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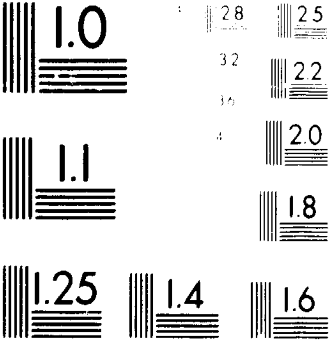
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org



MICROCOPY RESOLUTION TEST CHART

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STANDARD REFERENCE MATERIAL 1010a

ANSI and ISO TEST CHART No. 2

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

MICROELECTRONICS MONITOR

Issue No. 12 14573 October - December 1984

Dear Reader,

As this is the third anniversary of the Microelectronics Monitor, it may be appropriate to review what has happened since the first issue was published. Starting with a small group of experts who met in June 1981 to advise UNIDO on the initiation of a programme designed to sensitize developing countries to the development of microelectronics and its implications, and to promote applications particularly suited to developing country environment, UNIDO has gone a long way preparing the ground by commissioning basic studies on microelectronics applications; software production and software engineering; software licensing; and a concept paper on the establishment of a silicon foundry cum design centre in a developing country. Another approach was the regional approach, starting with expert group meetings in Latin America, Asia and the ECWA region. More recently, UNIDO has been working towards establishing a regional network for microelectronics in the Latin American and Caribbean region which is proposed to be established at a meeting in Venezuela in June 1985. A national meeting on microelectronics applications in Kenya to be held in February 1985 with participation from neighbouring East African countries will be a first step towards developing a programme for Africa. A series on the state-of-the-art of microelectronics in developing countries includes studies on Bangladesh, India, Pakistan, Republic of Korea and Venezuela.

The Microelectronics Monitor has reported on all these activities and, it is hoped, has also fulfilled its mandate of serving as a current awareness bulletin. However, we in UNIDO feel that it might still be improved in that it should more closely reflect what is going on in developing countries and also analyse trends to assist policy makers in their decisions. This would call for processed information. Efforts in this direction have been made by publishing special supplements, one in December 1983 on technology and market trends in the production and application of information technology (1981-1983); and one on flexible manufacturing systems (FMS), which is published as a supplement to this issue. However, our resources both in finance and manpower are very limited. Still, we are flexible in our approach and open to suggestions. If you feel you have events to report happening in your part of the world or if you have comments, please write to us. Needless to say, we are grateful to all those readers who have been encouraging us during the last three years by expressing their appreciation of the Microelectronics Monitor and confirming the need for it.

May I wish you on behalf of all my colleagues a very happy and prosperous 1985.

G.S. Gouri
Director
Division for Industrial Studies

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

NEWS AND EVENTS

UNIDO organizes microelectronics meeting in Kenya

The Kenyan National Council for Science and Technology in co-operation with UNIDO will hold a national meeting on applications of microelectronics and software in Nairobi on 18-23 February 1985. Representatives of neighbouring East African countries such as Ethiopia, Sudan, Tanzania, Uganda and Zambia will also attend and present country papers. The objectives of the meeting are to review the issues and implications relating to the application of technological advances in microelectronics and its applications in the context of the Kenyan economy and to suggest actions for its benefit. Particular attention will be paid to the impact on selected sectors of industry, the policy orientations that may be necessary and the measures to be taken for strengthening industrial and technological capabilities in this field. Though the emphasis will be on microelectronics and software, the field of electronics as a whole will be considered and the impact microelectronics will have on it.

REMLAC to be initiated

The expert group meeting for the initiation of a regional network for microelectronics in the ECLAC region (REMLAC) on which we reported in earlier issues will take place on 3-7 June 1985 in Caracas, Venezuela. Representatives from selected countries in the Latin American and Caribbean region will meet to establish the network and elaborate its modalities as well as a programme of work. The network is envisaged as providing a framework for co-operation in which other countries in the region may also join later. A UNIDO mission is currently under way in selected countries to ascertain the interest of the respective governments in the network and to identify existing institutions to act as focal points of the network. The meeting will be organized by UNIDO in co-operation with ECLAC and SELA.

UNIDO's TIES 1/ offers computerized information system

The Computerized Registry Information System (CORIS) is the information system operated on personal or minicomputer and designed for handling information in the process of evaluation, registration and monitoring of technology transfer agreements by the specialized government agencies. The experience of such agencies - often called technology transfer registries - in developing countries clearly indicated that the effective organization of handling information (collecting, storage, processing and disseminating) can substantially contribute to the overall registry performance as well as increase the benefits resulting from the international exchange of information.

Consequently, this area has gained increased attention within UNIDO's co-operative framework called Technological Information Exchange System (TIES). Following the recommendations of the TIES meetings, the UNIDO secretariat has developed the concept of the computerized registry information system and commissioned the software package for this system. 2/ CORIS shall serve as an important tool for technology transfer registries in their day-to-day operations.

* * *

NEWS FROM COGIT MEMBERS 3/

International Federation for Information Processing (IFIP)

On the occasion of the 25th anniversary of IFIP a one-day symposium will be held at the Technical University of Munich on 25 March 1985. Lectures will include one on "History and Future of IFIP" by IFIP's President, K. Ando. Other invited lectures will focus on "Assessment of Information Processing"; "Man and Machine"; "Sense and Nonsense of Information Processing"; "Hardware"; "Software"; and "Technology and Industry".

1/ Technological Information Exchange System.

2/ The software for CORIS has been designed by the Foreign Trade Data Centre Warsaw, upon request of UNIDO secretariat.

3/ For details on COGIT *vide* Microelectronics Monitors 9 and 10/11.

Computers in industry: from design office to shop floor: the work of IFIP's TC 5 [4/]

Advancing the state of the art in various facets of computing is one of the aims of the International Federation for Information Processing (IFIP), a federation of national professional bodies. IFIP's technical work is organised by a number of Technical Committees, each of which devolves its professional work to specialised working groups. Technical Committee 5 (TC 5) is concerned with computer applications in industry, and in its strong emphasis on applications rather than research it differs from most other IFIP technical committees. In its mode of working and its "end products", TC 5 conforms to the general IFIP pattern of workshops and working conferences of experts, open international conferences of wider appeal (often organised jointly with other bodies), and published conference proceedings. In two respects, however, it again differs from the majority of TCs. First, because the subject of automation in industry is a highly fashionable and commercial one, the conference marketplace is already overcrowded. In this situation TC 5 aims at quality rather than quantity, with the major effort now concentrated on a triennial open "systems" conference which reviews the whole field. This event is the International Conference on Computer Applications in Production and Engineering (CAPE), the first of which was held in Amsterdam in 1983. CAPE '86 will be held in Copenhagen. The second aspect of TC 5's activity that differs from the norm is that the committee is directly associated, with the North-Holland Publishing House, in editing and publishing a bi-monthly (previously quarterly) journal, Computers in Industry. This is published commercially by North-Holland; its content reflects the interests of TC 5 but covers the field as widely as possible.

Achievements and Problems

Successful industrial computing systems can transform the business performance of manufacturing and process companies. These benefits have been demonstrated in large companies and are becoming progressively more relevant to smaller companies also as the cost of computing continues to fall. Computer aided design and computer aided manufacture have become familiar and fashionable as CAD and CAM, but there is more to industrial computing than CAD and CAM - and, indeed, there is more to CAD and CAM than is represented by today's state of the art in mechanical engineering. Within the broad areas of design and manufacture, constituent activities are potentially susceptible to computerisation. These embrace specification, design synthesis and analysis, design detailing and drafting, preparation of the product documentation (drawings, parts lists, etc.), preparation of the manufacturing processes, preparation of the test and quality assurance process, manufacture and assembly, material resource planning, production planning and production management, and product packing and shipping to warehouse. Feedback between many of these activities is important.

Much progress has been made over the past 30 years in automating these activities. In design, specification languages are being developed which will provide a unique definition of the product to be used as the reference specification. Advanced analysis and simulation programs are available; and detailing and drafting are highly efficient thanks to advanced algorithms and powerful interactive graphics. Artificial intelligence and pattern recognition techniques have led to reading devices which can interpret manually prepared engineering drawings, and production drawings are being automatically generated. In manufacturing, also, similar trends are evident. Numerically controlled machines have been followed by the introduction of machining centres, flexible manufacturing systems and manufacturing cells with automated supervision. These will soon have advanced automated sensors, while robots are being introduced to assembly and finishing tasks. Automatic transport and packing devices, electronically controlled assembly lines, automatic test equipment and extensive scheduling systems are available and in use. Data flow and factory control will be monitored by large computer systems, and data will be managed in hardware-oriented database machines; thus technical staff may store, retrieve and modify data instantly. Much if not all of the information needed by the production departments will be created in the design phases. Design data will be smoothly transferred to manufacturing using local and wide area networks, and drawings and other human-readable documents will become less important. Expected intelligent work-stations for designers, producers and managers will feature interactive graphics, data dictionaries, advanced editing facilities, voice recognition and speech analysis.

These various possibilities have been pioneered in industry by the larger companies. Smaller companies will follow as the benefits of computer-based systems - reduced lead times, higher quality products, flexibility in customising and cheaper products - become clear.

4/ Excerpted from an article written for IFIP by Kenneth Owen, former Technology Editor of The Times, London.

Though the technological opportunities are evident, they are accompanied by a number of serious problems - technical, organisational, social and cultural. On the technical side, a problem is that virtually all the industrial programs and systems have been developed in isolation. Specification languages, simulation programs, drawing systems, NC machine tool languages, production control systems and the like lack proper communications and standards. Substantial interface programs are needed in attempts to create integrated systems. In addition, data entry methods for the various parts of the design/manufacture complex exhibit different notations and language incompatibilities. The basic solution to this immense problem lies in the definition of the data elements that constitute the product and its related design and manufacturing process. Integrated systems require standardised data elements. Standardisation is needed also in data-entry language notations. (Ironically, though there is an accepted set of standard symbols used in electrical drawings, the language description of the same symbols appears in hundreds of notations in the various CAD/CAM programs).

Another technical problem concerns back-up. As more and more functions are automated, care is needed on such questions as back-up, recovery, security and safety. If human actions and interventions are completely replaced by automation with no mechanism for manual fall-back, catastrophe may result in cases of system malfunction. An organisational problem has emerged with the rise of new professions (and professionals) within the factory environment. Design offices are supported by CAD experts, prodution units have to try to communicate with CAM engineers, and production management is faced with an increasing dominance of computer-oriented logistics personnel. Other new professions include those of the database manager and data librarian. All these information-based new professions differ significantly from the traditional technical disciplines and, because "natural" lines of responsibility are disturbed, problems of communication result. Social problems, also, arise as a result of the changing nature of the design and test process. Instead of communicating with colleagues in a continual iteration, individuals now sit at terminals and are paced by the high-speed processor. All too often the "human" part of the human/machine dialogue is ignored in the design of CAD/CAM systems. In terms of national cultures, the new computer-based systems are creating problems in non-English-speaking countries because of their use of the English language. And, inevitably associated with the much-increased productivity of automated industrial systems is the familiar and serious problem of employment. Though the industries which produce computers, software, peripherals, robots and CAD/CAM systems will undoubtedly continue to grow and so provide new employment, it must be accepted that the number of new jobs will amount to only a fraction of the jobs that will be lost because of industrial automation.

The role of TC 5

Against this background, Technical Committee 5 aims to promote the international exchange of information over the whole field of computer applications in industry. Its scope embraces control computers, computers in manufacturing, computer applications in design, simulation, computers for traffic control, problem-oriented languages, interactive graphics and other facets of the subject. In programming languages and in education respectively, TC 5 works closely with two other IFIP technical committees, TC 2 and TC 3. The technical work of TC 5 is handled by six working groups. These cover:

- Computer-aided design
- Discrete manufacturing
- Common and/or standardised hardware/software techniques
- Maritime industries
- Automation of production planning and control
- Product specification and product documentation.

Technologies such as computer aided design, computer aided manufacture, flexible manufacturing systems (FMS) and industrial robotics are being implemented rapidly in industry at present, the TC 5 chairman, Prof. A. Rolstadas (Norway) notes. The only barrier is that of finance. Competition in today's marketplace calls for a high degree of automation; "This is a snowball that has started rolling". An important part of TC 5's role, says Professor Rolstadas, is to make industry aware of the technology that is available, and show examples of how the technology can be used, so that industry can judge for itself what to invest in and apply. Equally important is to hear from industry where the perceived problems lie, so that appropriate research can be encouraged. In reviewing the overall scene Professor Rolstadas is wary of attaching too much importance to the future impact of artificial intelligence (AI) techniques ... . The TC 5 chairman acknowledges the value of specialised AI techniques - as applied, for example, in the vision part of robotics systems. But he does not favour the use of expert systems as advisers. "That is very dangerous. When you're under stress it is easy to follow the computer's advice without checking it thoroughly. And many trivial decisions can act as a basis for other, more powerful decisions. If you can find the right balance, expert systems will be very useful; if not, they might prove very bad." Much of the current general interest in industrial computing relates to the manufacture of discrete products, and at the present time this emphasis is reflected in TC 5 activities. But Professor Rolstadas is aware that the committee must not neglect problems in the field of continuous processing. In industrial applications generally, the TC 5 chairman points to two problem areas which merit high priority. First, the need to enable the many available systems to communicate with each other. Second, the need to integrate CAD and CAM systems.

The Working Groups

Computer Aided Design is the theme addressed by WG 5.2, whose chairman, Dr. Ketil Bo of Norway, includes expert systems as one of three significant topics for the future development of this field. The other two are human/computer interaction, and technically oriented databases. If the problems of these areas can be solved, he says, computer aided design will take a considerable step forward. Over the years WG 5.2 has worked consistently towards CAD "building blocks" for modular systems ... "Knowledge engineering in computer aided design" was the subject of a WG 5.2 working conference held in September 1984. A working conference on Design Theory for CAD will be held in Tokyo, Japan 1-3 October 1985. The conference will provide guidelines for the development of future CAD systems.

Discrete Manufacturing (as distinct from continuous processing) is the concern of WG 5.3, whose chairman is Mr. J.P. Crestin of France. This area includes the highly active and on occasion emotive topic of robotics, the subject of much applications development at present. A key problem in current robotics is to combine the high precision of computer controlled positioning with the "brute strength" ability to lift heavy loads. Robots in assembly, which represent the next major field for automation, will need advanced vision and force-sensing systems. "Industrial robots in discrete manufacturing" was the subject of a WG 5.3/IFAC working conference held in June 1984. A triennial international conference on computer software for discrete manufacturing, known as PROLAMAT, is sponsored jointly by WG 5.3, AFCET and IFAC. In 1985 this event will be in Paris, addressing the five themes of design and implementation of CAD/CAM systems, computer aided design, computer aided process and production planning and optimisation, robotics and automated manufacturing systems, and artificial intelligence in CAD/CAM. The WG 5.3 chairman is also chairman of the international programme committee for PROLAMAT '85.

Maritime Industries, including the offshore energy industries, are covered by WG 5.6 with Professor C. Kuo of the United Kingdom as chairman. The scope of its work includes "methods of automation of the operations of shipping companies and shipyards, of oceangoing vessels and smaller craft, of fisheries, and of other maritime industries and installations, topics in the use of the associated computers, signal gathering equipment, data presentation devices, and associated equipment and techniques". Computers have helped to transform ship technology from the art-based tradition of "naval architecture" to a science-based activity. Ship design is complex, involving the creation of a three-dimensional structure able to operate in both the air and the sea medium. Full structural analysis of any marine vehicle can now be performed using computers, but much remains to be done in the areas of management information and in man/machine communication. WG 5.6's major regular conference event is the International Conference on Computer Applications in the Automation of Ship Operation and Ship Design (ICCAS), held every three years. In 1985 this conference will be held in Trieste, Italy. In addition, in-depth workshops are being organised on the application of computer graphics to design, management information systems, and the application of expert systems in ship technology.

Automation of Production Planning and Control: this subject is covered by WG 5.7, chaired by Dr. Peter Falster of Denmark. The production management area, Dr. Falster points out, has been dominated for decades by practical solutions. Its foundation consists of separate models - for functions such as inventory control, material requirements planning and manufacturing activity planning. A single integrated theory is lacking. No one has yet formulated production laws which could form the starting point for a general theory for production management systems; hence the many problems facing attempts to establish true system software modules for production planning and control. A recent focus for WG 5.7 work in this basically important area was a working conference (held jointly with IFAC) on modelling production management systems. A closer integration between the production management systems and those for design and manufacture is another important topic on which WG 5.7 is working. The group's area of interest includes project management as well as production management.

Product Specification and Product Documentation is the subject addressed by WG 5.8, TC 5's youngest working group. Professor G. Musgrave of the United Kingdom is the chairman of this group, which is now building up a balanced membership reflecting both theoretical and practical interests. Formation of this working group reflects the implications of the trend for products to be specified not by drawings but in numerical form, and for this to be followed through at all stages of the manufacturing sequence. Thus an important sub-area consists of the interfaces between product specification and CAD; between CAD and product documentation; and between product documentation and CAM and production management. Theoretical linguistics work in computer science, it has become apparent, is not being related to production engineering. Based on a balanced industrial/scientific membership, WG 5.8 intends to attempt to remedy this situation. In addition to the interfaces mentioned above, other important sub-areas of the group's work include formal product specification languages; compilation methods for Petri nets, evaluation nets, finite state machines, etc.; and information processing methods of integrated text and graphics.

Working Group WG 5.4 is an exception to the normal pattern of IFIP working groups. Chaired by Mr. N.E. Malagardis of France, this group has as its subject "Common and/or standardised hardware/software techniques". The group operates also as the European Workshop on Industrial Computer Systems (EWICS), representing the European branch of the International Purdue Workshop on this subject. EWICS provides a working body for the preparation of pre-standardisation proposals, and for monitoring and participating in international standardisation activities. It aims to promote the efficient use of industrial computer systems through education, dissemination of information, and the development of standards and guidelines. The group's detailed work is handled by eight constituent committees, concerned respectively with industrial real-time FORTRAN; industrial real-time BASIC; interfaces and data communications; man/machine communications; safety and security; distributed intelligence; application-oriented specifications; and real-time databases. ...

Volunteers in Technical Assistance (VITA)

For the past 25 years VITA has been engaged in an effort to provide high quality technical information in usable form to people, institutions, government agencies, and businesses in developing countries at no cost to them. Through VITA, almost 5,000 volunteers in more than 100 countries donate their time and share their expertise in researching and responding to thousands of requests each year. The Agency for International Development and other public and private donors have provided the necessary support for this effort.

Computer Survey

Microcomputers in Khartoum help plan railway schedules. In Mexico and Kenya, they are used to process and print text in languages with unusual alphabets. And in Colombia, microcomputers make the engineering calculations for bridges, tunnels, and buildings. These are just a few of the uses for microcomputers reported so far in a survey VITA is making of microcomputer applications in developing countries. As might be expected, microcomputers are more typically used for accounting, word processing, technical analysis, information storage and retrieval, inventory control, and statistics.

Over 1,400 individuals, businesses, and organizations in the Third World are being polled. The survey is concentrating on microcomputer applications by indigenous users, both public and private, rather than by expatriates. Recipients are asked about the type of hardware and software they are using, how they are applying the technology, and what type of information network they are plugged into, if any. VITA will use the information gathered in the survey to help plan its conference on "Microcomputers for Development", tentatively scheduled for late 1986. If you can help identify Third World organizations that are using microcomputers - or if you have any comments or suggestions - please write or call Sheila Ferguson at VITA, 1815 N. Lynn St., Arlington, Va. 22209, USA. Tel. (703) 276-1800.

VITA/NTIS Agreement

VITA and the National Technical Information Service (NTIS) have signed a formal memorandum of understanding to improve systems for the exchange of specialized information with developing countries. NTIS, an agency of the U.S. Department of Commerce, is the central source for the public dissemination of U.S. government sponsored research in the business, economic, and scientific fields. The agreement will extend through Fiscal Year 1986.

A number of co-operative projects are expected to be funded under the agreement. For example, VITA will help to conduct a variety of training programs tailored to the specific needs of developing countries. VITA also will review and evaluate selected technical materials for suitability to development applications, undertake joint marketing efforts in support of information dissemination, conduct impact evaluations and studies of specific programs, and help apply new technologies to international information services.

The Commonwealth Science Council (CSC)

Training Workshop on Basic Principles of Microprocessor Based Systems (MPBS)

As part of the 1984/85 activities of its Industrial Support Programme, Commonwealth Science Council (CSC) plans to organise a training workshop on Basic Principles of Microprocessor Based Systems (MPBS). CSC's Industrial Support Programme aims to enhance indigenous capability in those aspects of science that are supportive of technical and/or technological services pertinent to resource development and industrialisation processes. The proposed workshop is a result of the realization that while the impact of microelectronics on society is phenomenal, various and varied, the acculturation of the concomitant (microelectronics) technology amongst countries of the developing Commonwealth is rather quasi-static.

The endeavour to organize the training workshop on Basic Principles of Microprocessor Based Systems is an attempt by Commonwealth Science Council:

1. To render familiar the fundamental principles behind the microprocessor and microprocessor based systems (MPBS); and

2. To promote an occasion for discussion of possible areas of collaborative endeavours (training, projects or research) in the field of microprocessor based systems.

The final content of the workshop programme will be selected so as to project on a more or less integrated approach towards software and software design principles.

Participants are to be nominated by their respective governments following receipt of CSC "Announcement and Invitation to Nominate" by CSC members or appropriate contact points. The nominated participant should be a young physical scientist/mathematician, technologist, or engineer with proven interest in the microelectronics/programming field.

