, and eight the third category. All the vendors sell in the micro category to one extent or another, and all in the mainframe category also sell in the mini category. The mapping of vendors to computer size categories is, therefore, diffused because of a broad spectrum of product offerings.

The market is most clearly defined at the top end - the mainframe/large mini systems. There are very few true mainframe systems in Kenya, although a number of suppliers have installations with larger numbers of users. The biggest of these is the Wang system at USAID, with 120 devices attached.

At the lower end, the appointed micro vendors compete with a changing field of unofficial vendors, and the market can only be approximately defined because of the sheer size of the micro market, and also because of the volume of hidden traffic. For every micro computer sold and installed by Kenyan vendors, there are an estimated three micro-computers which have entered the country having been directly acquired overseas.

The impact of the micro-computer on the public and private sector has already been considerable. The small businessman sees it as a relatively quick, cheap way of bringing the benefits of automation to his firm; the larger organization is allowing the proliferation of micro-computers (whether planned or unplanned) as an antidote to the often poor service from the central DP department or simply as an extension of office automation services. Some organizations are taking a more co-ordinated approach by planning networks of micro-computers within an all-embracing information processing strategy.

The choice of computer, mainframe, mini or micro, is important as well as price. In Kenya, the break-even on workstation costs between stand-alone micros and centralised minis occurs at about four workstations, i.e. if fewer than four workstations are required, micros are cheaper and, if more than four workstations are required, a mini or mainframe is cheaper.

Leading the market is mainframe, mini and microcomputer market sales is CAL (Computer Applications Limited). In the early 80s its mini product filled a vacuum in the marketplace and gained a strong, installed base. While it was targeted at small to medium-sized businesses, more recently sales of the 'Super-mini' VS range has allowed CAL to penetrate the larger user installations.

Of the Big Five in Kenya, CAL, along with BML, operates as a representative of the hardware manufacturer (Wang Laboratories) rather than a branch or subsidiary. This relationship is part of Wang's international marketing strategy, allowing CAL much greater business flexibility than its Kenyan competitors who are subsidiaries.

Five years ago IBM had a strong Kenyan subsidiary - since then they have been increasingly less aggressive and have been shedding parts of their business - type-writer products to MBC (Modern Business Communications), BCS appointed as their authorised micro dealer and now also to handle their main systems marketing.

Five years ago, ICL were more dominant, but when the market went for micros and minis, they have become less well placed. They have retained much of their installed base, but they haven't managed to expand significantly out of that. The ones who have been most constant are NCR, a very aggressive subsidiary and with an important market presence.

Apple are represented by Comprite, a well-established distributor, and have done very well - a well-known brand at low cost, ideal for many people in this market. Olivetti are represented by BML. They are very active in the market place at micro level; and there are one or two other minor players. ...

One thing that has changed is the cost of computers compared to the developed world. This is because of the decline of the value of the K. shilling compared with the currencies from where Kenya imports.

Also, the duty and sales tax have changed dramatically. Duty is now 80 per cent and the sales tax which is imposed on the dutied amount bring the total to 143 per cent. This puts the cost to almost three times as much as in the developed countries.

One field which was non-existent five years ago was word-processing. Multinationals like the UN, World Bank, USAID and so on, expected to have such facilities in Kenya. People got to know about word-processing, which was mainly pioneered by a few local organisations and subsidiaries of multinationals like Caltex and Pfizer, particularly American subsidiaries. Finally, when word processing became available on micro computers, the field became much broader, people generally became much more aware of computers, much more confident and therefore relaxed.

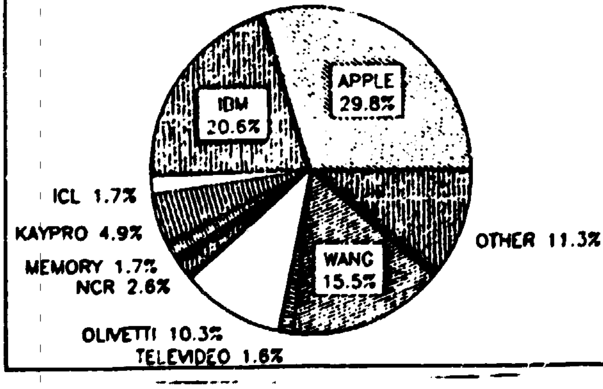
At Government level, there is concern expressed about the consequence of computers on employment - do computers destroy jobs? Mike Eldon, CAL's Managing Director, feels the computer is a tool to help manage resources, particularly management resources. "One of the consequences will be to have an impact on jobs, but it is for an individual employer to plan and guard himself and his employees against possible negative consequences. Computers used correctly create an efficient organisation and employ more people."

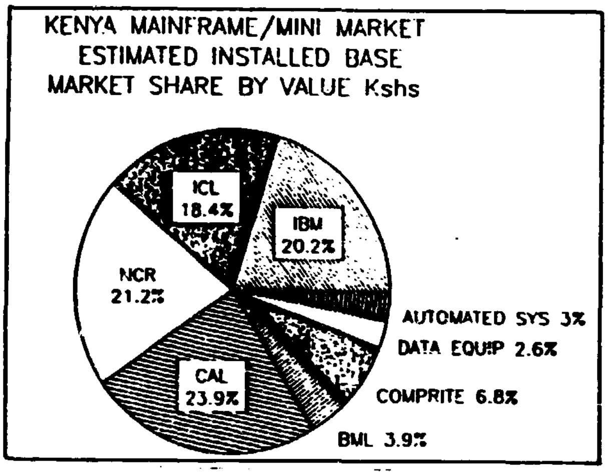
The computer industry is highly competitive when it is building up to multi-million shilling decisions at board level. Computers in Kenya, like elsewhere, will continue to spread and projects do tend to succeed.