British Computer Society (BCS)

The Society is improving its service to members by launching a newsletter. It will be published 10 times a year. The first issue will appear in January 1985. Anne-Marie Coles has been appointed editor. The newsletter will keep members informed of Society events. There will be a number of regular features in which the activities of the branches and specialist groups will be prominent. In addition to the newsletter, Computer Bulletin is to be relaunched in March. The new Bulletin will have a much broader scope than it does at the moment and five associate editors have already been appointed. The sections they will cover are business applications, esoteric (including design), education, innovative news, and books and other media.

* * *

If the CAP fits ...

To promote long-term planning for health of the elderly by the year 2000, a Computer Assisted Planning Software package (CAP) 5/ has been developed for WHO Member States by researchers at the Johns Hopkins School of Hygiene and Public Health. The principal objective is to provide health officials and planners with an inexpensive and easy-to-use information tool. The package comprises a program disc which generates a choice of coloured graphic displays plus a data disc containing a store of comprehensive data for use with a portable personal computer. From its use by health personnel in the USA, Norway and Canada, the CAP software package has proved itself to be useful in performing the following tasks:

- Illustrating targets or goals, and the gap between current trends and the selected targets over time;
- Monitoring progress towards goals;
- Estimating the implications of changing demographic structure or economic conditions on health services utilization and resource requirements;

5/ Computer Assisted Planning: Application to Health of the Elderly by the year 2000, Karen Davis, Professor and Chairman, Dept. Health Policy and Management, Johns Hopkins School of Hygiene and Public Health, Baltimore, Maryland, USA. World Health Statistics Quarterly, vol. 37, No. 3, 1984, WHO, Geneva.

- Simulating alternative strategies for achieving policy goals;
- Comparing the disparity in resource allocation across geographic areas, or population groups.

While the CAP software package has yet to be taken up by developing countries, the technology is simple and available at reasonable cost. Also, the format permits rapid revision of data as better estimates become available. The CAP model can be readily extended to analyses of maternal and child health, for example, and need not be restricted to health concerns of the elderly. Similarly, it can be extended to environmental health concerns, accident prevention, etc. (ACCIS Newsletter Vol. 2 (4) November 1984.)

IIE Conference on CIMS

The Institute of Industrial Engineers (IIE) hosted its Fall '84 conference in Atlanta, Ga. (USA) on 28-31 October 1984 dedicating it to the theme of computer integrated manufacturing systems (CIMS). More than 50 CIMS sessions covered a broad spectrum from hardware/software selection to unusual applications for both. Main topics addressed included flexible manufacturing systems; information issues; selection and implementation issues; integrating the manufacturing and design process; and scheduling and control issues.

Copies of the proceedings can be obtained at a cost of $70 for non-members from IIE, Technology Park, Atlanta, Norcross, Ga. 30092.

Semicom/Japan '84

The Semicom/Japan exposition took place in Tokyo on 3-5 December 1984. The show was sponsored by the (US) Semiconductor and Material Institute (SEMI) and was supported by the US Embassy in Tokyo. The exposition was followed by a two-day technology symposium at which technical papers on low temperature wafer processing, materials and lithography were presented by industry leaders from Japan and the USA.

MAJOR CONFERENCES AND EXHIBITIONS 1985

January

23-26	INTERNEPCON/Semiconductor Exhibition, Tokyo, Japan
31-1 Feb	Seminar on the Factory of the Future, Royal Aeronautical Society, London, UK

February

2-6	The Middle East Electricity and Electronics Exhibition, Jeddah Fairs and Exhibitions Ltd., Jeddah, Saudi Arabia
12-14	Microprocessor Development Show, Wembley Conference Centre, London, UK
13-15	International Solid-State Circuits, Conference Centre, New York, USA

March

6-7	Conference on Key Issues on Technology Transfer, and Exploitation of Intellectual Property, Cambridge, UK
12-14	Semicon Europa 85, Zurich, Switzerland
14-19	China Tronic- Exhibition on Electronics, Test and Measuring Instruments and Production Technology, Tainjin, China
20	Lecture on Evolution in Manufacturing Automation, Institute for Mechanical Engineering, London, UK
26-28	Circuit Technology 85 and Interconnection 85, London, UK

April

14-18	International Conference on Software Engineering for Telecommunications Systems, Eindhoven, Netherlands
16-18	International Conference on Advances in Command, Control and Communications Systems: Theory and Applications, Bournemouth, UK

April (cont'd)

16-19	International Industrial Electronics Show, Budapest, Hungary
17-24	Hanover Fair, Hanover, FRG

May

14-16	Test and Measurement World Expo, San José, USA
25-29	Intel 85, International Electrical and Electronics Exhibition, Milan, Italy

June

4-6	Software 85, Earls Court, UK
11-15	International Telecommunications Exhibition and Conference, Oslo, Norway
24-27	Computers in Manufacturing Show and Conference, Olympia, London, UK

July

1-5	Laser/Optoelektronik Show, Munich, FRG

September

2-4	International Conference on Automated Manufacturing Techniques in Electronics, University of Edinburgh, UK
5-7	INTERNEPCON/Semiconductor Exhibition, Hong Kong
24-26	Artificial Intelligence Show, Wiesbaden, FRG

October

1-3	Semiconductor 85 International Exhibition and Conference, NEC, Birmingham, UK
16-19	Industrial Electronics Fair, Vienna, Austria
18-24	IEE 85, International Electronics Exhibition, Shanghai Exhibition Centre, China

November

4-8	Paris Components Show, Paris, France

December

7-12	International Computer Show, Peking, China

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The following news items have been excerpted from the sources indicated with kind permission of the journals concerned. A list of these journals is attached as annex I to this issue.

TECHNOLOGICAL DEVELOPMENTS

Here come the 'Monster Chips'

Trilogy Systems Corp. USA made headlines in 1980 when it announced it was taking on IBM by developing a mainframe computer. To make the machine more powerful than anything the No. 1 computer maker offered, Trilogy intended to leapfrog current semiconductor technology and build "monster chips" as big as a man's palm - hundreds of times larger than today's conventional integrated circuits. But last August, with its cash hoard badly depleted, the company gave the industry two shocks: First, it dropped its ambitious plans for the new computer; weeks later, it threw in the towel on giant chips as well. Although Trilogy's efforts with monster chips initially looked like a flop, experts are now changing their tune. They credit the startup with clearing the way for the next round of semiconductor technology. Thanks to Trilogy, declares Will Strauss, technology analyst at In-Stat Inc., an Arizona market researcher, "the semiconductor industry is probably two to three years closer" to huge chips known as wafer-scale integrated circuits. Adds Robert McGeary, an analyst at Dataquest Inc., a Californian market researcher: "When everything has settled, I think we'll find that Trilogy solved a lot of problems." Already, Mosaic Systems Inc. in Troy, Mich., USA and Britain's Sinclair Research Ltd. expect to offer commercial monster chips next year. ...

Another measure of progress: The amount of research and development is exploding. Among the companies following in Trilogy's footsteps are General Electric, GTE, Texas Instruments, Mostek, Gould, Honeywell, WaferScale Integration, Toshiba, Nippon Telegraph & Telephone, and perhaps International Business Machines. In addition, Trilogy is currently talking to Digital Equipment, Sperry, and CII-Bull - all of which are investors - as well as Control Data, about picking up on elements of Trilogy's unfinished wafer-scale work. And active research projects continue at Rensselaer Polytechnic, Massachusetts Institute of Technology, Columbia University, and Lawrence Livermore Labs.

Today the electronics industry follows a peculiar route in building products around integrated circuits (ICs). After 200 or more circuits are fabricated in a batch on a silicon wafer 4 in. to 6 in. in diameter, the wafer is chopped into tiny chips that are then enclosed in plastic or ceramic packages. Each of these final ICs ends up being far larger than the tiny silicon chip. But an equipment maker immediately tries to cram the packaged circuits back together as tightly as possible on a printed-circuit board. The chips are fastened to the board with hundreds of electrical connections, each of which is a potential failure point. By leaving the wafer intact, in the form of a giant superchip, the industry would gain important advantages: improved reliability and better performance in smaller, lower-cost packages. In a computer, for instance, half to two-thirds of the time required to process data is taken up by signals scurrying from chip to chip. By minimizing such delays with the wafer-size circuits, Trilogy had hoped to build a computer that would execute 32 million instructions per second, yet cost only $4 million.

But Trilogy overestimated its ability to deal with some formidable hurdles, not the least of which was developing the equipment needed to make the chips. "They were ahead of their time," says In-Stat's Strauss. "The industry infrastructure just isn't there." Most observers agree that Trilogy tried to do too much too fast, perhaps because it figured that it had ample cash to accomplish almost anything. But Jack I. Raffel, a group leader at MIT's Lincoln Laboratories, points out that "you can't trade time for money without limit." Designing a wafer-size circuit, for example, is an awesome job. Even a fingernail-size circuit can easily take two years or more to create - and that is with the help of the latest computer-aided design (CAD) equipment. But no one makes CAD equipment for laying out an entire wafer. As a result, Trilogy had twice as many engineers devising new CAD tools as it did designing the actual circuits. The startup also had to find a way to test the monster chips to find defects - and a way to bypass the faulty areas and patch the good parts on the wafer together. So many things can go wrong in fabricating the minute circuit elements that defects are unavoidable, but they are easy to handle in conventional wafers: The bad circuits are chucked out when the wafer is cut up - and 30% to 50% of the chips are typically discarded. But when the wafer is left intact, that approach obviously will not work.

Trilogy's solution was triple redundancy: Three different circuits had to come up with the same result to keep a wafer chip running. The wafers needed 120,000 logic gates - a gate is a switching station of four or more transistors - shared among the three primary circuits and a special "referee" circuit. If all three results from the primary circuits did not match, the referee would "vote" with the majority on the assumption that the discordant answer was caused by a defect. Heat was a major problem for Trilogy. Its wafers generated the heat of a 1,000-watt light bulb. The company tried to get rid of it by piping cooling water through a heat sink on the back of the wafer, but the heat apparently was not removed uniformly. Sources say that localized hot spots on the wafer occasionally caused catastrophic failures.

While these and other problems are under attack by universities and other companies, Mosaic and Sinclair are sidestepping some of the thornier problems to get their monster chips to market. Although totally different, both offerings are based on technology developed at Burroughs Corp. The Detroit computer-maker first took up the wafer-scale challenge in the early 1960s. Now Mosaic's Johnson, formerly engineering vice-president at Burroughs, is giving second life to a hybrid approach to wafer integration: Unpackaged chips cut from various wafers are bonded to the surface of a special wafer that contains a grid of embedded "wires" to connect the chips together. Mosaic expects to begin shipping wafers this winter to Evans & Sutherland Computer Corp., which will use the huge chips to drive the video display for a new flight simulation computer. Constantine A. Neugebauer, manager of semiconductor packaging at General Electric Co.'s research center, hails the hybrid concept because "one can achieve a performance level that is very much like wafer-scale integration, but without having to solve all the problems that Trilogy had." The chief technical officer at one major semiconductor producer agrees. He calls Trilogy's approach "a waste of time" because there are "10,000 things that are wrong with it from a cost point of view," and adds: "What makes sense is the hybrid approach." Sinclair Research, on the other hand, is sticking with pure wafer-scale integration - but applying it first to memory circuits. This is much easier than the logic circuits Trilogy had in mind, because the wafer is simply a checkerboard of hundreds of identical circuits, each capable of holding up to 2,000 characters of information. The wafer-scale circuit is put together by testing each of these subcircuits and detouring around the duds until 250 of them have been connected together. The finished wafer, says Sinclair, "is a silicon equivalent of the Winchester disk [memory]. It will do the same job, but it will be enormously smaller, use enormously less power, and be 1,000 times faster." The wafer memory will store more than 500,000 characters, 15 times the capacity of today's biggest memory chip. The company's latest project is a "system-on-a-wafer" that includes a microprocessor.

No shortage of ideas now exists on what wafer chips might make possible. For example, some computer scientists believe wafer-scale integration holds the key to a new computer more powerful than those that exist today. And John McDonald, a professor at Rensselaer Polytechnic Institute, wants to combine microprocessor, memory, and other circuits on a wafer and use it to paint images on video screens far more rapidly than can now be done. He envisions applications in industry, defense, and medicine - including a computer-aided tomographic scanner that would show live CAT "movies". Because processing video images takes so much memory and computer power, image processing could be the main near-term market for wafer chips, says Bernd K. F. Koenemann, a senior engineering fellow at Honeywell. For example, the key to the wristwatch-size TV set recently introduced by Japan's NTT is a "miniwafer" memory chip. Declares Joseph M. Lenart, manager of switching systems research at GTE Laboratories: "Any large electronic systems company that does not understand the potential of wafer scale will, I think, be severely handicapped in its ability to compete in the future." (Business Week, 3 December 1984.)

Single chip carries three technologies

Engineers at SGS-Ates Componenti Elettronici SpA, Agrate, Italy have developed a new process called Multipower BCD, which integrates linear bipolar, CMOS, and double-diffused D-MOS power devices on the same chip. SGS expects the integration of very high-efficiency D-MOS devices to make possible ICs capable of delivering upwards of 400 W, with power dissipation low enough to permit their being mounted in cheap multipin packages. The technology uses only standard production techniques, beginning with normal bipolar junction isolation, sinker, and buried-layer steps, followed by a vertical D-MOS silicon gate process usually used in the fabrication of discrete power MOS devices. The originality of the process resides in its ability to efficiently mix low- and high-voltage components. In standard IC technologies, the voltage capability is determined mainly by the thickness of the epitaxial layer and is identical for all devices, both signal and power.

If the epitaxial thickness is increased to allow inclusion of a high-voltage transistor, the linear dimensions of all the transistors, even the small signal devices, must be increased proportionally. This limits significantly the complexity of signal-processing circuits that can be economically integrated on a high-voltage chip. Multipower BCD, however, permits the realization of high-voltage lateral D-MOS structures in an epitaxial layer based on the normal dimensions for low-voltage bipolar linear elements. It is thus possible to mix on the same die very dense CMOS logic, high precision bipolar linear circuits, very efficient vertical D-MOS power devices and high-voltage lateral D-MOS devices. The saturation loss of a power D-MOS transistor can be reduced by increasing its area so designers will be able to make a trade-off between power dissipation and silicon area. That is, they can choose to increase their use of silicon to reduce their dependence on copper and aluminum packaging and heatsink materials.

The Multipower BCD architecture centers around a vertical D-MOS silicon gate structure where the lower level is a doped polysilicon gate and the upper level is the source metallization. The main advantage of this approach is that because the MOS channel regions, which measure only 1.5 μm, are defined by the difference in lateral diffusion lengths of two different impurity distributions, both of which are introduced through the same opening in a polysilicon mask, the structure is self-aligned. In its simplest version, Multipower BCD utilizes 10 masking steps. These yield vertical CMOS silicon-gate n-channel transistors, lateral D-MOS silicon-gate n-channel transistors, MOS silicon-gate p-channel transistors, bipolar npn transistors, bipolar lateral pnp transistors, diodes and zener diodes, junction and polysilicon resistors, and oxide and junction capacitors.

Increasing the number of masking steps to a maximum of 14 makes possible combinations of MOS n-channel transistors for dense CMOS structures, high-voltage p-channel transistors, npn transistors with improved gain, and multilayer interconnection. So far, the company has realized a 60-V D-MOS H-bridge for use as a test vehicle, and expects the voltage capability of the technology to rise in two steps to 250 V and then 400 V. SGS expects to have samples of its first three multipower products as early as the middle of 1985. Likely candidates are an intelligent dc motor driver, a dc-dc switching-mode power supply, and a switching-mode motor driver. (Reprinted from Electronics Week, 10 December 1984,)

Optoelectronic circuits

A team of engineers at Philips' (France) principal French research laboratory says it has solved the mystery surrounding one of the missing links holding back fabrication of fully integrated optoelectronic circuits. The Laboratoires d'Electronique et de Physique Appliquée (LEP), located in this Paris suburb, has come up with a way to produce low-loss waveguides in a localized epitaxy process that is compatible with those used in the fabrication of light-emitting diodes, diode lasers, and photodetectors. If the realization of optical ICs is a long way into the future, a number of other applications for which the guides can be used are nearer at hand. The deposition of electrodes on the guides would let them exploit electro-optical effects on propagating light, opening the way for their use as dephasers, interferometers, modulators, and switches. Such treatment would make them active, rather than passive, components.

The only serious candidates for use in integrated applications are III-V materials, particularly gallium arsenide compounds. Even though high-quality GaAs LEDs, lasers, and detectors have been available for some time, waveguides have for years been in the embryonic stage because researchers have concentrated almost exclusively on using etching techniques to produce them. The snag is that etching semiconductor crystals causes lateral roughness, which results in unacceptably high losses - as high as 4 dB/cm - during lightwave propagation. LEP's answer to this seeming dilemma is as maddeningly simple as Columbus's explanation of how to stand an egg on end. While others were trying to perfect etching techniques to minimize roughness, the LEP engineers decided to avoid that entire problem by growing threads of GaAs using selective epitaxy. Their reward is a fourfold reduction in attenuation losses (1 dB/cm) over waveguides produced by etching. In addition, the method can be used to produce monomode or multimode devices in structures grown atop a substrate or embedded in it. With the latter option, the entire configuration has the advantage of being planar.

Fabrication of the waveguides begins with a standard GaAs substrate upon which is deposited a 1,000-Å-thick layer of dielectric, either silicon dioxide or silicon nitride. After stripes of from 1 to 8 μm are opened in this layer along the substrate's crystallographic orientations, the waveguides are grown through this dielectric mask using a standard gallium, arsenic chloride, and hydrogen vapor-phase epitaxy system. Embedded waveguides are achieved by etching more deeply into the substrate before growing the crystal. The waveguides' exact form, and therefore their light-propagation properties, can be manipulated by varying the temperature and amount of arsenic chloride used during crystal growth. Usually, the highly anisotropic guides are optically isolated from the substrate by an n+-doped layer, which can even be the substrate itself. The usual optical-index difference between GaAs and the surrounding air is a further source of efficient optical confinement, as is finishing waveguide growth with a second n+ layer. This improves confinement characteristics by minimizing any surface roughness. In addition to their low attenuation, waveguides thus produced offer a number of advantages. They are pyramidal in shape, and their ends are thus bounded by facets oriented toward the substrate. These structures can be used as prisms for coupling light entering the waveguide through the substrate. The plus here is that coupling is simplified and that only one end of the guide has to be cleaved. This eliminates the attenuation and distortions caused by Fabry-Perrot effects, which are common when both ends are cleaved. Another advantage is that the guides can be adapted easily to change the direction of light, thus increasing on-chip packing density. Instead of the standard approach, in which curved waveguides are etched into the GaAs, resulting in a loss of several dB per radian - LEP simply etches mirrors into the substrate at an angle of 45° to bend the light path. (Reprinted from Electronics Week, 3 December 1984,)

MARKET TRENDS AND COMPANY NEWS

SC industry works on fresh demand-prediction theory

RCA Semiconductor has joined with Sprague Electronics and the Semiconductor Industry Association (SIA) in the testing of a new mathematical model that can forecast the amount of inventory on end users shelves. The current massive drop in semiconductor demand is being largely blamed on over stocking by customers earlier in the year when faced with shortages. The new model which has already been successful in predicting demand for passive components, will help to identify true levels of demand. ... The model could be ready for use by the end of the first quarter of 1985. It may then take a further twelve months to prove its predicted talent in the market place. (Electronics Weekly, 19/26 December 1984).

Silicon shortage puts chip prices in a spin

According to a survey from the US Department of Energy, published in the Wall Street Journal, prices of raw silicon - from which semiconductors are made - have risen to $80 a kilogram in the last few months, almost double the 1982 figure. But the shortages of silicon are not having the same effect on European prices, according to Adrian Tarr, an industry analyst at Mackintosh International consultants, because Europe and Japan are larger producers of raw silicon than the US. Prices should level out, says Tarr, if overall production of silicon meets industry projections for 1988, making the market worth $50 billion rather than $18.7 billion in 1983. But there may still be shortages in some areas, such as bipolar logic chips, because many manufacturers are turning to metal oxide silicon. Silicon for memory chips is expected to be in full supply again early in 1985. (Computer Weekly, 18 October 1984.)

Growth of semiconductor industry to slow in 1985

An Electronics Week survey of leading U.S. semiconductor houses indicates the industry continues to scale back dramatically its expectations for growth this year. ... But if the outlook now seems grim, executives indicate 1984 was far better than they had expected a year ago, mostly on the strength of dramatically increased sales [illegible] levels in the first half of the year.

The poll, conducted in the closing weeks of 1984, s[illegible]es are now projecting that total worldwide semiconductor sales neared the $[illegible] billion mark last year. That represents about a 50% increase over 1983's $18 billion. Predictably, ICs logged the steepest rise in 1984, growing about 55% to just under $21 billion last year. Discretes also showed unusual strength despite an industry trend toward integration. They registered a nearly 29% increase, according to the survey, which placed discrete sales near $6 billion last year.

Total MOS memory chips registered a 44% jump in 1984, reaching $5.79 billion versus $4.02 billion during the previous period. Dynamic random-access memory sales, which were dented by steep price erosion in the final four months of last year, grew 52% in 1984, crossing the $3 billion barrier from $1.98 billion in 1983.