Kenya is a small country, not very rich, but everyone is computerising. The scene is changing so rapidly and so dramatically, new th... are becoming viable and also existing users, as t... become confident with what they have, extend the use they make of computers.

There is continuing dramatic technological development in computers, because it is possible; because of the benefits accruing from employment; because of the stimulus to do so, and because of the extent of the competition.

KENYA BUSINESS MICROCOMPUTER MARKET
ESTIMATED INSTALLED BASE
MARKET SHARE BY VALUE Kshs





(African Technical Review, September 1986)

Latin America

Overcoming incommunicado in Latin America

One of the most serious obstacles to the development of networks among small and medium-sized organizations in Latin America is the lack of reliable information on the real costs of telecommunication on the continent. This conclusion is the opening line of a review, reported by the Bulletin Contact-Cero, on the seminar held in Rio de Janeiro in May to evalute the Interdoc project of the world communications networks between NGOs (non-governmental organizations).

From an analysis of practical experience in contracting telephone services in the Argentine, Brazil, Chile, Mexico and Peru, it results that great tariff and cost differences exist among these countries. Mexico is indicated as being the most favourable from this point of view among the five analyzed with regard to the installation of communication network nodes while waiting for a more thorough analysis that also includes Bolivia, Colombia, Uruguay and Venezuela.

The minimum installation costs of a line (including taxes and, if it be the case, a guaranty deposit) do not exist in the Argentina and Brazil. In Mexico they go as high as US$24 (twice that for commercial organizations) and increase threefold in Chile and sixfold in Peru. The rental of a 300-baud telegraph line in Mexico goes no higher than US$1.5 per month, whereas it goes as high as US$28 in Chile and US$52 in Peru (respectively US$38 and US$103 over slow 1200-baud data lines).

The variable costs differ even more. In Mexico an hour of transmission goes as high as US$10, somewhat higher in Chile (US$14) and the Argentine (US$15) rises to US$23 in Peru and costs a whopping US$53 in Brazil. As far as volume is concerned, the 1,000 characters of the "average page" cost US$0.1 in Mexico, somewhat more in the Argentine (US$0.17) and in Chile (US$0.22), then go as high as US$0.7 in Peru and again cost a whopping US$1.45 in Brazil.

These studies by Interdoc, the world NGO network, precede that body's installation of a facility for the South-South exchange of messages (i.e. without passing through industrialised countries). Supported by the existing public telephone companies in the various countries, and which puts an end to the lack of communication among countries of the third world, especially among those of Latin America. (IBIPRESS Bulletin No. 97, 7 September 1986)

United Kingdom

University chip design

University researchers in Britain who want chips made up as part of their projects will have to look to industry in future rather than to their paymaster, the Science and Engineering Research Council (SERC). The SERC has decided that its two chip fabrication centres, at Southampton and Edinburgh universities, will no longer produce chips made by standard manufacturing processes. The centres cost the SERC £75,000 per year to run. In future, researchers who want designs turned into silicon by standard processes will have to go to so-called silicon brokers, who take orders for chips and place them with companies that have spare capacity on their fabrication lines. University workers who want to try out new chip-making techniques will still be catered for at Edinburgh and Southampton. In future, the centres will make chips only in ones rather than a batch at a time.

The decision to concentrate on specialist chips was taken by the SERC's Engineering Board during a recent review of its chip activities. "It is intended that the more standard types of silicon processing should be undertaken by industry, taking advantage of the cost-sharing benefits available under the brokerage scheme of the Alvey initiative," the SERC says. The Alvey brokerage scheme is an attempt to give more researchers access to fabrication facilities by using brokers to seek out firms with under-used production lines. Imperial College, London, for example, has a deal with a broker called Micro Circuit Engineering which enables under-graduates to see their circuit designs take form in silicon.

The SERC, meanwhile, has passed the buck on an ambitious scheme to set up a fabrication line capable of coping with all stages in the production process. The SERC's present facilities can handle only parts of the complex chip-making procedure. In Belgium, the University of Leuven has set up a plant that can handle all the requirements of electronics researchers in Belgian universities. But the SERC has rejected proposals for a similar type of centre in Britain on the gounds of cost. The idea has been passed on to Sir Austin Bede's Alvey 82 committee, which is looking into the future of the Alvey research project. (This first appeared in New Scientist, London, the weekly review of science and technology)

Alvey launches Analyst Assist

The Alvey Directorate has unveiled one of the biggest software engineering projects yet to be funded under the Alvey scheme. The £2m Analyst Assist programme (which is fully funded under Alvey I and thus safe from the vagaries of "After Alvey") involves Data Logic, Scicon, the University of Manchester Institute of Science and Technology, Michael Jackson Systems, and the Admiralty Research Establishment (ARE) at Portsdown.

The consortium aims to develop tools that improve decisions taken during requirements stage. According to Scicon, up to 80 per cent of reported software faults are caused by errors made during the analysis and specification phase of a system's development.

"The trickiest process is getting an understanding of what the user really wants. The tools will help systems analysts to elicit information from users on what they want and will then be used to build specifications for people writing the software."

"It will also feedback to the users to ensure we have got it right," explained Scicon software engineering manager, Brian Andrews. He said that the project was particularly unusual in having both commercial and defence applications. Two evaluators will be brought in on the final phase of the prototype development - the ARE and a major commercial company.