Only read-only memories had weak growth in 1984, caused by sluggish consumer video-game and computer markets. ROMs gained 10%, hitting $530 million. Processor chips - including microprocessors and single-chip microcontrollers - also turned in a good year, with 1984 sales reaching $2.9 billion, compared with $1.9 billion in 1983. ...

Nearly all long-term scenarios call for a two-year recession followed by a buying surge, around 1988, equal to the one experienced in 1983-84. But semiconductor leaders are still hopeful of growth next year, according to the survey. In 1985, total worldwide semiconductor sales are expected to rise 7%, climbing to $28.8 billion. Sales of integrated circuits are projected to grow just under 10% to $22.9 billion, while discretes are expected to slip 2% to $5.9 billion.

Table 1

Worldwide Semiconductor Market
(Billions of dollars)

Category	1983	1984	1985	1986	1990
Semiconductors, total	$18.153	$26.935	$28.799	$31.855	$55.0-$75.0
Integrated circuits	13.535	20.979	22.867	22.867	47.0- 63 0
Discretes	4.618	5.956	5.932	6.324	8 0- 11.0

Table 2

Worldwide Market for Selected Semiconductor Devices
(Millions of dollars)

Category	1983	1984	1985	1986	1990
MOS memory, total	**$4,020**	**$5,790**	**$6,510**	**$7,540**	**$18,000–$28,000**
DRAM	1,980	3,010	3,350	4,000	10,000– 13,000
SRAM	590	1,000	1,150	1,300	3,000– 4,600
ROM	520	530	560	540	1,000– 3,200
EPROM	850	1,040	1,130	1,300	3,000– 5,000
EEPROM	80	210	312	400	1,000– 2,200
Microprocessors, total	**$1,900**	**$2,900**	**$3,680**	**$4,250**	**$8,000–$13,000**
Microprocessor units					
8-bit	900	1,180	1,340	1,350	1,000– 2,200
16-bit	290	440	550	690	2,000– 3,000
32-bit	–	–	30	80	300– 1,200
Single-chip	550	880	1,100	1,300	2,500– 3,300
Others	160	400	660	830	2,2[illegible]0– 3,300
Standard logic, total	**$2,950**	**$4,670**	**$5,210**	**$5,7[illegible]0**	**$6,300–$9,200**
Bipolar	2,400	3,860	4,280	4,700	5,500– 6,000
CMOS	550	810	930	1,020	1,800– 3,200
Semicustom, total	**$560**	**$785**	**$1,290**	**$1,730**	**$2,700–$5,400**
Gate array	355	490	730	900	1,000– 1,900
Standard cells	45	75	160	360	1,000– 2,500
Fused	160	220	390	470	700– 1,000
Full custom	**$700**	**$880**	**$1,200**	**$1,320**	**$2,000–$3,000**
Linear	**$2,700**	**$3,600**	**$3,780**	**$4,200**	**$6,000–$10,000**
Power	**$800**	**$1,040**	**$1,110**	**$1,170**	**$2,000–$3,000**

... Whether or not the economy stays strong, nearly all agree that average selling prices will take a steep fall in 1985, accounting for much of the drop in dollar growth rates. For example, 64-K DRAMs, which were selling for $5 each in 1983, are expected to tumble to an average selling price of $2 to $2.50 in early 1985. In a weak 1986, that price is projected to fall well below $2. Dataquest Inc. of San Jose, Calif., is projecting that standard discrete bipolar logic will still show an increase despite the falling prices. From 1983 to 1989, bipolar logic is expected to grow at 9.8%, says Andy Prophet, senior analyst in the Semiconductor Industry Service at Dataquest. MOS logic, which consists mostly of CMOS technology, is expected to grow faster, from $497 million in 1983 to $1.4 billion in 1989. ... (Excerpted from an article by J.R. Lineback in Electronics Week, 1 January 1985,)

Flexible Manufacturing Systems (FMS)

The last issue of the Monitor introduced the subject of FMS to our readers. This issue's special year-end supplement is also devoted to the subject. The following article 6/ looks at the question whether FMS is suitable for big firms only and comes to the conclusion that it can also benefit the small firm.

Most small firms believe that FMS is far too costly. The well publicised installations certainly encourage that view: the Yamazaki plant needed an investment of $40 million; a Volkswagen system cost £4 million; and the Anderson Strathclyde system cost over £6 million. Even some of the smaller systems are too expensive: Okuma (£1.1 million) and Toshiba Tungalloy (£1.2 million). Others can have too high an output of a limited range of parts: for example, the Brother Flexible Transfer Line at £0.9 million. So is there any future for FMS in the smaller firm? I believe there is. First, the aims of FMS should be examined. It may be argued that unmanned manufacturing is the important point; or that the

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6/ This article is based on a paper given at the conference "Manufacturing Technology: Research & Development" organised by the Irish Manufacturing Committee. The proceedings of the conference have been published and are available from Gareth Lyons, Dept of Mechanical and Manufacturing Engineering, Trinity College, Dublin. Price: £19 plus post and packaging.

system must always have several machines running together with automatic guided vehicles or a conveyor linking them. These may, in fact, be important. But there are more fundamental aims than this. The following are the six major aims.

1. Minimising lead time in the works. A conventional shop often plans a sequence of operations on a component at an operation per week with the work lying in stock between the operations. A survey carried out by New 7/ shows that the median number of operations for component production in a wide range of industries was around 10, giving a median manufacturing lead time of 5-10 weeks. The survey showed that generally less than 20% of this time was in useful work. If all the operations could be done immediately in sequence, then the lead time could be reduced to less than two weeks.

2. Reducing stocks and work in progress. As can be seen above, a reduction in manufacturing lead time should also reduce the amount of work in progress. The Japanese have shown that this can be done through different production control systems such as their Kanban or "Just in time" method. ...

3. Minimising the handling of work materials. In a conventional shop, each operation implies time taken in setting up to run each batch, probably using a different jig or fixture. Another survey 8/ showed that setting and tool adjustment could amount to 16% of the productive time. As well as lowering machine use, this obviously also reduces the productivity of the operative. The cost of jigs and fixtures can be significant, not only in their direct manufacturing cost, but in storage, maintenance and the time needed to locate and provide them to the workplace.

4. Increasing machine utilisation. In a conventional factory, the use of machines is usually determined by the operative attending the machine; the machine often does not operate for a short while at the start and finish of each shift, during meals and other breaks, during personal time and for other reasons such as waiting for material. Annborn 9/ estimates a figure of 1.55 hours down-time per eight hour shift for these reasons. Economics also restrict utilisation to two shifts a day, five days a week for about 46 weeks a year. In a year there are 8,760 hours: These figures give 3,680 available hours, of which the operative is available for 2,976 hours (following Annborn). So under normal two shift working, the machine is only available for about one-third of the total time. The actual cutting time, of course, is much less than this. FMS principles aim to improve this significantly.

5. Reducing labour costs. The conventional system of one man/one machine as implied above is relatively expensive on direct labour. So if technology allows automatic control of the manufacturing process, the direct labour content can be reduced significantly. It is important, however, that this aspect is not overstated. The cost structure of a typical engineering product is 50% bought out, 35% overheads and only 15% direct labour. Direct labour in many engineering practices today can account for only 10% of total costs.

6. Flexibility. The conventional machine shop is normally organised to run in economic batch sizes. The machines may be general purpose and extremely flexible but the costs of setting up make the production of small batches or one-offs uneconomic. One aim in using modern technology is to enable small quantities to be produced economically.

The implications of these points are that we should aim for systems which allow small batches of relatively complex components to be produced rapidly with one or two set-ups only. These should be capable of operating for significant periods with little direct operative supervision. If the fixturing and set-up can be done off the machine, then so much the better. These points then are what we are aiming for with FMS.

7/ New C.C. Managing Manufacturing Operations. BIM Management Surveys No. 35 1976. British Institute of Management.

8/ West Midlands Economic Planning Council, COI. Midland Tomorrow. "Industrial Productivity" - Scope of improvement No. 81975.

9/ Annborn M. Proceedings of the Second International Conference on Flexible Manufacturing Systems. P. 41 London 1983.

Rotational Machined Components

In many cases a single CNC turning centre (probably a better title today than lathe) can provide an effective flexible machining cell. The cycle time is usually relatively short, so an automatically delivered stock of material is necessary. This can be done in a variety of ways:

- Robot situated at the front of the lathe loading and unloading individual pieces from a carousel conveyor.
- Overhead gantry crane loading and unloading pieces from a carousel or Europallet.
- Built-in piece conveyor and automatic load/unload device.
- Automatic bar loader for a CNC bar Auto.

With careful design of chuck and gripper, a robot load/unload device can be used to reverse a piece so that both faces can be machined during the same operation. Many turning centres can now be provided with two turrets, making available a wide variety of tools on the machine; some machines can use overhead gantry loading for automatic tool change as well as piece change. Introducing a third axis on the CNC control enables the spindle to be rotated accurately and held in specific positions. Powered tools, such as mills, drills, slotters and so on, can now be made available in a turret to allow the implementation of second operations such as cross drilling, flat milling, etc. while the part is still in the chuck, thus enabling more work to be done at one set-up. NC part programming can be done off-line or by MDI on the shop floor; there are advantages and disadvantages to both methods. Most modern CNC controllers allow for the storage of a number of part programs - and this should give high flexibility to production. In practice, however, this flexibility may be limited in unmanned or lightly manned conditions by the need to change tools unless the centre is fitted with automatic change-over of tools in the turret. Changing the chuck jaws in the case of significant variations of piece diameter is another operation demanding manual intervention and pallets, of course, have to be changed with every change of bar size. This can be a limitation to flexibility and small batch size when running unmanned. Torque monitoring systems are available to ensure safe working when unmanned and the use of Renishaw probes can give additional checks on tool wear as well as adaptive control, if necessary.

Prismatic Machined Components

While a rotational component can normally be gripped directly by the handling devices, such as robots, and by the machine tool, the variety of shapes of prismatic components make it imperative that they are mounted on a standard pallet which can be used to transport parts around the system and locate them accurately in the machine. As with rotational components, one machining centre with a large tool magazine and automatic tool change can go a long way towards realising the ideal of FMS. In the case of prismatic components, an important point in determining the detail of the system is the cycle time for machining a single set-up. To offer the minimum loss of time on part changeover, it is essential to mount the component on the pallet off the machine while cutting is continuing on the previous work piece. An automatic pallet changer, either rotary or shuttle type, will be necessary and with cycle times of many hours on complicated components, a simple APC is all that is necessary.

As the cycle time reduces, the concept of unmanned manufacture for significant periods means a greater number of parts held in a buffer store awaiting machining. This could be a 4, 6 or 8-pallet carousel, depending on the length of unmanned working required and the average cycle time. For unmanned machining overnight, a cycle time of the order of two to four hours would imply a four pallet carousel, while cycle times of 60 minutes or so would need eight stations to keep the machine running all the time.

Of course, many users do not feel it necessary to go to the lengths of running on full unmanned night shift. Table 3 compares the time available on a conventional machine on two shifts, a CNC machine on two shifts, an FM Cell (CNC machine plus carousel) on two shifts with a gap between the two shifts to allow two hours extra unmanned machining on each shift and finally FMS (CNC machine with large buffer store) on two manned and one unmanned shift. Allowances are made for meal breaks, personal time, waiting time, set-up time, maintenance and so on in accordance with general experience. A CNC machine offers an improvement of 59% in useful time, an FM Cell 67% above that and an FMS on three shifts 17% above the Cell.

Table 3

EFFECTIVE MACHINE TIME AVAILABLE

	TOTAL HOURS PER YEAR	LESS MEAL BREAKS, PERSONAL TIME, ETC.	ALLOW FOR UTILISATION, SET-UP, MAINTENANCE, ETC.
Conventional machine 2 x 8 hr shift	*8x2x5x46 = 3680*	*- 20% = 2944*	*x 0.5 = 1472*
CNC machines 2 x 8 hr shift	*8x2x5x46 = 3680*	*- 9% = 3350*	*x 0.7 = 2345*
'FM Cell' machine 2 x 8 hr separated shifts with 2 hrs unmanned	*(8x2)x2x5x46 = 4600*	*- -0% = 4600*	*x 0.85 = 3910*
'FMS' machine with 2 x 8 hrs shifts unmanned night shift	*8+3x5x46 = 5520*	*- 0% = 5520*	*x 0.83 = 4582*

With shorter cycle times, providing even two to three hours of unmanned running and ensuring continual availability of material may require one to consider a full FMS with an automatic guided vehicle feeding material to the APC on demand and with a significant size of buffer store. The expense of this, with a master computer in hierarchical control of the system, would probably then lead to having at least two machines fed by the system under DNC control. ... To get good utilisation of machining centres with high flexibility, one must give considerable thought to the question of tooling: a much greater variety is needed than with turning centres. Obviously, standardisation can help considerably in reducing the number of different tools needed ...

Usually, even with fair-sized magazines, there will be a need to change at least some tools when one job is changed for another. If this is done manually, waiting time may be incurred as cutting is not normally allowed during manual tool loading for safety reasons. ...

For a small machining centre, the Matchmaker FMS offers an interesting concept with two inter-connected tool magazines. The upper magazine can be loaded manually as required while the lower magazine is feeding the spindle with the appropriate tools. The CNC system then is able to shuffle tools out of the lower magazine when finished, replacing them with new tools from the upper magazine for later operations. Significant thought must also be given to the question of fixturing and clamping components in a prismatic system. Designing a universal fixture for the family of parts being machined is ideal, but is usually impracticable for a really flexible system machining a wide variety of parts. The simplest fixturing and clamping systems are probably the best, though consideration should be given to the use of modular fixture systems when the total part requirements are small. ...

Sheet metal components

While most FMS and FM Cells installed have been based on metal cutting, sheet metal working systems also exist and can be attractive to the small firm. The CNC punch and nibbler machines such as the Amada, Trumpf or Strippit are well known and in significant use in small firms. These are usually equipped with a turret containing 20 or 30 punches for rapid change from one tool size and shape to another.

Trumpf, however, argues that manual change of the tool can be accomplished in only a few seconds so a simpler machine without the turret change may be more attractive to the smaller firm. It also argues that laser profile cutting (or plasma for thick sheet) is more economic than mechanical nibbling. Stacks of sheets can be fed using an AGV from the warehouse (automatic or manual) to an automatic load mechanism for the CNC punching machine. After punching and profiling, an unloader stacks the parts ready for the AGV to move to the next operation. More sophisticated sheet metal working centres are supplied by Salvagnini, as well as other firms, where after automatic feeding, punching and profiling on a CNC machine the sheet is automatically transferred to a CNC bender where the panel can be folded into the final shape. The bending system is not confined to 90° bends: 45° double bends, and so on can also be carried out. This company also offers a CNC guillotine which automatically calculates the optimum cutting pattern for a number of sheet sizes to be taken from standard sheet, carries out the cutting and stacks the different sizes of guillotined sheets ready for use. The combination of such a machine feeding several punch and bending machines automatically by an AGV takes us to a true FMS. Obviously these systems are tied to flat panels with little or no draw and the conventional presses still needed for deep drawing and pressing are not yet suitable for FMS, though rapid tool changing could make them much more flexible.

Other products

Systems exist in laboratories and experimental development areas for other components and processes though these areas are not yet fully available or in production. Fanuc is assembling AC and DC Servo Motors using flexible assembly systems based on robots. Systems of sequencing, automatic insertion and soldering of completed printed circuit boards exist and can be seen in many electronics manufacturers, particularly those in high volume production. The basic technology could be adapted to the flexible manufacture of small batch quantities and these will be seen in the near future. These systems will undoubtedly become production realities and have some attractions to smaller firms in the next few years.

Economics

Although the systems described here are much less in cost than a full-scale FMS, it must be accepted that the capital investment is still significant. Many of the machines described here with carousel component storage, automatic loading, and the appropriate tooling, will not leave much change out of £200,000. Such a sum may not, however, be beyond the resources of many smaller firms and machines such as the matchmaker FMS and CNC sheet metal punchers and nibblers are found frequently in smaller firms as well as larger. A typical set of economic data for a machining centre equipped with an 8-pallet carousel can be developed from figures quoted by Popplewell at FMS2 10/. The assumption is that there is a requirement to produce 25 different parts with an average machining time of 20 minutes on CNC machines and 30 minutes on conventional machines.

The overall requirement is for an average of 10 a week of each component. Table 4 shows that a single CNC machining centre developed into an FM Cell with an eight-pallet carousel could produce this quantity while two conventional CNC machines would be needed (there would be about 15% surplus capacity in this case) or four conventional machines. It is assumed that each manual machine would require one operator, that one operator would man two CNC machines and that the FM Cell would require 0.5 men per shift. In Table 4 only the direct costs of manning the machines (at £10,000 per man/annum) and the cost of stockholding (at 20%) are considered. This is obviously an oversimplification. Any CNC machine incurs extra cost in part programming while the indirect cost of materials handling, fixturing, supervision, etc. for the manual machines is likely to be higher, as is the floor space cost. Tooling costs also have been ignored. It is felt, however, that these are secondary factors and the real pattern of economics is essentially as shown in Table 4 where the cost of owning the machines for one, three and five years is shown. Even in the first year the FM Cell is more economic than either of the other two.

Table 4

COMPARATIVE ECONOMICS OF PRODUCING 11,500 COMPONENTS PER ANNUM ON AN FM CELL, CNC MACHINES AND MANUAL MACHINES

	CNC WITH CAROUSEL (FM CELL)	CNC	MANUAL
No. pieces/annum	11,500	11,500	11,500
Hours/annum	3,833	3,833	5,750
Useful hours available per machine	3,910	2,345	1,472
Machines needed	1	2	4
Cost	£165,000	£240,000	£80,000
Labour needed (men)	1	2	8
Labour cost per annum at £10,000 per man	£10,000	£20,000	£80,000
WIP at £20 per part	3,000	15,000	75,000
Finished parts in stock at £30 per part	4,500	7,500	37,500
Cost of stockholding & WIP at 20%	£1,500	£3,500	£22,500
Total running cost per annum	£11,500	£23,500	£102,500
1 year cost	176,500	263,500	182,500
3 year cost	199,500	310,500	387,500
5 year cost	222,500	357,500	592,500

10/ Popplewell F. Proceedings of the Second International Conference on FMS P. 643 London 1983.

This is normally the case when additional capacity is required. It is sometimes more difficult to make a straight economic case for replacing existing normal capacity with an FM Cell or FMS unless intangibles such as better delivery dates, easier production control and so on are taken into account. In this case, we would have an investment of £165,000 to find plus tooling, fixtures and other extras - say £195,000 in total. We would save directly seven operatives and the cost of stockholding, say a total of £91,000, though the employment of an additional part-programmer could reduce this to, say, £76,000. This is a payback period of about two and a half years and a DCF figure of about 27% over a five year project period. This is still attractive and is more so than replacement with straight CNC machines.

Obviously, these considerations cannot be generalised. It is necessary to consider each case on its merit and go into more detail of the potential savings and costs than the simple calculation here. However, it does suggest that the case of advanced technology, such as FM Cells, should be well worth consideration, even by relatively small firms. (Excerpted from an article by Prof. Brian Hundy in Technology Ireland, January 1985.)

Silicon foundries 11/

They provide an option to the high cost of starting a new production line. Additionally, they offer the customer new design resources and technologies.

Silicon foundries are destined to play a critical role in the further evolution of the semiconductor industry. Integrated circuit users have always been faced with the decision between leading edge technology and circuit cost. While they were once limited to a choice of only full custom designs and standard ICs, the last decade has seen the evolution of a larger "middle-ground" with the evolution of Programmable Logic Arrays (PLA), gate arrays, and standard cell designs. This broader range of choices has not only provided more technology/price trade-offs, but allowed the user to participate more in a circuit design tailored to meet specific applications. The IC user also has a broad range of choices in the design and production of the circuit. Regarding the circuit design, the IC user may choose to develop the design himself or use an outside design house, another manufacturer, and/or a combination of all three. In the case of circuit production, the IC user can fabricate it himself, use another IC manufacturer, or use the silicon foundry most suitable for his needs.

Advances in design and computer software technology are making possible an ingenious new alternative that has been rapidly gaining interest in the industry. Design workstations and silicon compilers promise an overpowering revolution by enabling the designer to create virtually any circuit. Not only will full custom and semicustom designs be possible, but a standard circuit could be "customized" by incorporating peripheral circuitry specific to the designers application. The designer can then submit the pattern generator (PG) tape or database tape to a qualified silicon foundry for production. It is fast becoming increasingly important for the designer to understand the valuable function of a silicon foundry - and the interface required to optimize throughput and to minimize circuit development and production costs.

The function of a silicon foundry is to accept design inputs, duplicate IC fabrication tooling, generate or duplicate IC test programs and produce the IC. A silicon foundry thus provides many benefits to the IC user. A silicon foundry offers additional production resources, providing an alternative to the sometimes prohibitive expense and risk incurred when building a new production line. Moreover, additional IC design resources are available through many silicon foundries as a result of their contractual affiliations with independent design houses. A silicon foundry may provide technologies in areas which the IC user lacks proficiency. Without the necessary expertise, the systems manufacturer may not be able to get the highest quality products. The silicon foundry does have the packaging, manufacturing, and processing expertise that enables the customer to receive top quality and reliability. At the same time, the IC user can exercise control of all results. Silicon foundries also offer the benefits of lower costs, reduced risk, and shorter design-to-production turnarounds than other sources. Silicon foundries can provide lower circuit costs, sometimes even lower than could be achieved with the IC user's own production lines. Multiple source security reduces the IC user's risk when obtaining circuits from a single supplier.