Host workstations for the software are currently under evaluation, with the main contenders being Sun and artificial intelligence workstations based on either Symbolics' or Lisp Machines' international engines.

Andrews said that all partners will have equal exploitation rights to the results of the three-year programme. The project leaders, Scicon and Data Logic, intend to both sell the tools as a product and as the basis of an in-house service. (Electronics Weekly, 1 October 1986)

UK takes leading expert role

Three world-leading applications of expert systems are to be developed in the UK in a £1.5 million programme funded by the government and the computing industry.

The programme is described as "tremendously significant" by the project leaders, who point out that the scheme will not only result quickly in products with international market potential, but also enable the supporting companies to gain experience of developing expert systems. The projects are all being led by UK computing services firms.

Each project will be backed by its own "club" of 15 to 20 firms. The clubs are now being set up by the Department of Trade and Industry following well-supported meetings with companies to present the projects.

Club members will pay around £10,000 each. The department is putting up around £200,000 for each project and the development companies will fund the rest. ... (Electronics Weekly, 18 September 1986)

USA

Pittsburgh to get national supercomputing center

The US National Science Foundation has approved a grant of nearly $40 million to the Mellon-Pitt-Carnegie Corporation - a partnership of the University of Pittsburgh and Carnegie-Mellon University - to establish a national supercomputing center in Pittsburgh. The center will serve the national community as well as local research efforts.

The center will purchase a $22 million Cray X-MP/48 supercomputer and other related equipment, making the Pittsburgh facility the most advanced of the five national supercomputing centers established by the NSF.

To be known as the Pittsburgh Center for Advanced Computing in Engineering and the Sciences, it will be operated by a consortium of CMU, Pitt and the Westinghouse Electric Corporation. In addition to the NSF grant, other funding for the center will come from consortium members, the state of Pennsylvania, the state's Ben Franklin Partnership, Cray Research, Inc., and other industrial supporters. Pennsylvania Governor Dick Thornburgh has already recommended that the state legislature approve a $5.25 million appropriation for the first three years of the center's operation as part of the state's support for the regional economic development plan.

With today's announcement, Pittsburgh joins four university-based supercomputing centers established last year by the NSF at Cornell University, Princeton University, the University of Illinois, and the University of California at San Diego. Last June, NSF officials announced they would transfer a Cray 1-S supercomputer from the National Aeronautics and Space Administration's Levis Research Center in Cleveland to the Pittsburgh universities as a preliminary step to designating the local schools as a supercomputing center. However, the Cray 1-S transfer was not made when it was determined that Pitt and CMU would have the opportunity to get the more powerful and sophisticated Cray X-MP/48.

Offices for the supercomputer center will be located in the Mellon Institute in Oakland while the Cray X-MP/48 itself will be located at the Westinghouse Energy Systems Computer Center in Monroeville under the direction of James Kasdorf. The supercomputer wil be linked to the campuses by high-speed communication lines and will enable researchers at CMU and Pitt to develop and pursue new research projects, primarily in science and engineering. Students will be trained in supercomputing techniques and supercomputers will be integrated into courses at both Pitt and CMU.

All five national supercomputing centers will be linked together by a NSF network. Researchers will be able to access the network at the nearest supercomputing site and communicate with any of the other supercomputers. For example, a researcher at the University of Wisconsin who wanted to work on the Pittsburgh supercomputer might access the network through the Illinois supercomputer. In addition, the Pittsburgh facility will be accessible to researchers from around the country through many major national communication networks. (R&DM Digest, March 1986)

Zimbabwe

The computer industry comes on key

Rationalisation will be the watchword for the computer industry over the next five years or so. Although demand far exceeds supply the total Zimbabwean market is simply not capable of absorbing all Zimbabwe's hardware manufacturers - currently about 20.

While there is a growing demand for computers in both the public and private sectors - the ministry of education has recently announced plans to computerise its administration - the rate at which hardware can be installed is limited by the amount of foreign currency available. Much of what is currently being installed tends to come in on the back of commodity aid programmes. Despite optimism about the country's economic performance - last year's growth rate was more than the 5 per cent forecast - there seems little prospect that the government will be able to ease up enough on foreign exchange control to make a marked difference to the amount of money available for hardware purchases.

A substantial body of opinion in the industry believes it will simply not make commercial sense for some manufacturers to push their Zimbabwe operation. "There's no question about it - we are overtraded at the moment. I'd be very surprised if there were the same number of vendors in five or 10 years time," said a leading Harare distributor. One reason for the large number of vendors was that the market was wide open at independence, which came after 15 years of sanctions, when whatever came into the country came in the back door. That there should be some settling down seems plausible.

But even those who argue in favour of competition between a large number of manufacturers feel that something may have to be done to control standards among the support companies that have sprung up. "There's nothing wrong with competition but something could be done about a lot of the service firms. Many of them are one-man operations and it is difficult to know what they are about," said an official at NCR.

Some industry officials believe government, too, is concerned about the poor back-up service received from some companies, particularly the smaller ones. They are also apparently worried about the threat of obsolete hardware being dumped if the market is not controlled and may consider cutting down the list of products deemed fit for import licence approval.

Dick Rawlings, managing director of the consultancy company Computer Awareness, argues that while government is right to be vigilant about the introduction of inferior products, it is much more difficult to define what constitutes dumping. "Some of the computers that are now on the market are simply not good machines. If government followed the guidelines offered by the industry - the Zimbabwe Computer Society for example - these machines would not get in," he said. "The question of what is an obsolete machine is difficult. We do not always need state-of-the-art stuff. If these machines can be available cheap, with no foreign currency problems, then I don't see that as a bad thing - as long as it is not being sold as something it is not. The danger with old machines is not that they are bad ones but that you need the parts. If there is a seven-year guarantee on parts, that's fine."

Rawlings points out that this is the time now to tune the industry, offering incentives for expansion: "The way things are going in South Africa we have every chance of becoming an exporting centre to the region. Look at Botswana - 80 per cent of the installations there are ex-Johannesburg. That could be ours. We could offer the whole thing, from hardware to software expertise." Already he has spent a lot of time on consultancy work in Zambia - where he worked on the computerisation of the central bank - Malawi and Botswana. For these countries, getting skills from Zimbabwe is a lot cheaper than flying in an expert from London.

Whatever happens to the rationalisation process, the market will remain open to the well-established manufacturers - Data General, ICL, NCR, DEC, Wang, Perkin Almer among others, - and those local distributors who do not depend entirely on hardware sales for their operating income. For those left in, the most buoyant markets are likely to be in those sectors which fit into the government's economic plans over the next five years. Industry sources believe foreign currency requests from manufacturing, mining and other export-oriented industries will be considered favourably while those from the retail sector will tend to lag behind. Total annual sales will remain about the same; it has been between US$2 million and US$4 million over the last few years. Aid schemes will continue to be a deciding factor.

Foreign exchange constraints aside, the government has backed the introduction of computers in the public and private sectors: "Since independence there has been a burst of activity, not least because government has taken a very positive attitude. They have resisted the temptation to compare the cost of a computer against the numbers of tractors or spare parts for industry that could be brought in. They have seen it as an investment in infrastructure, like roads," says Alistair Watermeyer, head of the Zimbabwe Computer Society.

Watermeyer believes the computing industry can contribute to Zimbabwe's export earnings: "I'd like to see the country become a centre of excellence for software, serving the region. The numbers are not going to be mind-boggling - may be US$750,000 in five years' time - but that is better than nothing." Certainly there seems to be some potential. Already one or two companies have penetrated South Africa, a highly competitive software market. Tulley Associates, the largest software house in the country, with about 40 professional data-processing staff on its books, is chasing export orders with a financial package it is developing. (South, August 1986)

GOVERNMENT POLICIES

UK and new technologies*

Many people believe that the impact of the new microelectronic technologies means there will be only a limited number of jobs in the future and that, as a result, for social reasons this dwindling number of jobs should be shared out as fairly as possible.

This defeatism needs to be challenged directly, because the reality is that the faster we adapt ourselves to the skills and opportunities of technological change, the more likely we are to be able to achieve a higher level of employment in future.

The underlying problem is not a growing shortage of jobs but a serious shortage of skilled people able to fill the jobs being created, in some cases very rapidly, in the microelectronic industries.

Last year the Government's IT (Information Technology) Skills Shortage Committee estimated a shortage of 5,000 engineers with IT skills by 1987/8. This was almost certainly an underestimate. On the basis of a recent survey, which the National Computing Centre (NCC) conducted among its 2,000 member companies, there is an additional shortage of at least 8,000 high-level skilled support staff.

What needs to be done to increase the level of skills and employment in our electronics industries?

Firstly, we must make urgent changes to our system of secondary education and training. British education must become less specialised and less biased against applied science and technology.

As a start, the Youth Training Scheme (YTS) should be transformed into a comprehensive vocational and educational programme for 16-19-year-olds. Greater public and private sector support for the information technology centres (ITECS) would help to place a larger number of young people from disadvantaged backgrounds in permanent jobs in the new industries.

We need to move forward to a system of skill training which is based on standards achieved rather than time served, which is modular and which is open to adults as well as school-leavers. This should be seen as an investment and requiring extra resources, if we are to supply an apprenticeship and training system on a par with that of our principal European competitors.

Companies must be encouraged to take on more trainees. We need to introduce a remissable tax

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* By Dr. David Owen, leader of the Social Democratic Party

system, under which each company or firm which spent more than the standard percentage for its industry on training in the new technologies would have all its extra expenditure rebated from public funds, while any company that spent less than this percentage would have to pay a tax equal to its underspending.

Above all, the present provision of places in our Universities, Polytechnics, and Colleges of Further Education needs to be expanded. Last year the government announced a four-year Engineering & Technology Programme costing some £43m which would create, it was claimed, over 4,000 extra places for school-leavers in the higher education system. This was welcome news. But under pressure from the universities however, most of this money has been used to create extra places on existing courses.

The problem is that many existing courses - orientated to the needs of the supplier industry - have a scientific and/or engineering bias and require good 'A' level qualifications in mathematics and physics as pre-requisites for entry.

But the required number of such schoolchildren are simply not present in the sixth forms of our secondary schools and, such is the difficulty in recruiting good physics teachers, there is little chance of this number increasing in the foreseeable future - and in fact it seems certain to decline. Bluntly, this severely threatens the prospects of the promised 4,000 extra graduates actually materialising in the future.

The solution, I believe, is to redirect government funding towards the establishment of a small number - say, two or three - centres of excellence with a sufficient critical mass of students to become acclaimed internationally and operating in all the main areas of undergraduate teaching, research, consultancy, software development, and provision of commercial courses.

These centres would aim to bridge the gap between industry and higher education, not least in producing a larger number of students equipped with the skills which industry needs in the new technologies.

The IT Institute established by the University of Salford, the NCC, and a range of large supplier companies, with 'start-up' government financial support, is a significant move in the right education.

Likewise, the Open Tech programme, in conjunction with the Cranfield Institute of Technology, has done valuable work in producing distance learning systems for technical qualifications, mainly at sub-degree level, and will need adequate resources in future to meet the need for continuing education and the up-grading of skills for the population as a whole.