There has been an overwhelming increase in the number of silicon foundries in recent years. Some silicon foundries are devoted to customer-owned tooling as a permanent business segment. On the other hand, other companies (standard product manufacturers) engage in

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11/ By Terrence A. Johnson, Marketing Manager, COT Products, Gould AMI Semiconductors.

silicon foundry production during an economic downturn, only to return to full-scale production of their own products and discontinuing silicon foundry when the economy booms. Inevitably, the customer is restricted to the times that he can use the manufacturer as a foundry. Still, there are the newer companies that have not yet gained the experience, full in-house capabilities, and production capacity which enable them to produce on a large scale. One must consider the experience of the company, demonstrated by its efficiency and flexibility in design, process, test, and packaging technologies.

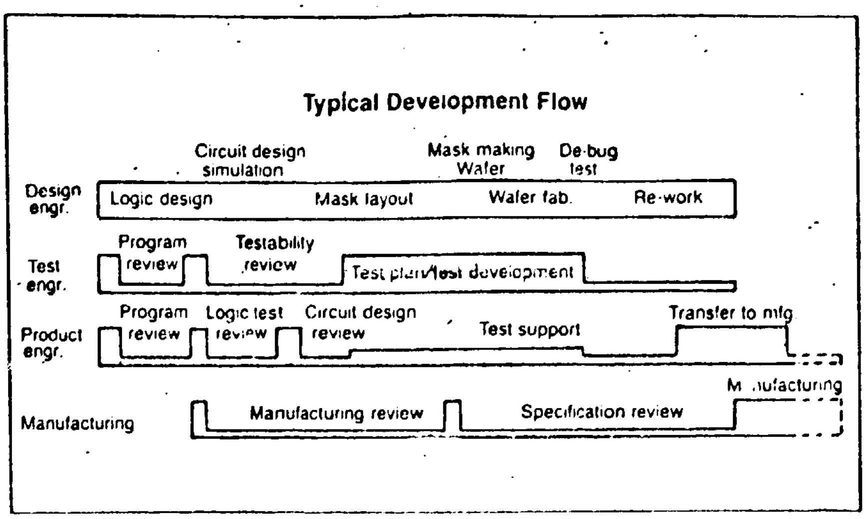
Other key considerations include:

- Compatibility of design rules: Design rules specifically required to duplicate tooling must be determined at the outset.
- Number of production processes available: A range of processes not only provide a variety of choices, but also demonstrate technological capability.
- Engineering support: The silicon foundry should have a qualified staff of engineers to interface with its customers.
- Full in-house capability: Everything subcontracted to the outside increases the probability of error and may lead to a loss of control.
- Protection of proprietary data: Some silicon foundries are actually competitors with their IC users' customers.

Many silicon foundries have their design data and software loaded into various workstations and/or in use by their design house affiliates. Design rules can also be provided to the IC user for his design. Alternatively, a Design Rule Check (DRC) can be performed by the silicon foundry to point up any modifications necessary. Once compatibility is achieved the silicon foundry can create the tooling for IC production.

The only difference between the typical full custom development flow and that of the silicon foundry, are the steps required for creation of tooling acceptable to the IC user. Gould AMI separates this tooling development cycle into three distinct phases in order to minimize problems/delays and to maximize IC user involvement/control. The first phase begins with the receipt of a pattern generator (PG) tape and extends to the shipment of colored overlays for customer inspection. After the customer approves the overlays, wafers or untested prototypes are sent to the customer for inspection, comprising phase two. In phase three, after untested prototypes have been approved, fully tested prototypes (tested with a fully debugged test program) are sent to the customer for approval prior to production. The IC user/designer approval required at the end of each phase helps to prevent errors in subsequent phases that might result in serious delays and additional costs.

In phase one of the tooling development cycle, there are three common interface vehicles: pattern generator (PG) tape, database tape, and the working plate. The PG tape is the most common and unquestionably the easiest interface to use since the industry is dominated by only three tape formats - Mebes (e-beam standard), David Mann, and Electromask. With this limited number of tape formats, most silicon foundries have found it economically feasible to develop conversion programs for the adaptation of the designer input format to their own pattern generator formats. Inputs by database tape (e.g. Applicon, Calma) are less



common since the variety of ways in which a circuit can be formatted makes it economically unfeasible for the silicon foundry to maintain such a large library of conversion programs. The greatest value of a database tape interface is to support computerized design rule checks. A typical purpose in using the working plate interface is for the complex merging of several different designs on a single wafer. Many silicon foundries subcontract mask-making to mask houses that specialize in this type of program. The most common use for this interface vehicle is to determine process compatibility before the customer commits to the cost of creating duplicate tooling for volume production. A small lot of wafers can be produced for verification of process compatibility at relatively low cost.

Once verification is confirmed, the tooling development cycle begins. For volume production it is necessary for the silicon foundry to create their own tooling. This makes it possible to control the availability and quality of working plates - and consequently control yields and product flow.

After the tape is converted to the format required by the silicon foundry, 10X reticles are generated, followed by colored overlays. The overlays are created on a scale requested by the customer. The overlays are sent to the customer, who verifies that they correspond accurately to the data contained on the input tape. When the customer has inspected and approved the colored overlays, 10X reticles are optically reduced to 1X and a mirror image, stepped master is generated. From this master, working plates are created for standard contact-print wafer fabrication. Next, the tooling undergoes stringent quality inspection prior to use in production. Then a limited number of wafers are produced and parametric data are compiled from each wafer for correlation with precise acceptance/rejection criteria previously submitted by the customer. These parametric data can be taken from test devices incorporated in individual die, or preferably, from a number of Process Control Monitors (PCM) located at key points on the wafer. If the wafers have met the customer's acceptance criteria, they can be delivered to the customer for inspection. Alternately, die can be selected from the center of the wafer and unsealed untested packaged devices (cut and go's) can be provided. Inspection at this point is to ensure correct logic implementation and performance of these untested prototypes.

In order to ensure consistent quality and reliability in volume production, a test program must be generated. This is usually the part of the development cycle that causes the most problems and greatest production delays. Typically, the customer's primary focus up to this point has been on obtaining a functional device. Only after this requirement is met are resources redirected toward testability, thus creating substantial delay in beginning production.

Having achieved a working design, less emphasis is often placed on generating an effective test program that minimizes costly test time. Submission of a customer test program for debugging (or required test data for silicon foundry generation of the test program) at the same time as a PG tape input is preferable, but not typical.

Through technological advances in circuit design and software, use of silicon foundries for customer owned tooled products has been rapidly gaining interest. A silicon foundry offers the options of enhanced throughput combined with minimal circuit development and production cost. Evaluating a company's experience, efficiency, and flexibility in custom circuit designs is essential for determining the right silicon foundry for an IC user's needs (see table below). With this broad range of choices in silicon foundries, IC users are able to participate more in circuit designs tailored to meet their specific applications.

Table 5

Criteria for selecting a Silicon Foundry

Criteria Considered	Work Station	Full Custom	Standard Cell	Gate Array	MSI/SSI
• System Physical Size	1	1	2	2	5
• System Housing Cost	1	1	2	2	5
• Flexibility for Design Changes	1	5	3	2	1
• Lead Time to Prototypes	1	5	3	2	1
• Hardware Costs in Production	1	1	2	3	5
• IC Purchase Cost	1	1	2	3	6
• Other Component Costs	1	1	2	3	5
• System Power Consumption	1	1	1	1	5
• Protection of Proprietary Data	1	1	2	3	5
• System Inspection & Support	1	1	2	3	5
• Reliability	1	1	2	3	5
• IC Non-Recurring Engineering Costs	1	5	3	2	1

Note. 1 = Best Achievable; 5 = Least Desirable

Siemens enters 256 K DRAM Race

With its 256-K dynamic random-access memories, The FRG's Siemens AG is entering a market that is certain to become the biggest in volume for any single component made so far. Currently dominated by a number of Japanese producers, that market could climb to 200 million units next year and go to "between 600 million and 700 million units in 1986," says Hans J. Penzel, general manager for MOS operations at the Siemens Components Group in Munich. "We think a peak will be reached between 1989 and 1991 when 256-K DRAMs will be shipped at annual rates of more than 2 billion units worldwide," he says. Meanwhile, not even 64-K DRAMs have reached their peak in volume. These, he adds, could crest between 1985 and 1986 when they will sell at an annual rate of between 1 billion and 1.5 billion units. ... (Electronics Week, November 12, 1984.)

The Latest in Bubble Memories

Intel, the company which pioneered and continues to develop magnetic bubble memory, has announced a bubble memory cassette featuring one megabit of storage capacity. It can be carried in the pocket, like an ordinary tape cassette, to a remote location, inserted in data acquisition equipment and then returned for processing in office computer. Bubble memory is slower than conventional semiconductor memory but it is faster, more reliable and much more rugged than floppy discs. The new cassette operates at temperatures of 1° centigrade to 65° centigrade and is priced at $605 in quantities of 100 units. (Electronics Report [Ireland], November 1984.)

Fujitsu gets licence from Intel

INTEL has given Fujitsu a licence to manufacture 80186s, 80286s and 8051s. Additionally the Japanese company will get the rights to the 80188 8-bit bus version of the 80186 and the 82284 clock generator and 82288 bus controller - both support circuits for the 80286. The agreement expands previous Intel/Fujitsu technology exchanges which gave the Japanese company rights to mask information on the 8086, 8088, 8089 and 8048. (Electronics Weekly, 14 November 1984.)

AT&T enters SC merchant market

AT&T Technologies Inc. has again entered the US semiconductor merchant market. The newly organised unit of AT&T backed away from its commitment to the merchant market in 1983, but has now made an agreement with Avnet Inc. the largest electronics distributor in North America. AT&T was the first manufacturer of 256K DRAMs, and one of the earliest to make a 32-bit microprocessor, all for internal use. Since early this year, General Electric has been a foundry also making those memory and microprocessor chips for AT&T, at its North Carolina plant. ... (Electronics Weekly, 5 December 1984.)

LSI expands semi-custom base

Semi-custom chip specialist, LSI Logic, has opened a second European design centre a year after opening its first in Bracknell. The centre - which will customise LSI's family of gate array chips - is situated in Munich. Svein Davidsen, LSI's European general manager, said more design centres in France, Italy and Scandinavia will follow as business expands. (Computing, 22 November 1984.)

Texas TDU makes semi-custom bid

The battle to embrace the small- to medium-size customer of semi-custom circuits intensified last week when Texas Instruments launched worldwide its transportable semi-custom design utility (TDU) which runs on professional computers. ...

The PC TDU is a software package which is mainframe originated but has been refined to run on professional computers like the IBM XT and AT or TI's own PC. Eventually it should run on about 20 IBM compatible models. Schematic capture via the PC CAD program, design database creation using the Hardware Design Language (HDL) and Test Design Language (TDL), test analysis, and other essentials in designing a circuit are provided. Active customers, that is those already using TI's semi-custom products make a one-off payment of $500 for the package. If they don't possess a computer this will set them back another £5,000 to £6,000. The PC CAD program is also an extra. ... (Electronics Weekly, 31 October 1984.)

Transputer sample soon

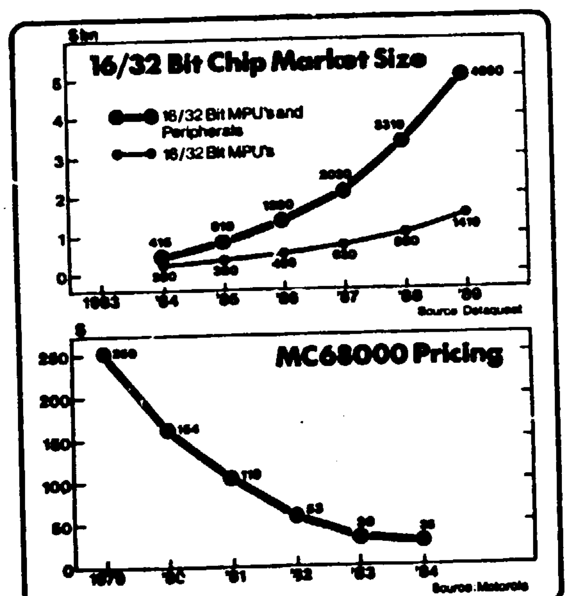
INMOS hopes to sample its transputer "hopefully in the first quarter - certainly by the second quarter," of 1985. The transputer will be sampled on an evaluation board costing

$2,000, said the company. It will be made in 2-micron CMOS with a die area two-thirds that of an 80286. Working silicon has not yet been demonstrated. When sold by itself, the transputer will cost "the standard rip-off price for 32bit CMOS processors - $500," said a company spokesman. In volume production that will come down to $50 for its top-end device and less for lower-performance versions. ... (Electronics Weekly, 7 November 1984.)

Motorola claims first true 32-bit microprocessor

Motorola has launched the MC68020, claiming it to be the only commercially available microprocessor with full 32-bit internal and external architecture. This means that all the processes that go on inside the chip and the input and output connections to it, are carried out 32 bits at a time, rather than 16 or eight as in previous designs. An analogy is filling a bucket with water from 32 taps rather than 16 or eight - it happens much more quickly. Measured in terms of millions of computer operations per second (MIPS), the new device, working at 2.5 MIPS, is about four times more powerful than its 16-bit predecessor, the MC68000.

The U.S. starting price for the new chip, which will be in limited production in Austin, Texas, in the first quarter of 1985, is about $370 in lots of 100. The price in Europe will be higher due to the 17 per cent EEC tariff. As production builds, prices might drop in much the same way as those of the MC68000, which went from $250 in 1979 to about $35 now. (see diagramme below).



How Motorola sees the growth of the market for superchips like its new 68020, above; below, the price of the 68000 fell to 14 of the original asking price in five years

(Financial Times, 3 July 1984)

APPLICATIONS

Firm focuses on helping the visually impaired

Founded in 1976 by two former civilian engineers for the U.S. Army Maryland Computer Services Inc. first concentrated on developing custom business applications for computers made by Hewlett-Packard Co. of Palo Alto. A year later, company president Deane Blazie and vice president Richard Kramer narrowed the firm's focus to adding products for the blind and visually impaired. The company came up with the microprocessor-based Talking Telephone Directory. In the seven years since, MCS has continued to bring out new products, largely financing its own research and development. More than 525 of the firm's talking terminals and computers have been sold. The computer sells for approximately $8,000 without Braille-oriented peripherals. A fully configured system costs $11,000, and training costs vary: In the field, it can run $1,000 plus expenses for the teacher; at the Maryland headquarters, half that figure. (Electronics Week, 1 January 1985.)

Japanese develop word processor for the blind

The last barrier to knowledge work in Japanese by the blind has fallen with the development of Versa Braille-word-processing software that enables sightless persons to transcribe tape-recorded prose, write original text, or write computer programs. The program was developed for NEC Corp.'s popular PC-9801 personal computer by NEC distributor Y.D.K. Co. and the Vocational Development Center for the Blind in Japan Inc., both in Tokyo. Like word processors for the sighted, it uses standard Japanese syllabary characters on the computer keyboard for phonetic input of text, which is converted to the combination of Kanji Chinese and Japanese characters used in written Japanese. The typist is required to add a syllabary-character tag to indicate the pronunciation of each Kanji Chinese character - a method developed for writing Japanese in Braille - for character selection. Other word processors rely on lexical, syntactic, and sometimes even the semantic content of the text for character selection and require the typist to check a video display for the occasional misconverted character. A complete system - including a speech synthesizer that echoes keystroke input, disks, printer, cathode-ray-tube display, and tape recorder - will sell for about $6,000 which Y.D.K. figures is affordable for firms employing the blind. (Electronics Week, 1 January 1985.)

Keeping an eye on the elderly, Down Under

Australian computing experts are creating an electronic monitoring system to allow elderly and disabled people to stay in their homes as long as possible. Sensors will alert a central hospital to obvious emergencies like fire or smoke. Technologies also used for burglar detection may give warning if a person has not moved for a certain time - perhaps unconscious in a diabetic coma, or after a fall. This project is being developed by the Centre for Research in Intelligent Systems (CRIS) at Deakin University, Geelong. It is funded by the Federal Department of Health.

The centre director, Professor Iain Wallace, is supervising laboratory trials of the three elements in the system: environment sensors to monitor heat, light, smoke, moisture, gas, electricity and other potential hazards; control devices for kitchen appliances, machines for physical and mental exercise, mobility aids and medicine dispensers; and the two-way communication network to link the elderly person, the sensors and the emergency service. Professor Wallace estimated that it should be possible to mass-produce monitoring systems for about $A5,000. (Electronics Weekly, 14 November 1984.)

Databases for the people

A Computer Index of British scientific, engineering and medical expertise is to be set up. Longman-Cartermill, the publishers of the index, is to send out questionnaires this year to every researcher in universities, polytechnics, medical schools and public laboratories. The aim is to make available to "anyone with a micro and a modem" information on expertise, knowledge and facilities offered by the institutions and their staffs. Longman-Cartermill will invest about £1 million in gathering the information, editing it to a standard format and putting it onto a data base. "A major aspect is to make available to industry all the people working in an area, from the world expert to the man with specific workbench skills," said Michael Tobert, who will head the project. The index is intended to have a set of key words that will make it accessible to both industry and academia. ... (This first appeared in New Scientist, 3 January 1985, London, the weekly review of science and technology.)

Memories for manufacturing automation

A novel use in automated manufacturing for one of the most exciting new memory chips has been developed by Lang Electronics, part of Vickers Systems. It has built a programmable controller using a plug-in memory unit based on a memory chip which retains its program when the power is turned off, yet can be reprogrammed simply and electronically. The memory is a read only memory (or E2PROM for short). It is fashioned in CMOS technology which gives high performance at low power. The Lang system comprises two units, a hand held programmer, a little like a professional pocket calculator, and the control unit itself.

The memory chip package simply plugs into the head programmer and is programmed using only six words of command. "These commands," Lang says "can produce extremely accurate programming of most complex processes, and the control unit has 36 input/output terminals to provide accurate control of machines and systems." The memory unit is then plugged into the controller to operate the machine or system. The E2PROM stores 2,048 words of data. (Financial Times, 2 July 1984)

Automated Manufacture: New gear for the gear makers

... The Sunderland division of David Brown Gear Industries (UK) decided last year to make a break with the past and replan its factory from scratch. The division makes work-reduction gear boxes that feature in a range of industrial and consumer machinery. The products essentially transfer the output from a high-speed motor to a shaft that turns at a lower speed but with a greater torque. The Sunderland factory turns out gear boxes in about 45 basic forms. These range from palm-sized units, which for example drive office machinery or children's mechanical rocking horses, to huge affairs that power conveyors or mixing equipment in industrial plant. To compound the complexity, each basic model comes in 13 different versions, depending on the ratio by which the speed of the motor attached to the gear box is reduced.

The motivation to change the Sunderland factory was strictly commercial. Orders for gear boxes started to dry up, partly as a result of the recession and partly due to stronger competition from overseas suppliers. "We were struggling", recalls Mr. John Westwood, the works manager of the Sunderland division. The company decided to rationalise its factory operation. The new approach appears to have paid off. With fewer workers, the factory has increased output. Annual wage costs and other overheads have fallen by £600,000, while in one year sales have increased by £2m. On this basis, the company has already more than recouped the £1.35m that the reorganisation cost.

The factory underwent metamorphosis during a three-week shutdown last year. In this time, engineers scrapped about 70 of the factory's existing 178 machine tools, almost all of them manually controlled, and reduced the area of the workshop by 30 per cent. David Brown spent £750,000 on seven new computer-controlled machine tools to supplement what was left of the manual machinery. It invested a further £600,000 on building work and new equipment to paint finished gear boxes.

The main result of the new hardware is that it greatly reduces the times needed to reset equipment to do different jobs. In the old factory, workers would have had to work round the clock for up to two days to change the function of a line of machinery consisting of about a dozen conventional tools. With computerised equipment, whose operation is controlled by a program devised by the factory's production-engineering department, this setting time becomes just a couple of hours. As a result, machines can be quickly changed to do a variety of jobs. They are thus in use for a higher proportion of the working day. In addition, the company can react more quickly to orders from customers and the mass of parts that the factory needs to store is reduced. ...

The mainly skilled workers who operate the machines were not touched by the job reductions. Over the past 14 months, their numbers have increased, from 148 to 162. Unskilled shop-floor workers decreased from 172 to 153, lending force to the argument that it is the lower grades of factory labour forces who have most to fear from manufacturing automation. (Financial Times, 17 July 1984)

Computers on the shop floor

Nowhere has the advent of computer technology met with such resistance as in its application on the factory floor. In some cases this fear is well founded: with any additional automation, job losses are liable to occur. However, this is not always the case, and in many instances, the successful installation can result in a more rewarding work environment for all concerned.

But most projects fail dismally. Either the system being installed is badly designed and unsuited to the application, or the key people in the organisation are not kept adequately informed or fully involved in the exercise.

However, with computer aided manufacture, the root of the problem is often that senior management are not fully aware of either the complexity of the problems they are attempting to tackle, or of the capabilities of the software and hardware upon which a new management information system is being based. ...

So, given the state of the art in both hardware and software, what are the possible shopfloor applications, and what are the likely benefits? The answers depend very much on the type of industry involved. Rather than analysing each industrial sector individually, let's see how different areas of application can be best handled across the board.

- Inventory control, purchasing and sales order processing systems apply to all industries and are best suited to the standard manual input method, coupled with the increased use of bar coding and/or intelligent data collection devices.

- Bill of materials/product formulation cont.. is an application that varies from one industry to another. A small, 25 person electrical manufacturing firm might have a bill of materials going through to multiple levels, and containing several thousand components at varying revision levels. The trend in this area at the moment is still very much to use manual input methods, though there is increased development in two areas: the linking of both automated handling systems for stock picking and the integration of robotic systems with product manufacturing routing data.

- Works order control/production information recording: in all industries the trend is towards getting as much data as possible automatically by means of sensor devices. This involves many areas. Time and attendance/job costing data, for example, are collected by devices on the shopfloor. This is particularly relevant for batch and one-off manufacturing industries. Other applications include monitoring of machines and downtime analysis; automatic testing; 'in-process' quality control; NC systems: automatic assembly; process control; energy management/costing and so on.

- Manufacturing resource planning: the planning of all manufacturing resources - manpower, machine, materials, and finance - is applicable to all types of industry but its importance depends on the complexity of the planning operation within the company itself.

This is typically, but not always, evident from the bill of materials and the product routing structures used. The MRP operation is essentially a number crunching exercise which takes its input from the inventory, purchasing, sales, production planning and resource capacity information that is available within the system. Therefore it does not depend on any form of direct input.

Regardless of what application is being addressed, or what mode of processing is being used, it is essential that certain features and concepts are built into the basic design of the computer system. Apart from looking for the obvious features - for example, menu processing, integration, user interaction and ease of use - one should look at criteria such as listed below, particularly if a package is being evaluated:

- Is the package fully supported?

- Is the reporting structure flexible?

- Can reports be produced on the screen?

- What source language is used?

- Are good standards employed?

- Is the system well documented?

Circumstances have improved dramatically since the early days of mainframe/batch processing. On the surface - given the range of tools available for computerised manufacturing systems - it would appear that planning, design and implementation have never been easier. Unfortunately this is not so. The basic problems of poor understanding and ineffective internal liaison are still very much in evidence. Essentially these problems, when they occur, can only be overcome either by devoting more time and effort internally to education, planning and review, or by involving third party companies, with relevant skills and experience in the application areas to be addressed.

Unless a company is prepared to take this type of action, it will run the risk of missing out entirely on the current trend of increased automation and growth in flexible manufacture systems. It must also be prepared to accept the inevitable consequences when competing companies become more efficient and less costly - and market share begins to drop. (Technology Ireland, January 1985. Excerpted from an article by A. Gallagher.)

Micros offer production control to small firms

Keeping too much or too little stock can shrink profits. So large firms use powerful mainframe and mini computers to keep up-to-the-minute control of production and inventory.

Microcomputers now allow smaller firms to automate their production control and management systems. Software packages allow materials requirements planning (MRP) at economic costs.

Omnicorp Technology Ltd., Ireland is one of several firms which have developed micro-based MRP systems. Aimed at manufacturers which employ between 20 and 200 people, its system is made up of six modules for managing product stocks, raw materials stocks, production control, production costing, bills of materials and purchasing. "The six MRP modules, a high speed printer amd two terminals of a multi-user microcomputer system can be installed for less than £14,000 (plus VAT)." A single user system would cost about £9,500. The program will work on either a floppy or hard disk CP/M or a PC-DOS based machine with 128K RAM and a 132 column printer ... (Technology Ireland, November 1984.)

Transformation in the automobile industry

Three significant and dramatic transformations during the first 100 years of its existence have brought the automobile industry from a small group of artisans and tinkerers concentrated in France and Germany to a vast world-wide enterprise. Now a fourth transformation, the result of high technology applied to automobiles and - especially - to the operations by which they are designed and manufactured, is in progress. This transformation will bring new pressures on labor and international trade, and the position of individual nations in the world's future auto industry will depend on their policies in response to these controversies. The product changes of this fourth transformation will not dramatically alter the basic character of the automobile - no new types of engines will be introduced, and the vehicles of the 1990s will probably look quite like today's. However, the new technologies will allow automakers to adapt their vehicles to changing safety, energy, and air-quality standards. In contrast, the changes in the design shop and on the factory floor brought by flexible automation will be highly visible, and they will fundamentally alter the nature of the industry. The need for semiskilled and unskilled labor will be greatly reduced, and smaller companies will be able to compete with industry giants in producing a large variety of vehicles. ...

Changes in the process of making autos are the core of the fourth transformation. Computer-aided design (CAD), using minicomputers and sophisticated software packages, will allow the designer to accomplish quickly with a television screen and light pencil the once-tedious task of making detailed drawings with paper and lead pencil. Designers are tying these systems to computer-aided engineering packages that ease the task of calculating shapes and choosing the best materials for specific assignments. The third step in this electronic network is computer-aided manufacturing (CAM), which transfers the coded instructions from the CAD screen to the robots and other flexible equipment needed to fabricate the parts. Eventually, an electronic path between designer and production machinery will reduce design time and labor while improving product quality and reliability.

On the shop floor, the basic tasks of building a car - fabricating thousands of parts such as gears and housings, assembling them into components such as pumps and transmissions, making the body, and installing the components within the body - will all be transformed. In the body plant, the stamping of the roughly 300 needed parts from sheet steel will be more highly automated. If plastic body parts are used, they will be molded by automated equipment. These parts will then be welded or glued together by robots, which will be programmed to handle a wide variety of body styles and options on the same assembly line. Paint will be applied by a new generation of the painting robots already at work in most of the world's car plants. And final assembly will also be automated. Cars will be redesigned to require less assembly, particularly in their cramped interiors, with the result that robots will be able to perform almost all functions now assigned to assembly workers. Quality inspection will also change. Flexible machinery will increasingly be able to check its own mistakes, and cars assembled of perfect parts will probably need little inspection at the end of the line. A final step in this process will be to link the technologies of design and manufacture with new approaches to organizing the remaining work; that is to say, to combine the lessons of the third and fourth transformations. This is the task General Motors says it is undertaking in its Saturn exercise, an effort to develop a new small car for North American production toward the end of this decade. The company plans to rethink the design of the product, the technology of the production process, and its traditional management practices in hopes of finding a dynamic new combination.

These manufacturing innovations will be cumulative and will fundamentally alter the structure of the industry. Until recently, most observers thought the trend in the world auto market was toward a small, standardized product. This trend was expected to match nicely the automakers' need for massive scale economies that would allow a few big companies to dominate the scene as they did in America by the 1970s. Many people predicted that as the product became more standardized and price became the key influence on consumer choices, more and more auto production would move to low-wage countries such as Korea and Mexico. However, the technological advances of the fourth transformation will reverse the predictions in each of these areas. First, the growing flexibility of automated production is combining with a clear consumer preference for variety and advances in product technology to make a wide range of automobiles practical. This will enable producers to develop cars for specific markets without paying the traditional cost penalty for smaller-scale production. Auto producers have traditionally had to run off about 250,000 copies of each body style per year and about 500,000 copies of each engine and transmission - the capacities of conventional plants - to achieve full economies of scale. With flexible automation, a producer may still have to sell at least 250,000 cars, but one plant will be able to make different models without changing tools or halting the production line. Similarly, one plant will be able to produce many variations of a basic engine or transmission design, and these could be sold to other manufacturers for low-volume product lines. Indeed, smaller producers such as Honda, Mazda, and Volvo have already combined finesse in targeting products to certain market niches with flexible production to become the most dynamic members of the industry. Traditional giants such as General Motors, Renault, and Toyota may have to work hard to adapt to the marketplace of the future that demands diverse and distinctive products.

Finally, because highly automated factories will drastically reduce automakers' need for labor, the widely anticipated shift to low-wage sites will not occur on a large scale. Instead, individual product lines will be produced mostly in the locales where they are sold. This trend will be consistent with the Japanese discovery that manufacturing as much of the vehicle as possible at the point of final assembly provides large savings in inventory costs and higher product quality. At the same time, exports of small volumes of many different models, designed to satisfy consumer demands for diversity, will also increase. In combination, these international flows of trade will be quite large.

Thus, the technological advances of the fourth transformation, more than the number of vehicles imported from other countries, will determine long-term employment levels in the auto industries of developed nations. Total employment in auto manufacturing in the United States, Japan, Germany, France, Italy, Sweden, and Britain reached a historic high of about 3.6 million in 1979. Employment will probably decline steadily to about 2.3 million by the year 2000 - a 36 percent reduction. This change will occur even though demand for cars in these countries will increase by about 30 percent during this period. Employment in the U.S. auto industry will decline by about 39 percent from the peak of 982,000 in 1979 to 596,000 in 2000. Clearly, this dramatic drop cannot be avoided by restricting imports. Indeed, this estimate assumes that Japanese and European automakers will increase their share of the U.S. market by less than 2 percent.

More dramatic still will be the change in the types of jobs in the auto industry. In particular, assemblers and semiskilled machine operators, who have traditionally constituted the bulk of the workforce, will become endangered species. A smaller number of workers with specific skills, such as programming computers and keeping a complex automated assembly system on track, will take their place. These declines in labor needs will be exacerbated by the changes of the third transformation, which make the production process more efficient.

This trend of exploding productivity presents a dilemma for policymakers in the United States, Europe, and Japan. Nations who wish to revitalize their auto industries - or retain their vitality - to fend off import threats, preserve exports, and boost overall productivity face dramatic reductions in the workforce in what has been the "industry of industries". Policymakers will undoubtedly be tempted to slow down the transformation, particularly during declines in the auto market, by restricting imports. However, these efforts will likely affect only the pace and not the ultimate outcome of change. We believe that decisionmakers will adjust their strategies as they realize that long-term protection will only retard the technological changes each producer must make to insure future competitiveness. The question decisionmakers must confront is whether workers, many of whom will suffer permanent dislocation, must bear the full burden of these changes. And because the auto industry has such a powerful effect on our whole consumer society, these issues of adaptation will eventually involve us all. (Excerpted from an article by James Womack, a research associate in the Center for Transportation Studies at M.I.T. and Daniel Jones, a senior research fellow at the Science Policy Research Unit at the University of Sussex in England. This article is adapted from "The Future of the Automobile", published in September by the M.I.T. Press. The book, written by Alan Altshuler, Martin Anderson, Daniel Jones, Daniel Roos, and James Womack, is the final report of the International Automobile Program, a four-year, seven-nation study conducted at M.I.T. under the joint direction of Professors Altshuler and Roos.) (Technology Review, October 1984.)

SOFTWARE

Software - a new industry in the OECD countries

The computer service industry is one of the fastest growing in the OECD. Its sales have been increasing by 10 to 20 per cent a year since the mid 1970s in almost all OECD countries (see chart). Certain particularly strong segments of the market may be growing even faster - perhaps by as much as 30 to 40 per cent. 12/ This growth is the bellwether of another, more general phenomenon common to all OECD countries where information technologies are spreading rapidly: the spectacular growth of investment in software development, not only within the specialised computer service industry but also in the user and hardware industries. More than half the software produced in OECD countries comes from the data processing, automation and electronic engineering departments of the user companies, and the software supplied by hardware producers accounts for about 60 per cent of the market for software (excluding internal markets).

... Despite its remarkable growth, the computer services industry is presently facing technical, commercial and financial challenges: the operating and competitive practices of firms are changing, and it may be difficult for many to adapt. The increasing complexity of hardware and operating systems, the appearance of new software generations and sophisticated software engineering techniques, and the growing requirements and constraints of users impose more demanding conditions on software creators. Whether developing software packages, customs software or integrated turnkey systems, the software houses now need much more sophisticated equipment and people than in the 1970s. The human resources capable of assessing and applying state-of-the-art opportunities have become very scarce. Since the rate of innovation does not always allow time for the employees to learn new skills, software houses are looking to the external labour markets where the qualifications they seek are becoming costly. The exceptionally high rate of turnover in the industry (from 10 to more than 50 per cent in France and the United Kingdom) is a special feature of the problem. It speeds up the spread of knowledge through the industry and invigorates the labour market but also provides little return on in-house training investment for university graduates, which can amount to as much as 6 per cent of sales according to an industry association estimate.

The risk of technology gaps among computer service firms looms larger than in the 1970s when software houses offering custom services had little competition and so were not obliged to keep up too closely with the state of the art. But in the 1980s, the package-software phenomenon compelled the software houses to become much more competitive, both at home and abroad. The most immediate response to the challenge of software packages for many software houses has been to develop packages themselves. But apart from the technological prerequisites, this strategy implies substantial development investment for an uncertain return. Packages involve very different costs and risks from traditional custom-made software. Packages also require a marketing activity out of all proportion to that needed for custom software: promotional campaigns must cover the whole potential market so as to reduce long-run costs. (The large-scale and successful launch campaign in 1983 for the 1-2-3 integrated microcomputer software is estimated to have cost about $3 million.) Most software houses cannot handle such an operation and have to go through several intermediaries (manufacturers, publishers, distributors, dealers etc.), with attendant costs (the designer's share of a software package for mainframe computers is estimated at only 20 per cent of the final price). The share is even lower (about 10 per cent) for microcomputer packages, since there are more intermediaries; but that is often offset by larger sales volume.

All these factors considerably increase the financial burden of competition in the growing sectors of the computer services industry. This is a new constraint for most software houses in these markets, prompting them to seek new financial and organisational arrangements. In the United States, where these trends have been taken furthest, there has been a very marked increase in mergers and acquisitions in the industry: there were 87 transactions, with a total value of $688 million in 1980, 118, with a total value of $766 million in 1981, and 146 acquisitions with a total value of more than $1 billion in 1983. Meanwhile a great many competitive software houses which have grown rapidly and wanted to keep their independence have been going public: in the United States, ten software houses did so in 1982 and 20 in 1983 (MSA, Pansophic, Lotus, MicroFocus and others). But only an existing firm with an established market position can raise finance through merger or an equity issue. Would-be new companies cannot, and neither can they hope to borrow from the banks, which are very cautious about financing new companies in this "intangible" sector. The principal remaining source of funds for the entrepreneur is venture capital. In fact, many newly created firms in the sector have been funded and sponsored by venture capitalists (Personal Software, Digital Research, Microsoft, Lotus, etc.). In the United States, 18 software houses were formed in 1980 with support from venture capitalists, and 90 in 1983,

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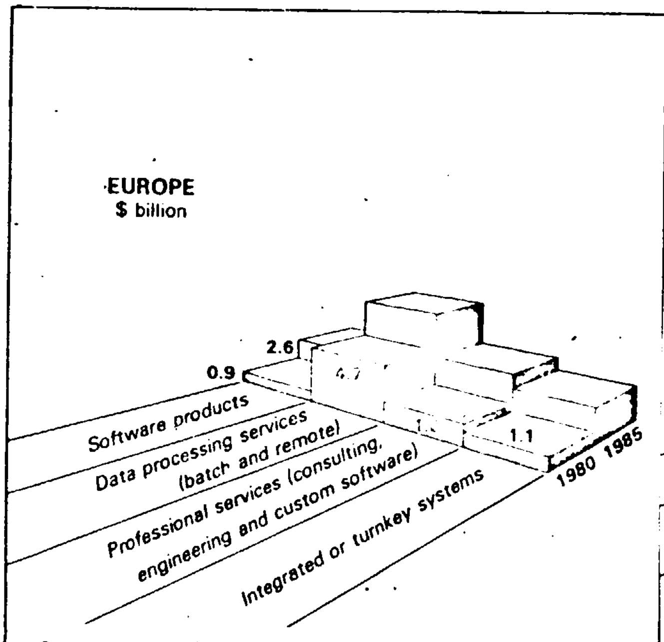
12/ "Software - An Emerging Industry", to be published by OECD in early 1985.

with a total funding of $180 million. According to certain observers, the lack of a fully developed venture capital market in countries outside the United States may be a major factor in their comparative backwardness in the package software market sector.

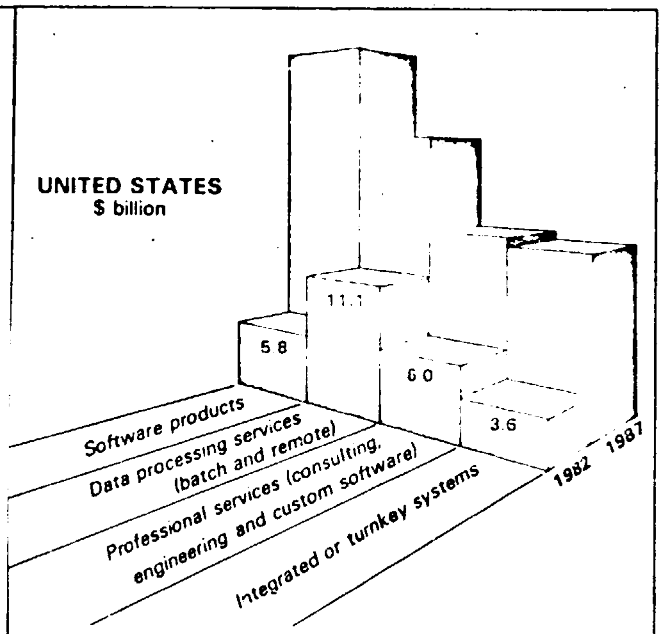
COMPUTER SERVICE REVENUES

Table 6



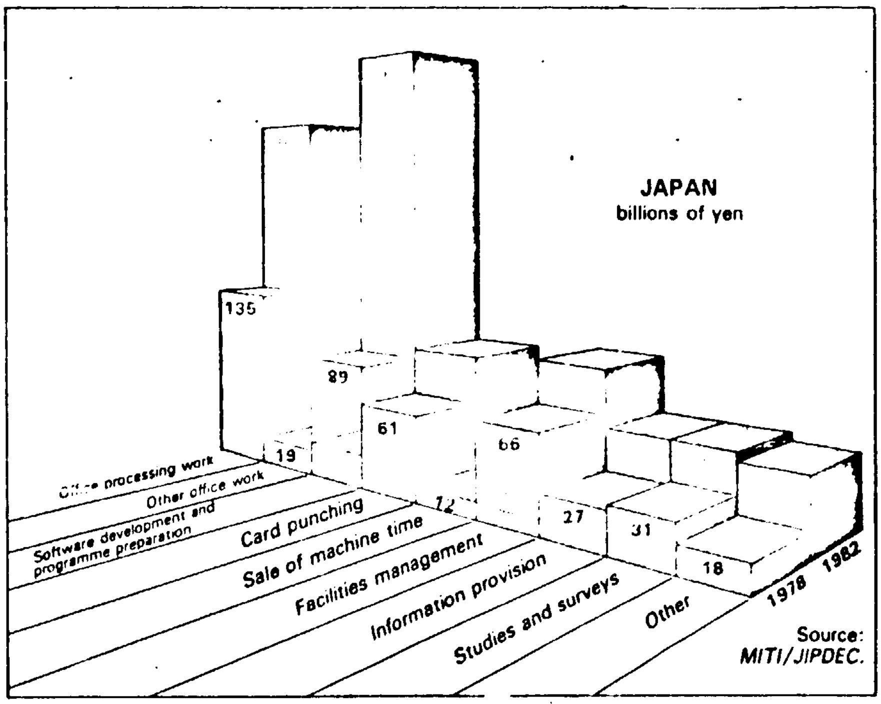
Source: *INPUT/ADAPSO 1983; Quantum Science ECSA.*

Table 7



Source: *INPUT/ADAPSO 1983; Quantum Science ECSA.*

Table 8



Source:
MITI/JIPDEC.

The challenge of integrated software

So-called "fourth generation" software towards which the industry is now moving involves close interconnection between systems software, applications software and databases. This raises a tricky problem for the software houses: how to remain competitive without becoming software "superproducers" i.e. without being able to offer full integrated software systems. Only a few software houses (Cincom, ADR, Cullinet) have already chosen the superproducer route. Most software houses will have to make their products compatible with those of other firms. In this case, they face difficult choices about which firms' products and standards to be compatible with. One innovative response to this challenge, particularly in the United States, is for software houses with complementary specialisations to enter into technological and marketing co-operation agreements. In this way, the firms concerned can offer integrated software and exploit the synergism of their technical skills and marketing resources, while sharing the heavy investments, and still maintain a degree of flexibility in their technical and environmental options. Such co-operative agreements have brought together conventional software houses and microcomputer software specialists for the purpose of developing integrated, distributed software systems (ADR and Visicorp, Visicorp and Informatics, Cullinet and Information Science, Computer Associates and Information Unlimited, Martin Marietta and Mathematica).

The challenge of the manufacturers

At the same time, software houses are having to re-position themselves vis-à-vis the new hardware and software strategies of the manufacturers. This involves following up or even anticipating the introduction of new hardware and software by the manufacturers. Since manufacturers aim to dominate certain software segments and to co-operate more closely with software houses in others, and since they organise their information and pricing policies and marketing accordingly, software houses will have to rethink their strategies and their specialist market slots.

Internationalisation of the Market

In software transactions, buyers and sellers should ideally be geographically close to each other for ease of training, documentation, maintenance, etc. Nevertheless, many software houses have been fairly vigorous in offering services and products in foreign countries, sometimes in association with local software houses, sometimes by establishing direct subsidiaries. But because of the geographic constraint, such subsidiaries cannot be just marketing units: they have to possess the necessary technological know-how and resources to carry out design and sophisticated maintenance. Many subsidiaries have been set up after a preliminary phase of co-operation with a local service company, enabling the parent company to see whether the local market is worth entering and to gain some experience in it. Few statistics are available to show the internationalisation of the computer services industry, partly because it is still emerging and few government structures have been set up to deal with it, but also because of the many different forms internationalisation can take - exporting, establishing subsidiaries, granting licences, etc.