Skill shortages, resulting in job shortages, suggest that Britain is failing to adapt to the new microelectronic technologies. But a reluctance to adapt will destroy far more jobs in the longer run than adapting to them will.

The Japanese IT Ministry (MITI) recently described their country as "a nation living by its technical expertise". Before the North Sea Oil revenues run out Britain too must become "a nation living by its technical expertise".

To have the expertise means tackling the shortage of skills. If we don't, not only will we be unable to improve our standards of living, we will have a very hard fight even to maintain it. (Electronics Weekly, 8 October 1986)

STANDARDS AND LEGISLATION

Microcode copyright

On 22 September 1986, William Ingram, a Federal District Court Judge in San José, (USA) ruled that the designers and manufacturers of microprocessors could copyright the built-in microcode that makes them run. Specifically, Ingram supported Intel's contention that NEC had illegally copied Intel's devices. Ingram accepted Intel's argument that the code was a software program subject to the copyright protections already afforded other software.

If Ingram's decision stands, NEC may eventually have to pay damages to Intel. More important, if Ingram's ruling becomes a precedent, it could influence the structure of the chip and computer industries for years to come.

For example, IBM - with the aid of partially owned Intel - could design a new family of personal computers based upon a proprietary microprocessor with a copyrighted code. It would be illegal to sell "clones" of those machines without IBM's licensed permission. While it is possible to design code to fulfil other functions of a computer - such as IBM's BIOS chip - one cannot promise software compatibility on a machine using a microprocessor with a different design. (Global Electronics, September 1986)

The Anglo-Saxon Trojan-European horse for M.A.P.

Backed by a fund of US$12 million and by 60 USA and European informatics giants (Japan not included), the British Ministry of Trade and Industry will be establishing CIMAP, the first large theoretical and practical demonstration in Europe of manufacturing automation protocol (MAP). The intention is to make MAP the industrial communications standard. MAP rests largely on seven hierarchical levels of interconnection of production units in the open systems interconnection (OSI) model for the International Standards Organization (ISO).

Within the European community's Esprit programme, various research centres, universities and as many as 17 large informatics and telecommunications manufacturers (including IBM's Euro-Afro-Asiatic division through its FRG subsidiary) have been developing the Amice Communications Protocol for Manufacturing which, since its origin, has been undergoing a probable squeeze between the American MAP's commercial potential and its technical efforts to take advantage of Geneva's ISO standard.

The UK CIMAP demonstration could be a hard blow to the European Amice protocol at a moment of the Esprit program's conversion. This program now finds itself between the unclear competition with the Eureka project and the financial and technical reorganization of the second Esprit phase (1987-89), with a significant grouping into a single block of the formerly differentiated areas of office automation and computer-integrated manufacture (CIM). (IBIPRESS Bulletin No. 92, 4 August 1986)

A common standard for Europe

The major European computer producers, Bull, ICL, Nixdorf, Olivetti, Philips and Siemens, by means of a recent declaration, have submitted a request to the governments of European countries for a common standard for the connection of electronic computers to be developed. The same companies have also put forward requests to the administrations of their respective countries to intervene with the authorities having jurisdiction in the USA and Japan for trade on the basis of reciprocity to be facilitated. Only in this way, the leaders of the proposing countries reiterated, will European industries have the opportunity of becoming competitive at international level.

The request for trading methods based on reciprocity principles, according to the spokesmen of the European companies, is being addressed mainly to the USA, where a 'buy American' act is in force which controls technology exports. In fact, this law protects the domestic market of US firms while the same firms benefit from free access to the foreign markets to which access is allowed by various governments.

In order to evade the monopoly of the de facto standards as dictated by the large US multinationals who are conditioning the European market, the producers on the old continent are also asking individual governments to address their purchases towards products which utilize OSI (Open System Interconnection) standards.

Europe has been moving in this direction for quite a while. It is to be recalled here that the European standard promotion and application group has already achieved good results, according to manufacturers. However, the pace must be accelerated to avoid forming the tail end of the technological development train, of the seven levels on which OSI is based, less than half have as yet been established. Hence much remains to be done.

The establishment of common standards open to all manufacturers would make competition with equal opportunities possible for all European companies and would give them a chance to free themselves from the conditioning of market standards. It is not however the intention for such requests to take on protectionist connotations but, on the contrary, open up more markets. As proof of this, stress has been placed on the importance of also IBM's adherence to the project. (IBIPRESS Bulletin No. 93, 11 August 1986)

ARSO-DISNET: an African network of information centres on standardization

The African Regional Standardization Organization (Oran-Arso) has created a sectorial regional information system grouping African countries for the better utilization of standards, technical regulations, metrology documents, certification and quality control.

Its reasoning is based on the universal availability of documents concerning standards, a concept developed by the international standardization organization network (ISONET). The information activities take place both manually and by computer, depending on the possibilities of the participating centres.

ARSO-DISNET is an information system constituted by a central unit (ARSO-DIS) and national focal points distributed in ARSO-member countries. It represents the regional point of information on standards and the system's co-ordination unit. It is the depository of standards and related documents produced by ARSO-member states and African regional organizations, constituting the standards part of the Panafrican Documentation and Information System of the United Nations Economic Community for Africa (PDISUNECA). Its task is also to advise the countries belonging to ARSO on setting up national information centres on standards.

ARSO-DIS will remain a light structure essentially oriented towards advisory and training tasks as well as towards the processing of documentary products and the dissemination of information.

As far as the above-mentioned focal points are concerned, we are speaking about the information centres of national standardization bodies, the latter being offices of ministries or of public establishments. There are no private standardization bodies in Africa. (IBIPRESS Bulletin No. 92, 4 August 1986)

SOCIO-ECONOMIC IMPLICATIONS

IT puts brain power at top of the class

Information technology is changing the way that business is done by making the brain-power of employees the single most important resource in a company, according to Professor Sir Douglas Hague, chairman of the Economic and Social Research Council (UK).

The pace of change will be so fast in the future that competition between rival firms will be won by the management which is most aware of the latest developments and how to use them. Regular retraining for managers will become a vital part of remaining competitive and not just something which is desirable if the time can be found, said Sir Douglas.

This will change the way that business management is taught and may lead to a new and competitive industry in providing the many training courses that companies will need; and hence change the way that business schools teach.

Sir Douglas also believes that these changes in teaching practice will eventually spread into other types of education and lead to a fundamental change in the way that universities and polytechnics operate.

"In the future, product life cycles will be extremely short and your competitors could be in there within weeks. It's not like the old days of building ships when it took years to catch up with the competion", he said.

This means that managers will have to be continually trained. "Your training becomes a competitive weapon. Unless you train your people to keep their brains up to the competition, then you will lose", he said.

There will need to be a greater collaboration between universities, polytechnics and businesses. Businesses should help design the type of course that are taught to students while universities will get drawn into businesses to help plan their training. "And information technology itself will help to make that education more effective", he said.

But producing these educational packages will become a new and competitive industry. "Business and business schools will begin to compete to design effective training packages. Some business people will produce management training programmes since they can do the same things as the business schools", he said.

"I think that there will be a lot of franchising of these courses. Once a package has been developed, other people can be trained to present it and to give tutorials", said Sir Douglas.

But the changes in the way that business management is taught will be picked up in other subjects, according to Sir Douglas. The nature of teaching will change so that university and polytechnic teachers will spend less time giving their own lectures and more time giving tutorials based around a course that has been bought in.

And then information technology will break the monopoly that universities have had over training and knowledge; the business of providing training will itself become a competitive industry. Packages will be produced which depend on computers, audio-visual presentation and personal tutorials.

"Universities have a monopoly of brains which will be broken by this new technology", said Sir Douglas. He thinks that even the universities' monopoly over degrees will then end and that it will become possible to get a qualification from the 'Granada College' or the 'Pergamon University'. (Electronics Weekly, 1 October 1986)

A blueprint for the new homeworkers?

In 1983, Rank Xerox disposed of one of its central London properties, Howard House, Cleveland Street, which had housed 42 staff. This saved £333,000 per year in rents, heating and other overheads. This could be done because of the head office staff, who had opted to become self-employed as 'networkers', working at home and selling their services back to the company.

A book published last month, Networking in Organisations, describes the continuing experiment started in 1981 by Rank Xerox. The managerial justification was to reduce overheads. An employee costing £10,000 needs another £10,000 in office space and facilities, and £7,000 for state benefits and other on-costs. These could be avoided if the executive was independent and worked from home.

So, the cost justification was there. But there were also risks. Would the networker remain loyal to the company? Or would he build up his non-Xerox business to the point where his contracts with Xerox suffered? He might start working for competitors.

In fact, the employee-employer loyalty was replaced by a different one, the loyalty of a small business to a major account client. The networkers and Rank Xerox itself claim that this is no less a loyalty. It is enhanced by including the networkers in company telephone directories and inviting them to the company's Christmas parties.

The problem of sensitive information is covered by a confidential disclosure agreement, signed by the networker along with his first networking contract. ...

Because the networkers are paid for output, not for hours attended, the task to be done has to be specified and costed more precisely. This makes it easier to decide whether the task should be done at all. Senior executives often ask their subordinates for a brief or report, and get back an over-refined 50-page analysis, because the subordinate wants to 'do justice to the subject'. If a networker was asked to do it, he would quote the real price for such a job, say £3,000. Such a figure might make the senior executive think twice about what to him may have seemed a 'simple request' at the time - he would at least have to refine the request. This sharper definition of tasks can save up to 30 per cent of their cost. ...

The networkers not only produce more, their work can be better. This is because they have a wider view of the world outside the organization. Their minds are more readily stimulated by new ideas. As the networkers come from the marketing, finance, personnel and management services functions, their worth depends on the new insights they can bring to a large organization whose tendency is always to become inward-looking.

Conversely, their knowledge of the organization gives the networkers the edge over completely external consultants. They need less briefing to start with, and their solutions are more likely to conform to the company ethos. ...

The networkers have to be entrepreneurs, who want to build a full-time business, starting with the spring-board of a contract which will occupy up to 50 per cent of their time. Those not suitable will be those unlikely to cope with the harsh reality of small business.

And of course, jobs which require continuous in-house presence, like receptionists, bank cashiers or those line-managers who keep the day-to-day work ticking over, are not suitable for networking. It is significant that only 4 per cent of Rank Xerox's head office staff are currently networking, and they do not envisage more than 15 per cent networkers in the future. ...

Employment in big companies has only been around for 200 years. Offices were large, when office-work was manual and then done by mainframes. But we are now in the age of the fractional horsepower electric motor electric motor and the microcomputer.

There is no real reason why the expensive city centre office blocks should continue to exist. In effect, Rank Xerox has given a blueprint for setting up and managing an alternative way of working in the electronic cottage. (Computing The Magazine, 20 March 1986)

Computers close the gap between rich and poor

Many of the poorer parts of the world are convinced that without information technology, the gulf between first and third world countries cannot be closed.