The computer services firms with the most foreign business are American, mainly in data processing services (ADP, GEISCO ...) and systems software (MSA, Informatics, ADR, Cincom, Cullinet ...). In 1979, five of the nine largest vendors of software packages in Europe were American, including the three leaders. According to a 1981 survey, package software of American origin has a preponderant share of the total systems packages available on the French market - over 80 per cent in operating systems, 45 per cent in database management systems, and 60 per cent in software development tools. This share is much less in packages which are more dependent on national characteristics but higher in more universal applications: 65 per cent in project management and nearly 50 per cent in technical applications. More recently, it has been noted in France that 45 of the 80 best-selling software packages (over 100 units sold in 1983) were of foreign origin. American software houses are not the only ones operating internationally. Since other national markets are so narrow, it is even probable that the most outward-looking firms are not American. For example, 20 per cent of French computer service firm sales in 1980 and 24 per cent in 1982, are known to have been abroad. British computer-service firms did 14 per cent of their business abroad in 1983 as against only 3 per cent in 1971.

Role and action of governments

However dynamic the firms are, they cannot handle the technical progress, rationalization of software activities, and the maturing and internationalisation of the software industry alone. The industry seeks new scientific and technical knowledge, new configurations of professional skills, diverse telecommunications infrastructures, appropriate standards, financial, legislative and legal frameworks, international cooperation, investment and trade frameworks. Governments, along with technical societies and trade associations have an important responsibility in the supply of these factors, at the national as well as the international level. (Excerpted from an article by Rauf Gönenç, in the OECD Observer, November 1984.

Computer food forecasting

The price of saving possibly hundreds of thousands of people from famine has now been set. At an estimated US$420,000 for nine Asian countries whose populations total 1.2 billion, almost a quarter of mankind, it is worryingly - yes, worryingly - small. "If it cost more," comments Professor Wayne Decker of the Department of Atmospheric Science, University of Missouri, USA, "governments would be sure to use it. People always respond strongly to high spending."

"It" is a set of software designed to be run on standard microcomputers that can predict the likely effects of drought. Because it permits planners to forecast the extent of probable crop failure 30-60 days ahead of harvest, it gives governments three to six months warning of food shortages in the marketplace. The intervening two to four months between harvest and marketplace is taken up with actual harvesting and distribution. The total lead time is enough for remedial action, moving food stocks into the affected area ahead of the crisis, thereby permitting purchase and transport of relief supplies at much lower non-crisis prices. In some instances, there might even be time to plant relief crops.

The need for such a system is obvious. Quite apart from the tragedy happening in much of Africa, India's rice production dropped below 100 kgs per capita as recently as 1982. That year, surpluses from earlier harvests were able to alleviate famine. But it created a crisis, and was, therefore costly. The country, in common with much of the rest of Asia, is still at risk. Food and Agriculture Organization (FAO) figures show that, in the nine countries that are now introducing the new technology, 72 per cent of all arable land is still unirrigated and, therefore, at the mercy of the weather. Drought, according to UN Environment Programme (UNEP) fears, could well become more frequent and more severe.

The technology, called agro-climatic assessment, is now being introduced in Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka and Thailand.

The process began back in January 1984, when senior officials from these nine countries attended an ESCAP-organized, USAID-funded, introductory seminar on agro-climatic assessment in Bangkok. Developed by the US National Oceanic and Atmospheric Administration (NOAA) in conjunction with the University of Missouri at Columbia, USA, the technology was then presented in detail to technical level teams from all countries at a two-week training workshop in Pattaya, Thailand in May. The latter part of 1984 saw a joint NOAA, University of Missouri and ESCAP team visiting all nine countries to help clear whatever bottlenecks may be found. During the same period, all nine countries were expected to apply the technology to the June-October main rice crop growing season. There will be another meeting in early February 1985 to evaluate progress.

Based on rainfall and other data, the technology gauges the moisture available to crops at critical periods of the plant growth cycle. If moisture deficits occur during these periods, agronomic and economic techniques permit forecasts of actual harvest shortfalls to be made. This information should permit governments to act before a crisis develops. On the technical side, the base data and computer programmes for all nine countries fit, with enough room to spare for another nine countries if need be, into an ordinary blue plastic beach bag. Organizationally, however, it is not so simple. "The technique involves meteorology, agricultural economic statistics and agronomy", points out an ESCAP staffer, "and people with these skills will usually work in different departments. To work, therefore, the technique requires close interdepartmental cooperation." Encouragingly, all participants at the training workshop showed far more enthusiasm than was expected. All the information and the people needed to make the technique work were already in place. All that was needed was the training, already complete, and the computers. The whole programme, including the cost of computers, the meetings, training sessions and follow-up missions is included within USAID's US$420,000 price tag.

Just how much famine can actually be averted, however, is going to depend on more than just good technology and organization. For even if the whole system works well, it can only be effective if there is an available stockpile of food to draw from. Rapidly increasing desertification, at the rate of six million hectares a year, according to UNEP, could threaten the stockpiles themselves. We will have to wait to discover whether agro-climatic assessment will prove of true benefit to mankind, or whether it will eventually be seen as just another technological stop-gap in the fight against famine. (Tim Sharp in Development Forum.)

Software extends the reach of mechanical CAD

CAD systems were developed over 20 years ago for automated drafting. Since then, little has changed in the physical appearance of workstations. Most have a vertical CRT mounted on a work surface that usually contains a keyboard, function menu, curser control, and digitizer. Hardware has become so standardized, in fact, that systems cannot be distinguished simply by looking at the equipment. In contrast, software has undergone substantial changes and is the primary factor differentiating one system from another. Most vendors now acknowledge that most development efforts are directed toward expanding software, with the workstation hardware regarded as merely "a skeleton on which to hang different programs."

More software can be packed into workstations because of increased computing power, with under-the-table minicomputers and desktop micros now having processing capabilities provided formerly by roomsize mainframes. The market force driving the development of these programs is the growing awareness that product development time and cost can be substantially reduced by using computer graphics for a broad range of engineering functions. The result is a variety of mechanical-design software packages that has expanded from automated drafting to include geometric modeling, kinematics, finite-element analysis, and dynamic simulation. Moreover, a number of systems now have numerical-control programming packages, providing a direct link to manufacturing. Many of these systems interface programs so that different design tasks can be done from a shared database, either at a single stand-alone workstation or through an interconnected network. In such an integrated system, the engineer builds on information from this database rather than starting from scratch or interpreting drawings. As a result, design accuracy is increased, development time is reduced, and redundant efforts are eliminated.

The size and shape of a part is represented in the computer with a so-called geometric model. The creation of this model through interactive graphics is usually the first step in product design. And geometric modeling programs are considered some of the most important in mechanical CAD because so many other functions use the geometric data as a starting point.

Most systems now have programs that construct geometric models with either wire frames or surfaces. But an increasing number of systems are turning to solid modeling. Wire frames use interconnected lines to represent part edges, resulting in see-through models that look like simplified stick figures of part geometry. Wire frame models are easy to construct and require relatively little computer time and memory, so they are widely used to provide information about the general outline of part shape. But wire frames can be ambiguous in representing complex geometries and often require considerable interpretation. Surface models are constructed by specifying and piecing together surface types such as tabulated cylinders, fillets, and ruled surfaces. Such models represent the exterior envelope of part geometry more completely than wire frames, so they are used mostly in applications such as NC programming where entire boundaries must be precisely defined. But surface models are still somewhat incomplete and ambiguous, because they do not define interior details. As a result, interpretation is required to differentiate, for example, a solid object from one made of sheet metal. Solid models overcome the drawbacks of wire frames and surface models by representing parts mathematically as solid objects, definining precisely what sort of material or void lies between edges and surfaces. This technology is one of the most active areas of computer graphics and is regarded as the key to CAD/CAM integration. The cost of solid-modeling programs and the high-powered computers for running them has declined steadily over the past few years, and the number of commercial software packages has grown from a handful to more than 25. Consequently, the number of solid-modeling workstations is growing rapidly and is expected to reach several thousand soon.

Most CAD systems use the solid-model database to directly compute mass properties for parts to determine parameters such as volume, weight, center of gravity, and moment of inertia. ometric modeling also is being closely linked with the finite-element method, considered to be one of the most powerful analytical techniques for determining stress, deflection, and other characteristics in structures. In this technique, a finite-element model represents the part with a mesh network of elements that divide the structure into a individual chunks more readily handled by the computer. After analyzing the segments, the computer combines the results to determine the behavior of the entire structure.

In the early days of finite-element analysis, mesh networks were drawn entirely by hand. Later, finite-element modeling routines, called preprocessors, used wire-frame and surface data as a basis for generating the mesh. But the data did not completely represent part geometry, so extensive operator interaction was required to place the elements. Most recently, finite-element modelers have been developed with preprocessors that can generate meshes faster through automatic node and element-generation. Such features are particularly effective when finite-element modelers are interfaced with solid modelers because physical property data required for the finite-element model are readily derived. Moreover, continuous loads and boundary conditions can be specified on the solid model and easily converted by computer software to point values for the nodes of the finite-element model. Finite-element modelers also contain graphics postprocessing routines that condense output data into visual form for ready evaluation. For example, color-coded displays can show areas of high stress. Output data can be displayed as a deflected shape, with deformations exaggerated to aid in interpretation. These deflected mode shapes can even be animated to show deformation of the structure under load.

Many CAD systems have kinematic routines to design moving components and study motion paths. The simplest kinematic features plot or animate the movement of hinged or slider-crank mechanisms such as doors or piston assemblies. These analyses ensure that moving components trace out the required paths and do not interfere with other structural members. More advanced software is also available to design and analyze four-bar linkages and other complex mechanisms. Before these computer-graphics programs were available, mechanical designers had to grind through lengthy mathematical equations or build physical models for time-cosuming, trial-and-error development. Designing mechanisms in this way can require hundreds of hours, whereas the same mechanism can be developed in a few minutes with kinematic software on the computer. ...

In integrated systems, mechanical CAD software often is interfaced with numerical-control (NC) programming routines, providing a link between design and manufacturing. The coded instructions produced from NC programming control automated machines that drill, grind, cut, punch, mill, and turn raw material into finished parts. In the simplest systems, NC instructions stored on punched-paper or magnetic tapes are placed on tape readers connected to the machine tool. More advanced systems use computer numerical control (CNC), where the machine is controlled by a dedicated minicomputer with NC instructions stored in its memory. The most sophisticated systems use direct (sometimes referred to as distributed) numerical control (DNC) in which individual manufacturing units are connected through communication lines to a central mainframe computer that supplies instructions. In creating NC instructions on a CAD system, machining information is typically provided by the operator through interactive question-and-answer prompt statements on the terminal screen. In this way, NC instructions are created graphically without requiring knowledge of programming languages. Consequently, engineers can produce NC progams to machine the parts they design. With this capability, designers are becoming increasingly involved in activities that were once the exclusive domain of manufacturing. In fact, NC programming is rapidly becoming a function of the design engineer.

Many turnkey CAD systems have this type of NC software, which is also supplied unbundled by software vendors. In a typical system, the terminal displays menus from which the user selects machine type, tool size, materials, feed rates, cutter speeds, and clearances. Next, the geometric model is displayed on which the operator defines machining operations for cutting the periphery, cutouts, pockets, holes, and other details. The system software then uses this input data to automatically generate NC instructions for machining the part. Most packages also can simulate the resulting tool path so the NC program can be checked: Motion is generally animated on the terminal screen to show the tool path with the action slowed or magnified. These features let the operator check that the NC program guides the cutter properly and provides for evaluation of alternative machining approaches. (Excerpted from an article by J. K. Krouse in Machine Design, 8 November 1984.)

Japanese achieve AI software first

Software that allows inferences to be drawn from more than one item of information was recently on display for the first time in Japan. This was one of several fifth generation products demonstrated in Tokyo by the Institute of New Generation Computer Technology (Icot) to delegates at the International Fifth Generation Computer Conference. ...

Icot has also reaffirmed its commitment to logic programming, despite criticisms of some foreign researchers. Doctor Kazuhiro Fuchi, director of Icot, believes that logic programming could be made the centre of major simultaneous advances in parallel systems programming, intelligent problem-solving applications and man-machine interface.

An Icot spokesman said that the software had been developed by the natural languages group of Icot and emphasised that the demonstration was only at the level of a small scale experimental model. The spokesman said that this was the first time that Icot had shown software which went beyond the study of the inherent meaning in single sentences to consider the inferences to be drawn from more than one item of information. ...

During the conference Doctor Moto-Oka, a professor of Tokyo uiversity, reported that his university team has test-manufactured a parallel inference engine. The device uses the Prolog language, and, when manufactured in a combination of 16 units, as is planned in the near future, Moto-Oka believes system performance 14 to 15 times higher than that of a single conventional processor will be possible. In addition, Icot has reported the development of new software able to understand the meaning of paragraphs made up of more than two sentences. The system has adopted the theory of situation semantics, developed last year at Stanford University. (Computing, 22 November 1984.)

(Computer Weekly, 13 October 1984.)

Software estimates chemical properties

A new software package developed by Arthur D. Little (Cambridge, Mass.) is said to reduce the time and cost of estimating chemical-property data dramatically. Called Chemest, the new package estimates 10 properties: water solubility, vapor pressure, boiling point, activity coefficient, bioconcentration factor, melting point, acid dissociation constant, Henry's law constant, rate of volatilization from water and soil adsorption constant. The package contains 32 estimation methods for the 10 properties. Chemest operates on DEC VAX 750 and 780 computers, or is available through a dial-up time-sharing service. (Chemical Week, 26 September 1984.)

Electronic University

San Francisco-based TeleLearning Systems has come up with an educational telecom network that connects students' personal computers with those of their instructors via standard telephone lines. On this network it offers about 170 courses. Like the Open University, correspondence courses and recorded cassettes, the system permits study anywhere and at any time. But TeleLearning's Electronic University outdoes these home learning methods by permitting live two-way communication. It also condenses complex communication protocols to single-keystroke operation, and is designed to keep down telecom transmission costs. ...

... Half a dozen US universities have signed up to employ the Electronic University as an approved teaching method, with another 40 or so conducting pilot evaluations. In March, Bobby Cugini, a double amputee, became the first person to sign up for an accredited course. Unable to attend college directly, he will take an English course at Edison State College using his personal computer. ... (The Guardian, 6 September 1984.)

French industrial quartet takes fling at software

About to take a foray into the software business are four large French organizations that normally make their respective livings outside the electronic data-processing business. What they will be peddling is nothing less than a jointly developed program that they are touting as the first global optimization program for energy costs. The collaborators are Serete SA, one of the country's largest engineering firms; Société Nationale ELF Aquitaine, the country's principal producer of oil and petroleum products; Cosmip Enterprise SA, a subsidiary of the Compagnie Générale d'Electricité, which specializes in industrial automation and electronics; and the Institut Français du Petrole, a government-supported agency devoted to petroleum-related research and development. The partners assert that their program, called SECI (for their respective initials) Manager, can handle energy management for any industrial site regardless of its size or complexity. Existing energy-management programs, they say, treat energy optimization only for isolated pieces of equipment or for certain limited equipment configurations.

Their plan is to fill this vacuum with an easy-to-use program based on user dialog, which, in its first generation, can take as inputs characteristic values of industrial energy systems such as fluctuations in fuel flow, power, total heat (enthalpy), system regulation apparatus, condition and yield of equipment, and even utility rates for all existing energy supplies. SECI Manager, which requires no expertise in data processing, then uses this data to put out operational simulations of the model thus constructed, as well as optimization models. The optimization models indicate how to achieve the minimum operational cost for a system, while taking into account the limits and constraints imposed by the user. A future version, which the four say will be available next year, will operate in real time. It will take inputs from on-line sensors, as well as the operator, to directly manage a given energy-consumption system under optimal conditions. The program's efficiency, say its creators, is largely the result of its being based on algorithms derived from real energy-consumption and -utilization curves. Other energy management programs, they claim, are based on linear calculations.

In addition the real-time version will incorporate a coherence module that corrects data from sensors as a function of the known precision of the sensor and related measures from other sensors. The result is a product that straddles the line between a computer-run management program and an expert system. The four groups are convinced that their invention is the most cost-effective way of dealing with an almost impossibly confused problem. "When you take into account the complexity of industrial sites as well as the continual change of the global energy landscape, it makes it extremely difficult to find the right strategy to optimize energy consumption," explains Gérard Sarrazin, deputy director of ELF Acquitaine's Energy Economics department. But even a limited saving would in most cases justify the cost of the program, he reasons. (Article by Robert T. Gallagher, reprinted from Electronics Week, 19 November 1984 © 1984, McGraw Hill Inc. All rights reserved.)

EEC crisis casts cloud over Ada

European development of the Ada language is in doubt as a result of the EEC financial crisis. Plans to develop pilot applications in Ada have been abandoned due to a severe cutback of the Multi-Annual Programme (MAP) by the European Council. The likely outcome now is that MAP will be merged with the larger Esprit programme after its two years are up in 1986. MAP has had a boost by the successful completion of a Danish Ada compiler, to which the EEC contributed. Now MAP is seeking tenders for a second stage, aiming to develop an Ada project support environment (APSE) and a formal definition of the language. About £3.4 million is available over the two years.

But the programme is coming in for criticism, with some EEC executives doubtin- the wisdom of calling for five or six competing projects in the formal definition area. They see this as a squandering of meagre resources.

But an EEC spokesman has defended the plan by arguin- that it was impossible to be sure which was the right project to choose, as the mathematics needed to establish a rigorous definition of the language had not yet been fully developed. ... (Computer Weekly, 18 October 1984.)

ROBOTICS

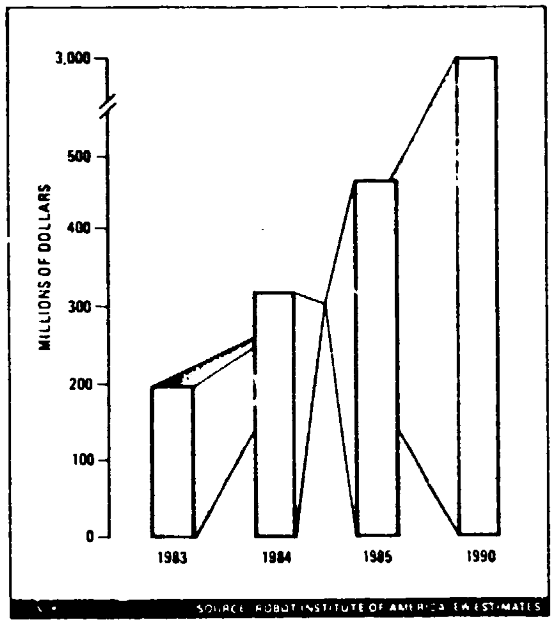
World population of industrial robots

At the beginning of last year, the British Robot Association estimated that the world population of industrial robots had reached around 37,500 units, of which Japan had the lead with 16,500, followed by Europe with 12,500 and the U.S. with 8,000. Within Europe, the FRG is a clear leader with 4,800 robots, followed by Sweden at 1,900, Italy at 1,800, the UK at 1,753, and France at 1,500. Industry experts predict the industrial robot market will expand during the next 10 years by a factor of up to 25.

Even if the use of robots increases as predicted - some forecasters project that there will be about 40,000 robots in service by 1990 - this would still affect only a few tenths of 1% of all employees in the industrialized countries, industry sources estimate.

US market for industrial robots

Table 9



Booming. The market in the U.S. for industrial robots grew approximately 50% in 1984 to about $300 million, according to the Robot Institute of America, and should grow by an even greater rate this year. By 1990, the market could reach $3 billion.

Robots in the GDR

More than 35,000 industrial robots are currently contributing effectively to improved performance within the economy. Their number has grown rapidly in the past several years. In 1981, more than 13,700 robots were at work in the national economy of the GDR. By 1982, there were roughly 22,400, and in 1983 more than 32,100. This trend is in keeping with the directive of the 10th SED Congress with regard to the five year plan which stipulates that a total of 40,000 to 45,000 industrial robots are to be manufactured and put into operation in the period from 1981 to 1985. Robotics is used under socialist conditions for rapidly increasing labor productivity as well as for significantly reducing the number of hazardous, monotonous and physically demanding tasks. High economic output is achieved and working conditions are decisively improved through modernization and step-by-step automation of entire production processes by using industrial robots.

Of the roughly 32,100 industrial robots in use in the national economy at the end of 1983, nearly 27,300 were in use in industrial applications. They are used primarily to automatically manipulate workpieces, tools and materials, and have performed excellently in the areas of welding and painting, and in loading machines and industrial furnaces. In the main factory of the "Herbert Warnke" VEB Metal Forming Combine, Erfurt, for example, a production unit comprising an industrial robot and two lathes was constructed, which brought about a 180 percent increase in labor productivity. This is an example of the objective of robotics in the field of machine tool and processing machine construction - to use robotics to modernize production equipment to such a degree that the output of the individual machine is increased by at least 30 percent and automation is greatly enhanced. (Excerpted from East Berlin Presse-Informationen, No. 88, 31 July 1984, original German.)

The world's fastest industrial assembly robot developed by ASEA

A new assembly system incorporating a newly developed robot, intended for light- and medium-volume assembly work, has been introduced by ASEA Robotics, a member of the Swedish-based ASEA electronics and electrical engineering group. According to the manufacturer, the robot, called IRB 1000, is faster than any other assembly robot now available on the international market. Its acceleration is said to be more than 50% higher than that of conventional arm-type robots. The design of the IRB 1000 is based on the pendulum concept with a hanging robot arm. It has six electrically powered motions and a repeatability of better than ±0.1. The Multigrip 1000, a new steplessly adjustable gripper system developed for the robot, is built from standard modules and comprises up to eight different two- or three-finger grippers which can be used simultaneously. With the system's standard magazine, the IRBM 1000, it is possible to arrange the automatic supply of material to facilitate production over a period of up to eight hours. ASEA's Robot Vision System can also be integrated in the IRB robot to enable the flexible supply of material and to perform inspection tasks. The new assembly station consists largely of standard products, thus giving low design, installation and commissioning costs, and offers a cycle time that is said to be 40% faster than that of earlier installations. (Science and Technology, SIP, November 1984.)