Information technology, according to Nabil Harfouch from Syria's Scientific Studies and Research Centre, will "play a crucial role in the efforts of the developing countries to narrow the technology gap and reduce their technological dependence".

Some 65 per cent of industry in the poorer parts of the world will be affected by technical advances taking place elsewhere, Harfouch told delegates at the recent IFIP conference held in Dublin. Apart from industry, social and working conditions, too, will feel the impact of the new technology, said Harfouch.

"The most important single issue in information technology for development is to formulate a clear national plan with well defined objectives for directing this technology towards useful products and results in fields considered to be crucial for development", he said.

Some countries have already adopted policies designed to foster their own computer industries and to ensure that inappropriate equipment is not dumped on them. India and Brazil, for example, both have tough laws aimed at protecting their home-grown industry.

In India, foreign companies are forced to go into partnership with local firms, a restriction which prompted IBM to leave the country. In addition, employers have to seek the consent of their workforce before they can apply for an import licence for foreign equipment. The measure is intended to protect jobs.

"Many systems introduced in the 1960s were sold on the grounds that they reduced staff: this is totally irrelevant in a country like ours", commented Prem Gupta, whose company CMC took over the servicing of IBM's computers when the company quit India.

CMC, owned by the Indian government, has recently completed the first phase of a project to computerize ticket offices on the Indian railways, a job that Gupta claimed would have been beyond a foreign company. There are some 20 different classes of ticket on the Indian rail system. Prices vary, for example, according to the route that the train takes to its destination.

At Delhi, the first station to go online, the average waiting time at booking offices was reduced from between one and two hours to 20 minutes. The time saved is the equivalent to $10 million-worth of lost working hours spent hanging around the station according to Gupta.

Brazil has banned the import of mini-computers and smaller, personal computers. Any imported software used at government computer sites has to be registered with the Secretaria Especial do Informatica, the government agency which co-ordinates the country's high-technology policy. The result of Brazil's stance is that half of the computer systems (worth $1.5 billion) installed in the country were made by the 75 computer firms that operate there.

Singapore, too, has established a National Computer Board with a mission to improve the country's software production.

Few developing countries, with the exception of those in the Far East, can afford the investment needed to produce hardware. But many are hopeful that they can compete in software, with its emphasis on people rather than machines. India hopes to earn $300 million a year from its programming activities. A note of warning, however, was sounded by Baruch Raz, a professor at Tel Aviv University. "Big computer companies don't want us to make master programs (software for controlling systems)", he said, "so we have to go for applications software. The trouble is we are not close to our markets and we have difficulty defining the problems we are trying to solve with software."

Training enough specialists is also a problem in countries with a shaky education system. To keep abreast of technological trends, developing countries are forced to spend hard-earned foreign currency sending students abroad to train. The trouble is, once there, the trainees are loath to return home to salaries a quarter the size of those in the West.

Some in the developed world are not happy with the efforts of the have-nots to keep up in information technology. "We are feeling the pinch from developing countries", said Steven Vajda from the Data processing Management Association, the professional body of American computer managers. Vajda called for a dialogue with developing countries aimed at removing barriers to American trade.

"The real question", said one speaker, is how developing countries are going to use information technology to solve their real problems rather than their balance of trade problems." (This first appeared in <u>New Scientist</u>, London, 18 September, 1986 the weekly review of science and technology)

The Club of Rome and the future of industrial informatics

During the Sisifo Forum held at INDISI (IBI's International Institute for Industrial Informatics) in Valencia, IBIPRESS obtained an exclusive interview from Mr. Alexander King, President of the Club of Rome and President of the International Advanced Studies Federation, and another from Mr. Adam Schaff, Professor of Political Sciences, International Counsellor in Social Sciences and member of the Club of Rome.

IBIPRESS: We are at the threshold of an age during which we shall see the appearance of robots capable of seeing and feeling. Do you think machines will help in improving the quality of man's life?

Mr. A. King: At the moment robots are able to assist in the automation of certain sectors of the industrial process. It is a task they do well and which gives workers a chance to avoid dangerous, dirty and repetitive tasks.

The robot generation to follow will involve entire industrial systems and, by doing so, the organizational nature of industries will be transformed. These changes will go as far as the mode of operation and will have influence on manpower, which will see its numbers reduced. There is, therefore, the likelihood of seeing the birth of a new type of company, a new sort of industry or, if change is resisted, to make the situation of workers more difficult still while at the same time considerably increasing unemployment.

Either of the two orientations may be chosen but, in my opinion, it is necessary as of now for people, without overlooking governments, to realize the dangers they may encounter along the way and not only consider the aspects that hold up the possibility of seeing the rise of a new society that offers man more leisure and allows him to develop his personal capabilities. All this requires a different sort of work distribution, something that is far from easy. Our present approaches to governments can be useful provided the latter themselves have been educated or brought to face the type of difficulties I have just mentioned.

The results we could obtain would be so marvellous for the future of mankind that no country would be able to refuse to envisage such an approach.

Mr. A. Schaff: robots will improve the quality of man's life because it is in fact preferable for man to avoid drudgery or also office work to dedicate himself to creative tasks which make it possible for him to develop his personality.

But things could happen differently, it is also possible to imagine a terrifying society in which man is totally alienated, with automatons and very little communication among persons. The latter would see their lives guided by robots. This is not mere science fiction. These things could happen if people are not vigilant.