Robot directory

An international directory of industrial robots is now available in the UK from Edson Evers Communications at a cost of £35.50. It was compiled in Japan and contains details of 250 robot systems from leading makers around the world.

COUNTRY REPORTS

Austria: Trade Unions fear job losses

An investigation sponsored by the Association of Austrian Industrialists showed that only 20% of 483 industrial enterprises surveyed confirmed that the number of jobs had been reduced due to the application of microelectronics. As a speaker for the Association put it "the number of labour employed in industry will stagnate as simultaneously with the reduction of traditional jobs new jobs are being created". On the other side, the Austrian Federation of Trade Unions has not yet overcome the fear of a threatening mass unemployment: "a 2% growth of the national economy used to generate a respective number of posts; this is no longer the case".

Computers in Austrian schools

Starting with the school year 1985/1986 informatics will be taught at all of the 238 secondary schools in Austria which will be equipped with computers by that time. Costs are estimated to amount to approximately $2.2 million.

The Vienna International School can boast one of the most modern computer installations in European schools. Two computer labs serve kids of tender kindergarten age as well as 18 year olds preparing to graduate.

Australia's approach to A.I.

The Deputy Premier Minister for Technology in Australia Mr. Brice, announced that a company called Formulab had successfully developed, and were in the process of preparing to market, intelligent computer-based systems which were substantially in advance of anything else available on the market. This new approach to artificial intelligence had been developed in secret in western Australia over the last three years. For the last year the Australian Government has been helping to finance the new centre which has culminated in the development of a number of key products which are likely to lead to substantial sales. The systems developed called "autonomic intelligence" have been incorporated into several unique products. One of these products is a graphics recorder. According to Mr. Richter, Chairman and Managing Director of the Formulab Group, the recorder is a computer-like structure incorporating non-volatile solid state cartridges and advanced enough to be analogous to the human brain. He said "the recorder makes possible the high-speed storage of more data than ever before in an extremely compact area, one solid state memory bric alone has a capacity of eight standard microcomputers - and the recorder's capacity can be easily trebled." The recorder can be used to make the production of graphics for commercial and teaching purposes very simple and for recording complete books in its silicon circuits. In fact the world's first silicon book has already been produced. Other uses include control devices for machine tools and security systems.

This intelligence system is also the heart of a non-volatile portable memory package that makes possible low voltage recording data in almost any area. The language used is called Confluent by its developers, because it has many streams whose values might merge and expand the language. It is believed to be the first exponential language. (Electronics Report, October 1984.)

Canada sets up fund for research projects

A $1-million annual fund has been created to give money to public and private Canadian companies that share research projects with companies from other countries on new information technologies. The International Collaboration Assistance Fund will give up to $200,000 to each project, that may include exchanging information or scientists and developing new technologies used for information systems. Applications will be evaluated in light of Canada's foreign policy objectives in science and technology, the importance of the transfer of knowledge to Canada and the likelihood that the transfer will lead to technological innovation. (Canada Weekly, 21 November 1984.)

Brazil buys Data General superminicomputer technology

Brazil's state-controlled computer maker, Cobra, is set to acquire the technology needed to manufacture the MV4000 and MV8000 superminicomputers of Data General Corp., Westboro, Mass., according to company president Fernando Azevedo. Azevedo said that the two firms have already agreed to the transfer of technology for the hardware and that negotiations continue for the operating system and software. He says Cobra needs the rights to the operating system "to make the superminis compatible with our existing line of mini- and micro-computers, the 500 and 300 series, as well as the 32-bit supermicro we'll be launching at the end of 1985 based on the Motorola 68020." (Electronics Week, 26 November 1984.)

China steps up pace in computer race

China is stepping up the pace of its entry into the computer market by setting up a manufacturing company. The Chinese company, Huxai, is based in Chengdu (Sichuan Province), and as well as manufacturing computers, it will undertake contract projects, leasing and consultancy work. The whole activity embraces 30 factories, research institutes and colleges. The Chinese government has indicated that it will shortly be interested only in importing computers from overseas makers who are willing to transfer their technology. This in effect puts foreign manufacturers on notice that they cannot export their products to China unless they are prepared to transfer their technology along with their products.

Electronics is now China's fastest growing industry. In the first seven months of this year, output of electronics products rose 42 per cent over the same period last year. Production of computers, microcomputers and ICs increased by 26 per cent, 91 per cent and 58.7 per cent respectively. Recent contracts secured by computer manufacturers in China include Gould, for a $5.8m contract to provide 11 systems and related software, and Fujitsu, for a £16.4m contract for 24 general purpose machines. (Electronics Weekly, 21 November 1984.)

Anglo/Chinese chip venture signed

A joint venture between the UK and China is to set up a company called China Ling Lang Microelectronics and Computer Company and is aiming to build a semi-custom chip factory. The UK side is an unnamed consortium of companies led by Rair. Funding of the joint venture is put at $50m, $30m in cash and $20m in capitalised technology and land values. Of the $30m in cash, $20m is coming from the Chinese side and $10m from the UK. The products of the joint venture are expected to be sold at least partly into the Chinese market and a time-span of 15 years has been initially allotted to the project.

China Ling Lang Microelectronics and Computer will be located in the southern Chinese province of Guangdong. It expects shortly to announce the names of the UK companies participating and a number of contracts with UK manufacturers and organisations for educational, constructional and technical support.

An existing Chinese transistor assembly factory will be merged into the joint venture. It will be expanded to meet demand in Chinese consumer electronics including TVs, radios and domestic appliances. (Electronics Weekly, 5 December 1984.)

Europe losing IT battle?

Despite the growth of the information industry in Europe and North America the prospects for European manufacturers look grim unless they fight back against US and Japanese competition. "Social, educational, economic and cultural benefits from the combination of technology and the demand for information is a package that we in Europe cannot afford to ignore," said Jansen van Rosendaal, Director of the Information and Innovation Commission of the European Communities in Luxembourg. "Growth rates are running at between 20 and 40 per cent depending on the technology area. Yet most of this is being provided by the American and Japanese companies who are aware of the growing and accelerating demand for information systems."

Closely involved with both the Euronet-DIANE system and, more recently the Esprit programme for European electronics, van Rosendaal saw the failure as lying across the whole area, from total systems to components. According to his figures, about a third of the world sales of data processing and telecommunications systems is in Europe, yet European industry provides only 10 per cent of world demand. He says that, according to official EEC figures, the Market imports no less than 83 per cent of its requirements in these areas. During his speech he pointed out that Europe, with its diverse cultural, legal and commercial systems was a prime market for information. "In fact, the demand for cross-frontier information between any two of the EEC partners should probably exceed that of interstate traffic on the eastern seaboard of the US."

Figures don't bear that out, though. American usage of data bases - calculated in volume of traffic per data base, is between six and seven times the European average. Yet, even on the social rather than the technical side, the benefits are enormous. One US Government survey (Federal Bureau of Statistics, May 1984) has shown that of the two million new jobs created there in the last 18 months more than 80 per cent were in the information industry.

While the situation as far as internal supply is poor, exports are declining as against the US and Japan. Van Rosendaal estimates that Europe is losing market share at the rate of about one per cent a year, and forecasts that the trend will accelerate over the next decade. "For while Europe is still a centre of innovation, particularly on discrete components and integrated circuits, our equipment manufacturers are increasingly looking to Japan for its low cost and reliable delivery and to the US for its ability to give high quality new products - especially custom-made circuits - at a price they can afford." ... (Electronics Weekly, 31 October 1984.)

French AI research looks to Alvey

French artificial intelligence researchers are envious of the UK's Alvey programme and have been talking to Brian Oakley of Alvey about collaboration. Robert Mahl, research director of the government-funded Agence de l'Informatique, said Oakley had expressed interest in French participation in projects on Prolog and software engineering and discussions would continue over the next few months. In other areas, such as Alvey work on banking automation, the French claim they could contribute, but Oakley was unwilling to collaborate with them according to Mahl. Mahl said that the lack of a co-ordinated programme like Alvey in France meant that France was falling behind in specific areas like image processing.

In 1984 the French Government spent around 300 million Francs on funding for fifth generation research work to the Agence de l'Informatique and the Ministry of Research. Mahl said this was little in comparison to Alvey funding. French researchers are disappointed that the money promised by the Mitterand government for Alvey type programmes when it came into power in 1980 has not materialised. Mahl is to visit the UK later this month to continue discussions with Oakley and to look at work being done at the National Physical Laboratory. (Computing, 27 September 1984.)

Microelectronics production increasing in GDR

Production of microelectronic products in the GDR has increased considerably since 1978. The manufacture of microelectronic components based on value rose in 1978 from 1.7 billion marks per year to over 4 billion marks in 1983. The number of integrated circuits in 1980 rose from 38 million to 59 million in 1983. Within the same period of time, yearly production of microcomputers grew from 3100 to more than 20,500. (Magdeburg Volksstimme, in German, 24 September 1984.)

Indigenous switches for India

The newly set up Centre for Development of Telematics (CDOT) of India has plans to develop and produce in 36 months a fully indigenous system for electronic switching that will radically change the Indian telephone and telecommunications scene. An estimated RS3,600 would be invested according to Dr. M. S. Sanjiva Rao, deputy minister for electronics.

The system to be developed is also to be aimed at the export market in developing countries for digital electronic switching systems. These will initially include stand-alone exchanges of small, medium and large capacities to meet the needs of the ordinary telephone service and will be adaptable to various voice and non-voice channels such as data, facsimile and telex. The electronic switching system will be developed indigenously without going in for foreign collaboration because none of the foreign system was suitable for Indian conditions. The first prototype switching system catering for 512 line electronic exchange is expected to be ready in one year. (Electronics Weekly, 7 November 1984.)

Japan launches commercial AI plan

Japan's first attempt to commercialise artificial intelligence (ai) will be launched in October by the Mitsubishi Research Institute (MRI). Under the scheme as many as 100 Japanese companies in business and industry will jointly fund a three-phase project aimed at producing custom-built system design in one year. Tetsuo Tamai, a programming specialist with the MRI, said that approximately 100 companies attended the introductory meeting last week. Several companies have already indicated they will participate, and the MRI expects at least 50 to respond shortly.

Each company has to provide an entry fee to the project of about £17,000, to participate in the basic research and prototype phase. Fees for the subsequent development of specialised systems for individual companies will be negotiated in the autumn of 1985. Tamai expects the first system application to emerge by early 1986. He said the 12 MRI researchers involved in the Icot fifth generation computer project will be among the broad range of specialists consulted during the course of the study programme. Foreign companies are not being invited to participate at this stage, but Tamai said this could come later, and he confirmed that foreign experts in the ai field are certain to have an advisory role. Tamai said the 'multi-client project' will initially concentrate on 'the development of common software for expert systems, after which case studies in certain domains will be formed to evaluate software and enable the demonstration of expert systems to the companies'. (Computing, 4 October 1984.)

Japan

- Computer software for peptid protein research

Mitsui Information Development Co., Ltd. has developed the world's first computer software system (PRINAS) for the study of peptid protein in cooperation with Peptid Research Institute of the Protein Research Promotion Association. It has also developed a new software for analysis of hereditary information, designed for use by personal computers. These software packages, which the company is going to put on the market shortly, are expected to make a contribution toward increasing efficiency in the study of proteins and genetic engineering.

- MITI to promote information systems for chemical industry

The Ministry of International Trade and Industry will make positive efforts to develop information systems for the chemical industry, and for this purpose will set up the ICIC (innovative chemical industry by computerization) project to develop the manufacturing methods of chemical substances with the use of computer systems. The ministry will spend a total of ¥15 billion for the development of software and hardware and also for the structuring of a data base for the purpose. The ICIC project is aimed at computerizing the most time-consuming basic studies of all the processes of chemical products from research and development to manufacture. (Chemical Economy and Engineering Review, Japan, October 1984.)

Malaysia is top producer

Malaysia has now emerged as a major world producer of electronics components. The 21 US companies in the country have so far exported more than M$10bn worth of electronic products collectively contributing to about 70 per cent of the Malaysian electronics industry's total export value of M$15bn. The American Business Council has pointed out that the accumulative gross investment so far required to generate this contribution to Malaysian exports by American electronics firms was more than M$700m. (Electronics Weekly, 12 December 1984.)

Republic of Korea: firm puts $140m into chip plant

A Republic of Korea company is spending $140 million on a chip-making plant to get into the market for 256 Kbit memory chips. The money will be spent on upgrading its $110 million plant built near Seoul earlier this year. The field is dominated by Japanese manufacturers and Texas Instruments of the US. Industry observers say Samsung Semiconductor will probably lose money on a 256 Kbit chip. Analysts say the Republic of Korea feels it is vital to gain chip-making experience if the country is to branch out in the computer industry. Samsung is making 64 Kbit dynamic random access memory (dram) chips based on the design of a US company, Micron Technology. ... (Computing, 22 November 1984.)

Joint Government-private venture for high-speed integrated circuits

A total of about Kr.50 million ($6,000,000) will be spent in Sweden on the development of integrated circuits of gallium arsenide and production facilities for such equipment over the next three years. The government will defray Kr.20 million of this cost while the remainder will be invested by the Ericsson group company Rifa AB, which is responsible for the project. Earlier this year, Rifa announced having developed the tiny high-speed gallium arsenide transistors, three to five times faster than conventional silicon transistors. The transistors are mounted in sets of four on chips measuring only 0.35 x 0.49 millimetres, which means that thousands of chips can be accommodated within the area of a fingernail. To date, work on the gallium arsenide transistor has been focussed on products such as photo and laser diodes for fibre optics and low-noise, metal semiconductor field-effect transistors, but the future potential is said to cover a much wider area. The goal of the Kr.50 million project is to build up production resources for gallium arsenide integrated circuits and design capabilities to handle orders from external customers for encapsulated and fully tested components. (Science and Technology, SIP, Stockholm, November 1984.)

Inmos tests transputer for ISSCC deadline

Inmos has got first silicon on its transputer and is committed to presenting a paper on the device at the International Solid State Circuits Conference (ISSCC) to be held in New York in February 1985.

It is a prerequisite for presenting an ISSCC paper that working silicon is demonstrated, so Inmos has two and a half months to test and debug the part. First tests are "very gratifying" said the company's marketing boss Dave Sherwood.

The transputer is particularly suited to applications involving the search and scan of databases - for instance in flight reservations equipment and weather forecasting. But the big one - the application for which the device was conceived - is the fifth generation computer. "The Japanese," said Sherwood, "have a terrific interest in the transputer as one of the options for the fifth generation. They keep coming back for more information. One of the specifications for the fifth generation is that it should have 10,000 words of voice recognition capability. The transputer is one of the few options they have for handling that lexicon." (Electronics Weekly, 21 November 1984.)

UK: Computer architecture attracts Alvey Directorate 13/

The £350-million Alvey programme of research into fifth generation computing may be expanded to include funds specifically for work on parallel processing. The Alvey Directorate is mulling over proposals that the field is so important it deserves a programme in its own right.

At present, computer architecture (the design of computers rather than the chips) is meant to be covered by the existing four streams of the Alvey scheme: chips, software engineering, man-machine interface and knowledge systems. But some researchers at a recent conference on computer architecture at Warwick University felt there was a danger that fundamental work could be left out. ... Alvey has delayed tackling architectures because of the difficulty of choosing between the many different ideas currrent in the British research community.

The only common theme in advanced research on architecture is the determination to break away from the present von Neumann designs and develop computers which are capable of processing different aspects of the same task simultaneously. This is parallel processing. Alvey, however, will take a different line to the Japanese. Instead of concentrating on software that embodies parallelism, Alvey will support projects that delve into hardware which carries parallel streams of 0s and 1s. British researchers are sceptical about the Japanese plans to demonstrate a fifth-generation processor in the autumn, which runs parallel software. "From what I can gather the processor is not very much more advanced from what one can buy commercially," said Ray Crispin, of the Alvey Directorate's chip programme.

Britain's efforts will revolve around two main pieces of research: the Dataflow machine at Manchester University and ALICE, a system developed at Imperial College, London. Both systems are what are called MIMD machines, that is they work with multiple instructions and multiple data. This distinguishes them from ICL's distributed-array processor (DAP) and GEC's GRID which are special-purpose parallel machines in which a single instruction is applied to many different pieces of data. ALICE and Dataflow could form the basis of general-purpose parallel computers. ALICE, which is constructed from Inmos Transputers (processor chips designed with parallel processing in mind), is already part of one Alvey

13/ The British government set up Alvey two years ago to nurture long-term research into the next generation of computers. See also earlier issues of the Monitor.

project led by Plessey whose aim is to produce a word-processor capable of responding to the human voice. The Dataflow machine, currently funded by the Science and Engineering Research Council is also expected to pick up Alvey money.

The Alvey Directorate expects to announce some 10 architecture projects, of which at least three will involve major commercial firms. The directorate will be backing a number of horses, according to Clarke. He explained that different architectures would be needed for different fifth-generation applications. Computers concerned with recognising the human voice or camera images in which signal processing is to the fore will have different processors compared with systems that deal in human knowledge.

One thing Alvey is certain about is the need to produce a translator which will enable many different computer languages to be run on the new architectures. The directorate plans to construct what is called a compiler target language which will allow programmers to write in one computer language and have their efforts run on many different machines. ... (This first appeared in New Scientist, 6 September 1984, London, the weekly review of science and technology.)

Siemens plans US SC facility

Siemens will build a wafer fabrication plant for semiconductors in the US in the course of the next two years. Siemens did over $100m worth of semiconductor business in the US last year.

The plant is most likely to be used to make Siemens' new generation of RAMs which it is developing with Philips. This agreement announced last month covers 1Mbit and 4Mbit DRAMs. As part of the plan Philips is establishing a research and development centre in Eindhoven where fundamental research in semiconductor technology will be carried out.

Philips and Siemens said at the time they expected to sink over £350m into the project, and expected the final investment to be even larger. The Dutch and German governments have also contributed. If the venture is to succeed, a US facility is essential. (Electronics Weekly, 14 November 1984.)

US: R and D consortia

U.S. industry's position of global leadership in high technology has eroded since the early 1970s because of declining federal and corporate investment in R&D at a time when other nations were stepping up their research efforts. But a consensus is emerging in both the public and private sectors that strong remedies are necessary to restore and maintain America's technological edge.

Joint research ventures have been pioneered by the electronics and computer industries, which must compete head-to-head with powerful Japanese consortia. The first industrywide effort was the Semiconductor Research Cooperative (SRC - Research Triangle Park, N.C.), established in 1982 as a nonprofit subsidiary of the Semiconductor Industry Association. SRC pools funds from member companies and sponsors basic research on microelectronics at key universities around the country. The consortium numbers about 35 companies, including IBM, Motorola, Hewlett-Packard, Control Data, Digital Equipment, National Semiconductor, Intel, RCA, and Rockwell International.

To meet SRC's $13.5 million budget in 1984, the corporate sponsors contributed a minimum of $60,000 and a maximum of 10% of the annual budget through fees based on semiconductor-related sales. The cooperative is funding 54 research projects at some 40 universities, including Berkeley, Carnegie-Mellon, Cornell, MIT, Rensselaer, and Stanford. All such projects are generic, in the sense that they provide information that will be useful to a broad spectrum of the member companies over a 5-10 year period. But "we are gradually biasing our research agenda to carry out more long-range research," says Robert M. Burger, SRC's chief scientist and senior technical officer. Member companies are represented on a Technical Advisory Board that defines research strategy, advises the SRC staff on research priorities, and helps evaluate the quality of the research being done. In addition, all corporate sponsors have equal access to information generated by the cooperative's research activities, which is disseminated to member companies through published reports and topical conferences. Although the results of SRC-funded research eventually appear in the open technical literature, sponsors get an early look at the results and thus gain valuable lead time. Participating companies also have a royalty-free, nonexclusive right to any patents or copyrights ensuing from the research.

SRC's greatest contribution, Burger contends, is in education. Before the consortium was founded, there was relatively little university research on silicon devices, even though they constitute by far the largest part of the semiconductor market. Now nearly 300 graduate students are working in SRC-funded research programs. As these students complete their education and move on to research positions in industry and academia, many will continue their work on silicon devices, contributing to an expanding research effort in the field. Moreover, SRC's impact will be national rather than regional. "By directing its research through various universities and centers of excellence," says Regis McKenna, president of Regis McKenna, Inc. (Palo Alto, Cal.), a high technology marketing firm, "SRC's effect is to disperse technology throughout the country, so that a few areas don't become dominant in everything." In addition to its work in research, SRC is thinking about extending the cooperative concept to development, including a plan - dubbed Project Leapfrog - to design the next generation of microchip fabrication equipment. Interest in the proposal is strong among many SRC member companies, Burger says, and preliminary discussions are underway. (Excerpted from a Special Report by J. B. Tucker, High Technology.)

SOCIO-ECONOMIC IMPLICATIONS

South must play active role in information revolution

Today we are witnessing a widening of the gap between those with ready access to information and those lacking in such access. The North-South gap has become the information gap, demonstrating conclusively that information means power. If left to its present dynamics, the Information Revolution will only strengthen the disparities. But I believe that need not be the case. It should be possible for the South to use the Information Revolution creatively as a vehicle to reduce and not widen the present gap. This is one of the basic challenges now confronting the third world. ...

... We must devise the means by which information about scientific and technological developments reaches those who could use it most - such as the small farmers and small entrepreneurs. So far, only the elites have had access to this information. But those who need information will be reached only if there is an appropriate information infrastructure - one that allows for communication between centre and periphery. The learning capacity of the so-called periphery is dependent on its developing its own capacity to generate, ingest and absorb information rather than on the power behind the process of one-directional transmission.

For this to come about, micro-information environments must be built up at the village level. There must be greater participation in and access to the whole information process, and more equitable distribution of communication facilities and information resources within societies. For this reason, farmers and small entrepreneurs in third world countries need their own radio stations to keep each other informed about crops, weather conditions, markets in nearby villages or towns and other data of immediate pertinence to them. This will take political courage on the part of governments; but unless they take these steps to create micro-information environments, their development efforts are bound to remain ineffective. Strategies devised by the centre can take the development process so far - the farmers and others on the periphery who have hitherto had little say in the process need to be active and informed participants in order to maintain the momentum of development. In the creation of such new micro-information environments, there may well be an inherent shift away from a traditional Western paradigm of linear communication - from sender to receiver - to modes of communication that are multi-modal and interactive, potentially more participatory, and perhaps also more congenial to non-Western forms of communicating.

Yet another impact of the Information Revolution is on power and the distribution of power. If allowed to run the course they are now on, the new instruments of communications and information seem bound to lead to much greater centralization of power and loss of freedom and privacy. On the other side of the coin, this revolution also contains the seeds of greater opportunities for sharing of power and wider participation by the people, particularly the impoverished hundreds of millions in the third world. For this to happen, however, the developing countries will have to find ways to develop and use these technologies in a manner that unlocks local initiative and creativity. They need to turn the Information Revolution around to make it serve their own needs, and especially the needs of the poor and the weak in their societies. Apart from political will, this will also require new surges of social and political innovation. Only when the third world accomplishes this will it have a chance of playing an active part in the Information Revolution - to be part of the solution and not part of the problem..

With the world's population due to swell to some six billion people by the year 2000, we are therefore forced to think about education and learning in new ways. There will simply be too many people to educate them formally in schools as in the past. The knowledge explosion which we are witnessing means in addition that the transfer of knowledge in the traditional manner, from teacher to pupil, is increasingly inadequate. The recognition is growing that conventional systems of learning can no longer absorb the range of knowledge generated and disseminate it in the usual educational time-span before that knowledge has become obsolete, nor can they respond adequately to the demands for equitable and widespread access to the knowledge necessary for coping with rapid social change and the enormous complexity of the modern world's problems. New modes of education, of the learning and sharing of knowledge, are therefore needed at all levels of society - new modes which can use to advantage all the new information services and technologies. We are talking here about the question of learning how to learn and how to be creative - not only in technical terms, but in political and social terms as well. One important challenge is posed by increasing life spans; we will have to find ways to allow the elderly to make socially and culturally productive use of their additional years, both individually and collectively.

Essentially at question is our capacity for social creativity - for power-sharing, solidarity-building, and new forms of civility in a crowded, competitive world. The Information Revolution can create problems of growing disparities, fragmentation, atomization of social cohesion, and impoverishment of human relations - through more and more impersonal interaction with the computer console and the television screen. But at the same time, it offers the third world great hope and promise, for if we act with imagination and creativity, ours can be the role of developing new alternative societal responses that will enable us to make the Information Revolution serve our own interests, values and aspirations in an increasingly interdependent world. (Excerpted from an article in the United Nations University Newsletter, June 1984, by Rector Soedjiatmoko.)

Impact of expert systems on UK construction industry

Information technology pundits have painted a job-rich future but the construction industry may find expert systems force 250,000 of its professionals out of their jobs. The construction industry is among the largest in the UK and employs a plethora of specialists selling expert advice. The use of expert systems will enable contractors access to less expensive advice by using computers. Expert systems will be able to interpret what we mean and provide answers we can understand. Dialogues between the user and the expert system allow non-experts to ask complicated questions on difficult problems while remaining protected from the full implications of the enquiry. The computer does the mental donkey-work. By combining small areas of expertise an expert system can provide a full range of services. For a construction contractor it could provide expert information on design, structure, quantity of materials and so forth. The system can do this in one place and, if need be, at one time. The client does not have to consult a wide range of professional advice. The construction industry is probably the largest single industry in the country and employs millions of people in a wide variety of jobs from joiners to geo-technical experts. There are about 500,000 professionals in the industry. ... The substitution of capital for labour has so far hit the unskilled and semi-skilled areas of all industries. The thrust towards expert systems will continue the trend through company hierarchies and encroach further and further into the white collar area.

The Government and many computer industry experts and economists have argued that high technology, and in particular information technology, will create the core of jobs for the future. Most of the arguments for such job creation are based on two assumptions. First, that there is sustained growth in Western economies, and second, that new (and usually unnamed) industries will spring forth in the service sector to open up extra opportunities for employment. The problem this scenario presents is for those industries which do not have elastic demand for their products. If expert systems find wide acceptance in the construction industry, productivity is likely to be increased greatly. Unfortunately the amount of work to be done is finite. Combine these two factors and as many as half of the construction industry's professionals may become redundant. ...

Professor Frank Land of the London School of Economics has argued that the drive towards expert systems has been too technology-biased and has not looked hard enough at the environments to which it is to be applied. It is this problem which concerns D. Taffs, technical director of the Ove Arup Partnership, a member of the Computer Applications and Methods Panel of the Institution of Civil Engineers (ICE), and an expert on the application of expert systems to the construction industry.

He said: "Relatively speaking you have not got any large scale funding of the kind promoted in other industry sectors, for example the Alvey and Esprit programmes in computer science. Very little is happening at the application end of it all. The work that is being done is small scale developments in university departments." Taffs and others are attempting to co-ordinate the work that is being done and to provide it with the kind of direction it needs to make it useful for the construction industry. The focal point for this activity is the Computer Applications and Methods Panel at the ICE. The panel is hoping to discover just what has been achieved by the construction industry and by university researchers. (The panel can be contacted in writing by any researcher or organisation interested in taking part, at the ICE).

In some ways the construction industry has been its own worst enemy in creating its own divisions and subdivisions over the years. Where once information was available from a small number of sources there are now many specialists providing limited amounts of important information for fat fees. The possibility of being able to call into an expert system service to get rapid answers for reasonable prices will be a problem the professions may not be able to answer. Taffs said: "The construction industry is subdividing all the time. We can offer accounting advice on funds flow internationally for financing overseas projects, as well as overall design, soil engineering, traffic engineering and so on. These are all specialist areas. Why employ one of these experts ultimately when you can call up an expert system?" The cost factor would seem to be the most important but a quick saving might result in higher costs in the long run. This is due to a combination of ignorance of the degree of expertise of a given system and to the system's misuse, where expert information is misinterpreted by inept users. ...

Expert systems are not likely to have a major impact on the construction industry for a number of years but some simple systems are already being prototyped. In Australia, for example, the code for siting buildings in the state of Victoria has been implemented to prototype standards. In the US researchers at Carnegie-Mellon University are investigating how underground water flow problems can be solved by a wider, less skilled range of people. Taffs believes that if the UK construction industry is to remain competitive it will have to adopt expert systems technology at least as fast as its major competitors. When it does so, Taffs believes, the number of professionals in the construction industry will be depleted by 50% or more. (Computing, the Magazine, 6 December 1984.)

Technology has modest impact on executives, survey shows

Advanced technology is not making the impact on Western industrialized countries - or at least on the minds of top executives there - that one might have imagined. A survey of more than 500 company directors in five countries - Australia, Belgium, Britain, the United States and the FRG - shows that one-third believe new technology has had little or no effect over the past five years on either the products they make or the way they make them. The survey was carried out earlier this year by Market Opinion Research International (MORI) of London for PA Technology, a division of the PA international consulting group. Notably, it did not include Japan or other "high-tech" areas such as Korea. Japan will probably be included in a follow-up survey next year.

Nevertheless, another aspect of the survey makes fairly depressing reading. Of those companies that claimed to have a definite strategy for managing innovation and the application of new technology, the biggest emphasis was on applying current technology to exploit existing markets. What PA calls the "cutting edge" of technology - using new technology to open new markets - was very poorly represented in this group and was not even mentioned by managers in the United States. (International Management, July 1984.)

GOVERNMENT POLICIES

Canadian government promotes research in integrated circuits

The recently formed Canadian Microelectronics Corporation (CMC) will make a significant contribution to the expansion of Canada's role in technology. It has been established to increase the capability of Canadian universities to pursue research and scholarship in all aspects of integrated circuits. The project was announced in May 1983 by the Minister of State for Science and Technology as part of the Technology Policy in Canada. The major funding for this undertaking comes through the Natural Sciences and Engineering Research Council of Canada. Close collaboration with Canadian industry has been essential in the development of the corporation and this support continues to be provided in the form of access to fabrication of silicon chips.

The VLSI Implementation Centre established in October 1982, was absorbed by the CMC in terms of both facilities and operation. It is a service office for design data processing, fabrication entry to Northern Telecom Electronics, and first-line support of the CMC design and test facilities loaned to Canadian universities. The Centre moved to new premises in late March after the corporation completed a formal contract with Queen's University at Kingston for provision of physical space and administrative services, with the CMC fully responsible for fiscal and technical services.

The establishment of a university-based national network of design and testing stations for large scale integrated circuits will be the first result of the CMC's program. The second result is expected to derive from a joint university and industry proposal to establish research centres for device physics, materials and process technology. As part of the first phase, the Corporation will purchase twenty-eight integrated circuit test stations, for loan to universities, each station consisting of a probe plus four other major instruments. In addition, forty design stations, with powerful graphics and plotting facilities, will be similarly purchased and distributed. The decision to loan equipment to particular universities is based on recommendations from an Awards Committee which assesses applications from the universities using criteria outlined in the corporation's business plan. At the time of writing, this procedure is being used to determine the distribution of the selected design facilities. It is anticipated there will be a further competition for test equipment in the near future.

The involvement of the universities is not limited to technological activities. The CMC is a non-profit corporation organized to respond to the concerns of its members in the university and industrial community. Direction and technical guidance are shared with representatives from the member institutions and the government in its role as principal funding agency. There are 12 directors on the board of the CMC, four each from university, industry and government. To fulfill the objectives of the corporation, in a manner consistent with the business plan, the management draws on working groups to bring forward recommendations which would lead to the purchase of facilities or improvement of procedures. An example of this is provided by the work of an equipment committee which was formed even before the letters patent for the incorporation were granted.

At a meeting in August 1983, the Equipment Committee outlined steps that would be followed in evaluating commercial design stations and software for integrated circuit design. Subsequently, vendors were approached but many were found to be unable to offer a system that included all of the functions requested, or could not make a working system with adequate documentation available in the desired time frame. To evaluate the systems that were provided, the CMC in each case issued a contract to a university group to do an engineering report based on the stated requirements, with comparisons to systems already in use. A test site was then visited by a review team which received the report, and specific tests were made in an attempt to make comparisons with other systems under evaluation. From this procedure, recommendations were made to the CMC which then invited the universities to apply for loan of facilities.

It is anticipated that this approach to upgrading the facilities and service available to the universities will be repeated several times in step with changes in the technology. However, the work of the CMC does not stop when a university loan agreement has been completed. The facilities remain assets of the corporation which has a continuing interest in their use and functionality. Part of the service of the CMC is to provide installation, training and maintenance. Some of these tasks are distributed back to vendors or the universities, with those having the know-how passing it on to those with less knowledge. An example of this was the Tutorial on Testing Integrated Circuits sponsored by the CMC in June 1984 in support of the test stations on loan to the universities.

There has been a noticeable increase in the participation of universities in the implementation program. Twenty-three have had some direct involvement. In the most recent multi-project chip run, a total of forty-four CMOS designs and nineteen NMOS designs were received from fifteen universities. Twelve design groups are using CMC test stations and seventeen groups will begin to receive design facilities in the near future. The universities have begun to see an improvement in their resources for circuit design and assessment. Although individual groups may be scattered geographically, it is expected that by using similar tools and by being a part of a single organization dedicated to integrated circuit technology, a positive environment will emerge for them to exchange experiences and to collaborate on research. The benefits to industry are predictable in terms of developed manpower in the short term and product innovation in the long term. In addition, many new university-industry contacts are being established through interaction on CMC work. These results are only the beginning. A great deal more is expected to be achieved over the period of the next several years.

CMC publishes a monthly newsletter, VLSI in Canada, for information exchange among Canadian individuals and groups working in VLSI-related fields. Copies can be obtained from Canadian Microelectronics Corporation, Queens University, Canada K7L 3N6.

Japan: Outline of research and development plan for Fifth Generation Computer Systems Project 14/

Introduction

In April 1982, a new non-profit research institution was established through the cooperation and with the support of the Japanese Government, the computer industry and the academic community. This institution named the Institute for New Generation Computer Technology (ICOT) takes a leading role in research on the Fifth Generation Computer Systems Project, which has attracted so much attention both in Japan and abroad.

The purpose of research and development on the Fifth Generation Computer is to establish the foundation for a quantum jump in the information technology field. To do this, a long-range approach will be taken. Japan's great strength in this field will be used to build the basis for a home-grown revolution in computer technology and, at the same time, a prototype of computers for knowledge information processing systems, which will meet the needs anticipated in the 1990s. The basic technologies which have to be established include a problem solving and inference function, a knowledge base management capability, an intelligent human-machine interface capability, an intelligent programming capability, etc. An overview of research and development activity on the Fifth Generation Computer Systems Project is given below. Since the ten-year plan remains flexible, the overview is mostly focused on the initial stage's R&D plan.

Background

As computerization advances, information technology with computers as its core has been applied to various areas of society, and become an indispensable tool in modern society. To provide for the conditions and information demands of the society in the 1990s, more advanced and higher-level functions and performance will be required of information technology; these include utilization of more varied media, easy-to-use computers, higher software productivity and application of information technology to those areas in which existing information technology has not been applied.

In order to meet these needs, the design philosophy itself of the current computer technology should be studied and evaluated. Conventional computers, following the von Neumann computer architecture, are now realized by the simplest hardware because the hardware was expensive and bulky when the first computers were invented. Most of the functions required are then realized by software in order to provide an efficient processing system. Therefore, the conventional computers have become numerical-processing oriented, stored-program sequential processing systems. High speed and large memory capacity have been pursued from the economic standpoint, producing the present enormously big computer systems. However, the situation has evolved as follows:

(1) VLSIs have substantially reduced hardware costs, so computer systems can use as much hardware as required.

(2) A new architecture for parallel processing is now required because device speed has approached the limit for sequential processing.

(3) Parallel processing should be realized in order to utilize effective mass production of VLSIs.

(4) The current computer technology lacks the basic functions for non-numeric processing of speech, text, graphics and patterns, and for artificial intelligence field such as inference, association and learning.

From these reasons, the Fifth Generation Computer Systems (FGCS) should be developed, which provide knowledge information processing systems. FGCS should thus employ latest research results in VLSI technology, as well as technology of distributed processing, software engineering, knowledge engineering, artificial intelligence, and pattern information processing.

Research and development themes

The Fifth Generation Computer Systems aim at knowledge information processing based on innovative inference functions and technologies that meets the needs anticipated in the

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14/ By Hitoshi Aizawa, Institute for New Generation Computer Technology (ICOT).

1990s, including intelligent interaction between man and machine and inference using knowledge bases. The functions required of such a system can be broadly divided into four types:

(a) Problem solving and inference function;

(b) Knowledge base function;

(c) Intelligent interface function;

(d) Intelligent programming function.

New application fields

The knowledge information processing systems realized by the Fifth Generation Computers are expected to expand extensively the fields where computers are applied such as manufacturing, service, engineering, and office and business management. VLSI CAD, machine translation and consultation systems are chosen to develop as the model systems to apply the basic Fifth Generation software to as well as to prove and assess the basic software system. The development of these application systems is planned in the intermediate and later stages.

Research and development plans

The research and development goals of the Fifth Generation Computer Systems are such core functions for the knowledge information processing as problem-solving and inference systems and knowledge base systems, that cannot be handled within the framework of conventional computer systems. In Japan, little effort has been made in research on the key technologies, particularly software and basic theories. The research in this field should be promoted because it has a great influence on development of hardware technology, including computer architectures and VLSIs. Since this project aims at computer technology for the 1990s, plans encompass as wide an extension of basic technology as possible. And this project is planned to span about 10 years, divided into an initial, intermediate, and final stages.

The emphasis in the research and development of the initial stage is on accumulating the research achievements of the past in the field of knowledge information processing, and evaluating and restructuring them. In addition, candidates for each research subject have to be screened and basic technology is developed for the intermediate stage. The research and development of the intermediate stage is focused on establishing computation models as the basis for software and hardware as well as algorithms and basic architecture based on the evaluations of the initial stage. Small- to medium-scale sub-systems are then built. The final stage puts an emphasis on appropriate functions of both software and hardware systems, interfaces to maximize these functions, and the architecture for the total system. Concerning the overall flow of research and development efforts, the initial stage is envisioned that software and hardware modules are built and also some experimental systems configured by integrating these modules. These systems include hardware and software simulators, prototypes for language processing, and experimental natural language processing systems. The intermediate stage is mainly devoted to improving and extending the results of the initial stage, and integrating them into inference and knowledge-base sub-systems. In the early part of the final stage, the configurations of these software and hardware systems developed in the intermediate stage are reviewed and evaluated. The total system is developed, integrating the sub-systems in order to define the ultimate goals clearly. (Electronics in Japan '83-'84, published by the Electronics Association.)

List of journals quoted in the Microelectronics Monitor

ACCIS Newsletter
ACCIS Secretariat
Palais des Nations
1211 Geneva 10
Switzerland

AEU
Journal of Asia Electronics Union
Dempa Publications, Inc.
11-15, Higashi gotanda 1-chome
Shinagawa-Ku
Tokyo
Japan

Business Week
A McGraw Hill Publication
1221 Avenue of the Americas
New York, N.Y. 10020
United States of America

Canada Weekly
Cultural and Public Information Bureau
Department of External Affairs
Ottawa K1A 0G2
Canada

Computer Weekly
IPC Electrical-Electronics Press Ltd.
Quadrant House
The Quadrant
Sutton, Surrey SM2 5AS
United Kingdom

Computing (The Newspaper and the Magazine)
VNU Business Publication BV
53-55 Frith Street
London W1A2HG
United Kingdom

Datamation
Technical Publishing
Dun and Bradstreet Corporation
875 Third Avenue
New York, N.Y. 10022
United States of America

Electronics Weekly
IPC Electrical/Electronics Press Ltd.
Stanford Street
London SE19
United Kingdom

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A McGraw-Hill Publication
1221 Avenue of the Americas
New York, N.Y. 10020
United States of America

Electronics Report
Computer Publications of Ireland Ltd.
66 Patrick Street
Dun Laoghaire
Co. Dublin
Ireland

Financial Times
World Business Weekly
Bracken House
10 Cannon Street
London EC4P 4BY
United Kingdom

High Technology
High Technology Publishing Corp.
38 Commercial Wharf
Boston, Mass. 02110
United States of America

IFIP Newsletter
International Federation for Information
Processing (IFIP)
3 rue du Marché
CH 1204 Geneva
Switzerland

Industrial Engineering
Institute of Industrial Engineers Publication
25 Technology Park
Atlanta Norcross, Ga. 30092
United States of America

Industrial World
Johnston International Publishing Corp.
386 Park Ave. S.
New York, N.Y. 10016
United States of America

La Lettre des Sciences et Techniques
Réseaux Technologie et Developpement
Groupe de Recherche et d'Echanges
Technologiques (GRET)
19 rue Blanche
75009 Paris
France

Machine Design
Penton/IPC Inc.
Penton Plaza
1111 Chester Ave.
Cleveland, Ohio 44114
United States of America

Nature
MacMillan Journals Ltd.
4 Little Essex Street
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United Kingdom

New Scientist
New Science Publications
Commonwealth House
1-19 New Oxford Street
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United Kingdom

Outlook on Science Policy
Science Policy Foundation
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United Kingdom

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Vance Publishing Corp.
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New York, N.Y. 10022
United States of America

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IPC Industrial Press Ltd.
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Science
American Association for the Advancement
of Science
1515 Massachusetts Avenue
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United States of America

Science and Technology
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Sweden

Semiconductor International
A Cahners Publication
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P.O. Box 5080
Des Plaines, Il. 60018
United States of America

Technology Ireland
Institute for Industrial Research
and Standards
Ballymun Road
Dublin 9
Ireland

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The Economist Newspaper Ltd.
25 St. James Street
London SW1A 1HG
United Kingdom

The OECD Observer
OECD Information Service
Château de la Muette
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READERS' COMMENTS

The Microelectronics Monitor celebrates its third anniversary. Whilst it is gratifying to continue to be encouraged by frequent letters to the editor coming from all parts of the world confirming that there is a need for the current awareness service that is provided therein, we are quite alive to the fact that news on developments in developing countries is scarce. We should be grateful, therefore, for contributions or comments from our readers in those countries. We thank you for your co-operation and look forward to hearing from you. Please write to: The Editor, Microelectronics Monitor, UNIDO's Technology Programme, P.O. Box 300, A-1400 Vienna, Austria.