Everything depends on man. Whatever he does will have an impact on his future. If we change society's structure we must adapt our social mechanisms to the new situation. (<u>IBIPRESS Bulletin No. 95, 25 August 1986</u>)

RECENT PUBLICATIONS

The employment effects of microelectronics in the UK service sector

This document was prepared by Julia Swann of the Technical Change Centre, London as a working paper under the World Employment Programme under the auspices of ILO. The study is the first in a series of studies on the employment effects of microelectronics in offices and service industries. Investigations were undertaken at three different levels: firstly at the service-sector level; secondly at the industry level (using four selected sub-sectors - banking, insurance, accountancy and local government); and thirdly at the case study level.

An important fact emerging from the study is that in the 1980s employment in office-based services is again rising steadily, despite the recession and the increasing use of IT - especially in financial business services. Service employment has increased because of the sustained demand for services and, in particular, for better quality services.

The extent to which IT de-skills jobs - or affects the quality of work life - flows more from the work organization in each individual case, rather than from any inherent quality of the new technology. Indeed as IT can be used to aid decentralization, it presents opportunities to make jobs more integrated and rewarding. Further adoption of IT systems should be encouraged rather than feared in an expanding office sector. But both management and unions should become aware of the desirability of designing new jobs and creating new organizational structures in order to use the new technology to their mutual advantage. (Available from International Labour Office, Geneva, WP 168).

Microcomputers and their applications for developing countries

This book is an overview of microcomputer applications in developing countries and the issues associated with their use and abuse. It looks into applications in agriculture, health, energy and municipal management and is based primarily on the deliberations of the first BOSTID symposium on microcomputer applications in developing countries, held in Colombo, Sri Lanka, November 1984 (vide Microelectronics Monitor No. 15). The report has been prepared by an ad hoc advisory panel of the Advisory Committee on Technology Innovation, Board on Science and Technology for International Development (BOSTID), Office of International Affairs, National Research Council and was published by Westview Press/Boulder, Colorado and London (ISBN 0-8133-7252-6).

The impact of industrial robots on the world of work

This article prepared by K.H. Ebel of the International Labour Office appeared in the International Labour Review, Vol. 125, No. 1, January-February 1986. (The International Labour Review is published six times a year and carries articles on economic and social topics of international interest affecting labour, research notes, notices of new books received by the ILO). In his article K.H. Ebel looks at the diffusion of industrial robots; the effects of robotization on employment; impact on working conditions; and industrial relations.

Impact of new and emerging technologies on trade and development

This review of the UNCTAD's secretariat's research findings (TD/B/C.6/136) was prepared for the Sixth Session of the Committee on Transfer of Technology which met in Geneva in October 1986. It comes to the conclusion that with regard to the effects of microelectronics technologies on developing country exports of manufactures, no clear trend can be distinguished in the direction or general nature of the effects of microelectronics technologies on developing country exports of manufactures. If one were to confine one's attention to the macroeconomic analysis of the most recent trade statistics (paras. 47-50), one would conclude that neither microelectronics nor other forms of technological change have prevented developing countries - including both the leading exporters and others - from increasing the growth of their exports and generally enlarging their market shares in total developed market-economy coutries' imports of a large range of manufactures. The reason for the contradiction with earlier predictions - i.e. that the diffusion of these technologies would have dire consequences for developing countries' exports - is not obvious. What is most likely, as suggested by some authors, is that microelectronics applications, including information technologies, have not diffused as rapidly in the industries of the North as was predicted on the basis of the speed with which such diffusion took place in the electronics sector itself.

Information technology for development - an international journal

As reported in earlier issues of the Monitor the UK Council for Computing Development (UKCCD) publishes an International Journal featuring papers describing practical applications of information technology in developing countries and also those which deal with the social, political or industrial implications of IT development, or which are concerned with training issues. Two issues of the Journal have been published so far. Contributions from authors in developing countries will be especially welcome and our readers are hereby invited to contribute to the Journal. Please contact Mr. J. Bogod, Director, UKCCD, 13 Mansfield Street, London W1M 0BP, England.

New journal to cover computerized translation

A new international journal, Computers and Translation (CAT), is to appear in 1986 from Paradigm Press, Inc. The publisher plans to cover such topics as: software in translating and language processing; hardware to process language; relevant research in linguistics, artificial intelligence, database construction, information science and terminology; and the social consequences of computerized translation for society in general and for the translating profession.

Individual subscriptions (paid by personal check) cost USD 35.00. Surface mail to Canada and Mexico is an additional USD 5.00; elsewhere outside the United States, USD 6.00. Airmail rates on request from: Paradigm Press, Box 1057, Osprey FL 33559-1057, USA (TP + 1 813/922-7666). Paradigm Press also publishes SCOPE, Computers & the Humanities, and Computers and the Social Sciences. (ACCIS Newsletter 4(2), July 1986)

Cahiers du Centre de Developpement

The University of Rennes, France publishes "Cahiers", a journal which comes out twice a year and focuses on global aspects of industrial development with particular emphasis on electronics industry and telecommunications. The most recent issue, Cahier No. 1-2, January-June 1986, contains a.o. a report on "Strategies in electronics industry and industrial development in Brazil" as well as an analysis of new conditions of development of the electronics industry in South East Asia with an interesting juxtaposition of government policies in India, the Republic of Korea and Singapore with that of Brazil. For more information please write to Marc Humbert, Centre de Developpement, Faculté des Sciences Economiques, 7, Place Hoche, 35000 Rennes, France. The Cahiers are published in French.

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REMINDER

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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Microelectronics Monitor
Reader Survey

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

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Which additional subjects would you suggest be included?

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Please make any other comments or suggestions for improving the quality and usefulness of this newsletter.

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